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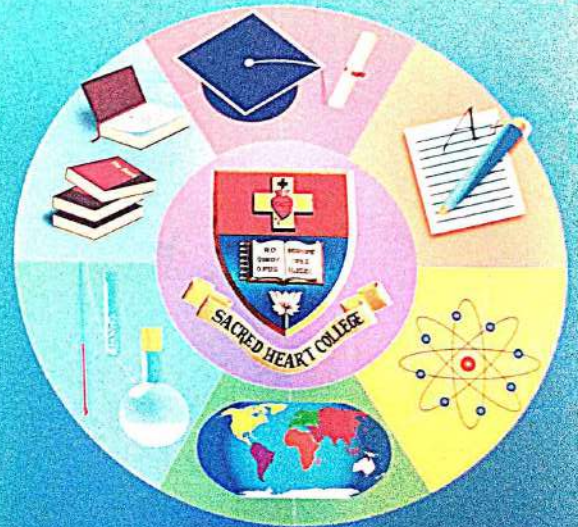
புதிய அவையம்



PUTHIYA AVAIYAM

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நற்றிணை காட்டும் நெசவுத் தொழில்

நிஷா. ஜெ

முனைவர் பட்ட ஆய்வு மாணவி, பதிவு எண்: 18213104022003
நாஞ்சில் கத்தோலிக்க கலை மற்றும் அறிவியல் கல்லூரி,
கரையக்காவியை - 629 153, கன்னியாகுமரி மாவட்டம், தமிழ்நாடு.
மனோன்மனியம் சுந்தரனார் பல்கலைக்கழகத்துடன் இணைவு பெற்றது.

முனைவர் ம. பெரில் திரேஸ்

ஆய்வு நேர்யாளர், துறைத்தலைவர், தமிழ்த்துறை,
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கரையக்காவியை - 629 153, கன்னியாகுமரி மாவட்டம்.

ஆய்வுச் சுருக்கம்

மலைகளிலும் காடுகளிலும் அலைந்து திரிந்து நாடோடி வாழ்க்கை வாழ்ந்து வந்த மனிதன் நிலையான வாழ்க்கை வாழ ஆரம்பித்ததும் நாகரிக வளர்ச்சிக் கூறுகளைப் பெருக்கத் தொடங்கினான். நாகரிக வளர்ச்சியின் தொடக்கமாக வேளாண்மை அமைந்தது. வேளாண்மை உற்பத்தியில் பருத்தி முதன்மையான இடத்தினைப் பெறுகிறது. இயற்கையோடு இயைந்து பறவைகளின் கூடுகளையும், சிலந்தியின் வலையினையும் உற்று நோக்கி நாகரிக மனித குலம் நெசவுக்கலையைக் கற்றிருக்கக் கூடும் எனக் கருத இடமுண்டு. பழந்தமிழரின் தொன்மையினைத் தாங்கி நிற்கும் நற்றிணை நூல்கள் நெசவுத் தொழிலின் சிறப்பினையும், அதன் முக்கியத்துவத்தையும் எடுத்துக் கூறியுள்ளதன் மூலம் நெசவுத் தொழிலின் மேன்மையை உணரமுடிகிறது.

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முன்னுரை

மனிதன் காற்று, பனி, வெயில், மழை போன்றவற்றிலிருந்து தன்னைக் காத்துக்கொள்ள இலை, தாழை, மரப்பட்டை.. போல் போன்றவற்றை ஆடையாக அணிபது தொடக்கம்தான். காலப்போக்கில் இந்த இலை மாறி நெசவுத்தொழில் செய்ய ஆரம்பித்தான். பருத்தியைக் சுத்தம் செய்து நூல்தூற்று அவ்வைப் பயன்பாட்டிற்கு ஏற்றவகையில் பல வடிவங்களிலும், வண்ணங்களிலும் பலவகை வேறுபாடுகள் திரைந்த ஆடைகளை உருவாக்க தொடங்கினான். ஆடை உருவாக்கத்தில் பருத்தி நெசவின் கலையையும் குறித்து விளக்குவதாக இக்கட்டுரை அமைகிறது.

நெசவுத்தொழில்

கைத்தொழிலில் சிறப்பற்றிருந்த பழந்தமிழர் தொழில்களுள் நெசவுத் தொழிலும் ஒன்று. கைத்தொழிலின் மூலம் அவர்களுக்கு வேண்டிய பொருட்களை அவர்களே தயாரித்துக் கொண்டனர்.

“பழங்காலத்தில் ஒவ்வொரு வீட்டிலும் இந்த ஆடை நெய்யும் பழக்கம் இருந்திருக்க வேண்டும்”

என்று அ.மு. பரமசிவானந்தம் குறிப்பிட்டுள்ளார்.

ஏழை மக்கள் பலரையும் வாழவைக்கும் நெசவுத்தொழிலினை ஆண்களும் பெண்களும் இணைந்து செய்து வருகின்றனர். முதன்முதலில் இந்தியாவில் தான் பருத்தி நெசவு செய்யப்பட்டது. இங்கிருந்து தான் இக்கலை மேலை நாடுகளுக்கும் பரவியது. இன்றும் காஞ்சிபுரம், சரோடு போன்ற பெருநகரங்கள் மற்றும் பல கிராமங்களில் நெசவுத்தொழில் சிறப்பாக நடைபெறுவதோடு வாழ்வு போராட்டத்திற்கு வழி சொல்லும் ஒரு தொழிலாக அமைந்துள்ளது. இந்திய அரசாங்கமும் நெசவுத்தொழில் வளர்ச்சிக்கு உறுதுணையாக அமைந்திருக்கிறது.

“பருத்தியாடையுடன் நெருங்கிய தொடர்பு கொண்டிருந்த தொழிலாளர் தமிழர்”

என கு.பகவதி குறிப்பிட்டுள்ளார்.

“நெய்தல் தொழிலில் ஈடுபட்டிருந்த காகுநர் (சாலியர்) களுக்கெனத் தனிகுடியிருப்புகள் இருந்தது”

என ந.அறிவராஜ் சுட்டியுள்ளார்.

நெய்தல் தொழிலின் தொழில் கூறுகள் பின் வருமாறு அமைந்திருக்கின்றன

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அவை

- மூலப்பொருள்
- பருத்தியை சுத்தம் செய்தலும் நூல்நூற்றலும்
- பாவோட்டுதல்
- சாயமிடுதல்
- ஆடை நெய்தல்
- அழகூட்டுதல்

ஆகியனவாகும்

மூலப்பொருள்

பொருளின் உற்பத்திக்கு முதனிலைத் தேவையாய் அமைவன மூலப்பொருள் ஆகும். நெசவுத் துறையில் ஆடை தயாரிக்கப் பயன்படும் எல்லா விதமான நூல்களும் இழைகளிலிருந்து தயாரிக்கப்படுகின்றன.

“இழை என்னும் சொல்லுக்கு “பஞ்சநூல்” என தமிழ்மொழி அகராதி விளக்கம் தருகிறது”⁴.

ஆடை வகைகளை பயன்படுத்தும் விதம், பயன்படுத்தும் காலம், அதன் உழைப்பு, தன்மை, அணியும்விதம் ஆகியவை இழைகளின் பண்புகளைப் பொறுத்தே அமைந்திருக்க கூடும்.

பழங்கால மக்கள் பருத்தி இழைகளின் நற்பண்புகளை அறிந்திருந்ததால் 5000 ஆண்டுகளுக்கு மேலாகப் பருத்தி பயிரிடப்பட்டு வந்துள்ளது. பருத்திக்கும் இந்தியாவுக்குமுரிய தொடர்பு முதன்மையானது. பண்டைய சிந்துவெளி, மெக்ஸிகோ, பெரு மற்றும் அமெரிக்க ஐக்கிய நாடுகளில் பருத்திச் செடிகள் வளர்க்கப்பட்டு வந்துள்ளன. இப்பருத்தியே நூலை ஆக்குவதற்குரிய மூலப்பொருள் ஆகும்.

“பருத்தி வேலிச் சிறார் மன்னன்” (புறம் 299:1)

“பருத்தி வேலிக் கருப்பை பார்க்கும்” (புறம் 324:7)

பழங்காலத்திலிருந்தே பருத்தி வேலிகளில் பயிரிடப்பட்டதாகவும் அவை செழித்து வளர்ந்ததாகவும், நெசவுத்தொழிலுக்கு இன்றியமையாத காரணியாகவும் பருத்தி அமைகிறது என புறநானூறுப் பாடல் வரிகள் விளக்குகின்றன.

பருத்தியை இழைகளின் அரசன் என்று கூறுவர். எல்லாப் பூக்களும் பூத்துக் காய்த்து கனிந்து விடும். ஆனால் பருத்தி பூத்து

காய்த்து வெடித்து பஞ்சாகி நூலாகி ஆடையாகி நம் மானத்தை காத்தாழிற்கிறது.

பருத்தியை சுத்தம் செய்தல்

பருத்திக்காயை உடைக்கும்போது பஞ்சோடு கலந்திருக்கும் விதைத் துகள்கள், இலைச்சருகுகள், சிறு இழைகள், மிகச் சிறிய மணல் துகள்கள் ஆகியவற்றை திறம்பட பிரித்தெடுக்கும் பணியினை பெண்கள் வீடுகளில் செய்தனர்.

“கோடைப் பருத்தி வீடு நிறை பெய்த
முடைப் பண்டமிடை நிறைந்த தன்ன”

- (நற். 354:1-2)

பருத்திக்காய் முற்றி முதிர்ந்து வெடித்து பஞ்சு வெளிப்பட்டதும் அவற்றை கொய்து வீட்டிற்குக் கொண்டு வந்து மூட்டைகளாக வைத்து விட்டு பெண்கள் கூடியிருந்து இத்தொழிலினைச் செய்தனர் என நற்றிணை வரிகள் கூறுகின்றன.

“வில்லெறி பஞ்சியின் வெண்மழை தவழும்”

- (அகம்.133:6)

“வழிதுளி பொழிந்த இன்குரல் எழிலி
எ.குறு பஞ்சிற் றாகி”

- (நற். 247:3-4)

என்னும் பாடல் வரிகளின் மூலம் பருத்தியிலிருந்து அதன் பஞ்சையும், கொட்டையையும் தனியே பிரித்து எடுக்க “வில்” என்ற கருவியினையும் கம்பு அல்லது எ.கு போன்ற பொருட்களாலும் அடித்து சுத்தம் செய்தனர் என்பது புலனாகிறது. பஞ்சினை அடித்து தூய்மை செய்யும் போது மெல்லிய துகள்களாகப் பறந்து செல்லும் காட்சியினை அகநானூறு மற்றும் நற்றிணை வரிகள் காட்சிப்படுத்துகின்றன.

தற்போது பருத்தி இழைக்கு எந்தவிதமான சிறு பாதிப்பையும் ஏற்படுத்தாமல் பிரித்தெடுக்க “ஜின்னிங்” என்ற இயந்திரத்தினை பயன்படுத்துகிறார்கள்.

பருத்தி இழைகளை முறுக்கேற்றுவதன் மூலமாக ஆடைகள் மற்றும் இதர துணிநூல் நுகர்வோர் பயன்பாட்டுக்கான தயாரிப்புகளை உற்பத்தி செய்வதற்கான மூலப்பொருளான நூலினைத் தயாரிக்கும் செய்முறை தான் நூல்நூற்றல் ஆகும். நூல் நூற்றல் என்பது துணிநூல் தொழிலில் முக்கியத்துவம் வாய்ந்த கூறு ஆகும். பழங்காலத்தில் பெண்கள் இத்தொழிலினை செய்து வந்தனர் என இலக்கியங்கள் கூறுகின்றன.

“பருத்திப் பெண்டின் பனுவல் அன்ன”
- (புறம். 125:1)

“பருத்திப் பெண்டின் சிறுதீ விளக்கத்து”
“ஆள் இல் பெண்டிர் தாளின் செய்த
நுணங்கு நுண் பனுவல் போல”
- (நற். 353:1-2)

“பனுவல்” என்னும் சொல் நூலைக் குறிக்கிறது. இரவு நேரத்தில் சிறு விளக்கின் வெளிச்சத்தில் நூல் நூற்றனர். கணவனை இழந்த விதவைப் பெண்கள் தங்கள் தனிமை துயரினைப் போக்கவும், தங்கள் வாழ்வாதாரத்திற்குப் பொருள் ஈட்ட வேண்டும் என்ற நோக்கோடு இத்தொழிலினை சிறப்புற செய்து வந்தனர் என நற்றிணை வரிகள் குறிப்பிடுகிறது.

“பஞ்சிதன் சொல்லாப் பனுவல் இழையாகக்
செஞ்சொற் புலவனே சேயிழையா - எஞ்சாத
கையே வாயாகக் கதிரே மதியா
மையிலா நூல்முடிவு மாறு”
- (நன்னூல்: 24)

பருத்தி நூலுக்கும், நெசவு நூலுக்கும் தொடர்புபடுத்தி நன்னூலில் கூறியுள்ளார்.

“நூலின் மென்மைத் தன்மைக்கு ஏற்ப பஞ்சிலிருந்து நூற்கப்படும் நூல் எண் 10, எண் 20, எண் 40, எண் 60, எண் 80, எண் 100, எண் 120 என பெயரிட்டு அழைப்பதை அறிய முடிகிறது.”⁵

பாவோட்டுதல்

பருத்தியினைச் சுத்தம் செய்த பின்னர், நூற்பு செய்த அந்நூலினைக் கொண்டு பெரிய இராட்டினத்தில் துணி நெய்வதற்குத் தகுந்தாற் போல பாவோட்டப்படுகின்றது.

“பாவு என்பதற்கு துணியிலோ நீள்வாக்கில் செல்லும்
இழை”⁶

என நர்மதாவின் தமிழ் அகராதி கூறுகிறது.

நூலினை எடுத்து நீளமாக விரித்துப் பசையிட்டு நன்கு மென்மையாகத் தேய்த்து நூலுக்கு மெருகு ஏற்றப்படுகிறது. நெசவு செய்தலுக்கு ஏற்றபடி நூலினை அமைத்தலை “பா” எனப் பழந்தமிழ் மக்கள் அழைத்துள்ளனர். இதனை தற்காலத்தில் “பாவாற்றுதல்” அல்லது “பாவோட்டுதல்” என வழங்குகின்றனர்.

“துகில் ஆய் செய்கைப் பாவிரித் தன்ன
வெயில் அவிர்பு நூங்கும் வெவ்வெவ் கள்ளன்”
- (அகம். 294:4-6)

நெசவு செய்வதற்கு முன்பு பாவோட்டி பாவினைப் பரப்பி வைக்கும் தன்மையினை அகநானூறுப் பாடல் வரிகள் கட்டுகின்றன.

சாயமிடுதல்

“சாயம் என்னும் சொல்லுக்கு துணி, பாய், முதலியவற்றிற்கு நிறம் சேர்க்க பயன்படும் ரசாயனக் கலவை”⁷ என க்ரியாவின் தற்காலத் தமிழ் அகராதி கூறுகிறது.

நெய்யப்பட்ட ஆடைகள் முற்காலத்தில் நூலின் நிறமான வெண்மை நிறங்களில் இருந்தன. பின்னர் தாவரங்கள், பட்டைகள் மற்றும் பூச்சிகளைக் கொண்டு சாயமிட்டிருப்பதை அறிய முடிகின்றது.

“நெசவியல் துறையில் ஆடைகளுக்கு வண்ணமிட இயற்கைச் சாயங்களை 5000 ஆண்டுகளுக்கு முன்னர் கற்காலத்திலேயே சீனர்களால் உபயோகப்படுத்தப்பட்டது”⁸.

பழந்தமிழர் மக்கள் நெசவு செய்த ஆடைகளுக்கு சாயமிடும் பணியைச் செம்மையாக செய்து வந்துள்ளனர். இறைவனின் படைப்பில் மனிதன் பெற்ற பல சிறப்புகளுள் நிறம் பற்றிய சிந்தனையும் ஒன்று. இச்சிந்தனை பழங்கால மக்களிடமும் இருந்துள்ளன. உடுத்துகின்ற ஆடைகள் பல வண்ணங்கள் கொண்டிருப்பதை விரும்பியதன் காரணமாகத் துணி நெய்யும் படைப்பில் அது ஒரு கலைத்திறன் உருவாக்க வழிவகை செய்து கொண்டிருக்கின்றது.

“இணைபட நிவந்த நீலமென் சேக்கையுள்” - (கலி. 72:1)

ஆடைகளுக்கு நீலநிற சாயங்கள் ஏற்றப்பட்டதை கலித்தொகை வரி கூறுகிறது.

“துவர் செயல் ஆடை” - (நற். 33)

செந்நிற ஆடைகளை பழந்தமிழர் பயன்படுத்தி வந்துள்ளனர் என நற்றிணை வரி தெரிவிக்கிறது.

“காயாம்பூங் கண்ணிக் கருந்துவராடையை” - (கலி. 108:10)

கருமையும் செம்மையும் கலந்த நிறத்தையுடைய ஆடையினை உருவாக்குவதில் வண்ணக் கலப்பு சாயங்களைப் பயன்படுத்தி வந்தனர் என்பதை கலித்தொகை வரி வெளிக்காட்டுவதாக அமைந்துள்ளது.

இன்று நீக்கி இயற்றித்தின் மூலம் பருத்தி துணிக்கு சாயப்படுத்திற்று. பல வண்ண சாயங்களால் ஆடைகளுக்கு மெருகூட்டும் தன்மையினை கண்டடைக காணமுடிகிறது.

ஆடை நெய்தல்

சாயப்பட்ட பாவினைக் கொண்டு பழங்கால மக்கள் ஆடை நெய்துள்ளனர். இது ஆடை உருவாக்கத்தின் நிலையாகும். இதற்காகத் தந் என்னும் இயந்திரம் பயன்படுத்தப்படுகின்றது. தந்யின் பல்வேறு பகுதிகளின் துணையினால் ஆடை உருவாகிறது. நெசவு செய்யப்படும் முறையில் தந்நெசவு, வீரல் நெசவு, மேல்நோக்கி நெசவு, கீழ்நோக்கி நெசவு எனப் பலவகையுள்ளன. தந்யின் பகுதிகளாக அச்சமரம், படுமரம், விழுது, கம்பு, குத்துக்கம்பி, கால்பலகை, ஓடம், ஊடைகுழல், பாவு போன்றவை அமைகின்றன. இவற்றுள் ஊடைகுழலும், ஓடமும் நெய்யும் போது இணைந்த பாவு குறுக்காகச் செல்லும் தன்மையுடையது. பலவகைப்பட்ட ஆடைகளை மக்கள் நெய்து அணிந்து வந்தனர் என இலக்கியங்கள் குறிப்பிடுகின்றன.

“புகாப்புக் கொண்ட புனிப்புக் கலிங்கமோடு” - (நற்.90)

“தேம்பாயுள்ள தேங்கமழ் மடருளப்
பாம்பியன்ன வடிவன காம்பின்

கண்படு சொலியின் இழையணிவாரா” - (புறம் 383)

நூலின் தன்மைக்கு ஏற்ப மெல்லிய நூலினால் பாம்பின் தோல் போன்ற தன்மையினையுடையதாகவும், மூங்கில் குழலின் உட்புறத்தில் உள்ள தோலை போன்ற மென்மையான ஆடைகளை பழந்தமிழ் மக்கள் பயன்படுத்தி வந்துள்ளதை நற்றிணை மற்றும் புறநானூற்று வரிகள் விளக்குகின்றன.

அழகூட்டுதல்

அழகுக்கு அழகு செய்வதில் தமிழர் மிகுந்த ஆர்வம் உடையவர்கள் என்பதை ஆடைகளில் பூக்கள் போன்ற சித்திரங்களை அமைத்து கலை உணர்வுடன் மதிப்பினை உணர்த்தினர். இவர்கள் ஆடைகளை சிறிய அளவில் தைத்து பூ வேலைப்பாடுகளையும் செய்திருந்தனர்.

“துன்னற் சிதா அர் நீக்கித்தாய

கொட்டைக் கரை பட்டுடை நல்கி”

- (பொருந்.154-155)

பட்டாடைகளில் கரைகளின் ஓரங்களில் முடிச்சிப் போட்டும், பூவேலைப்பாடுகள் செய்தும் ஆடைகளை உடுத்தி வந்தனர் என பொருநராற்றுப்படை மற்றும் புறநானூறு பாடல் வரிகள் விளக்குகின்றன.

பூசிக்கக்கூட, பூசிக்கில், சிலப்புகலிச்சம் போன்ற அண்டமொழிகளின் மூலம் பழந்தமிழர் ஆடைகளை அழகூட்டி வந்தனர் என்பதனை அறிய முடிகிறது.

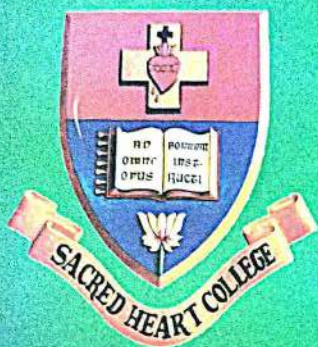
இன்னும் கரைகளை அழகுச் செய்வதில் பூ வேலைப்பாடுகளால் அலங்கரித்து ஆடைகளை கிண்கி ண்கல் அணிவதானபடி காண முடிகிறது.

முடிவுரை

இந்தியாவின் வளமான காலங்களைக் கடந்த கணக்கற்ற பாரம்பரியத்தினைக் கைத்தறி தொழில் தேர்வுகளிலிருந்து கைவினைச் சமையாக தொகுத்தொழில் விளைவிக்கிறது. பருத்தியை விளைச்சல் செய்து சுத்தம் செய்யும் பணியினைத் திறம்பட செய்து வந்தனர் என்பதனை அறியமுடிகிறது. நூல்துறையில் கைம்பெண்கள் சிறப்பாறு விளக்கினர். சாயப்பட்ட ஆடைகளை பழந்தமிழர் அணிந்து வந்தார்களனர். துணைவிய வேலைப்பாடுகளுடன் பலதரப்பட்ட ஆடைகளை நெய்து உடுத்தி வந்தனர் என தெரிவிக்கிறது. பழந்தமிழர் இலக்கியங்கள் இன்றும் திணைத்து நிற்பதற்கு தொழில்முறை ஆதாரங்கள் நம் கண்முன் காட்சியளிக்கின்றது என்றால் மிகையாகாது.

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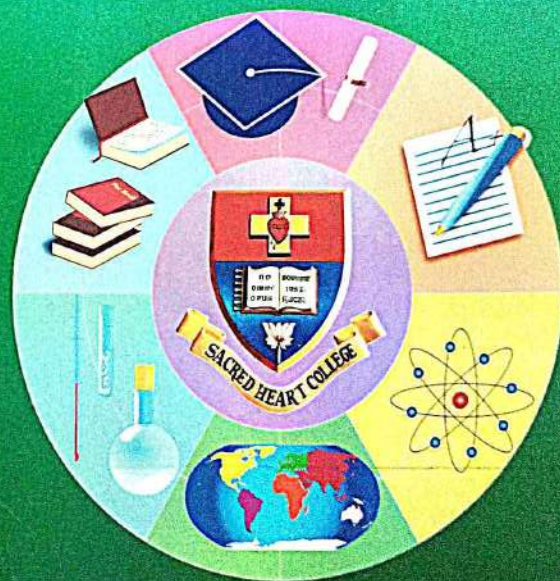
புதிய அவையம்



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வணிகத்தில் மனிதநேயம்

பண்டைக் காலத்தில் வணிகம் என்பது பொருள் ஈட்டுவது என்னும் நோக்கத்துடன் மட்டுமல்லாமல் உலகத்தார்க்கு உதவிட வேண்டும் என்ற பரிந்த மனப்பான்மையுடன் மேற்கொள்ளப்பட்டது எனலாம். பல் இடங்களில் விளையும் விளைப பொருட்களை ஓரிடத்தில் கொண்டு வந்த அப்பொருட்களை கிடைக்காத வேற்றுடங்களுக்கு அனுப்புவதால் நாடு முழுவதும் மக்கள் வறுமையின்றி வாழ முடியும். இப்படிப்பட்ட பரிந்த மனப்பான்மையுடன் தான் பழந்தமிழர்கள் வணிகத்தில் ஈடுபட்டனர் என கருதலாம்.

ஒரு இடத்தில் உற்பத்தி செய்யும் உணவுப் பொருட்களை அப்பொருள் கிடைக்கப்பெறாத பிற இடங்களுக்கு எடுத்துச் சென்று விற்பனை செய்து அங்குள்ள மக்களும் அப்பொருட்களை பயன்படுத்தும் படி செய்தனர்.

“புகர்வாய்க் குழிசி பூஞ்சுமாட்டு இரி,
நாள் மோர் மாறும் நல்லாமேனி,

.....
அனைவிலை உணவின் கிளை உடன் அருந்தி”
- (பெரும் 159-162)

என்றபாடல் வரியில் இடையர் மோர், தயிர் ஆகியவற்றை உற்பத்திச் செய்து இப்பொருட்கள் உற்பத்திச் செய்யப்படாத பிற இடத்திலுள்ள மக்களுக்கு கொடுத்து அந்நிலத்தில் கிடைக்கக் கூடியநெல் முதலான பொருட்களைப் பெற்று அவற்றைத் தாமும் உண்டுதல் சுற்றத்தாருக்கும் அளித்தனர் என்பதை அறிய முடிகின்றது.

சங்க இலக்கியத்தில் ஒன்றான பெரும்பாணாற்றுப்படையின் வழி பழந்தமிழரின் மேலோங்கி காணப்பட்ட மனித நேயப் பண்புகளை இக்கட்டுரையின் மூலம் அறிந்து கொள்ள முடிகின்றது.

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பொன்னிலன் நாவல்களில்
மொழிநடை

த. ஜாஸ்மின் பிரியா
முனைவர் பட்ட ஆய்வு மாணவி, பதிவு எண்: 18213104022002,
நாஞ்சில் கத்தோலிக்க கலை மற்றும் அறிவியல் கல்லூரி,
கனியக்காவினை - 629 153, கன்னியாகுமரி மாவட்டம், தமிழ்நாடு.
மனோன்மனியம் கந்தரனார் பல்கலைக்கழகத்துடன் இணைவு பெற்றது.

முனைவர் ம. பெரில் திரேஸ்

ஆய்வு நெறிபாளர், துறைத்தலைவர், தமிழ்த்துறை,
நாஞ்சில் கத்தோலிக்க கலை மற்றும் அறிவியல் கல்லூரி,
கனியக்காவினை - 629 153, கன்னியாகுமரி மாவட்டம்.

ஆய்வுச் சுருக்கம்

மொழிநடை என்பது படைப்பாளன் தம் படைப்பில் கையாளும் எழுத்து நடை, பேச்சுநடையைக் குறிக்கிறது. கதையை கூறும் முறையானது எழுத்து நடை எனவும், கதைமாந்தர் உரையாடும் முறையானது பேச்சு நடை எனவும் வழங்கப்படுகிறது. மொழிநடையானது எழுதுவோருக்கும், எழுதப்படும் பொருளுக்கும் ஏற்ப வேறுபட்டு அமையும் இயல்புடையது. பொன்னிலன் நாவல்களில் பயன்படுத்தப்படும் நடை உணர்ச்சியுடன், சிறந்தக் கருத்துகளை வெளிப்படுத்தும் எனிய நடை ஆகும். கன்னியாகுமரி மாவட்ட மக்கள் பேச்சு பேச்சு வழக்கிலேயே அவருடைய நாவல்கள் படைக்கப்பட்டுள்ளன. மலையாள மொழியின் கலப்பு சில இடங்களில் காணப்படுகிறது. நாவலில் வரும் பாத்திரங்களின்

இயல்புக்கு ஏற்ப உரையாடல் அமைகிறது. செய்கின்ற தொழிலின் அடிப்படையிலும், படிப்பு, வயது போன்றவற்றின் அடிப்படையிலும் பேச்சு நடையானது மாறுபடுகிறது. ஆசிரியர் தம்முடைய நாவல்களில் இதை தெளிவாக விளக்கியுள்ளார். சமுதாயத்தில் தாழ்நிலையில் இருக்கும் மக்கள் முதலாளிகளிடம் பேசும்போது பயன்படுத்தும் மொழிநடையானது ஏழ்மையின் அவலத்தை தெளிவுபடுத்துகிறது. பெரும்பாலான நாவல்களில் கதைப்பின்னல் சிறப்பாக அமையப்பெற்றிருந்தாலும் நடையின் செயற்கை தன்மையால் அதன்தரம் குறைந்துவிடுகிறது. கதை அமைகின்ற குழுவிற்கு ஏற்ப உரையாடல் அமையும் போது நடை இயல்பானதாக அமைகிறது. பொன்னிலன் நாவல்களில் அமைக்கப்பட்டுள்ள பாத்திரங்கள் எந்த குழுவிலிருந்து வருகின்றதோ அதற்கேற்ற பேச்சுநடையும் தெளிவாக அமைந்துள்ளது. இதன் மூலம் ஆசிரியரின் மொழி ஆளுமைத் திறனாது வெளிப்படுகிறது. ஒரு குறிப்பிட்ட வட்டாரம் சார்ந்த மக்களின் வாழ்வினை மையப்படுத்தி நாவல் படைக்கப்படும் போது அம்மக்களின் மொழி நடையானது, பாத்திரங்களின் மொழிநடையில் இயல்பாக வெளிப்பட வேண்டும். கொச்சைப் பேச்சுநடையைக் கையாண்டு எழுதுவதாலோ, அல்லது பாத்திரங்களின் இயல்பான பேச்சு நடையைக் கொச்சையாக அமைப்பதாலோ ஒரு நாவல் வட்டார நாவலாக ஆக முடியாது. கதை சொல்லப்படும் முறையினாலும், கருத்து வெளிப்பாட்டிற்குப் பயன்படும். சொல், தொடர், அமைப்பு முறையினாலும் நடைச் சிறப்பை அறியலாம். நாவலில் அமையப் பெறுகின்ற உரையாடல், பாத்திரங்களின் இயல்பான தன்மை, பேச்சு மொழியில் பயன்படுத்தும் வார்த்தைகள் என பலதன்மைகளின் அடிப்படையில் தான் அது குறிப்பிட்ட வட்டாரம் சார்ந்த நாவல் என தீர்மானிக்கப்படுகிறது. பொன்னிலன் நாவல்கள் இடம்பெறும் கிராமப்புற மக்களின் வாழ்க்கை முறை, பழக்கவழக்கங்கள், சொழில்கள், வேலையின்மை, வறுமை, சமுதாயத்தில் தாழ்நிலையில் உள்ள மக்கள் ஒடுக்கப்படும் நிலையில் காணலாகும் மக்களின் மொழிநடையை விளக்குவதே இக்கட்டுரையாகும்.

முன்னுரை

ஒரு இலக்கியம் உருவாவதற்கு மொழி இன்றியமையாதது ஆகும். இலக்கியங்கள் ஒவ்வொன்றும் மொழியை ஊடகமாகக் கொண்டிருக்கின்றன. மொழிநடையில் ஒவ்வொரு காலத்திற்கும் இடையே வேறுபாடுகள் காணப்படுகின்றன. ஒவ்வொரு இலக்கியப் படைப்பும் வேறுபாட்டுடன் திகழ இம் மொழிநடையே காரணமாக அமைகிறது. இனக்குழு சார்ந்த சமுதாயத்தில் பேசும் மொழி வட்டார வழக்கிலிருந்து வேறுபட்டதாக அமைகிறது. படைப்பாசிரியரின் சொந்த அனுபவங்கள், பழகும் மனிதர்கள், தொழில் செய்யும் இடம்

போன்றவற்றால் திடைக்கும் அனுபவத்தால் ஒரு படைப்பை உருவாக்க முடியும். வட்டாரம் சார்ந்த நாவல்களை எழுதி புகழ்பெற்றவர் பொன்னிலன் ஆவார். பொன்னிலன் நாவல்களில் வருகின்ற மொழிநடையைப் பற்றி கூறுவதாய் இக்கட்டுரை அமைகிறது.

மொழிநடை விளக்கம்

மொழிநடை என்பது ஆசிரியர் தம் கருத்தை மக்கள் புரிந்து கொள்ளும்படி இனிய எளிய நடையில் தம் படைப்பில் செய்திகளைக் கூறுவதாகும். அது ஆசிரியர் கூற்றாக இருந்தாலும், பாத்திரங்களுக்குள் வரும் உரையாடலாக இருந்தாலும், அது எந்த சமுதாயத்தை அல்லது எந்த வட்டாரத்தை பற்றிய படைப்பே அவர்களது மொழிநடையிலேயே அமைக்கப்படுகிறது. மொழியும், அதன் சொற்களும், இலக்கணமும், நடையும் நம்முடைய நடைமுறையையும், பயன்பாட்டையும், பழக்கவழக்கங்களையும் அடிப்படையாகக் கொண்டவை. இவற்றின் அடிப்படையில் படைப்பு உருவாகும் போது அது சிறந்த படைப்பாகிறது.

படைப்புகள் முழுவதும் இலக்கிய நடையில் அமைந்தால் படிப்பவர்களின் ஆர்வம் குறைவுபடுகிறது. அதேநேரம் முழுவதும் பேச்சு தமிழிலேயே அமைந்தால் படிப்பதற்கு சற்று இனிமை குறைந்ததாக இருக்கிறது. எனவே கதை மாந்தர் பேசுவது பேச்சுத் தமிழாகவும், ஆசிரியர் பேசுவது எழுத்துத் தமிழாகவும் அமைந்தால் இனிமையாக இருக்கும். "நடை என்பது ஆசிரியரின் தன்மையை வெளிப்படுத்துவது என்றும், ஆசிரியரின் உள்ளத்தின் சொல்லோவியம், குணத்தை அறியும் கலை" என்று கூறலாம்.

எல்லா இலக்கிய படைப்பும் ஒரு முறையில் அமைவதில்லை. ஆசிரியரைப் பொறுத்து மொழிநடையும் மாறுபடுகின்றது. பொன்னிலனின் மொழிநடையில் வட்டார வழக்குச் சொற்கள் அதிகமாக இடம் பெறுகின்றன. கொள்ளைக்காரர்கள் நாவலானது களியக்காவினை சார்ந்த மக்களை பற்றியது அதில் அப்பகுதி மக்கள் பேசும் தமிழும் மலையாளமும் கலந்த மொழிநடையே காணப்படுகிறது. அதுபோல புதிய தரிசனங்கள், மறுபக்கம் போன்றவற்றில் நாகர்கோவில் வட்டாரம் சார்ந்த மொழி நடையும், கரிசல் நாவலில் திருநெல்வேலி மாவட்டத்தில் கிராம மக்கள் பேசும் மொழிநடையும் அமைந்துள்ளது.

நாவல்களில் மொழிநடை

உரைநடையில் அமைகின்ற நாவல் இலக்கியமானது அது படைக்கப்படும் காலச்சூழலுக்கு ஏற்ற சமுதாயத்தை பிரதிபலித்துக் காட்டுவதாக அமைகிறது. "ஒரு கலைஞர் தம் படைப்புகளில் வரும்

கதை மாந்தர் இன்ன இடத்தில் வாழ்பவர் அல்லது இன்ன இனத்தைச் சார்ந்தவர் அல்லது இன்ன சொழில்லில் இருப்பவர் என்று இனங்கண்டுகொள்ளவே வட்டார வழக்குகளைப் பயன்படுத்துவர்². இனங்கண்டுகொள்ளவே வட்டார வழக்குகளைப் பயன்படுத்துவர்². கதைமாந்தர் வாழும் இடம், அவர் சார்ந்த இடம், செய்யும் சொழில் ஆகியவற்றுக்கு ஏற்ப ஒரு இலக்கியப் படைப்பில் வட்டார வழக்குச் சொற்கள் இடம்பெறுகின்றன.

நாவலில் இடம் பெறும் மனிதர்களின் சமூக அனுபவங்களை சரிவர சித்தரிப்பதன் மூலம் நாவல் ஒரு சமூக ஆவணமாக சிறப்பு பெறுகின்றது. குமரி மாவட்டத்தில் நிகழ்ந்த சில வரலாற்று நிகழ்வுகளையும், சமூகச் சிக்கல்களையும் பதிவு செய்யும் வகையில் படைக்கப்பட்டதே இவருடைய நாவல்கள் ஆகும்.

மறுபக்கம் என்னும் நாவலானது வரலாற்று நிகழ்வுகளின் பிரதிபலிப்பாகவே அமைகிறது. 1982-ம் ஆண்டு நிகழ்ந்த மண்டைக்காட்டு கலவரத்தை மையமாகக் கொண்டுள்ளது. மக்களின் நம்பிக்கைகள், சடங்குமுறைகள், வழிபாடுகள், நேர்த்திக்கடன் செலுத்துதல் என மக்கள் ஒட்டுமொத்த வாழ்க்கை முறையினது அவர்களது இயல்பான மொழிநடையிலேயே நாவலில் இடம் பெறுகிறது. அடித்தள மக்களே இந்நாவலில் பாத்திரங்களாக வருகின்றனர். அவர்களின் வாழ்க்கையையும் போராட்டங்களையும் அவர்களின் பேச்சுநடையிலேயே வெளிப்படுத்தியுள்ளார்.

“சொல்லும் கருத்தில் தெளிவு, நுட்பம், எளிமை, சுருக்கம் முதலியன கொண்டு விளங்குபவற்றை நல்ல நடை என்று கூறலாம். ஆகவே அழகிய செஞ்சொற்களால் இனிமையாகவும், எளிமையாகவும், நுட்பமாகவும் கருத்தினை உணர்த்துவதே நல்ல நடையாகும்”³.

பொன்னிலன் பயன்படுத்தும் மொழிநடையும் இதுபோன்ற இயல்புடையதாகும். சமுதாயத்திற்கு எதை கூறவேண்டும் என்று நனைக்கின்றாரோ, அச்செய்தியை மக்கள் புரியும்படி நாவலில் கூறிவிடுகிறார்.

“திருக்கார்த்திகையை ஊர் சிறப்பாகக் கொண்டாடியது. ஒரு மாதமாகவே இளைஞர்கள் பொரிஞ்சான் புல்பிடுங்கி உலரவைத்து, முற்றங்களில் குவிக்கத் தொடங்கிவிட்டார்கள். காடெல்லாம் அலைந்து உயரமான கத்தாளம் பூக்களைத் தண்டுகளோடு வெட்டி வந்து, உலரவைத்துச் சொக்கப்பனை மரம் தயார் செய்தார்கள்”⁴.

கொள்ளைக்காரர்கள் என்னும் நாவலில் அதிகமான மலையாளச் சொற்கள் கலந்து வருகின்றன. அரிசி வாங்க செல்லும் பெண்களின் உரையாடலானது கிராமப்புறங்களில் இயல்பாக மக்கள் பேசும் நடையிலேயே அமைந்திருப்பது நாவலுக்கே உரிய

சிறப்பாகும். அரிசியை வாங்கிக் கொண்டு வரும் புஷ்பபாயின் உணர்வானது தாய்மைக்குரிய தனித்தன்மையோடு வெளிப்படுகிறது. “சேகவே, என் மக்களோக்க எங்கள் கெடக்கனுமோ வயத்துப் பரியோட எங்கயெல்லாம் அலஞ்சியோண்டு திரியினுமோ” என்று கூறுவது தாய்மையின் ஏக்கத்தை வெளிப்படுத்துகிறது.

பொன்னிலன் நாவல்களில் பேச்சு வழக்குச் சொற்கள் அதிகமாக காணப்படுகின்றன. எளிமையான சொற்களைப் பயன்படுத்தி சொல்ல வந்தக் கருத்தைச் செறிவாகக் கூறியுள்ளார். கரிசல் என்னும் நாவலில் கலியாணம் ஆயிரிச்சி, வரல்லயா, ஏன்யா, வரல்ல, போயிட்டான்யா போன்ற எளிமையான பேச்சுவழக்குச் சொற்கள் இடம்பெற்றுள்ளன. இந்நாவலில் வட்டார வழக்குச் சொற்களும் இடம் பெற்றுள்ளன.

தானியம்	- கவசம்
போகனி	- சிறுபாத்திரம்
நகை	- உருப்படி
காங்கல்லன்னா	- விடியற்காலம்
வண்டிமாடு	- பிணையல் மாடு
கண்ணிகள்	- வலையில் மீனைச் சிக்கவைக்கும் முடிச்சுகள்
போணி	- கஞ்சிகொண்டு போகும் சிறிய வாளி

போன்றச் சொற்கள் இடம் பெற்றுள்ளன. எல்லா நாவல்களிலும் இதுபோன்ற வட்டார வழக்குச் சொற்கள் இடம்பெறுகின்றன. அடுக்குத்தொடர்கள், உவமைகள், பழ மொழிகள் போன்றவைவும் இடம் பெறுகின்றன. மக்கள் பயன்படுத்தும் இயல்பான சொற்களைப் பயன்படுத்தி அவர்களின் மன ஒழுக்கங்களையும், பிரச்சனைகளையும் வெளிப்படுத்துவதில் பொன்னிலன் சிறந்தவராவார்.

சமுதாயமும் நாவலும்

இலக்கியங்களின் தோற்றத்திற்கும், சமுதாயத்திற்கும் நெருங்கிய தொடர்பு உண்டு. இலக்கியங்கள் அவை தோன்றிய காலகட்டத்தில் வாழ்ந்த மக்களின் வாழ்க்கை முறையை தெளிவாக விளக்குகின்றன. பொன்னிலன் நாவல்களில் ஏழை எளிய மக்கள் அன்றாடம் சந்திக்கும் பல பிரச்சனைகளையும் கான முடிகிறது. கரிசல் நாவலில் வறுமையால் மக்களின் மனம் வேதனைப்படுவதை “வகித்துப்பசி தாங்காமக் கேட்கிறோம் மொதலாணி. வத்தப்படி ஒங்க மனசுக்கு எதிரா ஒரு வார்த்தை சொல்லுவோமா மொதலாணி”⁶ என்று அவர்களது மொழிநடையில் கூறியுள்ளார்.

கொள்ளைக்காரர்கள் நாவலில் அரிசி உணவுக்காக மக்கள் படும் இன்னல்கள் விளக்கப்படுகின்றன. அரிசி வாங்க செல்லும் பெண்கள் அதிகாரிகளிடம் அகப்பட்டு தங்கள் அரிசியை இழந்து விடுகின்றனர். அரிசிக் கடத்தலை சொழிலாக கொண்டவர்கள் அரசியல் கட்சிகளின் துணையோடு எந்த இடையூறும் இன்றி தங்கள் வேலையைச் செய்கின்றனர். "லாறி லாறியா அரி போஷனு அதக் கேக்க துக்க ஆளல்லை". இது போன்ற நிகழ்வுகள் அனைத்தும் மக்கள் அன்றாடம் இயல்பாக பேசும் பேச்சுநடையிலேயே நாவல்கள் படைக்கப்பட்டுள்ளன. கரிசல், கொள்ளைக்காரர்கள், புதிய தரிசனங்கள் போன்ற நாவல்களில் அதிகாரத்துவம் மேலோங்கி காணப்படுகிறது. தேடல், புதிய மொட்டுக்கள் போன்றவை மக்கள் மூடநம்பிக்கையாலும், சமுதாயத்தில் உயர்ந்த அந்தஸ்தில் உள்ளவர்களால் ஒடுக்கப்பட்ட மக்கள் ஏமாற்றப்படுவதையும் ஆசிரியர் அம்மக்களின் இயல்பான மொழிநடையில் தெளிவாக விளக்கியுள்ளார். நாவலின் ஒவ்வொரு பகுதியும் சமுதாயத்தில் நாம் காணும் மக்களின் வாழ்க்கை முறையை எடுத்துக்காட்டும் வகையில் அமைந்துள்ளன.

முடிவுரை

பொன்னிலன் தனது படைப்புகளில் குமரி மாவட்ட மக்கள் பயன்படுத்தும் மொழிநடையை பயன்படுத்தி தனது படைப்புகளை படைத்துள்ளார். மக்களின் பிரச்சனைகளையும், தேவைகளையும், பழக்க வழக்கங்களையும் அவர்களுடைய இயல்பிலேயே கூறியுள்ளார். வட்டார வழக்குச் சொற்களும் இவருடைய நாவலில் அதிகமாகக் காணப்படுகின்றன. நாவல்களில் நிகழும் உரையாடல்கள், நம் கண் முன் காட்சி போல் விளக்கப்படுகின்றன. இதற்கு மொழிநடையே காரணமாகும். ஆழ்ந்த கருத்துக்களை எளிய நடையில் எடுத்துரைப்பதே பொன்னிலன் நாவல்களின் சிறப்பாகும்.

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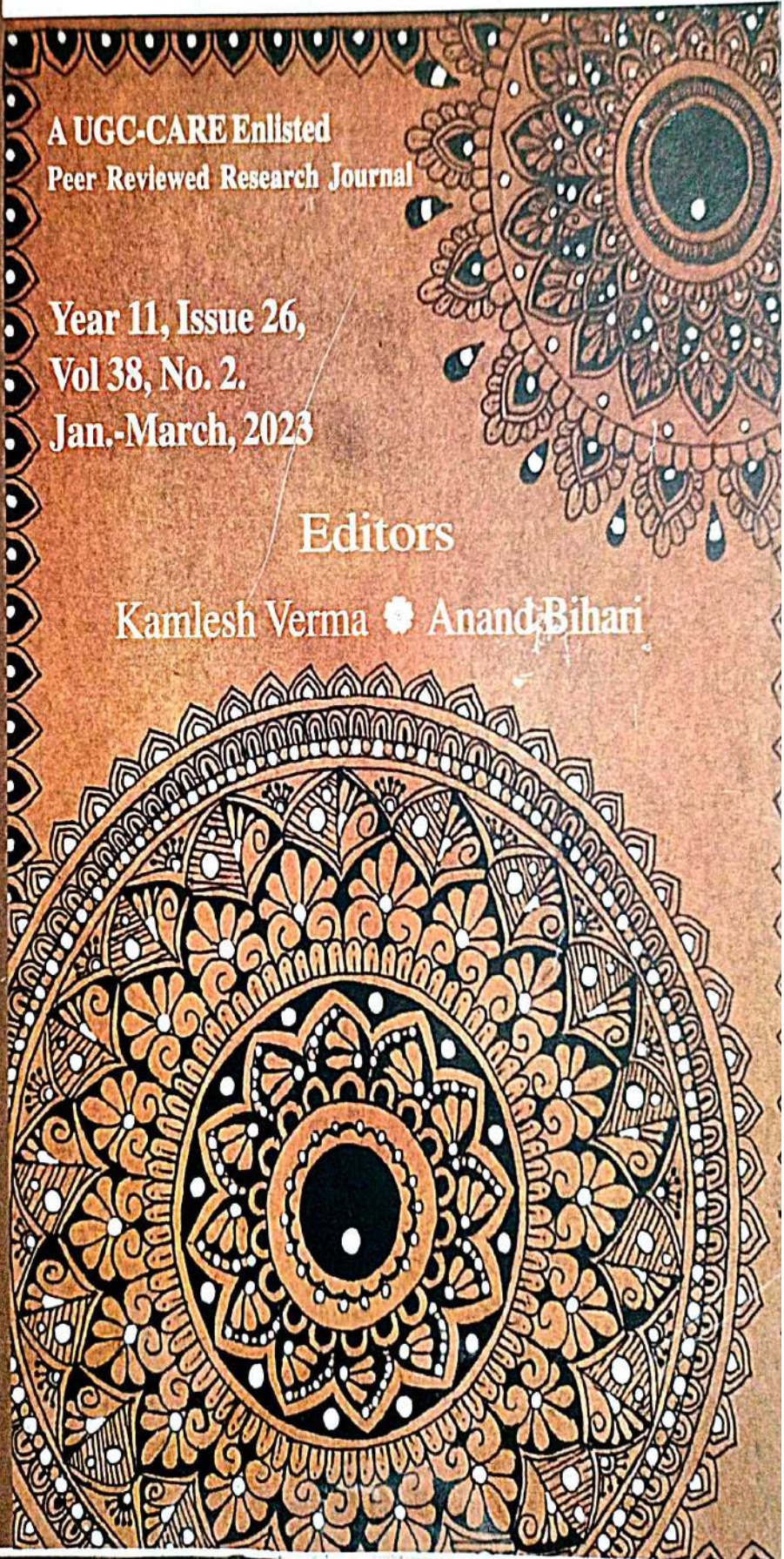
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Importance of Marriage Ideals in Premchand's *Gaban*

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Abstract

In Indian society marriage is considered as the most important relationship. Mutual understanding, love and care are some of the important factors, which are necessary to keep the marital life strong. In *Gaban*, Premchand has depicted the problems in the marital life of the couples, which can destroy marriages.

Keywords : Family, Marriage, Middle class society, Jewels.

Marriage is considered the most important sacred bond, between husband and wife since ancient times in India, which brings together a man and a woman, and connects them together for life time through sacred rituals. Family is an important link between a human being and society. Marriage is all about husband and wife living together with mutual understanding to create a family. But for the achievement of this understanding there should be compatibility among husband and wife.

Indian culture is very rigid about its age old norms. Premchand felt deeply that the age-old social norms of marriage are rotting the society. He criticized mismatch in marriage, dowry system and child marriage. These issues led to disparity among the husband and wife, which in further destroyed the peace and serenity of marital life of couples and led to unhappiness in the families. Premchand in his stories and novels has portrayed all the anomalies present in marital life. Thereby, people will save themselves from these malpractices. Premchand who was against all these malpractices had joined Arya Samaj which was rebelling against all these problems.

Premchand in his writings eulogized the marriage ideals. If husband and wife are not able to follow the ideals of marriage, then their marital life suffer, which in further leads to

discord in the family. He wrote about the problems, which degraded the sacredness of marriage, with an aim of readers becoming aware of it.

Gaban looks upon the problems prevalent in the middle-class society; people of this class always suffer from a sense of low self-esteem, as they are not able to afford what they want. They aspire to be like upper class society people. The problem with the people is that they are not able to work out their life with what little they earn. There is a want among them to have more than what they can afford.

The story of the novel begins in Allahabad. The story revolves around the life of young couple Jalpa and Ramanath. It tells about the plight of middle class couples who are entrapped inside the vicious circle of vanity. Instead of being satisfied with what they have, they destroy their own peace, in their greed for more. Ramanath and Jalpa are best example of it.

Dindayal and Dayanath belong to middle class families. Dindayal as an agent of a landlord has a meagre income of five rupees per month, which was not enough for running a family. He had other sources of income, from where he got money, which are never mentioned. His daughter Jalpa, at an early age develops a craze for jewellery, and is assured by her elders that during her marriage she will get her favourite piece of jewel (Chandrarahar) from her groom. Dayanath, a father of three sons, worked in the court, he was an honest man, and he somehow managed to take care of his family with his income of fifty rupees per month. His eldest son Ramanath is a carefree person. Dayanath was not able to send him for further studies due to lack of money. That didn't matter to Ramanath, because he never took life too seriously. His life is totally built up on the foundation of lies. Dayanath hesitates in getting Ramanath married, because "to marry off someone who doesn't even concern himself about where his next meal is coming from" felt wrong to him (*Gaban*5).

He wants to live a life of extravagance. He enjoys himself by moving around extravagantly through help of his friends. Ramanath represents weakness of the middle class society. He runs away from his responsibilities and thinks illusions created through lies are good. He is morally a weak person. He wavers in taking decisions till the end.

Jalpa and Ramanath's marriage takes place without any problem of dowry unlike in the case of most of the marriages. But Dayanath spends too much on marriage celebrations, much more than the money he had. He buys jewellery on loan, for which he is not being able to pay back. Therefore Ramanath steals Jalpa's jewels and gives it to the jeweller. He lies about his family's true conditions to his wife. After he gets a job in the municipality office through his friend Ramesh, he lies about the income to his wife. He starts getting decent salary but is not able to save any, even though he took bribes from the office. Because, he boasts in front of his wife and to make her happy he spends extravagantly. He buys jewellery for her on loan, thereby, gets in high debt. He lies to Jalpa's friend Ratan, about the price of Jalpa's bracelet and by mistake ends up spending her money also. To escape from problems he tries to use office money (with no intention of embezzling it). Which, Jalpa unknowingly gives to Ratan. Thereafter, Ramanath feeling unable to put back the office money gets a fear of embezzlement case against him, therefore he runs away to Calcutta.

In Calcutta, police arrests Ramanath on suspicion of another case, scare him with

false charges (since no actual embezzlement had happened) and forces him to become a false witness by bribing him with money and job. He being a morally weak man falls for it. Thereby after getting trapped in devious games of police, he gives false testimony. Jalpa when gets to know about it, is furious with Ramanath's cowardliness.

When Ramanath used to buy jewellery for her, she in her obsession of jewellery used to become more devoted to him. But that doesn't mean her character is limited to the typical image of a middle-class woman with love of jewellery. She has self-respect and moral strength also, as she returns her mother's jewellery, which is sent to her when Jalpa's jewellery gets stolen, she vehemently says, "I won't take charity from anyone, even my own mother" (*Gaban* 39).

When Jalpagets to know the truth about the actual financial condition of Ramanath, she regrets her own behaviour, a new change comes within her and her true devotion towards her husband comes to the fore as she happily sells off her favourite jewels to return the office money and pay off the debt. Jalpa likes jewellery but that doesn't mean she doesn't love her husband. When she learns about the true condition of her husband, she sacrifices her attachment to all the splendour and luxury and comes out as a devoted wife. It is Jalpa who puts a lot of effort to bring her husband out of his erroneous path.

There is marital love between Jalpa and Ramanath, but it lacks trust and devotion. In marriage happiness can be achieved only through understanding and truth. He gets in trouble because of the lies he thought would protect his conjugal life. Jalpa in her cravings for jewellery never tried to analyse the financial condition of her husband. Situation wouldn't have taken a wrong turn "[if] Jalpa had been able to hold herself steady through the stormy blasts of her cravings, if Rama had not yielded to his embarrassment" (*Gaban* 68).

He hesitates in making decisions and behaves like a coward. He himself creates troubles for himself, and then feels incapable of facing them. Apart from all these negative traits, he has some redeeming qualities also. Hisson like affection towards Devidin, and his wife Jaggo (without paying attention to the fact that they, belong to a lower caste). And most importantly his unending love for Jalpa.

Ramanath is a morally weak person, and Jalpa is infatuated with jewellery, which she is able to overcome because of inner strength, her pure love and concern for her husband. This is something which Ramanath lacks. In the end after all the trials and tribulations, when both reject show off and love of luxury, they are able to enjoy the true bliss of married life. Trial was necessary to cleanse them of all the faults so they are truly prepared for a true bond.

Another problem is of incompatible marriages prevalent in the society. Premchand had critiqued unmatched marriages in his other works like *Nirmala* and *Sevasadan* also. As he had to go through one in his own life as Amrit Rai points, "His own father remarried at an old age and left behind a widow and a little son" (38). Not only that "he himself had been married off at a tender age, and had to bear at first the responsibility of making a go of an utterly incompatible and awkward match, and later the guilt of failing to do so" (38).

Ratan has a mismatch marriage with a much older widower Vakil Sahib. After the death of her parents, Ratan's uncle gets her married to Advocate of Allahabad's High Court, Indra Bhushan. Ratan respects Vakil Sahib and he treats her with fatherly affection.

He buys for her everything she wants. But there is no husband and wife love between them. They respect each other's feelings. But somehow it lacks mutual understanding. He is not able to foreshadow the troubles; she will have in future, if he doesn't give her, her share of property. Even when he is very sick, he also like Ramanath wavers in taking decision. Towards the end of his life, Vakil Sahib with a full knowledge of legal system didn't settle anything for his wife for her secure future.

She had sacrificed her youth for him, as she herself tells Jalpa "I never even thought that I'm a young woman and he's an old man" (*Gaban* 137). She also liked jewellery like Jalpa. She had everything in terms of luxurious life, she enjoyed herself in roaming, buying things and parties. Her luxurious life quelled her anxiety related to marriage. But everything is destroyed when her husband's nephew Manibhushan through his deviousness usurps everything, after his death. Ratan thinks that she will be able to survive, without her husband. But as a widow she has no place in the society, no identity without her husband, and no place in her husband's family, because after husband's death as she says in anguish, husband's family "is not a bed of flowers for you, but a bed of thorns" (*Gaban* 245).

The other couples whose marriage the novel gives us glimpse of is Devidin and Jaggo and Dayanath and Jageshwari. Dayanath is an honest man, in his many years of government job he never took bribe, his wife Jageshwari is not enthusiastic about this behaviour of his, since she acutely feels the poverty they are in. she is remorseful of the fact that even after all the struggles she has faced in bringing up the family, her little desires also never got fulfilled.

Then there is Devidin and Jaggo, who also have different temperaments, except for the love of their dead sons and their affection for Ramanath. Devidin is a man who believes in simple living unlike his wife who has a craze for jewellery.

Like Devidin and Jaggo, both Dayanath and Jageshwari also have different opinions on matters. But these old couples have a strong relationship as they stand out for each other in times of need. For a successful marriage Premchand through this novel has represented that, there should be understanding and compatibility

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पद्म भूषण पंडित सामता प्रसाद ट्रस्ट ऑफ तबला की अध्यक्ष व मेरी परम श्रद्धेय माँ श्रीमती शकुन्तला जौहरी ने दिनांक 25/03/2023 को अपना पार्थिव शरीर त्यागकर परलोक गमन किया। 'कुतप' शोध पत्रिका का शुभारंभ उक्त ट्रस्ट के आधार पर ही हुआ है। अतः ट्रस्ट व कुतप परिवार की ओर से माँ को भावभीनी श्रद्धांजलि प्रेषित है व पूर्ण विश्वास है कि सूक्ष्म जगत से आपका आशीर्वाद व प्रेरणा सतत मिलती रहेगी। इहलोक व परलोक का सम्बन्ध जुड़ा रहेगा। आपको नम आँखों से कोटिशः नमन वंदन करती हूँ।

Editorial

This is VIIIth issue of '**Kutap**' Journal. This is a special issue in terms of variety of readings. There are three chapters in this particular issue. First one is based on music & interdisciplinary. From an International Seminar titled 'Promotion of Indian Language, art and culture regarding' National Education policy 2020; which was held on February 10th and 11th 2023, organized by Music and Performing Arts Department, University of Allahabad, 10 best research papers have been selected for this issue of Kutap and placed in chapter IInd. chapter IIIrd has included research paper of Arts & humanities from



Arunachala College of Engineering for Women, Kanyakumari, district Tamilnadu. Communion of North, East, West & South through vast ocean of knowledge is the first & foremost aim of the formation of the Journal Kutap. For readers, there is an adequate amount of material to nourish their brain. This special issue is dedicated to my beloved, great mother Smt. Shakuntla Johri, who inspired me to start Kutap Journal. She left us for her heavenly abode on March 25th 2023. My heartfelt Naman to her.

I tender my Heartfelt wishes & congratulations to all authors for their valuable contribution.

Thanks and Regards

Prof. Renu Johri

Head

Dept. of Music and Performing Arts
University fo Allahabad

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Depiction of Oppressed Peasants in Premchand's *Godaan*

Amala Thomas* & Dr. D .Joel Joselin†

Abstract—Munshi Premchand was always at his best when it came to writing about the village life. The present study deals with Premchand's portrayal of suffering of peasants in the village through his work *Godaan*. Through the character of Hori, Premchand explores the various factors which lead to peasants' deplorable condition. Is it external or internal? This work tries to analyze the problem.

Keywords: Peasants, Gandhian ideology, Progressive, Village, Rural, Urban, Colonialism

Dhanpat Rai Srivastava (13 July 1880 - 8 October 1936), known by the penname Munshi Premchand, is the most acclaimed writer of Hindi-Urdu literature. Premchand was also a prominent member of "All India Progressive Writers' Association", which was formed in India in 1936. *Godaan*, which is considered a masterpiece among his writings, was published in 1936, it was also the last novel he wrote.

Godaan was written around at the time when, in India, national movements for independence were running in full swing. He never took active part in national movements, but he believed that, as a writer he could bring about change through his works. Premchand was a writer of the people. He was very sympathetic towards the down trodden people of the society. He believed in the writer's role as a social reformer. He was a firm believer in literature as a tool in bringing change by projecting the reality of the society to the readers.

This novel epitomizes his ideas and shows the stark reality of struggling peasant class. The novel looks upon the lives of the people living in the city of Lucknow which was Awadh's capital, and Belari and Semari, the two villages in the province of Awadh. Hori the tragic hero of the novel, symbolizes the peasant class of India, and, their never ending battle against poverty as they are constantly subjugated by the ruling class. Hori a poor, hard working peasant from the village Belari, has only one simple dream in his life, which is to own a cow. Even though, Hori and his wife Dhaniya work hard, day and night, it is never enough to even provide a proper meal in the family. Hori, like other peasants in his village is always in debt, because of family commitments, and especially moneylenders' callousness. He never questions or resist, against the cruel traditions and customs which he knows are the cause of his misery. He easily gives in to the words of the exploiting moneylenders. He has blind faith in destiny. In the end Hori dies, without having his dreams fulfilled.

Premchand in his works focuses upon the social and economic conditions of people of that time, especially in *Godaan*, the peasant class. As many critics have also pointed out Premchand is at his best when he depicts the rural society. As Prem kumar has pointed out, "Premchand was born and raised in a village and he best understood life in rural surroundings. Although he spent a considerable portion of life in various cities, he had recognized early in his career that India was essentially a rural society, and that any attempt at reforming India must focus on the village" (67).

Both city and village are presented in a stark contrast with each other in his writings. Peasants in colonial India are shown to be doubly subjugated because of the colonial and feudal system, who with their capitalistic interests, had broken the spirit of peasant people. The main center of this exploitative culture, was epitomized as being the city with its decadent urban culture. As we see especially in *Godaan*. City people as seen in the novel, are corrupt and selfish, as showcased in the characters like Khanna (the industrialist) and Rai Sahib (the feudal landlord), who are the epitome of moral decay, as their only motive in the entire novel is to squeeze money out of poor working class people. Even some characters like Professor Mehta, Miss Malti, Mirza Khurshed and Pandit Onkarnath, with their high talk are not shown to

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be doing anything fruitful for the poor people.

This depiction coincides with the Gandhian philosophy of rural-urban dichotomy. During his lifetime apart from socialist ideology, Premchand was also influenced by Gandhi's social outlook. Premchand, for a time, was a follower of Gandhian ideology of thought, according to which, he also felt that elite classes of urban areas had a parasitic nature towards the poor peasants, and city culture was an extension of British imperialistic ideology. As P.C. Joshi points out "Gandhi saw in the town-village confrontation a major expression of the irreconcilable cleavage between Indian nationalism and British colonialism" (46), not only that, Gandhi also believed in as Joshi further says in the "non-class concepts of 'change of heart on the part of propertied classes and of 'reformed' and 'good landlords' as trustees of peasants" (45). Premchand incorporated these ideas in his earlier novels. For e.g. in *Karmabhumi*, city comes across as a place only for rich people. Selfish and arrogant; these elite city people exploit the working people for their own gain. But in the end there is change of heart in many of these wealthy people. In *Gaban*, as Kumar points, the main characters at the end fed up with their city life "go and establish a utopian community by the river Ganges away from the corruptions and degradations of city life" (71). In *Sevasadan* too we come to see moral decaying in the city of Benaras, where the main protagonist Suman, falls prey to false enchantment of the life of prostitution.

In the novel *Godaan*, rural and urban society with its characters, are kept apart, with Rai Sahib and Hori's son Gobar being the connecting links. City's evil influence can be seen through changes in Gobar's behavior. Gobar was always rebellious, but he always used to respect his parents. His stay in the city changes him a lot, which is seen after he returns the village. He becomes disrespectful towards his parents and elders in the village, and having acquired some money in the city, he becomes very proud. When he returns to city with his wife Jhuniya, their lonely existence is quite visible, unlike in the village, where close ones are always there to support.

Even if Premchand had adhered to the Gandhian philosophy in the earlier writings, he goes beyond that in *Godaan*. As Joshi points "Premchand, did not allow himself to become a prisoner of Gandhi's backward looking idealization of the village and denigration of the town" (43).

Premchand has taken a more critical stance in his outlook to the peasant suffering, and as Joshi says "Premchand no longer focus on the 'enemy outside' the village" (53). A deeper look gives us an understanding that there is more about the problems of peasants' suffering. It is true that the city dwellers have shallow outlook towards the peasants. But the peasants are to be blamed themselves for their situation as they are not willing to stand up for themselves and are ready to be victimized by the backward traditions and social ideologies which help the corrupt people like village superiors (the moneylenders) to victimize the peasants, by using their gullibility.

Premchand in *Godaan* moves away from the Gandhian ideology of villages being the idealistic place, and the idea that, change in social order is possible through change of heart among elite class. Premchand shows problem in Hori's fatalistic behavior and his meek adherence to the prevalent social order and norms, along with that, village elite with their unquestioned power, strangle the dreams of the peasants. Hori is too meek and submissive and never questions the traditions. In a way he can be blamed for his own tragedy.

It is true that the rural society has taken the whole sympathy of Premchand, in terms of its suffering peasant class and city does not. He also believed in the village community's sanctity. Especially, the fact that their harmonious life is being crushed by the elite class living in the city. We also feel pity for a poor peasant like Hori who dies miserably. But he doesn't idealize the village society; also he wants to show the stark reality of that time, in which he has been writing.

It's only Gobar who stands for himself, even though his future is not clear in the end. But it's for sure that he won't follow the suffocating ideas of the society. Hori's sad death in the end of the book fills the readers with a sense of hopelessness, through Hori's plight, the writer questions the social system, and wants to make the people realize, the dilapidating conditions peasants are living in, and how much

necessary it is to bring change in the society.

The writer's intention is focused on understanding and criticizing the problems prevalent in the society. This can be eradicated, only if the people understood it in full gravity. The book questions the degrading conditions of the poor peasants, which is still prevalent in the society. Premchand emphasizes total change in the society.

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TREATMENT OF HISTORY IN HILARY MANTEL'S WOLF HALL

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ABSTRACT:

The British writer, Hilary Mantel, earns both critical acclaim and bestseller status for her Cromwell trilogy. She is two-time Booker Prize winner for the first two books of this trilogy. This paper highlights the ways in which Mantel handles the historical characters in a lively and interesting manner in her first Booker Prize winning novel *Wolf Hall*.

FULL PAPER:

Hilary Mantel is Hilary Mary Thompson, born in July 6, 1952 in Hadfield, Derbyshire, England. She has been composing novels for really a long time before her scholarly fame. Her novels showcases her dull mind and complex expertise. She is known especially for her depressingly funny, socially examining books set in an extensive variety of contemporary and historical fiction. The most famous of her all novels, *Wolf Hall* (2009) portrays the growth of Thomas Cromwell, former Lord Great Chamberlain of the United Kingdom. It is praised for its great degree and complex depiction of its characters. It turned out to be a worldwide smash hit and won the Booker Prize. Its sequel, *Bring up the Bodies* (2012), centers all the more barely around Cromwell's part in the defeat of Anne Boleyn, and it too won the prestigious Booker Prize as well as the top honor of the Costa Book Awards. Both of these novels are adopted for stage play by Royal Shakespeare Company in 2013 and it is also made into television miniseries in 2015. In 2020, mantel released her last part of her Trilogy, *The Mirror and the Light*, which accounts Cromwell's tumble from power and his execution. Hilary Mantel had her sad demise on 22nd September, 2022 because of stroke.

Hilary Mantel is viewed as the representative of the Post-World War II English fiction writer. Her twelve novels range from the obscurely creative thrill to historically fictitious work. She is thus, the post-modern novelist. Her books though mirrors the comic components, yet she is a serious writer expressing the ethical vision. Her

books depicts her perspective towards life in a hopeful and in most part in a negative way. Her liking for history and historical events enable her to generate praiseworthy works like *A Place of Greater Safety* (1992), *A Change of Climate* (1994), *An Experiment in Love* (1995), *Beyond Black* (2005) and the Thomas Cromwell series.

Wolf Hall firmly follows the true history of Tudor Court. The Tudor reign begin with the King Henry VII, who believes firmly that to maintain the power one must keep a strong allies. So he marries his first son Arthur, to the Spanish princess Katherine of Aragon. Arthur passes just four months after his marriage and the second son, Henry VIII is made the King. Henry VIII is strong-willed to marry Katherine, and for that he gains a special ecclesiastical order which would permit him to wed his sibling's widow. Unfortunately, Katherine fails to give him a son and the only child left for them is Mary Tudor.

Wolf hall is set up in the England of 16th century. King Henry VIII is trying hard to divorce his wife Katherine and wed Anne Boleyn, but as Catholic Church believes marriage to be long-lasting and permanent, it does not support him for his divorce. Thus, he breaks away from the clutches of Roman Catholic rules and declares himself as the supreme head of the church and the country. He did this with the assistance of his self-determined and skillful minister, Thomas Cromwell, who is the protagonist of this historical novel. *Wolf Hall* begins with his humble, poor life as a child of blacksmith to his prosperity to rise as a lawyer and a legal adviser to the king himself.

Mantel has been evaluated as a hazily fanciful narrator. Her books range from confusing thriller to dark humor and to historical novels. She focuses mainly on family life, seclusion, the idea of time, feminism, religion, the outcome of the political and social framework. In this way she manages a variety of themes throughout her novel.

The *Wolf Hall* begins with the scene of Thomas Cromwell as a child being beaten mercilessly by his father, Walter. The scene makes it clear about father's brutality towards his only son. Everyone sympathize over the future of Cromwell and the thing that it is better for him to leave the house than to tolerate beatings. Thomas, too feel it as the proper solution and leaves the house. In France, he learns three card game and helps the lowlanders, where he learns good and miserable side of life. His only longing is to get enlisted in the military to be an officer: "he walks around the docks saying to people, do you know where there's a war just now?" (Mantel 14). Cromwell from the very young age dreams of achieving a great height.

Wolf Hall cherishes, recollection of childhood memories which plays an essential part in the evolution of the characters as well as the plot of the novel. Thomas Cromwell, is seen recalling his sad miserable life, which caused him to leave his house and achieve on his own. *Wolf Hall* also has the description of King Henry VIII thinking of his lost blissful childhood: "I lived at the palace at Eltham, I had a fool called Goose" (Mantel 618). Queen Katherine too recalls her childhood multiple times.

The novel portrays that, people of Tudor court are exceptionally ambition to snatch power, even if it is through their double dealing or through defilement. When King Henry VIII realizes that the church won't give him a divorce, he nullifies the power of the church and declares himself as the supreme head over all the churches. Anne Boleyn with her timid diplomacy, secures the favor of the King and earns high posts for her brothers and father. She also remains strict on the notion that before beginning the relationship, King Henry VIII must legally marry her.

Cromwell is an intellectual man. He is fully aware that men wear mask to hide their own identity. One must be very careful and always find out what people wear under their clothes. That is, one must be careful towards others motifs. Thus, he keeps a close eye on people's defiance and reservations to execute his plans at the right moment. To earn the favor of the king, Cromwell disregards his own principles and satisfies all the cravings of the King. Cromwell knows that Cardinal Wolsey is powerful only till he satisfies King's desire. Wolsey's power and nobility disappears at the King's dismay, which teaches Cromwell that he should have the King's aid to rise in court. As needs be Cromwell is ready to continuously oblige to the King even when he is ethically against to what King is doing. When Henry request the King to prosecute Thomas More for a wrong doing which he didn't carry out; Cromwell shows no opposition. Thus, Cromwell's ambition combined with his important skill assists him to climb to the high position in the King's court.

King Henry VIII is an ardent devotee of Roman Catholic Church. He, thus wants to nullify his marriage with the papal support. He waits for twenty years to get a male heir. If Henry VIII fails to produce a male heir then there is a chance of Civil War. It is because of this that he marries six women; namely Katherine of Aragon, the mother of future Queen Mary I; Anne Boleyn, the mother of Future Queen Elizabeth I; Jane Seymour, the mother of future King Edward VI; Anne of Cleves; Catherine Howard and Catherine Parr.

Marriage, thus plays a major role in *Wolf Hall* as the story revolve around the dissolution of one marriage and legitimization of another marriage of Henry VIII. Katherine who doesn't want to divorce the King, plays all her cards till Cromwell persuades her advantages saying that, her daughter Mary will be made the Princess and she will get a decent sum of wealth for her living.

Anne Boleyn who the King needs to marry, likewise is been anxious to become the Queen of England, which is impossible unless she legally marry the King. She feels the vulnerability and uneasiness about her marriage. As their secret marriage is fixed, there fosters another problem, one Harry Percy claims that he has covertly married Anne and she is his lawful wedded wife and the King can't marry her. It is Cromwell again who decides to dispose of this case. In a public gathering where King needs to get the public consent to his marriage, a nun, Elizabeth Barton, shows up and predicts the destruction of the Kingdom if he marries Anne. Anne at this time keep a close watch on the individuals who support her and individual who go against the marriage. The people assisting their marriage were heavily rewarded and the rivals where tormented after she legally became the Queen.

In the beginning of the novel, the castle of Cardinal Wolsey is being vacated and he is being ordered to return back the great seal of England, which is his power of authority. He is shifted to Tower, which is a place of torment. This embarrassment of Wolsey gives Thomas Cromwell a tricky idea of revenge. He, thus intentionally draws near to the King so that he can do the things all the more without any problem. He sends Cardinal Wolsey to north and instead of going with him, he sends Rafe and Richard to accompany Wolsey. Meanwhile he is working to become more close to the King. Cromwell plots vengeance against all who are responsible for Wolsey's condition. Among them he needs to diminish the significance of Stephen Gardiner, Henry Norris, Harry Percy, Duke of Norfolk and Duke of Suffolk and some others. At a certain point of time, after becoming the counselor of the King, he puts before the House of Commons a bill to suspend the money to be deposited to Rome. This is a plan of Cromwell to show the King, his true supporters. Thus, King finds out who all are for him and who all are against him. He does it cunningly. At this point he forces to desert the Stephen Gardiner from his house in the name of Anne Boleyn. He thus, outsmart every individual in plotting revenge. He works cunningly like a wolf. King Henry has praised him saying that he is as clever as a bag of serpents.

The theme of childhood, ambition, religion, marriage etc. in *Wolf Hall* leads to a major theme, transformation. The protagonist, Thomas Cromwell, a son of Blacksmith transforms into a strong and powerful man. He elopes at the age of nine to escape his father's beating and comes back only twelve years later with a wife, Liz. He gets an opportunity to work with Cardinal Wolsey which paves him a way to become close to king and he with his talent emerges as a Counselor to the King, then becomes a keeper to the jewel house. He later replaces Stephan Gardinar and becomes a master Secretary. Then, becomes King's deputy in church affairs too. *Wolf hall* thus, is the story of transformation of Cromwell, which Hilary mantel showcase in an amazing and trustworthy way.

Hilary Mantel is noted for her thematic diversity:

Diversity of theme is the main characteristic of novels of Hilary mantel. There is no one connection in Hilary Mantel's two novels, in respect of theme. Even the sequel of Thomas Cromwell's trilogy novels has different themes *Wolf Hall* deals with rise of Thomas Cromwell from a son of a poor blacksmith to King Henry's right hand. The sequel of this novel *Bring Up The Bodies* is about beheading of Anne Boleyn and Cromwell's avenge on his enemies. (Deokar 18)

She has uniqueness and writes each novel with the unique theme.

Hilary Mantel makes clear her 'novelistic vision'. She states life itself is unstable and so we are. If one tried to be stable then he or she would be finished. Therefore, Hilary mantel hates monotonousness in writing and wants choice. (Deokar 201)

The theme of *Wolf Hall* is vastly distinct. When Thomas Cromwell and Thurston, his cook, discuss Cardinal Wolsey and Norfolk, they discuss the historical concept that "man is wolf to man". This is the central theme of

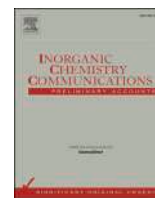
this novel. The main characters in this novel are trying their hardest to stay in power in the English court by any means necessary. Man has transformed into a wolf in this circumstance.

Although *Wolf Hall* is a historical novel, as a piece of fiction it offers a relatively accurate insight into the lives of people living in the Tudor period. Through this novel Hilary Mantel paints a picture of people in Tudor England. She does not provide a historical factual record that fits stereotypes; but also describes how English people used to think and act during that time. During this time, aristocrats, kings, queens, and even priest has a tendency to say that man is wolf to man. Characters and incidents in the current novel demonstrate the same trend. The saying, man is a wolf to man means, the man acts like a wolf towards another man for his own benefits. King Henry wants to marry Anne Boleyn and divorce his first wife in order to produce a male heir. Yet, Pope of Rome doesn't permit him to do as such. The idea of a male heir is the King's obsession. He captures Cardinal Wolsey and imprisons him for treason, where he dies. By punishing Cardinal Wolsey, the King hope to instruct the Pope. Thomas More, who disagree with the King's status as head of the Church of England, and he too is beheaded by him. King Henry thus, transforms into a wolf and kills his enemies to fulfill his wish. Anne Boleyn needs to wed King Henry and she too becomes like wolf and is ready to kill anyone who gets in the way of her in becoming the Queen of England. The theme of man is wolf to man oozes throughout the novel revealing the Tudor's tendency.

The characters portrayed by Hilary Mantel have not been depicted in historical context. She has however reinvented them. She has shown the readers what goes on inside these characters' heads. The phrase "man is wolf to man" serves as the novel's overarching historical theme. The main characters in the novel use both good and foul tactics to gain or maintain power in English court. The current novel has a very straightforward plot, in order to make it easier for readers to comprehend the serious historical novel and keep them interested in reading. *Wolf Hall* thus is definitely a work that bought fame and recognition to our late writer Hilary Mantel.

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The influence of activated carbon annealing temperature on sunlight-driven photocatalytic dye degradation and biological activity

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ABSTRACT

In this study, activated carbon (AC) produced from jasmine flowers was effectively manufactured using a hydrothermal carbonization procedure at various annealing temperatures. The XRD pattern revealed the graphitic phase of carbon. The surface morphology of nanoparticles exhibits uneven shapes. To investigate the photocatalytic activity of methylene blue (MB), it was photodegraded using visible light irradiation. Under solar light irradiation, the prepared activated carbon was used as a potential photo catalyst for the photocatalytic degradation of brilliant green dye, which revealed 96% degradation. The antibacterial activity of activated carbon was tested against *S. Aureus* (MTCC-737) and *E. coli* (MTCC-443) microbial pathogens, and the zone of inhibition layer was studied. To the best of our knowledge this is the first study to use jasmine flower based AC as a photocatalyst for the efficient breakdown of MB dye.

1. Introduction

Water is an important component of daily existence. According to the UNESCO World Water Assessment Programme (WWAP), one hundred million humans, one million seabirds, and one hundred thousand marine animals perish annually due to water pollution [1]. Industrial sludge, heavy metals, pesticides, organic dyes, and other substances greatly pollute the water supply. Humans acquire a variety of illnesses due to water contamination. Even minute amounts of dye can degrade water quality. During the colouring process, the textile and paper industries release a large amount of dye waste [2]. Methylene blue is a heterocyclic aromatic dye that appears blue when oxidised but is colourless when reduced. Methylene blue causes loss of coordination, fast heartbeat, hallucinations, fever, nausea, vomiting, and diarrhoea. The non-biodegradable colour methylene blue causes several health issues and environmental pollutions [3]. Traditional techniques cannot breakdown

methylene blue adequately. Only photocatalysis totally destroys dye without producing sludge or by-products. It is frequently used to treat coloured molecules as a result of its low cost, environmental friendliness, and absence of sludge [4]. Because of their large surface area and porosity, activated carbons (AC) are commonly used as an active material for methylene blue degradation. Activated carbon is utilised in a variety of environmental applications, including wastewater treatment, mercury removal, water purification, and gas purification, as well as energy storage, super capacitors, and batteries [5]. Corn cob, wheat straw, and rice hull in agricultural biomass-derived activated carbon [6], hazelnut shells [7], walnut shells [8], and peanut shells [9], eggshells [10], and coconut shells [11] were utilised. Activated carbon is produced using a variety of synthetic techniques, including pyrolysis, physical activation, and chemical activation. To convert carbon, the physical activation process requires high temperature and pressure. By completing the heat degradation of raw material with chemical reactions, chemical activation may be done in a single step. Chemical

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Nomenclature

AC	Activated carbon
FT-IR	Fourier Transform Infrared Spectroscopy
H ₂ SO ₄	Sulphuric acid
H ₃ PO ₄	Ortho phosphoric acid
HCL	Hydrochloric acid
K ₂ CO ₃	Potassium carbonate
KOH	Potassium hydroxide
MB	Methylene Blue
Na ₂ CO ₃	Sodium Carbonate
NaOH	Sodium hydroxide
O ₂	Superoxides
OH	Hydroxyl radicals
SEM	Scanning Electron Microscope
TEM	Transmission Electron Microscope
XRD	X-ray Diffraction
ZnCl ₂	Zinc Chloride

activation operations are conducted using acidic reagents, such as ZnCl₂, H₃PO₄, HCL, and H₂SO₄, or with essential reagents, such as KOH, K₂CO₃, and NaOH. Because they are very stable and can transfer electricity, carbonaceous materials can be used to stabilise hybrid systems and make photocatalytic energy happen.

Zhang et al., 2021 [12] stated that carbon stalk-derived hydrothermally treated activated carbon for the photodegradation of methylene blue removal obtained a 99.4% degradation efficiency at a 150 mg/L methylene blue concentration. Nizam et al., 2021 [13] described activated carbon produced from rubber seed and shell for cationic methylene blue elimination. The interaction and hydrogen bonding result in the elimination of methylene blue. Wang et al., 2020 [14] generated activated carbon by utilising phosphoric acid as the activation agent in an integrated corncob hydrothermal carbonization process. Activated carbon's surface area was measured at 480 m²/g. The ability of activated carbon to absorb dye rose from 41% to 82%. Emrooz et al., 2020 [15] created micro and mesoporous activated carbon produced from Azolla to remove methylene blue. According to this study, at the conclusion of 120 min, activated carbon mediated by jasmine flowers achieves a maximum degradation efficiency of 94%. Comparing the observed results to earlier reports. The hydrothermal carbonization method is the simplest, most ecologically friendly, time-and energy-efficient method for incorporating nanoparticles. The fundamental objective of this study is to produce a low-cost, high performance, low-temperature absorbent. Lin et al., 2021 [16]. The activator NaOH improves the surface area and photocatalytic activity of the material.

This study seeks to manufacture the catalytic activity of activated carbon by degrading methylene blue dye under UV irradiation using conventional and simple carbon. Jasmine flowers will be used as a biomaterial in an affordable hydrothermal carbonization process. In addition, the biological activities of activated carbon at various temperatures of annealing were evaluated against a variety of microorganisms that cause disease. This research covers, to the best of our knowledge, the production of activated carbon using jasmine flower extract. The annealing temperature regulated the nanoparticles' form and size.

2. Experimental procedure

2.1. Materials

All of the chemicals and reagents are utilized without being purified further. Sodium hydroxide (NaOH), Methylene blue (C₁₆H₁₈ClN₃S), Hydrochloric acid (HCL) were purchased from Merck. Methylene blue is

a pollutant dye used for degradation.

2.2. Preparation of activated carbon

Jasmine flower-derived activated carbon was effectively produced by the hydrothermal carbonization method. Jasmine flower powder was added to 20 ml of distilled water together with an activating agent (NaOH) at a ratio of 4:1, followed by three hours of stirring. The solution was transferred to a 100 ml Teflon autoclave and placed in an oven at 100 degrees Celsius for three hours. To eliminate untreated biomass, the solution was cooled, filtered, and washed with distilled water and HCL. The sample was baked in an oven at 80 °C for one night, and then it was put together at different annealing temperatures (400 °C, 500 °C, 600 °C) [17].

2.3. Characterization techniques

A PAN analytical XPERT PRO diffractometer with Cu-K radiation (-1.54) was used to identify the structural and phase characteristics of activated carbon generated from jasmine flowers. FT-IR spectroscopy was used to analyses functional groups. The FT-IR spectra were captured using a Perkin Elmer spectrophotometer. SEM analysis was used to analyse surface morphology and particle size measurement. The Joel JSM 6390 Scanning Electron microscope was used for SEM examination. The high-resolution transmission electron microscopy was captured with the Gatan Quantum ER 965. The spectrum was acquired using Nanoplus and a particle size analyzer.

2.4. Photo catalytic performance of activated carbon

In the photo degradation investigation, the as-prepared photo catalyst (AC) was disseminated in 100 ml aqueous solution of MB dye. The solution was ultrasonically agitated for 30 min in a dark room before being exposed to radiation to provide the right adsorption/desorption conditions. The solution was then exposed to direct sunlight while being stirred magnetically. The reaction solution was kept at 37 °C while 5 ml of the suspension was taken every 10 min and centrifuged for 10 min at 3000 rpm. The UV-Vis spectrophotometer was then used to analyse the photodegradation behaviour [18].

2.5. Reactive species experiment

Reactive oxidative species entrapment studies were carried out to investigate the potential photocatalyst mechanism of MB dye over the AC. By adding 1.0 mM of disodium ethylenediamine tetra-acetic (h⁺), ethanol (e⁻), isopropyl alcohol (OH[•]), and benzoquinone (O₂^{•-}), respectively, different types of scavengers were used in this experiment to trap photogenerated electrons, holes, hydroxyl radicals, and superoxide radicals. For the scavenger investigation, the same photocatalytic experimental methodology was used.

2.6. Antibacterial activity

AC synthesised using jasmine flower were evaluated for their ability to combat *E-Coli* and *Staphylococcus aureus* using the disc diffusion method. All samples were inoculated into sterile nutrient broth (Hi Media) (5 ml). Additionally, they were incubated for 3 to 5 h to bring the culture up to McFarland standards (106 CFC/ml). By spreading 100 ml of revived culture on Mueller Hinton-Agar/Hi Media using a spreader, 3 repetitions of each individual organism were organised. 50 ml samples of AC nanoparticles were put in one well (7 mm- diameter) (7 mm-diameter). All of the petri plates with organisms whose antibacterial effect was indicated by a zone of inhibition in mm were kept in the incubator at 37 °C for one day.

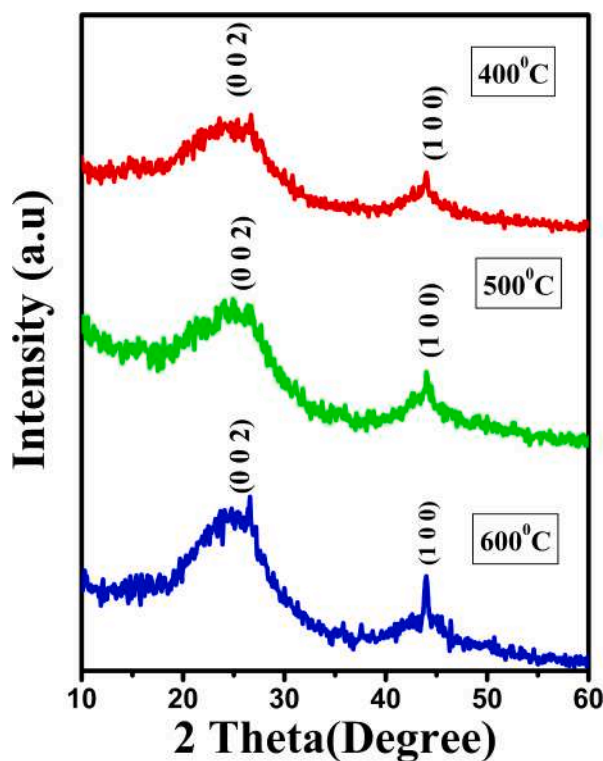


Fig. 1. XRD spectrum of Activated carbon (AC) NP's.

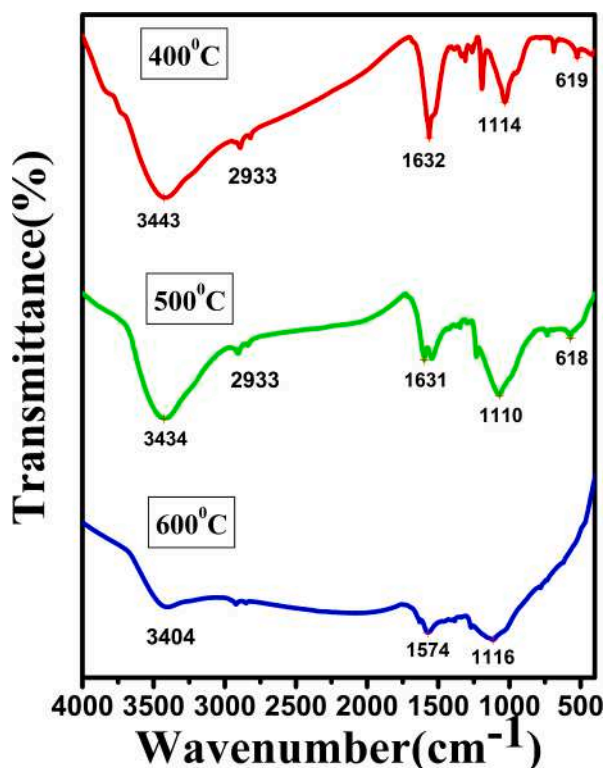


Fig. 2. FTIR spectrum of Activated carbon (AC) NP's.

3. Results and discussion

3.1. X-Ray diffraction

Using XRD analysis, the phase and crystalline nature of activated

carbon were determined. Fig. 1 depicts the XRD pattern of activated carbon at various temperatures of annealing. The X-ray diffraction peaks at 26° and 43.2° correspond to Bragg reflection planes (002) and (100), respectively. The observed pattern corresponded to JCPDS. 7440-44-0 [19] is the file number. The peak at 26° shows disordered carbon or amorphous carbon, whereas the peak at 44° denotes the graphitic phase of carbon. Activated carbon's X-ray diffraction reveals a hexagonal graphite structure that corresponds well with JCPDS file number 75-1621 [20]. Due to an increase in the interplanar distance of the activated carbon, the noticeable peak visible at 43.2° progressively shifts upward when the annealing temperature is increased. The increase in annealing temperature facilitates the proper migration of atoms inside the lattice [21]. The small change in diffraction peak locations may be attributable to the presence of strain in the crystal structure, which is common in nanocrystalline produced using an eco-friendly process.

3.2. Fourier Transform Infrared spectroscopy

FT-IR spectroscopy was utilized to analyse the functional groups of the studied activated carbon. Fig. 2 depicts the FT-IR spectra of activated carbon at various annealing temperatures. The designated band at 3744, 3434, 3443, 3393 cm^{-1} corresponds to the O-H stretching vibration of alcohol, phenol, carboxylic acid, or water [22]. This frequency corresponds to the C-H stretching vibration of the aliphatic molecule. The band at 1631 cm^{-1} corresponds to the C = C transition. Vibrational stretching of the aromatic ring [10]. The band seen at 1578 cm^{-1} corresponds to the sulphate group's adsorption. The band found at 1337 cm^{-1} corresponds to C-H asymmetries. C-O stretching vibrations are represented by the band at 1270 cm^{-1} . The detected band at 1110–1114 cm^{-1} corresponds to the vibrational bending of CO-H bonds. The peaks at 780 and 619 cm^{-1} are from the O-H group [23,24]. Annealing temperature increases, water molecules are eliminated. Due to varying annealing temperatures, there is a little difference in peak shift and intensity.

3.3. Scanning electron microscope with EDX

Using SEM and TEM photographs, the morphological analysis of activated carbon was observed. Fig. 3A-D displays SEM images of activated carbon heated to 400 °C, 500 °C, and 600 °C, respectively. The enhanced surface morphology of activated owing to a higher annealing temperature [25] is revealed by SEM pictures of irregular and agglomerated nanoparticles. A number of holes and cavities are present on the surface of activated carbon as a result of the emission of hot gases during the annealing procedure. Energy Dispersive X-ray Analysis was used to identify the components of the produced activated carbon nanoparticles (EDX). Carbon and oxygen peaks have been proven to exist. The remaining small peaks are attributable to plant extracts, and their quantities are negligible. Fig. 4 A-C depicts the elemental analysis spectrum.

3.4. Transmission electron microscope

Transmission electron microscopy (TEM) images of activated carbon nanoparticles at 600 °C are shown in Fig. 5 A and B. The uneven forms of activated carbon result from the particles' synthesis. The photos demonstrate the activated carbon's high surface area, which can hinder the recombination process and potentially activate charge carriers. These approaches are quite effective at catalysis.

3.5. Particle size analyser

Fig. 6 displays the DLS spectrum of activated carbon. At 400 °C, 500 °C, and 600 °C, the average particle size of activated carbon is 120 nm, 185 nm, and 190 nm, with polydisperse index values of 0.387, 0.375, and 0.345, respectively. According to the DLS spectrum, particle

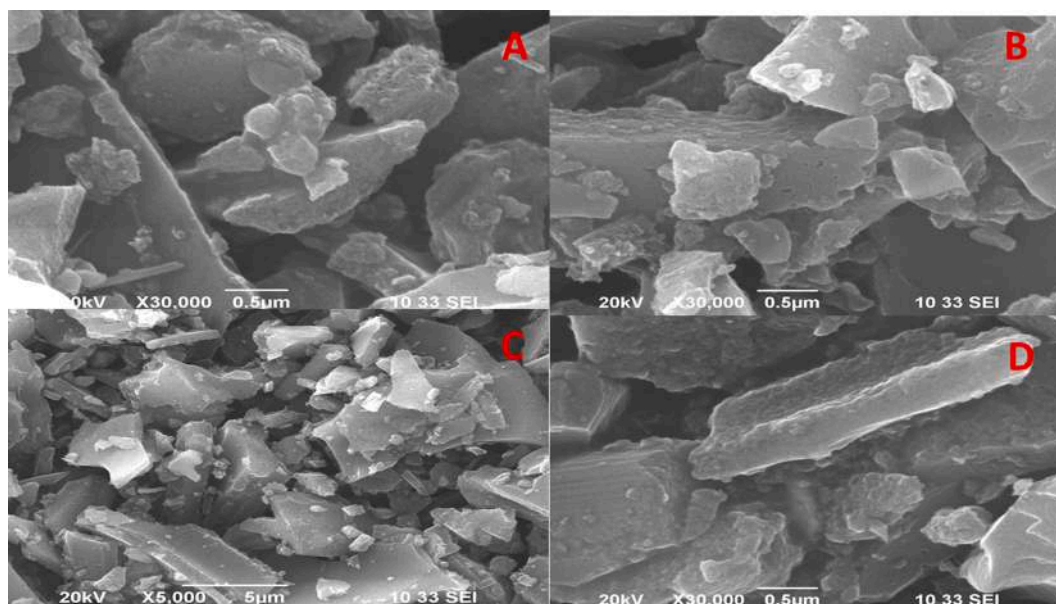


Fig. 3. SEM images of Activated carbon (AC) a. (400 °C), b (500 °C), c and d (600 °C) at different magnifications.

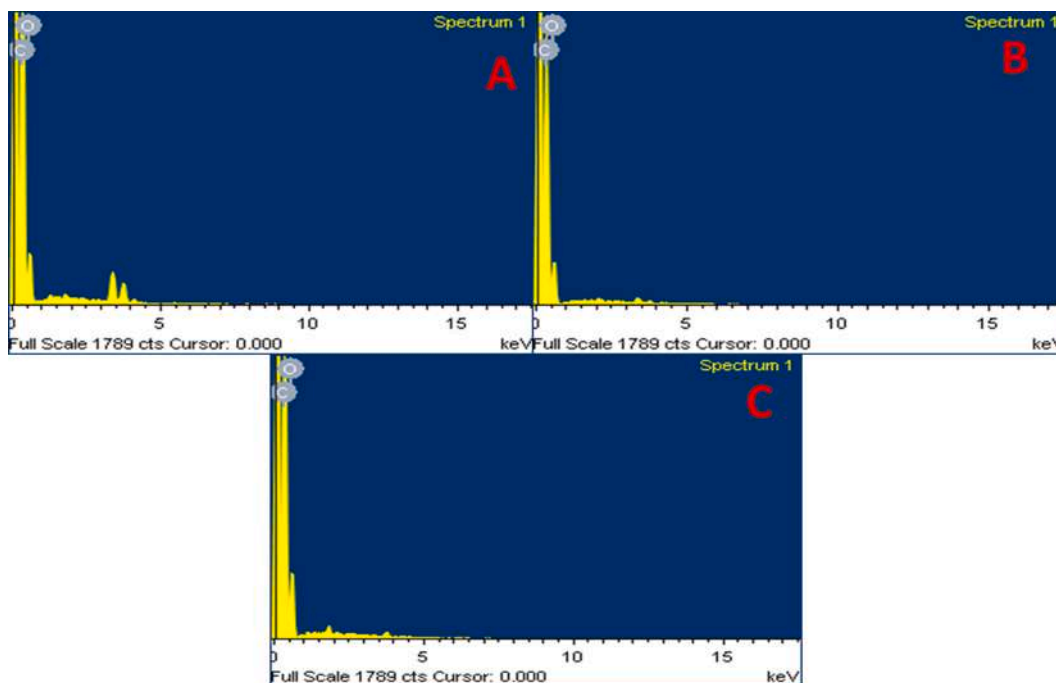


Fig. 4. (A-C) EDX spectra of Activated carbon (AC) NP's.

size values increase as the temperature rises.

3.6. UV-Visible spectroscopy

UV-Visible spectroscopy was used to study the optical characteristics of activated carbon. Fig. 7 depicts the absorbance spectra of activated carbon at various temperatures of annealing. The UV spectrum may be used to forecast surface morphology, oxygen deprivation, and contaminants. As a result of the electrical shift from the valance band to the conduction band, activated carbon with a preset absorbance peak at 249 nm absorbs light. The values of the energy band gap may be estimated using the Tauc plot.

$$\alpha h\nu = (h\nu - E_g)^n \quad (1)$$

Where is the absorption coefficient, α represents a constant, h represents the energy of light, and E_g represents the energy bandgap [26]. The energy band gap values of activated carbon at temperatures of 400 °C, 500 °C, and 600 °C are 2.04 eV, 2.00 eV, and 1.94 eV, respectively. Due to an increase in annealing temperature, band gap values may fluctuate somewhat. Bandgap energy values decrease owing to an increase in crystallite size and annealing temperature. This phenomenon suggests that the interatomic distance increases when the amplitude of atomic vibrations grows in response to an increase in thermal energy. The annealing temperature decreased the optical band gap of activated carbon (Fig. 7 b-d), with 600 °C annealing reducing the optical band gap somewhat more than 400 °C and 500 °C annealing. However, the altering effects on the band gap of activated carbon did not appear to be

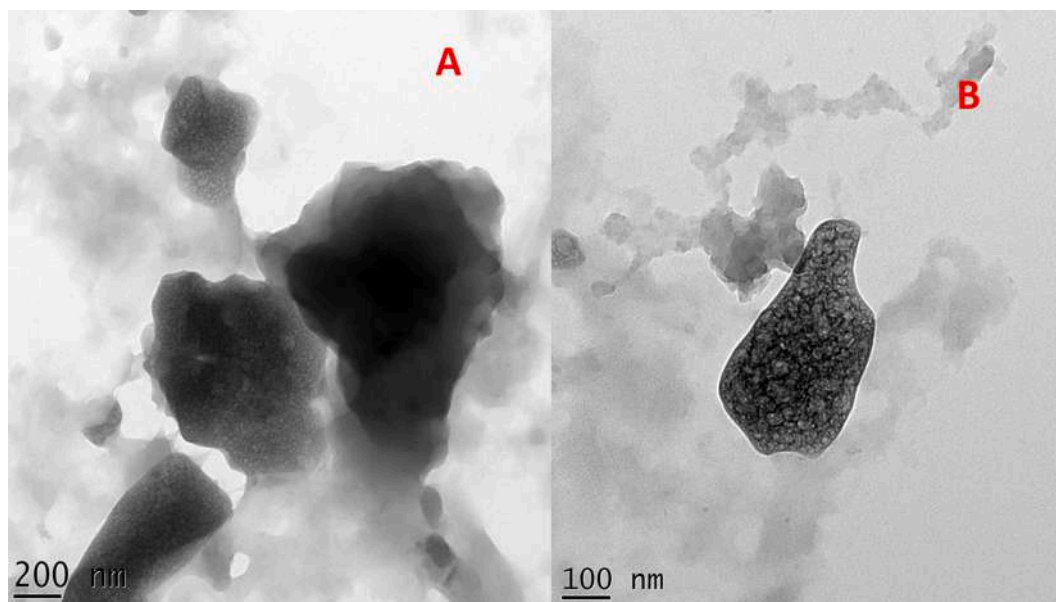


Fig. 5. A, & B TEM images of Activated carbon (AC) NP's at (600 °C).

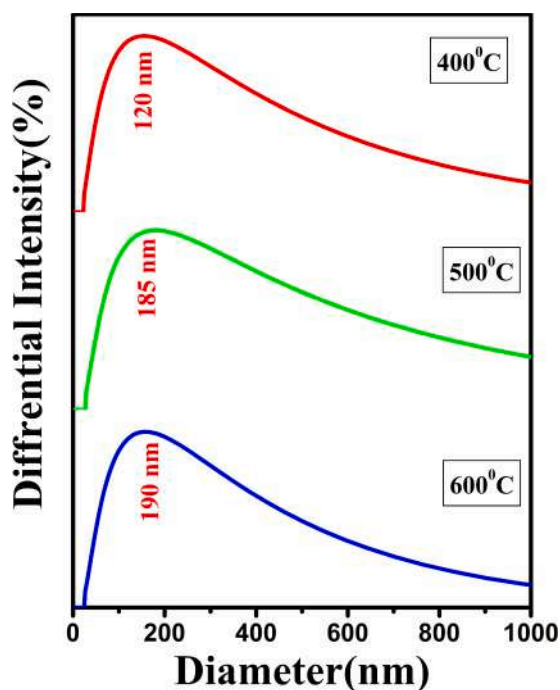


Fig. 6. (A-C) DLS spectra of Activated carbon (AC) NP's.

significant. The effects of thermal annealing on photocatalytic activity and its dependence on annealing temperature cannot be explained only by the optical bandgap decrease generated by thermal annealing, according to these results.

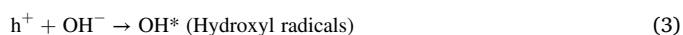
3.7. X-ray photoelectron spectroscopy

The XPS analysis was used to determine the surface electrical state and chemical composition. The XPS spectra of synthesised activated carbon (600 °C) were shown in Fig. 8. The synthesised Activated carbon contains C and O elements, according to the XPS survey spectra. Two unique peaks can be seen in the X-ray photoelectron spectroscopy (XPS) spectra of AC at energies of 284.5 and 532.2 eV, which are ascribed to

carbon and oxygen, respectively. Fig. 8 displays the XPS high resolution narrow scan C 1s spectrum. It has a large peak at 284.5 eV, which is consistent with a non-functionalized carbon, as well as contributions from aliphatic C sp³ and C sp² hybridization, all of which are associated with the carbon surface. The existence of a C-C/C-H transition in an aromatic compound might be responsible for the binding energies 284.5 shown in the figure. The range 532.2 eV was where the surface O 1s peak was seen. The O 1s signal is not very responsive to the kind of oxygen ring bonds [27].

3.8. Photocatalytic activity

The photocatalytic activity of methylene blue (MB) was investigated by observing its photodegradation under visible light irradiation. Fig. 9 depicts the photocatalytic activity of activated carbons at various annealing temperatures. Activated carbon breaks down methylene blue quickly because its pores are very active and it has a lot of surface area. Maximum absorbance spectra of methylene blue are observed at 650 nm due to the absorption of the azo bond present in MB dye [28]. When ultraviolet light is allowed to penetrate through the surface of carbon, electrons from the valance band are stimulated into the conduction band, leaving holes. The positive holes interact with H₂O to produce free radicals (OH[•]), whereas photo generated electrons interact with the surface of carbon to make superoxides (O₂^{•-}). Free radicals (OH[•]) and superoxides (O₂^{•-}) are a major cause of methylene blue degradation [29,30,31]. Together, these reactive radicals break down organic substances into CO₂, H₂O, and other minerals. Oxygen vacancies and defects turn into active centres to collect photo induced electrons during the photo catalytic reaction process. As a result, photo induced electron and hole recombination can be successfully suppressed. The absorption of O₂, which is transformed into superoxide radicals (O₂^{•-}) by contact with photo induced electrons, can also be aided by an increase in oxygen vacancies. These superoxide radicals are active in the oxidation of organic contaminants by generating additional radicals like OH[•] and H₂O₂. Fig. 10 is a diagram illustrating photocatalytic activity. Free radicals and superoxide react with dye molecules to produce carbon dioxide, water, and other organic chemicals. During deterioration, the following processes occur: Fig. 11.



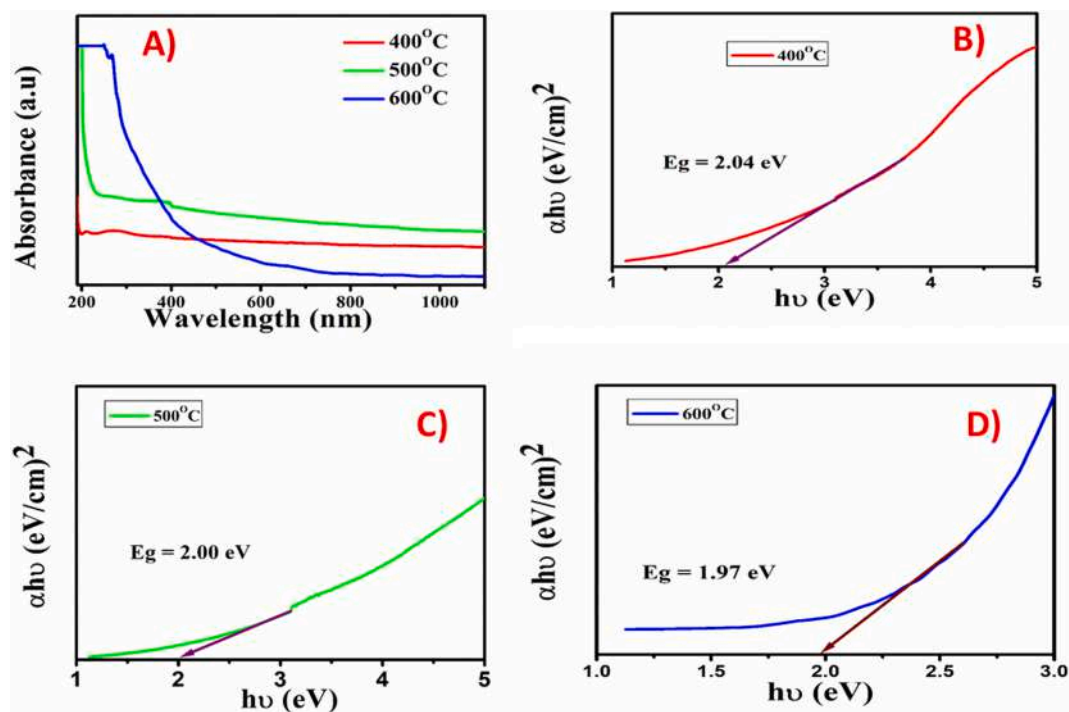


Fig. 7. A UV-absorbance spectrum and (B-D) Tauc plot of Activated carbon (AC) NP's.

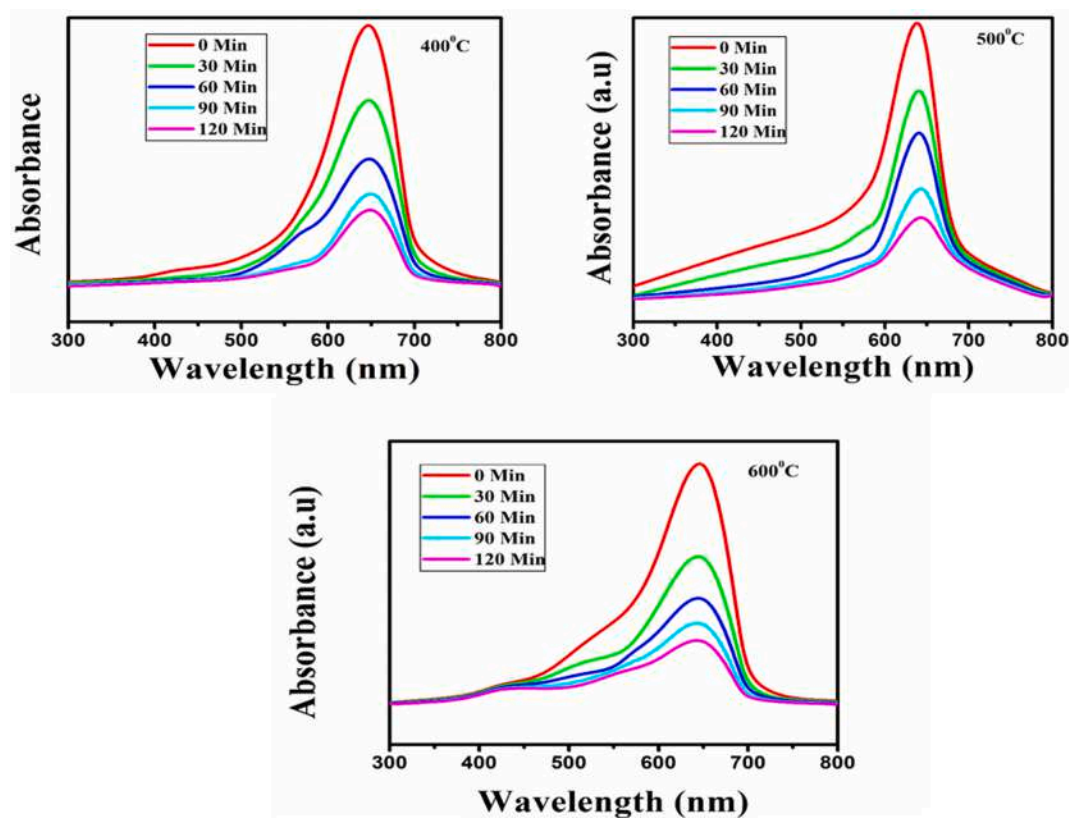
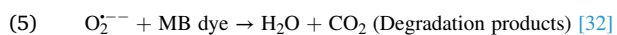
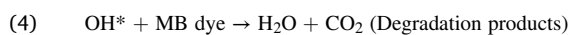
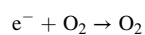
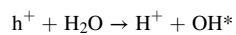


Fig. 8. (a-c) XPS spectra of activated carbon (600 °C).



(6)

(7)

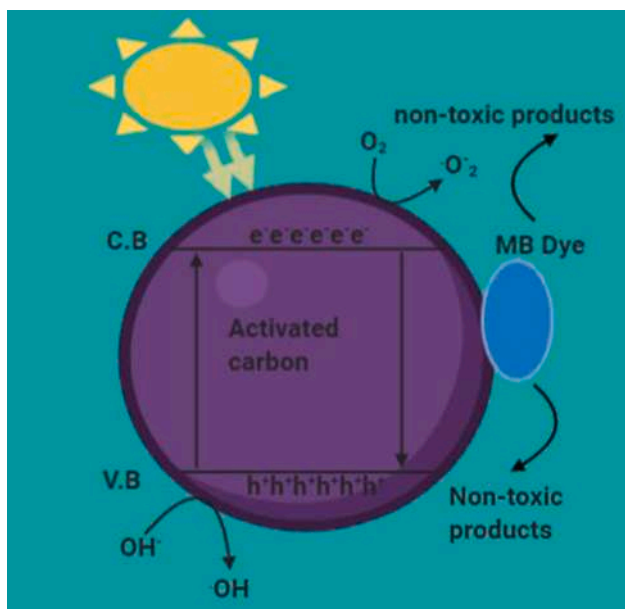


Fig. 9. Time-dependent UV-vis absorption spectra for degradation of MB (400 °C, 500 °C and 600 °C).

Activated carbon annealed at different temperatures (400 °C, 500 °C, and 600 °C) exhibits maximum degradation efficiencies of 86%, 90%, and 94% after 2 h, respectively. The conversion of the amorphous phase to the graphitic phase enhances the efficiency of degradation. Photocatalytic performance is improved by highly active pores and surface area [33]. The surface polarity, surface area, and aromaticity that result from the adsorption of organic pollutants [34] are crucial properties. During photodegradation, methylene blue is transformed to leuco methylene, resulting in a shift in hue from dark blue to colourless [35]. Several characteristics, including carrier recombination, particle size, surface area, surface acidity, and the presence of a greater number of hydroxyl groups, affect the photocatalytic activity of catalytic material.

In this study and previous research, 600 °C (sample 3) exhibits a greater percentage of degradation than 400 °C (sample 1). Due to the higher surface-to-volume ratio and low recombination rate of electron-hole pairs formed by optical exposure, the enhanced photocatalytic activity can be attributed to the many accessible surface states. As part of this investigation, the comparison in Table 1 shows how unique the study is about how methylene blue breaks down. Table 2.

3.8.1. Photocatalytic performance of activated carbon based photocatalyst

The results obtained are summarized in Table 1 and compared to earlier publications on photocatalyst, including activated carbon. Under the impact of UV or visible light, several nanostructures of photocatalyst based on activated carbon were utilised to degrade organic dyes. According to Table 1, activated carbon generated from egg shells can breakdown 82% of Methylene Blue dye for 120 min in the presence of sunshine, and the majority of reported activated carbon nanoparticles

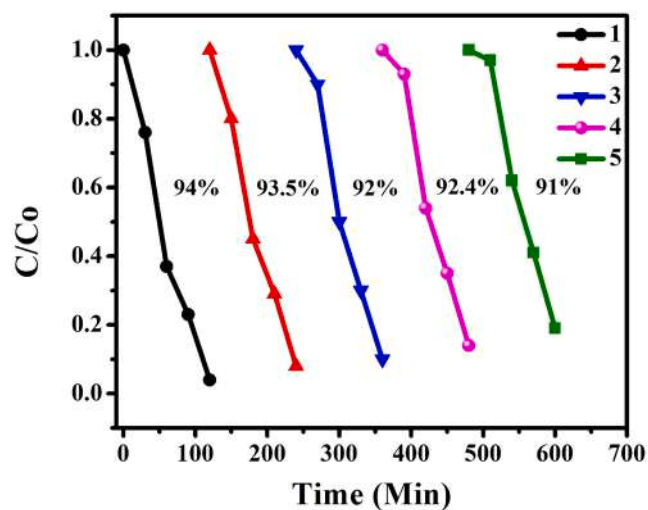


Fig. 11. shows reusability of activated carbon (600 °C) after 5 cycles.

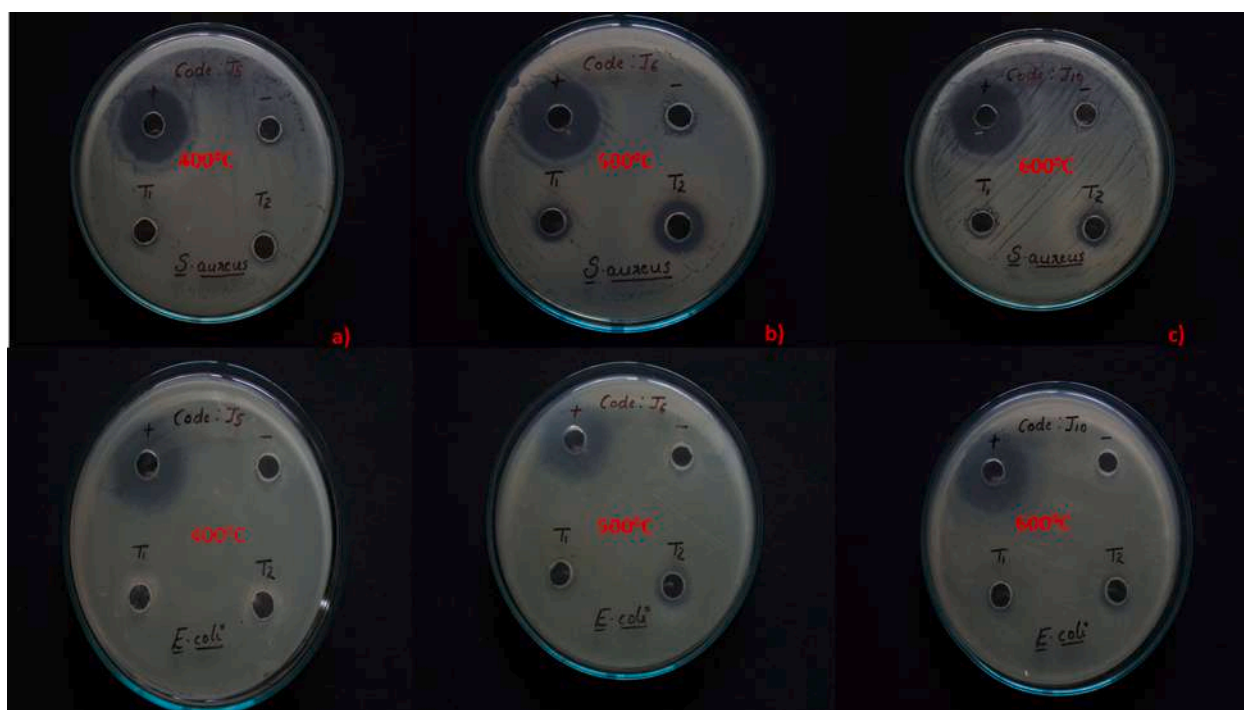


Fig. 10. Schematic representation of Photocatalytic degradation of MB dye.

Table 1

Photocatalytic performance of AC-based photocatalyst for the degradation of organic dyes in aqueous solution.

S.No	Nanocatalyst	Time	Dye	Degradation efficiency	References
1.	Activated Carbon (Coconut shell)	120 mins	Methylene blue	68%	[36]
2	Activated Carbon (coffee grounds)	150 Min	Methylene blue	20.97%	[37]
3	Activated Carbon (Jack fruit leaves)	30 Min	Methylene blue	84%	[38]
4	Activated Carbon (Egg shell)	180 Mins	Methylene blue	82.8%	[39]
5	Activated Carbon (fir bark)	180 Mins	Methylene blue	96%	[40]
6.	CuS, CdS and CuS-CdS	10 Mins	Methylene blue	80, 59 and 99.97%	[41]
7	La-doped ZnO	90 Mins	Methylene blue	88%	[42]
8	Zinc sulfide	60 Mins	Rhodamine B	93	[43]
9	ZnS	90 min	Brilliant green	88	[44]
10	ZnS, CdS and CuS	60 min	Bromothymol blue dye	63.88%, 83.42% and 46.23%	[45]
11	CdS and Sn-doped CdS	180 min	Methylene blue	91.39% and 97.56%	[46]
12	CdS, TiO ₂ , CdS-TiO ₂	60 min	Acid Blue dye	68%, 09%, and 84%	[47]
13	ZnO-AC/A + P	60 min	Malacite Green and Congo Red	92%	[48]
14	ZnO-NR/ACF	120 mins	Methylene blue	90%	[49]
15	Nano Zinc Oxide/Nanohydroxyapatite	100 min	Methylene Blue	91%	[50]
16	Activated Carbon (Jasminum)	120 Mins	Methylene blue	94%	This Work

Table 2

Antibacterial efficacy of AC.

Nanomaterials	Bacterial pathogen	Zone of inhibitions (mm)	References
Zinc oxide	<i>Staphylococcus aureus</i>	29	[57]
	<i>Escherichia coli</i>	22	
Ag NPs	<i>Aspergillus niger</i>	25	[58]
	<i>Microsporum canis</i>	23	
	<i>Staphylococcus aureus</i>	17	
Ag-NPs	<i>Escherichia coli</i>	7	[59]
	<i>Staphylococcus aureus</i>	12	
Ag-NPs	<i>Escherichia coli</i>	15	[60]
	<i>Klebsiella pneumoniae</i>	10	
	<i>Salmonella Typhimurium</i>	20	
	<i>Salmonella Enteritidis</i>	20	
AC	<i>Aspergillus flavus</i>	21	[61]
	<i>Aspergillus Niger</i>	22	
	<i>Fusarium solani</i>	22	
	<i>Candida albican</i>	24	
	<i>S. cerevisiae</i>	23	
AC (600 °C)	<i>E scherichia coli</i>	12	Present work
	<i>Staphylococcus aureus</i>	10	

can degrade the dye for more than two hours. However, after 120 min of sun irradiation, 600 °C activated carbon had a maximum photodegradation efficiency of 94% for MB dye. In the near future, the activated carbon in its current state may be useful for the photodegradation of MB dye using sunlight.

3.9. Reusability

Fig. 12 shows reusability of activated carbon (600 °C) after 5 cycles. The long-term stability and reusability of the optimized AC photocatalyst (600 °C) towards the degradation of MB dye was studied under five cycles of sunlight exposure. The concentration of MB dye should be constant in each cycle, and the recovered centrifuged catalyst is used in subsequent cycles of the degradation process. The catalyst remains efficient and has remarkable photostability even after four cycles. Maximum MB dye degradation occurs after 120 min, and the efficiencies for the first, second, third, fourth, and fifth cycles are 94%, 93.5%, 92%, 92.4%, and 91%, respectively. The results of the present investigation therefore support the fact that AC formed during the photocatalytic destruction of MB dye under sunlight irradiation may exhibit excellent

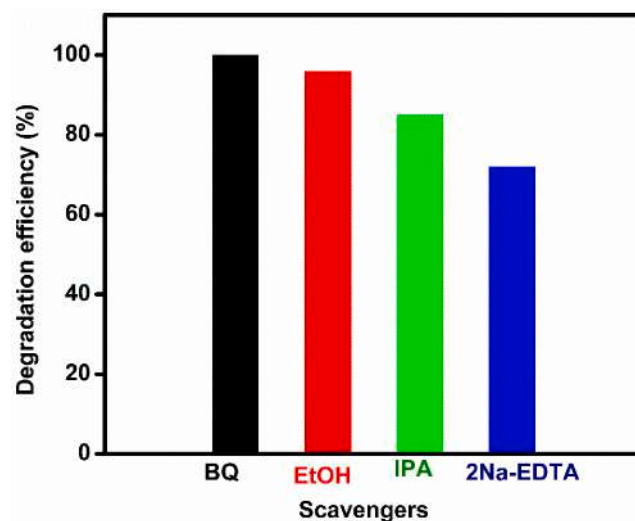


Fig. 12. Scavenger studies of activated carbon (600 °C).

photostability, stability and excellent photo corrosion resistance.

3.10. Scavenger studies

Fig. 12 shows the experiment for capturing reactive species while AC is being photocatalysis by sunlight. It was found that the addition of IPA and 2Na-EDTA scavengers reduced the photocatalytic efficacy of AC toward the degradation of MB dye. However, the degradation of MB in comparison to AC as a photocatalyst is not noticeably altered by the addition of ethanol and BQ. These findings suggest that the main reactive species involved in the photocatalytic breakdown of MB under solar illumination are holes and hydroxyl radicals.

3.11. Electrochemical impedance spectroscopy

Using an electrochemical analyzer in a typical three-electrode setup, measurements for Mott-Schottky (MS) and electrochemical impedance spectroscopy (EIS) were made. The working electrode's active area was 0.5 cm² by 1 cm². EIS was carried out using an open circuit voltage of 0.2 V and an AC voltage amplitude of 5 mV, with a frequency range of

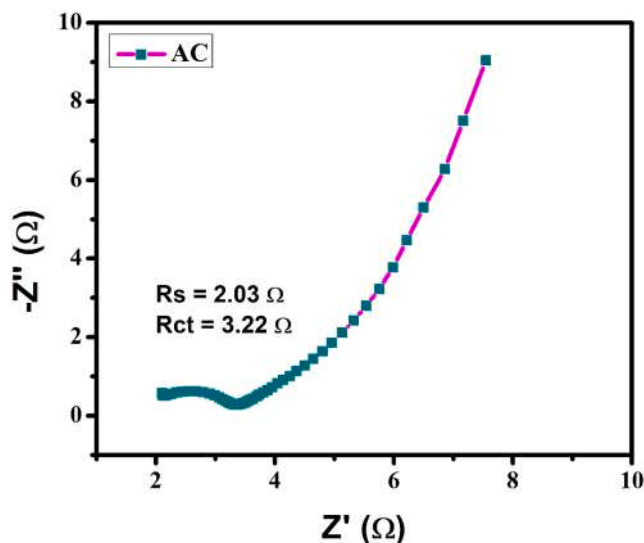


Fig. 13. Electrochemical impedance spectra of o activated carbon (600 °C).

0.1 Hz to 100 kHz. The analysis of the photogenerated charge separation and transfer during the photocatalytic process was done using the electrochemical impedance spectroscopy (EIS) of as prepared activated carbon. Generally, the Nyquist plot's semicircle's radius represents the rate of reaction taking place at the photocatalyst's surface. The reduced arc radius in the Nyquist plot (see Fig. 13) suggests that surface imperfections in the produced AC may be the cause of the rapid reaction rate and efficient charge transfer with decreased electrical resistance [51].

3.12. Morphological stability of prepared AC

TEM and SEM were used to assess the morphological stability of the recycled/recovered photocatalyst. According to TEM and SEM analysis, even after the third cycle of photodegradation, the AC authenticates that no structural change has been seen even after fifth cycle (Fig. 14). The fact that the degradation efficiency was still 96% even after three cycles further demonstrates the high photostability and reusability of the as-prepared AC under simulated visible-light irradiation.

3.13. Antibacterial activity

Fig. 15 depicts the antibacterial action of activated carbon. The antimicrobial effectiveness of activated carbon was evaluated using the disc diffusion technique. The antibacterial activity of gram-positive (*S. aureus*) and gram-negative (*E. coli*) bacteria was evaluated (*E. coli*).

Possible response mechanisms include the following:

1. Electrostatic interaction between nanoparticles and the cell wall membrane
2. Individual particle diffusion to the cell membrane.
3. Superoxides and free radicals are produced.

It is possible that superoxides and free radicals would arise since the experiment was conducted in a dark environment [52]. The interaction between the carbon surface and the negative cell wall membrane of *E. coli* results in electrostatic attraction, and the rupture of the cell wall leads to protein denaturation and cell death. The adsorption ability of carbon leads to effective antibacterial activity against *E. coli* [53]. The cell wall of Gram-negative bacteria has an outer lipopolysaccharide membrane and a thin layer of peptidoglycan, whereas the cell wall of Gram-positive bacteria has a thick layer of peptidoglycan [54]. These results suggest that not all positively charged NPs are more biocidal than negatively charged AC NPs toward the pathogens under study. Furthermore, it is challenging to say which pathogens are more vulnerable to exposure to positively charged AC NPs. In the literature, it is hypothesised that the electrostatic attraction between negatively charged microbial cell membranes and AC NPs with a positive surface charge can significantly increase the adhesion of AC NPs, giving positively charged AC NPs stronger antibacterial activities than negatively charged AC NPs. In this investigation, bio-formed activated carbon nanoparticle agglomerates were utilized. These large aggregates are less likely to penetrate the bacterial cell membrane and cause internal harm. It appears that direct interactions between activated carbon nanoparticles and the membrane surfaces of bacteria result in the mechanical rupture of the cell wall, which might be an efficient mechanism for the antibacterial activity of the sample. It was discovered that when the concentration of activated carbon-NPs increased, the size of the inhibitory zone grew. Crystalline structure and particle shape have a minimal effect on antibacterial activity, but surface area and concentration have a significant impact [55,56]. Gram-positive bacteria result in a smaller inhibition zone because it is difficult to destroy *S. aureus*' cell wall. Compared to amorphous carbon, the graphitic phase of carbon has superior antibacterial activity. Antibacterial activity is determined by the surface area, crystallinity, crystallite size, and particle size. A high concentration of activated carbon results in a larger inhibitory zone. The fact that the activated carbon material being studied is very good at killing bacteria shows that it is a great choice for treating wastewater.

4. Conclusion

This work used a hydrothermal carbonization method and a jasmine flower as biomass to make activated carbon. The hexagonal graphite phase of carbon is shown by the XRD pattern. FT-IR spectroscopy was used to identify the functional groups in activated carbon. The

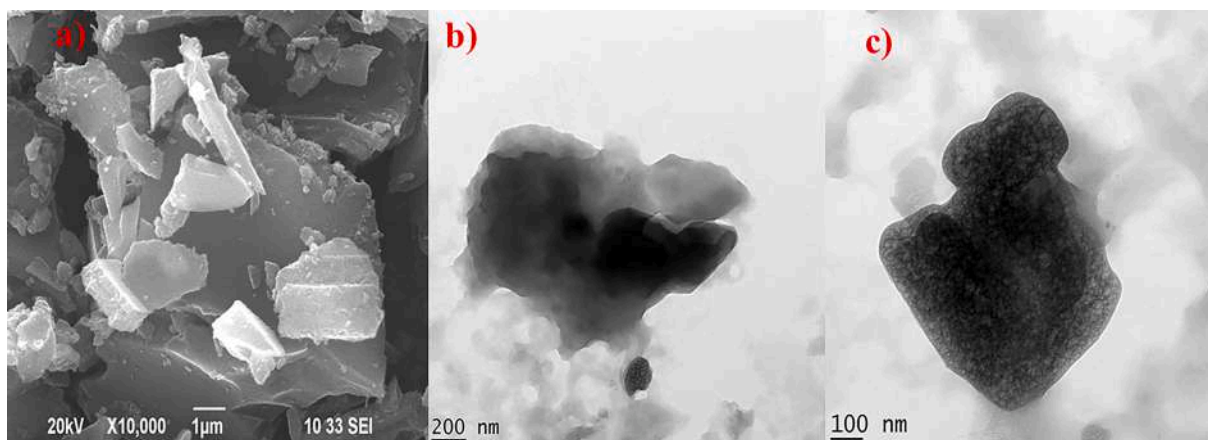


Fig. 14. a, b, c Morphological stability of activated carbon (600 °C) after 5 cycles.

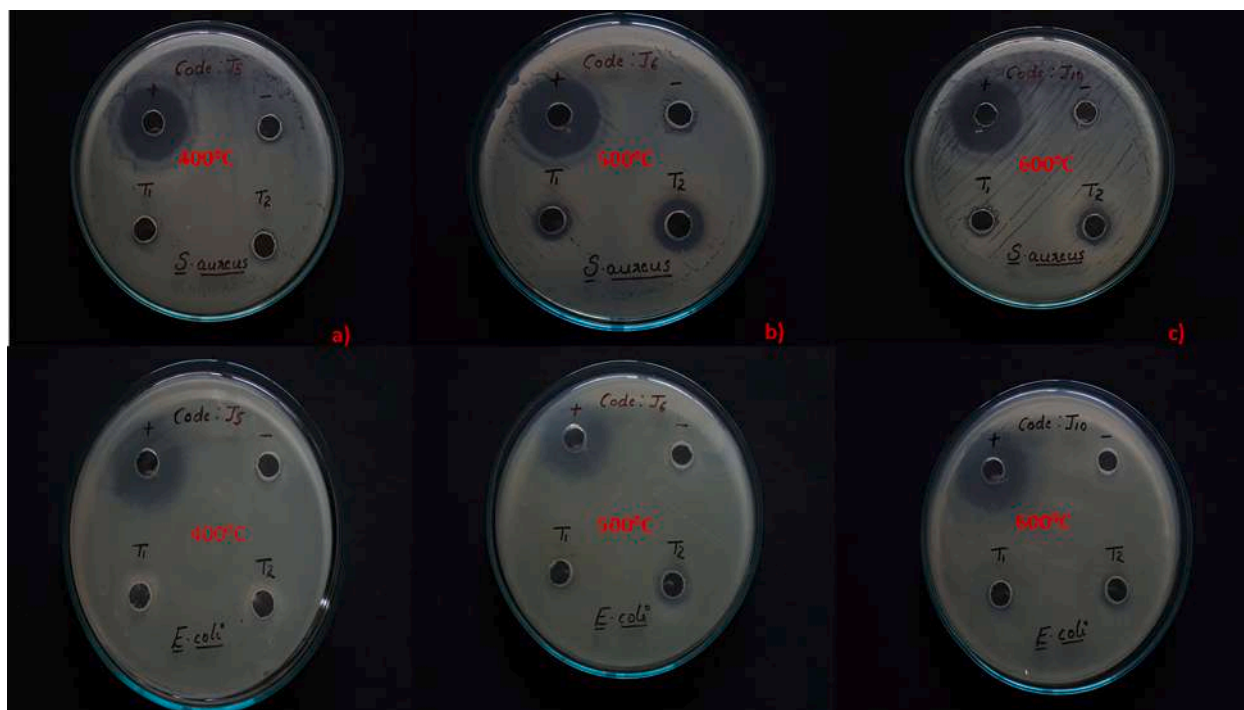


Fig. 15. Antibacterial activity of Activated carbon (400 °C, 500 °C and 600 °C).

production of agglomerated and irregular-shaped nanoparticles was shown by SEM and TEM. The optical absorption occurs at 249 nm in the UV spectrum. At different annealing temperatures, the energy band gap of activated carbon is 2.04 eV, 2.00 eV, and 1.97 eV (400 °C, 500 °C, and 600 °C), respectively. Under visible light irradiation, the greatest photocatalytic degradations for MB was recorded at 94 percent. As itself, activated carbon has strong antibacterial action. According to the findings, the generated activated carbon material is very suitable for wastewater treatment and environmental applications. The Nyquist plot's smaller arc radius verifies the efficient separation of photo-generated electron and hole pairs. The reusability investigations reveal that AC still display remarkable photostability and degradation efficiency even after four cycles. It is firmly believed that the prepared AC may serve as a potential photocatalyst for environmental remediation in the near future because they exhibit excellent photocatalytic performance even in their pristine form due to small crystallite size, high sunlight absorption, effective separation of charge carriers for a longer period of time, and high reduction and oxidation ability.

CRediT authorship contribution statement

M. Amalanathan: Supervision. **M. Aravind:** Synthesis, Manuscript Writing, Review, Conceptualization, Data curation. **M. Sony Michael Mary:** Formal analysis. **Nafis Ahmed:** Resources. **P. Velusamy:** Validation. **Kumari Subitha T:** Writing help. **Raazia Noreen:** Investigation. **Shafaqat Ali:** Investigation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Hydrothermally synthesized Ag-TiO₂ nanofibers (NFs) for photocatalytic dye degradation and antibacterial activity

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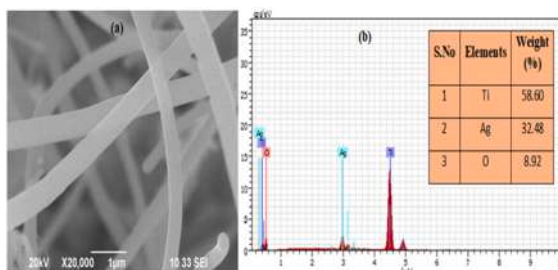
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HIGHLIGHTS

- Ag nanoparticles modified with TiO₂ nanofibers was synthesized by the hydrothermal method.
- The Ag-TiO₂ Nanofiber achieved high photocatalytic performance toward the removal of Methylene blue.
- The Ag-TiO₂ Nanofibers displayed the attractive antibacterial efficacy against both gram positive and gram negative bacteria.
- The Ag-TiO₂ nanofibers are suitable for waste water treatment and biomedical applications.

GRAPHICAL ABSTRACT



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ABSTRACT

This work successfully utilised eco-friendly green synthesis to produce Ag-TiO₂ nanofibers (NFs). As pollution and energy limitations have become global issues, there is an ongoing need to develop more effective catalysts through straightforward and environmentally friendly methods. The Ag-TiO₂ nanofibers (NFs) XRD pattern exhibits an anatase TiO₂ and FCC crystal structure of Ag nanoparticles. The SEM investigation revealed a nanofiber-like surface morphology. The Ag-TiO₂ nanofibers (NFs) exhibits an optical band gap energy is 2.5 eV. Methylene blue (MB), malachite green (MG), Congo red (CR), and crystal violet (CV) dye aqueous solutions were used to evaluate the photocatalytic performance of the synthesized Ag-modified TiO₂ nanofibers (NFs) under direct sunlight irradiation. The effects of catalyst size on the efficient breakdown of MB dye were also investigated. The optimum catalyst concentration was found to be at 0.02 mg/mL. At 120 min of direct sunlight, the highest photosynthetic degradation efficiency (DE percentage) of 94% was achieved for MB dye. Ag-TiO₂ nanofibers (NFs) have been demonstrated to have exceptional antibacterial activity against Gram-positive bacteria such as *Staphylococcus aureus* and Gram-negative bacteria *E-Coli*. Because of these great qualities, it seems

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likely that the Ag–TiO₂ nanofibers (NFs) made could be a great photocatalyst for getting dye pollutants out of wastewater.

1. Introduction

In recent years the most important challenges facing humanity now are the scarcity of clean water, growing population and pollution of existing water sources. There is a correlation between pesticides and other organic dyes in water sources and the transmission of water-borne diseases. A significant and widespread negative influence on the water supply is caused by impurities such as plastics, textiles, electronic trash, and industrial wastes. In recent years, addressing environmental issues resulting from huge releases of toxic substances has become a vital priority for the scientific community. Dye pollutants are exceedingly difficult to remove from wastewater. MB is a negative polar dye frequently employed in textile and artwork printing and painting. The negative effects of methylene blue are headaches, nausea, vertigo, and skin discolouration. Numerous technologies, including adsorption [Liu et al. \(2020\)](#), the biological process [Javaid et al. \(2011\)](#), membrane filtration [Kurt et al. \(2012\)](#), improved oxidation [Yasar et al. \(2013\)](#), and other physical and chemical processes, have been utilised to eliminate hazardous colours from wastewater. These procedures have the drawbacks of high temperatures, high pressure, energy consumption, and a longer time frame. Due to issues with effluent, sludge formation, and adsorbent repair, none of these approaches is superior for dye degradation. When dye molecules are exposed to sunlight they break down into carbon dioxide, water molecules, and simple mineral acids [Priyanka and Lens \(2022\)](#). Therefore, heterogeneous photocatalysis paves the way for an eco-friendly, cost-effective, and effective method of environmental clean-up ([Thakur et al., 2020](#); [Roongraung et al., 2020a,b](#)).

Gaurav K. [Upadhyay et al. \(2019\)](#) synthesized that ZnO: TiO₂ nanocomposite for removing methylene blue. The optical bandgap of the ZnO: TiO₂ nanocomposites has decreased from 3.30 eV to 3.10 eV. After 120 min, the ZnO-modified TiO₂ nanocomposite degrades at its fastest rate, between 75 and 90%. [Moradi et al. \(2018\)](#) reported that under UV irradiation, the magnetic NiFeO₄@ZnO nanocomposite degrades direct blue dyes and reactive blue dyes. NiFeO₄@ZnO nanocomposites degrades natural blue dyes and reactive blue dyes by 98.5% and 96.5%, respectively. [Mukhopadhyay et al. \(2016\)](#) synthesized that plasmonic Au-coated ZnO/TiO₂ catalysts completely degrades under CR and MB under UV light irradiation. According to [Aqeel et al. \(2020\)](#) sol-gel process was used to prepare the nano photocatalyst Zr/Ag/TiO₂. Zr/Ag/TiO₂ nanocomposites have 93% dye degradation efficiency. [Santos et al. \(2015\)](#) used a hydrothermal technique to prepare Ag/TiO₂ nanocomposite to decolourize tartrate azo dye. According to [Kumar et al. \(2020\)](#) the photocatalytic activity of the Ag/TiO₂ composites degrades 78 percent of methyl orange dye after 180 min.

Noble metal nanoparticles have strong Surface Plasmon Resonance (SPR) properties and a high electron trapping capacity. In the present research work aims to synthesis and analyse Ag–TiO₂ nanofibers (NFs) for the effective photodegradation of Methylene blue (MB), malachite green (MG), Congo red (CR), and crystal violet (CV) dye aqueous dye solution under solar irradiation. Ag–TiO₂ nanofibers (NFs) may be able to absorb UV and visible light from the sun and attract additional dye molecules to the surface, which is a good way to break down organic dyes. The most important factors for enhancing photocatalytic activity are metal ions dopants (Cu, Co, Ag, Au), composite networks, and the different kinds of light sources used (UV/Visible or sunlight). Metal doping can reduce charge carrier recombination and improve photocatalyst visible light absorption based on ZnO and TiO₂.

2. Materials and methods

2.1. Materials

The ingredients Titanium Tetra Isopropoxide (TTIP), Silver nitrate (AgNO₃), and Methylene blue (C₁₆H₁₈ClN₃S) were purchased from Sigma Aldrich. Without any additional purification, all chemicals and reagents are used.

2.2. Synthesis of Ag–TiO₂ nanofibers (NFs)

Ag–TiO₂ nanofibers (NFs) were synthesized by employing a simple and environmentally friendly hydrothermal method [Aravind et al. \(2021\)](#). After adding 10 mL of titanium tetra-isopropoxide (TTIP) to a beaker with a capacity of 100 mL, the next step was to add 5 mL of jasmine flower extract and 20 mL of distilled water. The solution was constantly stirred at a pace of 400 revolutions per minute (rpm). The titanium solution should now have added 0.1 M of an AgNO₃ solution. The solution was kept warm in an autoclave made of stainless steel and heated for one day in a muffle furnace at a temperature of 180 °C. Calcination took place for 6 h at a temperature of 500 °C [Wang et al. \(2020\)](#).

2.3. Characterizations of Ag–TiO₂ nanofibers (NFs)

The Panalytical X-Pert Pro diffractometer was used to measure powder X-ray diffraction. The Shimadzu Prestige 20 IR-Spectrophotometer was used to record the FT-IR spectrum with an area of 400–4000 cm^{−1}. Scanning Electron Microscopes with Energy Dispersive X-Ray Spectroscopy (Jeol JSM 6390 and QuinTox KM9106) were used to analyse surface micro-morphology and their elemental analysis. A Jasco V630 UV–Visible Spectrophotometer was used to measure UV–visible absorbance spectra. Dielectric measurements were made with a CHI604E electrochemical analyser and a Hioki LCR impedance analyser.

2.4. Photocatalytic measurement

The degradation of MB aqueous dye in visible light was investigated. The Ag–TiO₂ nanofibers (NFs) were distributed in a 100 mL aqueous MB dye. So that adsorption and desorption may occur properly before irradiation can take place. The solution was ultrasonically agitated for 60 min inside a dark room. Every 30 min, 5 mL of solution was collected and centrifuged at 3000 rpm for 10 min. The temperature of the reaction mixture was kept constant at 37 °C. The photodegradation behavior was evaluated using a UV–Vis analyser. Similarly, different quantities of catalysis (0.005 mg–0.02 mg) of Ag–TiO₂ were used to assess the catalytic effectiveness of the samples. The following equation is used to determine the degradation efficiency (DE) of dye.

$$\text{Degradation Efficiency (\%)} = (C_0 - C) / C_0 \times 100 \% \quad (1)$$

where C₀ – Initial concentration of dye solution.

C – Final concentration of dye solution [Ahmad et al. \(2020\)](#).

2.5. Antibacterial properties

The antibacterial properties of Ag–TiO₂ nanofibers (NFs) were investigated using disc diffusion. The antibacterial activity of Ag–TiO₂ nanofibers (NFs) was examined using gram-positive (*S. aureus*) and gram-negative (*E. coli*) bacterial pathogens [Wong et al. \(2020\)](#). 8 (milli

meters) mm wells were punched in Mueller Hinton Agar (MHA) and wiped with positive and negative strains. In each well was poured a solution of prepared Ag-TiO₂ nanofibers (NFs) of varying concentrations. The agar plate was incubated for 24 h at 37 °C. The inhibitory layer was measured in millimetres Rao et al. (2019).

3. Results and discussion

3.1. XRD analysis

Fig. 1 a) Demonstrates the XRD pattern of Ag-TiO₂ nanofibers (NFs). The Braggs reflection planes (101), (110), (004), (111), (102), (200), (105), (211), (204), (220), and (116) correspond to the diffraction peaks 2(θ) at 25.56°, 27.48°, 36.17°, 38.28°, 41.36°, 48.37°, 54.54°, 56.92°, 62.81°, 64.35°, and 69.20°. The diffraction peaks measured at 38.28°, 48.37°, and 64.35° correlates to the FCC crystal structure of Ag-TiO₂ nanoparticles. The detected XRD peaks precisely matched with the JCPDS card numbers 07–6173 and 04–0774 Roongraung et al. (2020). The average crystallite size of Ag-TiO₂ nanofibers (NFs) is 33 nm (nm). In the XRD pattern of Ag-TiO₂ nanofibers, dual phases consisting of a tetragonal anatase phase and a face-centred cubic lattice of silver nanoparticles are seen. The Ag nanoparticles couldn't get into the TiO₂ crystal lattice, so they gathered on its surface.

3.2. UV-visible absorbance spectroscopy

Fig. 1 (c and d) depicts the UV-visible and Tauc plots of Ag modified

TiO₂ nanofibers (NFs). The Ag modified TiO₂ nanofibers reveals the absorbance peak reaching between 208 and 396 nm (NFs) Liang et al. (2022). The redshift is triggered by the presence of Ag-nanoparticles on the surface of the TiO₂ nanostructure. Because of the localized SPR effect, the plasmonic Ag nanoparticles in the TiO₂ catalyst may easily absorb light and excite the surface electron for transmission to an acceptor Li et al. (2018). The Tauc plot was used to obtain the optical band gap values,

$$h\nu = A (h\nu - E_g)^n / \alpha \quad (2)$$

where α is the optical absorption coefficient, E_g is the bandgap energy, A is an optical constant, and n indicates the transition order Arifin et al. (2022). The optical band gap values of the Ag-TiO₂ nanofibers (NFs) determined are 2.5 eV. While Ag nanoparticles have been added on the surface of TiO₂ nanoparticles, compared to commercial TiO₂ nanoparticles, the bandgap gradually decreases. When Ag nanoparticles are present on the surface of the TiO₂ nanostructure, a huge quantity of photons with a longer wavelength are absorbed. It makes photocatalysis work better. Electrons are excited from the VB (valance band) to the CB (conduction band) and subsequently shifted to the Ag fermi level. UV spectra result in a decreased photoelectron carrier recombination rate Shen et al. (2022).

3.3. Fourier transform –infra red (FT-IR) spectroscopy

Fig. 1 b) shows the vibrational spectra of as-prepared Ag-TiO₂ nanofibers (NFs) using jasmine flower extract. The band obtained at

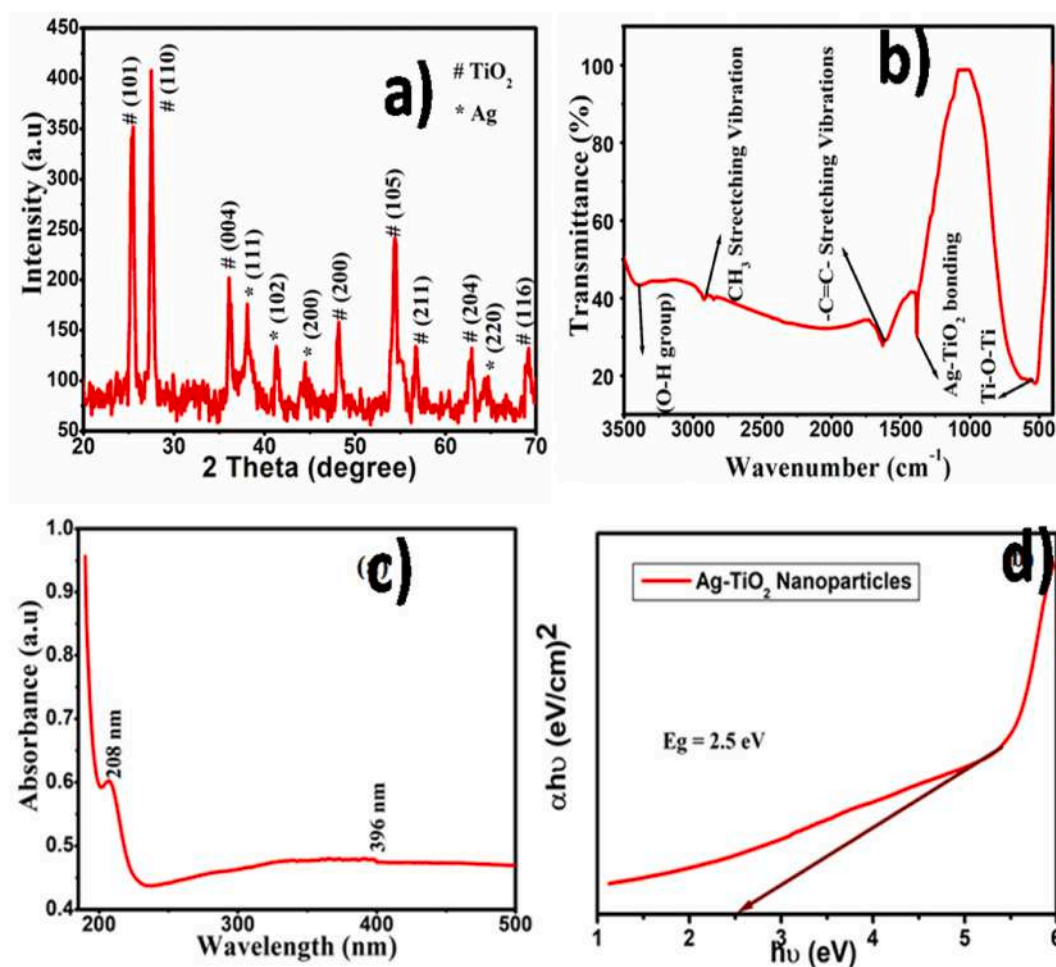


Fig. 1. a) XRD pattern of Ag-TiO₂ nanofibers (NFs), b) FT-IR spectra of Ag-TiO₂ nanofibers (NFs) using jasmine flower extract (c and d) UV-visible absorbance spectra and Tauc Plot of Ag-TiO₂ nanofibers (NFs).

3385.3 cm^{-1} denotes the hydroxyl (O–H) groups Zhang et al. (2012). The peak at 2851 cm^{-1} corresponds to the $-\text{CH}_3$ stretching mode of vibration Ashraf et al. (2020). The $-\text{C}=\text{C}-$ aromatic stretching vibrations band obtained at 1631.30 cm^{-1} Jaber et al. (2020). The band observed at 1355 cm^{-1} represents the Ag–TiO bond. The signal at 1355 cm^{-1} supports silver NPs deposition on the surface of TiO₂ NFs. The Ti–O–Ti vibrations in Ti are seen by the 528 cm^{-1} peak Carvalho et al. (2018).

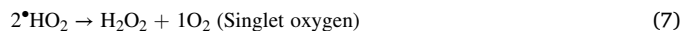
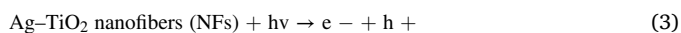
3.4. Scanning electron microscope with elemental dispersive analysis X-ray spectrum

Fig. 2 (a and b) display the SEM and EDAX images of the Ag–TiO₂ nanofibers (NFs) respectively. The surface morphology demonstrates that a vast number of nanofibers made of TiO₂ are regularly aligned Kang et al. (2019). When Ag nanoparticles are decorated on the surface of the nano-structured TiO₂ nanofibers results in the size and form of the composites may be controlled to a certain extent. The EDAX spectrum of Ag–TiO₂ nanofibers (NFs) reveals the presence of key components, including silver, titanium, and oxygen.

3.5. Photocatalytic performance

3.5.1. Mechanism of photodegradation of dye molecules

The photocatalytic dye degradation of Methylene Blue is shown in Fig. 3. When sunlight falls on the surface of Ag–TiO₂ NFs, photoelectrons (e^-) may be excited from the valance band to the conduction band by leaving holes (h^+) in the Valance band. Photo generated e^- and h^+ migrated to the Ag–TiO₂ nanofibers (NFs) surface, preventing electron hole pair recombination. However, because Ag has a higher fermi energy level than TiO₂, electrons move from Ag to TiO₂. When light (visible) is irradiated on the surface of Ag–TiO₂ nanofibers (NFs), the Schottky barrier effect mechanism causes Ag and TiO₂ to form new F_e (Fermi energy) levels and change some values, resulting in improved photocatalytic activity. Water molecules infiltrate the gaps in the valance band, allowing hydroxyl radicals ($\bullet\text{OH}$) and hydrogen ions (H^+) to get through. Superoxides (O_2^-) are formed when photo generated electrons absorb dissolved oxygen. Reactive hydroxyl groups and superoxide react with aqueous solutions to produce CO_2 and H_2O as by-products Kang et al. (2019).



The accumulation of noble metal (Ag) nanoparticles to the surface of a TiO₂ catalyst prevents the trapping of electron hole pairs and decreases the rate of electron-hole pair recombination. Due to the SPR effect, the incorporation of silver nanoparticles increases the visible light absorption capability of TiO₂ nanoparticles and their catalytic activity Chen et al. (2012). TiO₂ is one of the most effective photocatalysts for removing persistent contaminants such as organic dyes, medicinal chemicals, bacteria, and viruses. The rapid recombination of charge carriers and the inefficient utilisation of light remain significant hurdles to its broad application. By altering the TiO₂ lattice with the noble metal silver, it is possible to enhance the catalytic performance of TiO₂ and shift its photocatalytic response to the UV to the visible light spectrum.

3.5.2. Effect of catalyst

The impact of the initial photocatalyst concentration was investigated by increasing the initial Ag–TiO₂ nanofibers (NFs) concentration from 0.005 mg to 0.02 mg per 100 ml in MB dye solution, which can be seen in Fig. 3 (a). When the amount of photoactive catalyst was increased from 0.005 to 0.02 mg, the photocatalytic activity increased, perhaps due to an increase in the active sites on the catalyst surface. Over 0.02 mg of catalyst decreased photocatalytic activity due to the optical scattering and light screening effects of nanoparticles. It is due to particle aggregation, a barrier to light irradiation. The degradation efficiency is diminished with a catalyst concentration of 0.005 mg/mL. Doping metal with TiO₂ may function as cationic dopants, enhance its sensitivity to visible light, and prevent recombination by modifying its electronic band structure. At the end of 120 min, the Ag–TiO₂ nanofibers (NFs) (0.02 mg) may disintegrate at a maximum rate of 94% Palaniswamy et al. (2021).

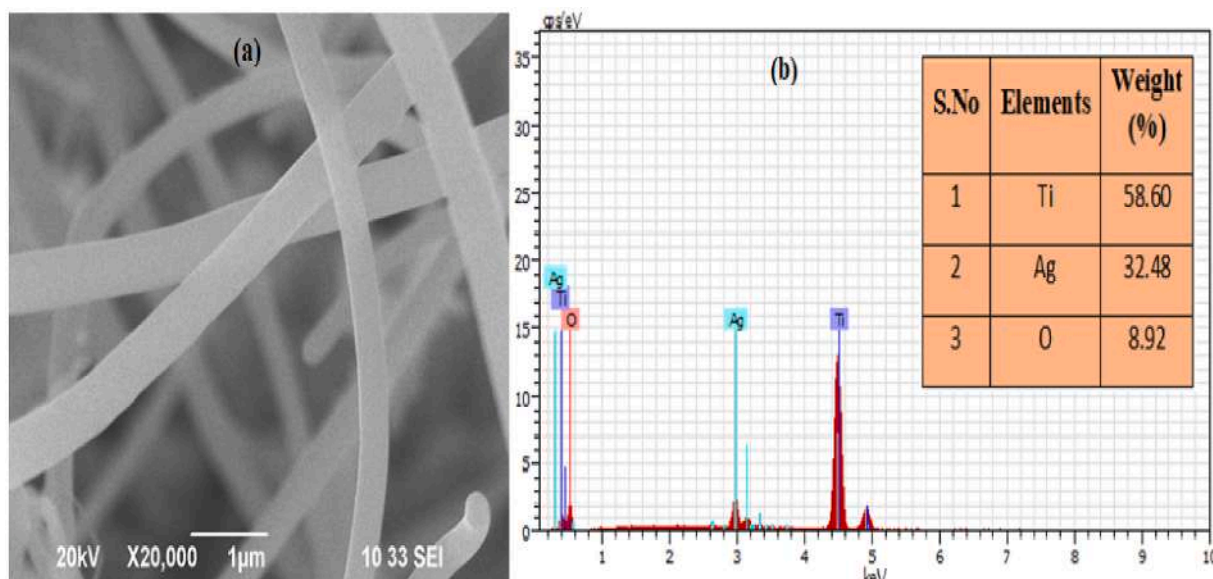


Fig. 2. (a, b) SEM and EDAX spectra of Ag–TiO₂ nanofibers (NFs).

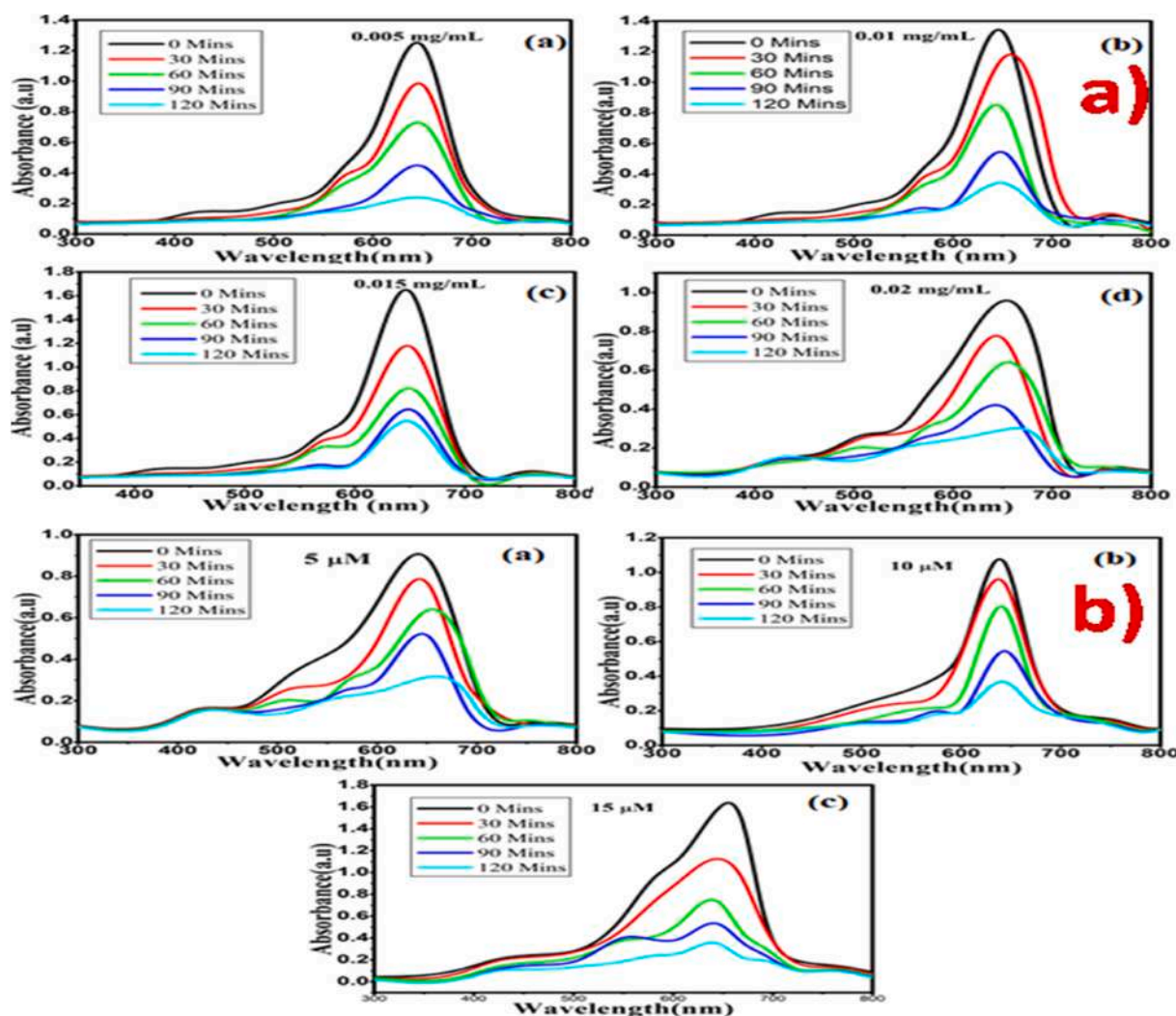


Fig. 3. (a and b): Time-dependent absorbance spectra (UV-Vis) of MB dye degradation (Effect of catalyst 0.005 mg to 0.02 mg and effect of dye dosage 5 μ M to 15 μ M).

3.5.3. Effect of the dye concentration

Fig. 3 b) illustrates the influence of diminishing efficiency on MB concentrations (5, 10, and 15 μ M). As the dye concentration increases, the effectiveness of photocatalytic degradation decreases. At lower concentrations, more active sites from MB molecules are adsorbed by Ag-TiO₂ NFs. Increasing the dye concentration prevents photons from ever reaching the Ag-TiO₂ nanofibers (NFs) surface, reducing the dye removal efficiency. Increased dye concentrations reduce the travel length of photons, hence decreasing the light-activated catalyst Palanisamy et al. (2020).

3.5.4. Photocatalytic degradation of malachite green

Malachite green, commercial dye effluents, was used as a target Organic Compound Model (OCM) to assess the photo activity of the fluorescent Ag-TiO₂ nanofibers (NFs) photocatalyst. In light adsorption, the Ag-TiO₂ nanofibers (NFs) performance was inadequate; only a small percentage (3–4%) of the dye was degraded after 60 min. In Fig. 4 a), the Ag-TiO₂ nanofibers (NFs) photocatalyst reveals the maximum photocatalytic degradation efficiency of 92% at the end of 1 hrs, when exposed to visible light. As stated in the optical characteristics, the Ag-TiO₂ nanofibers (NFs) photocatalyst has low band-gap energy. Radical recombination outpaces separation when exposed to UV light, whereas electron-hole production is expected, and recombination is weak when exposed to visible light. Malachite green photodegrades in the sunshine

without energy, which benefits both financially and environmentally. The negatively charged catalysts can easily be coated with cationic MG dye, and the Ag-TiO₂ nanofibers (NFs) photocatalyst demonstrates outstanding photocatalytic performance.

3.5.5. Photocatalytic degradation of crystal violet

The crystal violet photodegradation estimates the catalytic performance of Ag/TiO₂ NFs under sunlight irradiation for 60 min. Fig. 4 b) Shows the time-dependent UV-Vis absorbance spectra of crystal violet dye degradation. The first experiment subjected the CV solution to sunlight irradiation without using photocatalyst. According to the findings, solar radiation causes materials to degrade at roughly 3%. Degradation was barely detectable.

On the one hand, we observe that the photocatalytic activities of Ag-TiO₂ nanofibers (NFs) photocatalysts in sunlight are distinct. After 60 min of direct sunlight exposure, the photodegradation efficiency for Ag-TiO₂ nanofibers (NFs) photocatalyst shows 80.3%. The photocatalytic activity was often sensitive to the crystalline, surface OH groups, particular surface area, and photocatalyst surface roughness. As a result, the Ag-TiO₂ nanofibers (NFs) photocatalyst exhibits superior photocatalytic performance when exposed to visible radiation. Doping ions will increase the number of electrons and hole traps in the Ag-TiO₂ nanofibers (NFs) photocatalyst lattice, fastening the charge carriers and preventing the recombination rate of photo generated e⁻ and h⁺,

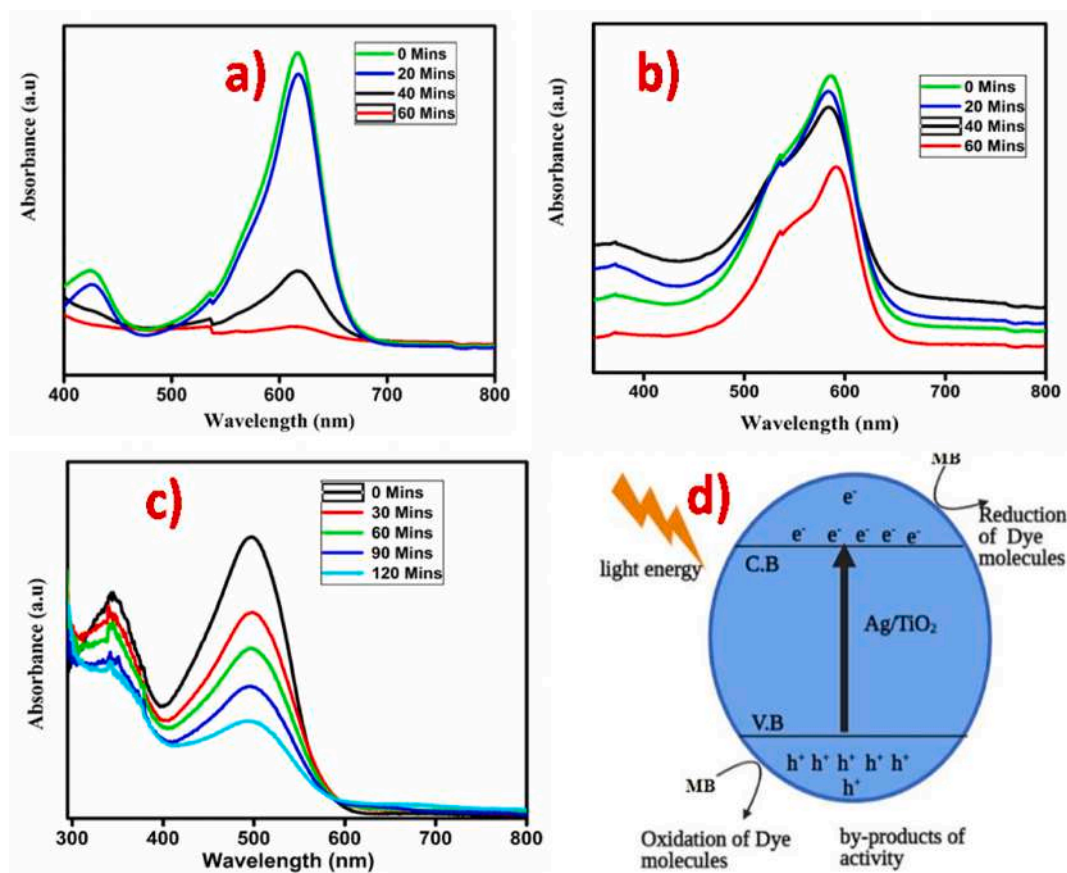


Fig. 4. (a–c) Time-dependent UV–Visible absorbance spectra of Malachite green, Crystal violet and Congo red and d) Possible reaction mechanism of dye degradation.

improving catalytic activity.

3.5.6. Photocatalytic degradation of Congo red (CR) dye

The decolourization of dye with initial concentrations (10 mg/L) CR under solar irradiation was used to evaluate the photocatalytic degradation efficiency of Ag–TiO₂ NFs. Fig. 4 c) shows the time-dependent UV–Vis absorbance spectra of CR dye degradation. The maximum absorbance ($\lambda_{\max}$) of the supernatant dye solution determines the concentrations of the CR dye at 498 nm. The photocatalytic performance was improved, possibly due to the enhanced surface to volume ratio and band structure alteration of the Ag NPs. It effectively limited the recombination of photogenerated (e^-/h^+) pairs. CR dye degradation using Ag–TiO₂ nanofibers that were hydrothermally produced (NFs). At 492 nm, CR exhibits the highest absorption. The decline in CR dye's maximal absorption at regular intervals of 30 min is indicative of dye degradation. The activity of the catalysts was initially examined using 0.02 mg of the catalyst exposed to visible light for 120 min. However, in 120 min, Ag–TiO₂ nanofibers (NFs) demonstrated 80.5% photocatalytic degradation. The increased photocatalytic activity of Ag–TiO₂ nanofibers (NFs) implies that the addition of silver greatly enhances Ag–TiO₂ nanofibers (NFs) catalytic activity.

However, only about 80.5% of CR was decoloured for 50 mg/L concentrations. Therefore, when the original CR content increased, the photodegradation efficiency of CR photocatalysis by the Ag–TiO₂ nanofibers (NFs) powder also dropped. Two factors are primarily responsible for the decline in the semiconductor's degrading efficiency as CR concentration increases. More molecules are adsorbed on photocatalyst when the CR concentration increases, lowering their active sites. Therefore, as more of the catalyst surface is occupied, the production of hydroxyl radicals will be reduced.

On the other hand, raising the CR can decrease the number of

photons that reach the catalyst surface. By adsorbing the light, CR molecules reduce photons' ability to excite photocatalyst particles. Consequently, photo degradation's effectiveness dropped. Under visible-light irradiation, the Ag–TiO₂ nanofibers (NFs) demonstrate effective photocatalytic activity in the breakdown of CR.

3.6. Ag–TiO₂ based photocatalyst

The catalytic performance of an Ag–TiO₂-based photocatalyst was compared with some other organics and is tabulated and summarized in Table 1. Table 1 shows that previously published Ag–TiO₂ catalysts could decolourize 79.8% of Methylene Blue dye in 150 min, while most Ag–TiO₂ composites could take more than 2 h to do the same. Compared to ternary composite materials, Ag–TiO₂ nanofibers (NFs) produced hydrothermally has a high photodegradation efficiency of 94% when exposed to sunlight (see Table 2).

3.7. Structural and morphological stability of Ag–TiO₂ nanofibers (NFs)

Powder XRD and SEM were used in the study to investigate the structural and morphological stability of Ag–TiO₂ nanofibers (NFs) (Fig. 5 a, b). According to the XRD pattern, the initial crystalline phase and structure of the Ag–TiO₂ nanofibers (NFs) subjected to photo-degradation did not change. Because dye molecules were incorporated into the material, the SEM pictures show a few agglomerations, leading to subtle morphological changes when the material was degraded.

3.8. Reusability

The stability and reusability of the optimized Ag–TiO₂ nanofibers (NFs) towards the dye degradation of MB were studied under sunlight

Table 1Comparison of photocatalytic performance of Ag/TiO₂ with reported literature.

Catalyst	Model pollutant Dye	Performance (%)	Source of light	Irradiation time (Min)	Reference
Ag/TiO ₂	MB	79.8	Visible	150	Zhao et al. (2017)
PS@Ag@TiO ₂	MB	90	Visible	30	Cha et al. (2009)
Ag ₂ O/ZnO-TiO ₂	RhB	95	Visible	150	Wani and Ganie (2021)
Pristine Ag/TiO ₂	MO/RhB	77/84	Sunlight	180	Heng et al. (2021)
Ag/Ag ₂ S-TiO ₂	CV	28.92	Sunlight	120	Shuang et al., (2018)
Ag-Ag ₂ O/TiO ₂ @polypyrrole	MB	83.9	UV	120	Kumar et al. (2016)
Fe ₃ O ₄ -TiO ₂ -Ag	MB	90.1	Visible light	85	Ghafuri et al. (2019)
Ag ₂ O/TiO ₂	MB	95.4	Visible light	180	Kavitha et al. (2021)
Fe ₂ O ₃ /TiO ₂	MB	-	UV	60	Ahmed et al. (2013)
g-CN-TiO ₂	MB	-	UV	-	Vijayan et al. (2023)
TiO ₂ -GO	MG and MB	85 and 93	Visible	60	Verma et al. (2023)
SiO ₂ -TiO ₂	MB	90	Visible	30	Mahanta et al. (2022)
Cu ₂ O-CuO//TiO ₂	MB and MO	87	Visible	120	Ansari et al. (2022)
Fe ₃ O ₄ /TiO ₂	RhB	91	Visible	120	Madima et al. (2022)
G-TiO ₂	MB	-	Visible	120	Shimi et al. (2022)
Ag/TiO ₂	MB	94	Sunlight	120	Present work

Table 2

Shows Zone of inhibition values of bacterial strains.

S.No	Gram positive (S. Aureus)	Gram negative (E-coli)
1.	14 mm	17 mm

exposure for five cycles. The concentration of MB dye should be constant in each cycle, and the recovered centrifuged catalyst should be used in subsequent cycles of the degradation process. The motivation remains efficient and has remarkable photo stability even after four cycles. Maximum MB dye degradation occurs after 120 min, and the efficiencies for the 1st, 2nd, 3rd, 4th, and 5th cycles are 92%, 92%, 92%, 90%, and 90%, respectively. Therefore, the results of the present investigation support the notion that Ag-TiO₂ nanofibers (NFs) formed during the photocatalytic degradation of MB under solar light irradiation may

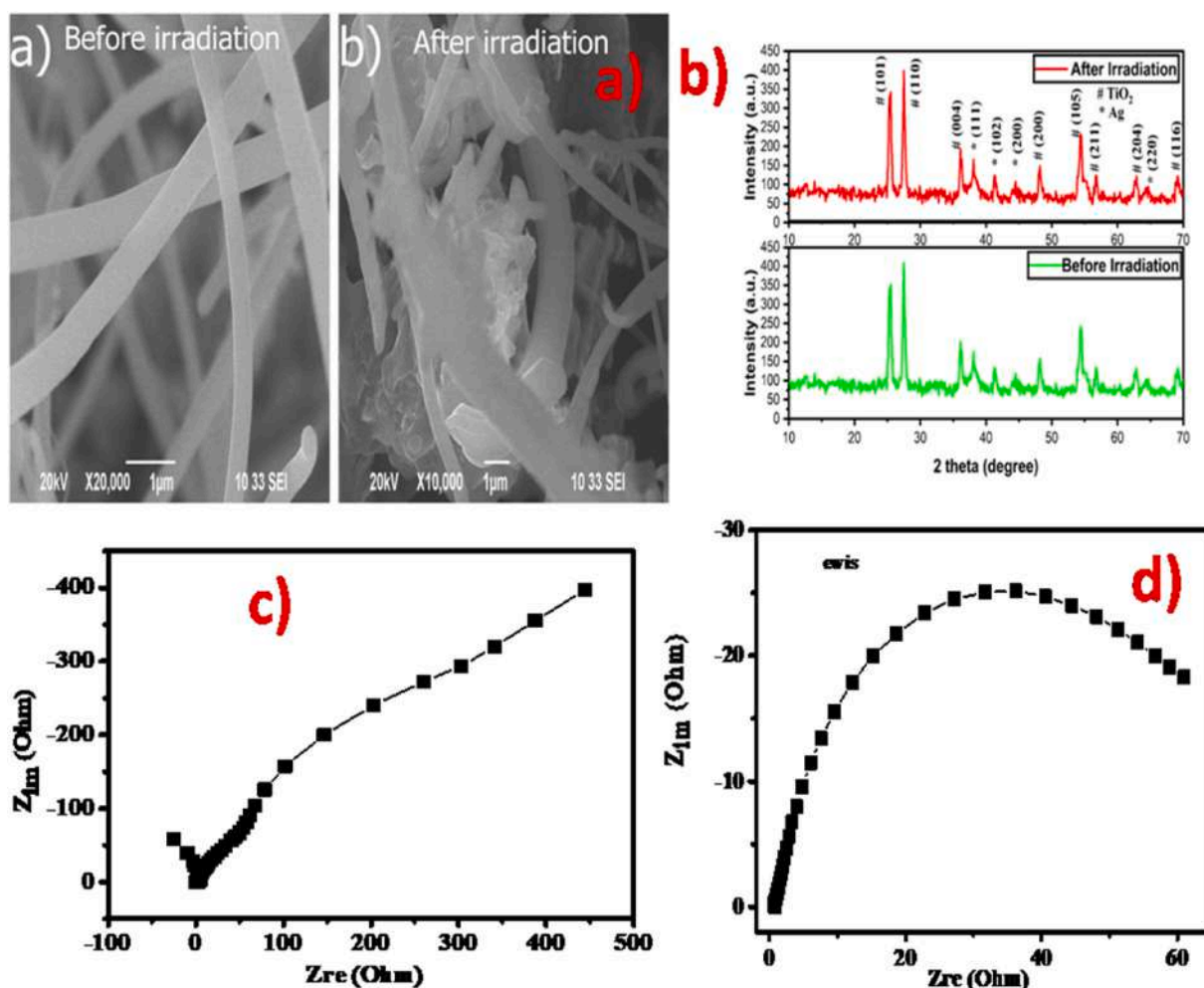
**Fig. 5.** (a & b) shows Morphological and Structural stability of Ag-TiO₂ nanofibers (NFs) after 5 cycles and (c & d) shows EIS spectra of Ag-TiO₂ nanofibers (NFs).

exhibit excellent photo stability, longer life span, and photo corrosion resistance.

3.9. Electrochemical impedance spectroscopy

The three-electrode electrochemical analyser performed Mott-Schottky (MS) and electrochemical impedance spectroscopy (EIS). The working electrode active area was 0.5 cm^2 by 1.0 cm^2 . EIS was carried out using an open circuit voltage of 0.2 V and an AC voltage of 5 mV with a 0.1 Hz to 100 kHz frequency. The photo generated charge carrier separation and transfers were analysed during the catalytic process using the EIS of as-prepared activated carbon. Generally, the Nyquist plot semicircle radius represents the reaction rate at the photocatalyst surface. The reduced arc radius in the Nyquist plot (Fig. 5 c and d) suggests that surface imperfections in the produced Ag-TiO₂ nanofibers (NFs) may be the cause of the enhanced photoreaction and improved efficient charge transfer with decreased electrical resistance Wilke et al. (2018).

3.10. Antibacterial activity

Fig. 6 (a) represents the antibacterial screening of Ag-TiO₂ nanofibers (NFs). Agar diffusion was used to visualise the antibacterial activity of Ag-TiO₂ NFs. Due to their powerful antibacterial capabilities, metals and metal oxides are used to treat various bacterial illnesses. Due to their potent antibacterial activity, silver nanoparticles are

traditionally used in medication delivery, biomedical imaging, tissue engineering, and cancer treatment. Nanoparticles based on TiO₂ are frequently employed for many applications Prakash et al. (2016). The cell wall membrane of gram-positive bacteria is composed of thin peptidoglycan easily disrupted by nanoparticles. Positive cell walls are composed of a 30 nm thick coating of peptidoglycan that is tough to degrade. Cell wall membranes are composed of lip polysaccharides, phospholipids, and proteins. Interactions between microorganisms and nanoparticles may change permeability and induce cell death Pinto et al. (2013). The inhibitory mechanism may involve (1) photocatalyst irradiation, (2) the production of active OH groups, and (3) the bombardment of silver ions and hydroxyl radicals on the bacterial cell wall, resulting in damage and death. TiO₂ nanoparticles disrupt bacterial cells by interacting with the cell wall membrane. The way bacteria breathe is changed by the plasmonic ions on the surface of TiO₂ nanofibers that are optically active (Parvathiraja and Shailajha, 2021). The interaction of Ag⁺ ions with gram-negative bacteria results in electrostatic attraction. Ag-NPs attach to phosphorus and sulphur in the bacterial cell membrane, as well as other intercellular components like DNA bases and proteins, disrupting bacterial function and eventual death Naseem et al. (2016). As predicted, there is no inhibition zone in control. *E. coli* produces the largest inhibitory zone of the two examined bacterial strains, measuring 7 mm , whereas *S. aureus* produces a zone of 4 mm . Changes in the zone inhibitory layer are attributable to the varying susceptibility and size of nanoparticles. The bactericidal activity of nanoparticles may result from the binding of surface to bacteria, which depends on the

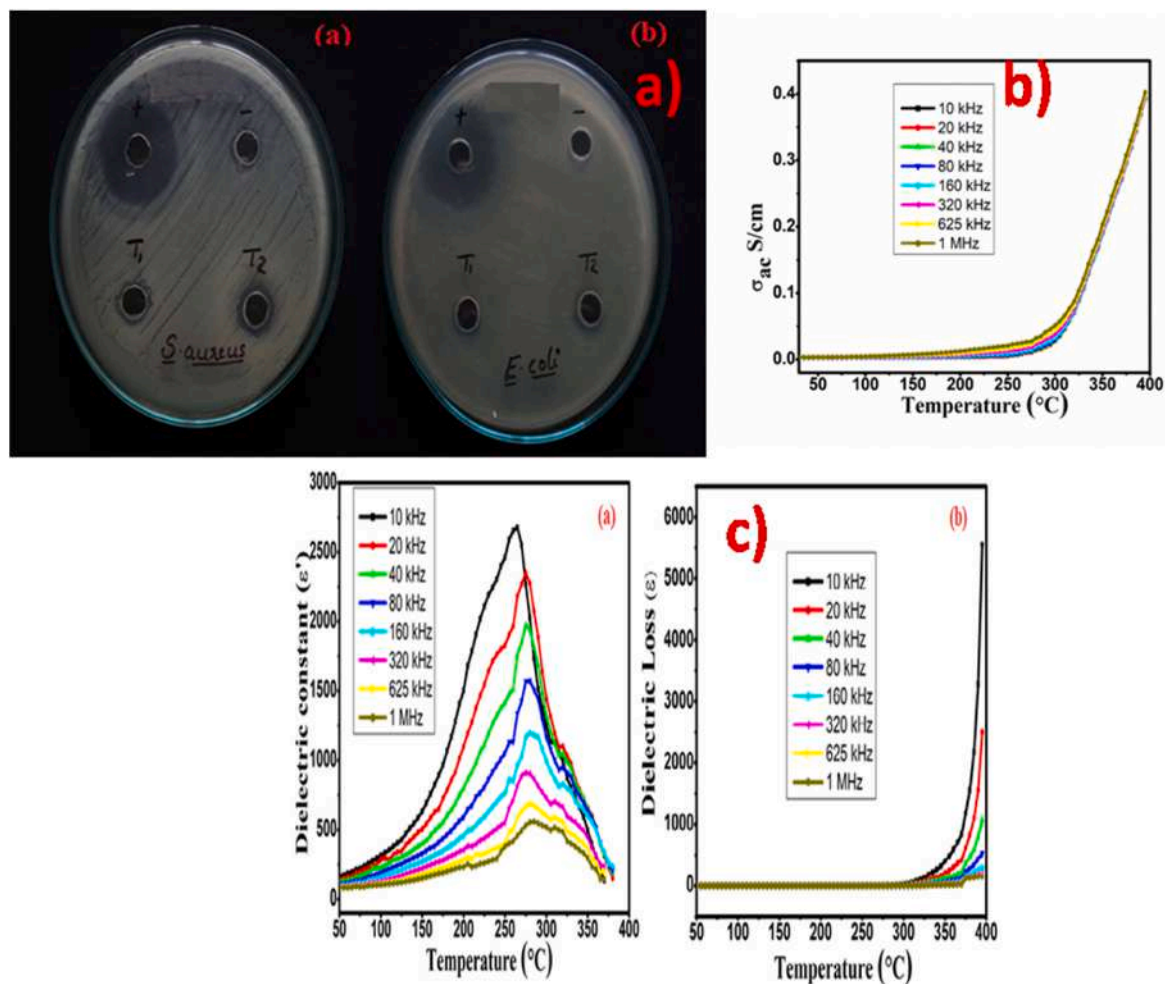


Fig. 6. a) antibacterial activity of Ag-TiO₂ nanofibers b) a. c conductivity spectra of Ag-TiO₂ nanofibers (NFs) and c) Dielectric properties of Ag-TiO₂ nanofibers (NFs).

amount of accessible surface area for interaction. As the particles' size rises, the surface O_2^- also concentration increases, resulting in a more efficient breakdown of the bacteria's cell wall and cytoplasmic membrane. Antibacterial activity is affected by the size and shape of the particles produced. Because of this, the nanocomposite made seems to be good for treating wastewater and biomedical uses. When compared to *Aureus* the gram negative *E-Coli* bacteria result higher zone of inhibition. Hence the prepared nanofibers are highly applicable for wood dressing and food packaging etc.

3.11. Dielectric properties

Fig. 6 (c) illustrate Ag-TiO₂ nanofibers (NFs) dielectric characteristics. Using a hydraulic pressure pellet under high pressure, the pellets were created. At various temperatures, the change in dielectric loss values is measured using frequencies ranging from 10 Hz to 1 MHz. A material's dielectric properties depend on its grain boundaries, grain size, charge carriers, charge orientations, temperature, the outside frequency, and how the experiment is done. Dielectric constant

$$\epsilon' = \frac{Cd}{\epsilon_0 A} \quad (10)$$

where, C_p -capacitance, t -thickness, A -samples' area, ϵ_0 -permittivity of free space ($\epsilon_0 = 8.85 \times 10^{-12}$ F/m) Sharma et al. (2015).

Dielectric loss or permittivity is obtained from the value of the dissipation factor

$$D = \frac{\epsilon''}{\epsilon'} \quad (11)$$

$$\epsilon'' = D \times \epsilon' \quad (12)$$

where D is the Dissipation factor, ϵ' is the Dielectric constant Suresh (2014).

As can be seen in Fig. 6 (c), the constant dielectric experiences an exponential decline with increasing frequency up to the point when it reaches a value that is almost constant in the high-frequency region. Results indicate that the dielectric constant values vary concerning temperature. Due to the frequency of electric charge carriers, dielectric constant values decrease with frequency; impurities, crystal flaws, and crystalline size result in greater dielectric loss factors at lower frequencies. When the quantity of nano-Ag in a composite is modest, it can be evenly dispersed to form many Coulomb islands, impeding electron transit and decreasing interfacial polarization. For higher temperatures, the space charge polarization is predominant. All four polarizations are present at low frequencies, so the dielectric constant value is high.

In contrast, these polarizations' progressive loss of significance at higher frequencies may account for their low value Jadhav and Biswas (2016). Positive and negative charges move towards the positive and negative electric field poles, respectively, when Ag-TiO₂ pellets are subjected to an external electric field. So, space-charge polarization happens at the Ag-TiO₂ surfaces, making nanocomposites with a much higher dielectric constant.

3.12. AC conductivity

The AC electrical conductivity were measured with different temperature. AC conductivity of Ag-TiO₂ nanofibers (NFs) was calculated using the formula

$$\sigma_{ac} = \omega \epsilon_0 \epsilon' \tan \delta \quad (13)$$

where ϵ_0 -permittivity of free space ($\epsilon_0 = 8.85 \times 10^{-12}$ F/m), ω -angular frequency. Fig. 6 (b) Illustrates the temperature-dependent AC conductivity of Ag-TiO₂ nanofibers (NFs). The conductivity (σ) was shown to increase with increasing temperature Kumar et al. (2017). Crystalline size, grain and grain borders, surface-to-volume ratio, and

nanocomposite structure determine AC conductivity. Thus, the composite material may be used in nanodevices, optoelectronics, and spintronic.

4. Conclusion

Using a hydrothermal technique effectively produced Ag-TiO₂ nanofibers (NFs). The Ag-TiO₂ nanofibers (NFs) XRD pattern reveals the FCC structure of silver and the anatase phase of TiO₂. From SEM investigation, nanofiber-shaped morphology was observed. The UV spectra of nanocomposites reflect their optical activity. For a 0.02 mg/mL concentration of catalyst, Ag-TiO₂ nanofibers (NFs) have a maximum degradation efficiency of 94%. The increase in photo-degradation efficiency may be attributable to a reduction in crystalline size, particle size, e^- and h^+ recombination rates, and other factors. The antibacterial activity of Ag-TiO₂ nanofibers (NFs) is efficient against gram positive and gram-bacteria. So, the Ag-TiO₂ nanofibers (NFs) can be used in electrical, biological, and wastewater treatment applications.

Author contribution

M.A, A.N: Writing – original draft S.A; Data curation T.S; Revising; Reviewing and Editing, A.A, R.A.A, M.S.S.M; Data Collection; M.S; Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

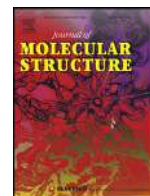
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Structural, Hirshfeld surface analysis, third order non-linear optical and molecular modelling of imidazolium glutarate single crystals for optical applications

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ABSTRACT

The Imidazolium glutarate (IMGA) single crystal was grown using a low-temperature solution growth method. The title crystal belongs to the triclinic crystal structure with space group P1. ¹³C and ¹H nuclear magnetic resonance spectra were recorded to evaluate the environment of the title compound. The grown crystal (2 0 2) was orientated using powder X-ray diffraction (XRD) studies. The vibrational modes present in the title compound were confirmed through Fourier transform infrared (FT-IR) and FT-Raman spectral studies. The IMGA crystal is stable up to 150 °C and material weight loss occurs between 150 and 258 °C. The UV-Vis-NIR studies show that 75% transmission in the entire visible region. The crystals' dielectric loss and constant were calculated as a function of frequency. Intermolecular interactions and fingerprint plots of the IMGA were executed by the Hirshfeld Surface (HS) analysis. The theoretical non-linear optical (NLO) properties like first-order hyperpolarizability and dipole moment have been studied. The 3rd order NLO susceptibility and related parameters have been studied by Z-scan measurement.

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1. Introduction

Organic materials are more attractive and versatile in the field of molecular optoelectronics [1,2]. The interactions between the molecules in organic compounds provide electrical, conducting, and optical properties [3]. Organic crystals have the significant advantage of being able to be modified according to our demands in terms of material qualities and chemical structure. The molecules in the crystal structure of the imidazolium-based dicarboxylic crystals form hydrogen-bonded chains, with strong N-H...O hydrogen bonds connecting the imidazolium cations and strong O-H...O type connections connecting the carboxylate anions [4,5]. Both kinds of chains self-assemble into layers or a supramolecular network. Imidazole is a critically important nitrogen heterocycle with unique biological and NLO characteristics [6,7]. Because of its chemical structure, imidazole can act as both a weak acid and a base, it serves as a proton transfer agent in living systems. Horike et al. [8], have achieved a significant improvement in proton conductivity

in a metal-organic framework (MOF)-based compound by using the proton donor-accepter capacities and rotational motions of a type of heterocyclic imidazole molecule. In addition, MacDonald et al. [9], Fuller et al. [10], and K. Pogorzelec-Glaser et al. [11] have produced anhydrous entirely organic proton conductors that are hydrogen-bonded (H-bonded). The structure of imidazolium glutarate (IMGA) and its electrical properties have been reported by Pogorzelec-Glaser et al. [11]. However, theoretical research can be useful in understanding the relationship between structure and property, which can help in the development of NLO properties. Using the Gaussian 09 w software, the molecular electrostatic potential (MEP), highest occupied molecular orbital and lowest unoccupied molecular orbital (HOMO-LUMO), hyperpolarizability, natural bond orbital (NBO) of the IMGA molecule have been determined [12]. The relationship between structure and NLO properties of imidazolium-based organic single crystals such as imidazolium hydrogen succinate [13], imidazolium L-tartrate [14], imidazolium diphenylacetate diphenylacetic acid [15] and 2ethylimidazolium D-tartrate [16] have been studied both experimental and theoretical. In this point of view, the title compound was studied both experimental (single crystal XRD, powder XRD, FT-IR, FT-Raman, etc.) and theoretical (optimized structure, HOMO-LUMO, NBO,

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Fig. 1. As grown IMGA single crystal.

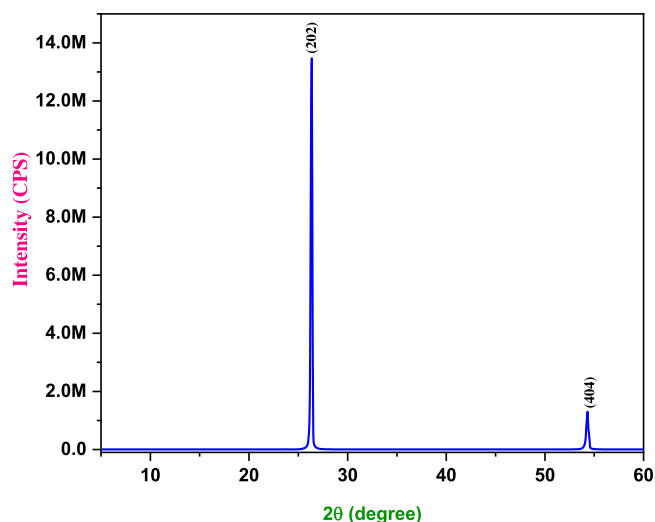


Fig. 3. Powder XRD pattern took along (1 0 1) plane of the IMGA crystal.

MEP, etc.). The obtained results are discussed in the forthcoming sessions.

2. Materials and methods

2.1. Growth of IMGA crystal

IMGA was synthesized by the reaction between imidazole (6.808 g, Merck) and glutaric acid (13.212 g, Loba chemical) taken in a 1:1 ratio. The calculated amount of glutaric acid was slowly added to a saturated aqueous solution of equimolar imidazole at room temperature to prepare the growth solution. A magnetic stirrer was used to thoroughly agitate the supersaturated solution for three hours at room temperature, producing a homogeneous mixing of the solution. Then the solution was filtered twice using a Whatman filter paper and put into a beaker covered with a thin polythene cover to reduce the rate of evaporation. Tiny crystals have been formed on the bottom of the beaker due to spontaneous nucleation. The purity and size of the crystal were improved by two times recrystallization processes. After 30 days, an optically

transparent good quality IMGA crystal of size $15 \times 10 \times 2.5$ mm³ was obtained. Fig. 1 shows the as-grown crystal of IMGA.

2.2. Computational details

The Hirshfeld surface and related fingerprint analysis were performed by CRYSTAL EXPLORER 3.1 [17]. The Gaussian 09 W programme has been used to do the quantum chemical computation (gas phase) of the IMGA using the Becke-3-Lee-Yang-Parr (B3LYP) level of theory [18] supplemented with the standard 6-311++G(d,p) basis set [19,20]. The GAUSSIAN 09 W package was used to determine the geometrical parameters, including energy, band gap, bond angle, dihedral angle, and atomic charges of the title molecule. The Gauss View 5.0 application [21] was used to display the optimized geometry. As a result, the B3LYP/6-311++G(d,p) basis set was used to generate the Mulliken atomic charge (MAC) distribution, HOMO-LUMO, MEP, and first-order hyperpolarizability, which were then viewed using the Gauss View 5.0 program. The title molecule's NBO analysis was computed using the NBO 3.1 programme [22].

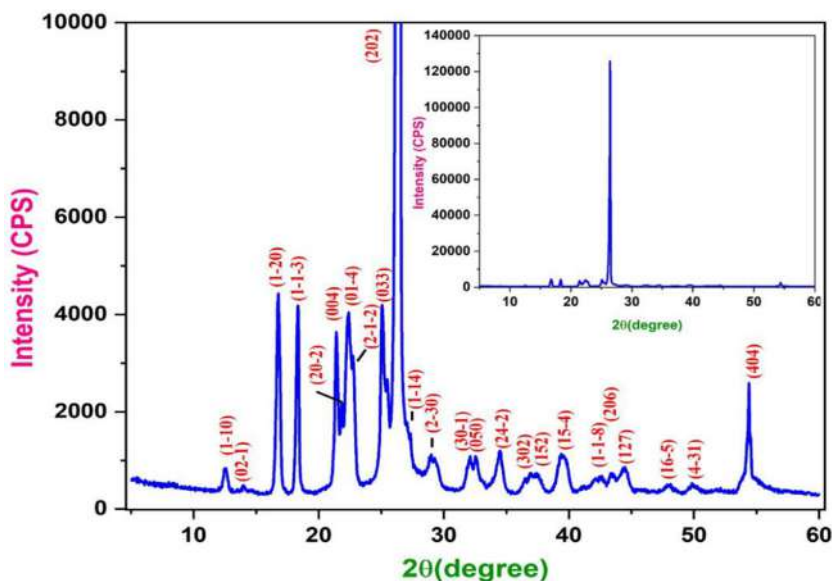


Fig. 2. Enlarged powder XRD pattern and observed powder XRD pattern of IMGA crystal.

Table 1
Observed lattice parameters of IMGA crystal.

Parameters	Single Crystal XRD (Present study)	Reported Data [7]
Crystal structure	Triclinic	Triclinic
a	8.34 Å ± 0.05	8.420 Å (2)
b	13.56 Å ± 0.08	13.685 Å (3)
c	16.97 Å ± 0.09	17.068 Å (3)
α	90.53° ± 0.09	90.62° (3)
β	103.59° ± 0.20	103.45° (3)
γ	91.17° ± 0.14	91.03° (3)
Volume (Å ³)	1890 ± 30	1912.2 (7)

3. Result and discussions

3.1. X-ray diffraction (XRD) analysis

The IMGA crystal was subjected to single crystal X-ray diffraction (SCXRD) technique using SAINT (APEX II) and SHELXTL software for frame Integration and structure solution and refinement, respectively. It reveals that IMGA crystallizes in the triclinic system with space group P1. The observed lattice parameters (Cell lengths, angles, and volume) are given in Table 1. It is in good agreement with the reported data [11]. The powder and as-grown IMGA crystal were subjected to powder XRD (PXRD) analysis using the Empyrean X-ray Diffractometer technique. The observed PXRD pattern of powdered IMGA is shown in Fig. 2. This figure shows that (202) plane intensity is very high (~128,000 CPS) compared to other planes. The sharp high intensity plane indicates the crystalline quality is good. The enlarged PXRD pattern and indexed (hkl) planes of IMGA crystal are shown in Fig. 2.

Basically, the crystals are anisotropic in nature, it gives different optical and electrical parameters for different planes or directions. In this point of view, the grown crystal top surface plane was identified using the same PXRD configuration. The PXRD diffraction pattern of the (101) plane of IMGA crystal is shown in Fig. 3. The crystal's PXRD intensity is very high compared to the powdered sample's PXRD intensity. Fig. 3 indicates the order of (101) planes such as (202) and (404) planes and the corresponding 2θ values are 26.36° and 54.35°, respectively. The observed planes and 2θ values (Fig. 3) are well-matched in powder sample XRD lower angle 2θ values (Fig. 2).

3.2. FT-NMR studies

The ¹H NMR (500.23 MHz) and ¹³C NMR (125.78 MHz) spectra of the IMGA crystal were recorded using a 500 MHz FT NMR Spectrometer (BRUKER AVIII 500) in DMSO as solvent. The ¹H and ¹³C NMR spectra show the signals due to various protons and carbons as shown in Figs. 4 and 5, respectively. Fig. 4, the strong signal due to imidazolium ring two symmetric protons appears in the region at 7.02 to 7.03 ppm. The COOH proton occurs at 7.659 ppm. The -CH protons in the glutarate moiety appear in the region of 1.72 to 2.25 ppm [23]. Fig. 5, the two symmetric -CH carbon present of the imidazolium moiety, which causes the signal at 122.06 ppm. The peak at 135.58 ppm occurs in the spectra due to the peak for -CH carbon, which is located between two NH groups of the imidazolium moiety [24]. The peak at 174.5 ppm occurs in the spectra due to the two symmetric carbonyl carbon presence of glutarate moiety. The presence of other protons and carbons is given in Table 2. Between two NH groups of the imidazolium

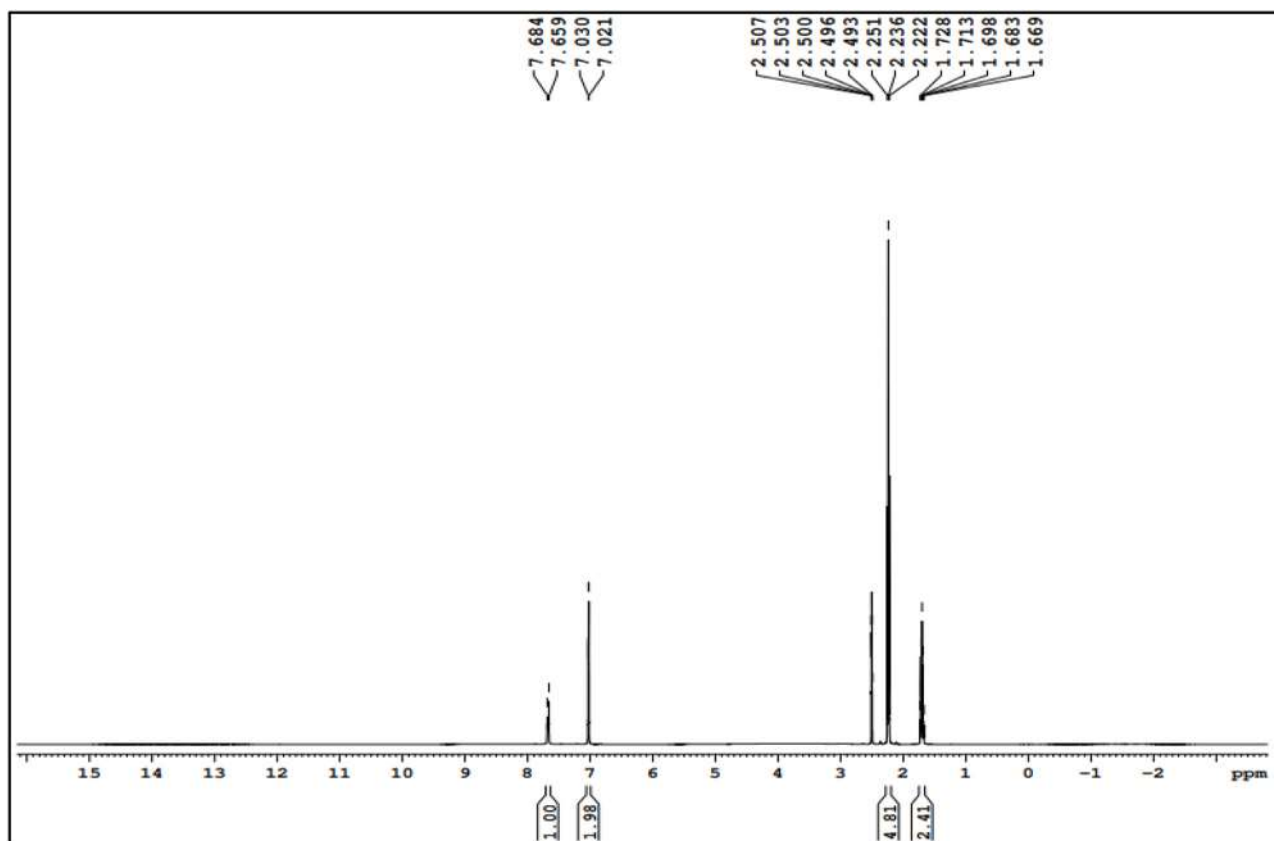


Fig. 4. ¹H NMR spectrum of IMGA crystal.

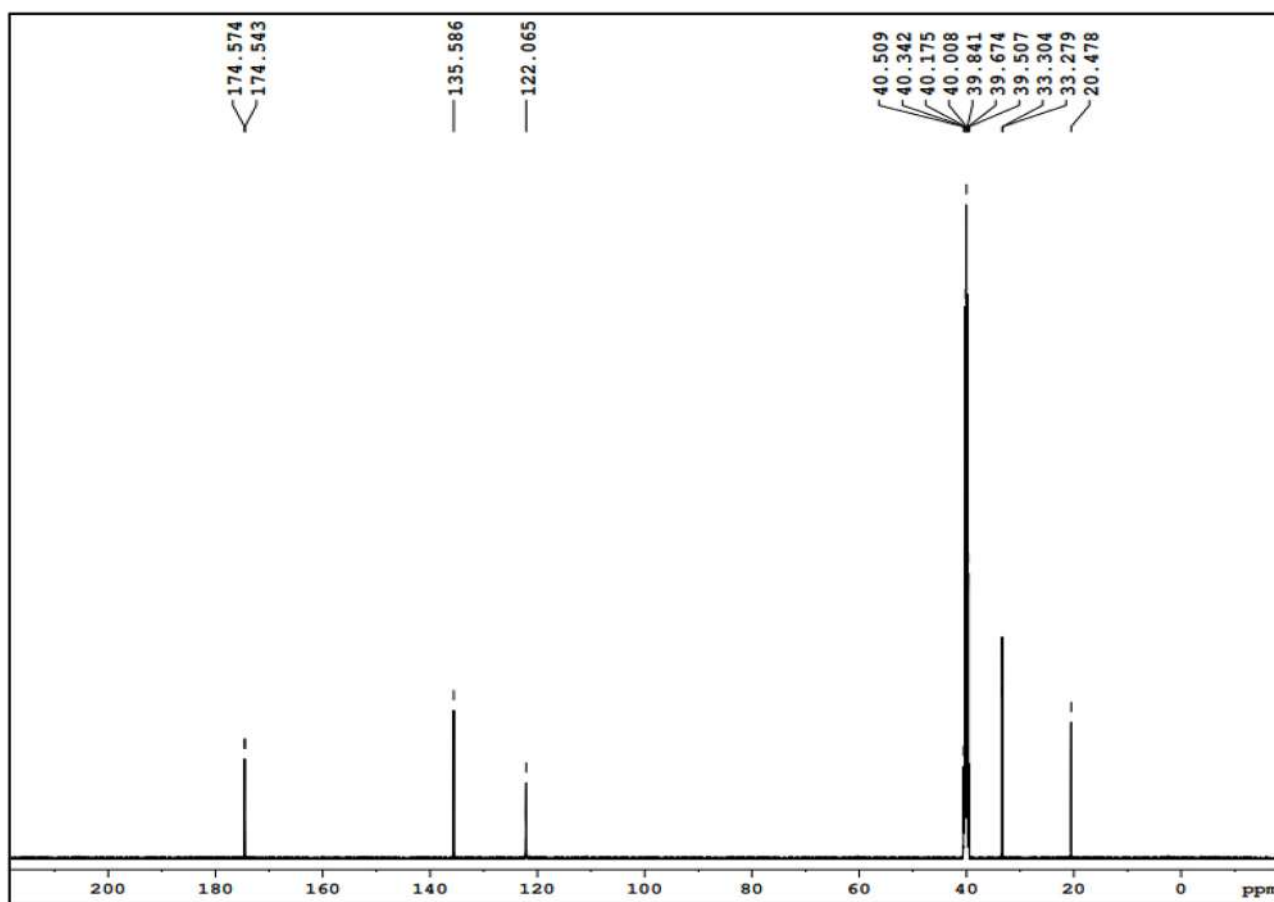


Fig. 5. ^{13}C NMR spectrum of IMGA crystal.

Table 2

Experimental ^1H & ^{13}C NMR chemical shift of IMGA crystal.

Atoms	^{13}C NMR (ppm)	Atoms	^1H NMR (ppm)
5C	20.478	10H	2.251
6C	33.279	11H	1.698
7C	174.543	12H	2.236
8C	20.478	13H	1.713
9C	33.304	14H	2.222
19C	135.586	15H	1.728
20C	122.065	16H	7.659
21C	122.065	22H	7.030
		23H	1.683
		24H	7.684
		25H	7.021
		26H	1.669

moiety, there is a peak for $-\text{CH}$ carbon, which is what causes the peak at 135.58 ppm.

3.3. FTIR and FT-Raman studies

The recorded FTIR and FT-Raman spectrum of the IMGA compound are shown in Figs. 6 and 7, respectively. The standard organic spectroscopy literature is used to assign the observed vibrational modes [25,26]. Table 3 lists the IMGA compound's observed vibrational modes and assignments. The $\text{O}-\text{H}$ bending modes (in the plane and out of the plane) of the carboxylic acid group [27] are observed at 1412 and 911 cm^{-1} in FTIR and 1420 and 910 cm^{-1} in FT-Raman, respectively. The aromatic $\text{C}-\text{H}$ bending modes (in the plane and out of plane) of the imidazole ring are observed at 1095 and 775 cm^{-1} in FTIR and

1094 and 775 cm^{-1} in FT-Raman, respectively. The presence of the NH^+ stretching mode of the tertiary amine salt is responsible for the peak at 2970 cm^{-1} in FTIR and 2930 cm^{-1} in FT-Raman. The presence of COO^- asymmetric and symmetric stretching modes of the carboxylate group are responsible for the peaks at 1680 and 1315 cm^{-1} in FTIR and 1685 and 1302 cm^{-1} in FT-Raman, respectively. The formation of the title compound's molecular structure reveals the existence of an amine salt (NH^+) and a carboxylate group (COO^-). Herewith the important vibrational modes are discussed, and the other vibrational modes are given in Table 3.

3.4. Hirshfeld surface (HS) analysis

The idea behind HS came from an effort to define the area a molecule takes up in a crystal to divide the crystal's electron density into molecular units of electron density. The two distances d_i , the distance from the HS to the closest nucleus inside the surface, and d_e , the distance from the HS to the closest nucleus outside the surface on HS, were compared to create fingerprint plots [28,29]. The d_{norm} surface exhibits either negative or positive values, when compared to the total of the van der Waals radii, depending on the length of intermolecular interaction. The SCXRD data (CIF file) were subjected to HS analysis using Crystal Explorer 3.1 [30]. Fig. 8a and b display the HS plotted over the d_i and d_e properties in the range of 0.569 Å (red) to 2.343 Å (blue) and 0.571 Å (red) to 2.380 Å (blue), respectively. Fig. 8c displays the HS plotted over the d_{norm} property in the range of -0.861 Å (red) to 1.063 Å (blue). Intermolecular interactions (IMIs) are shown through colour coding. Intermolecular interactions with distances

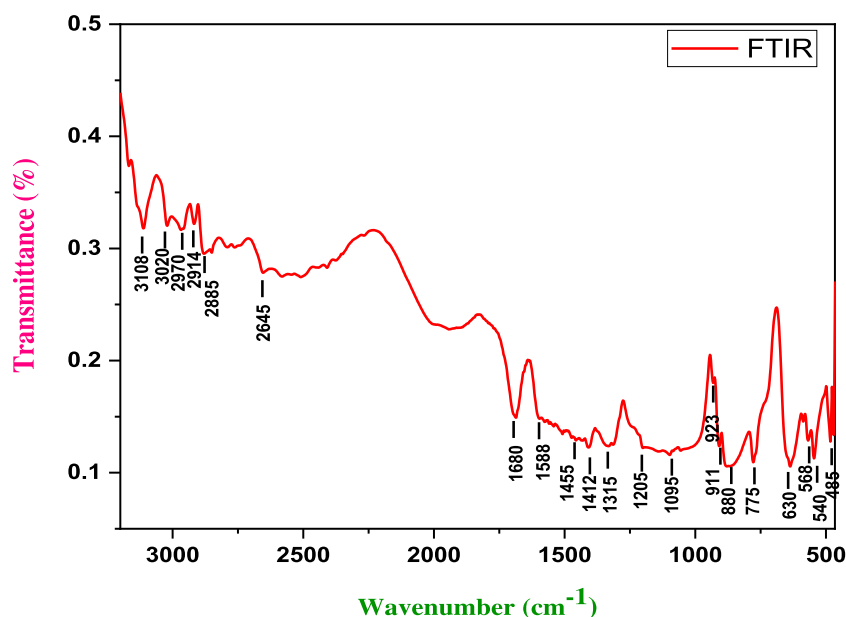


Fig. 6. FT-IR Spectrum of IMGa crystal.

Table 3

FTIR and FT-Raman vibrational assignment of IMGa crystal.

Wavenumber (cm ⁻¹)		Mode of vibrations	Assignments
FTIR	FT-Raman		
3108	-	N-H stretching	Presence of amine group
3020	-	Aromatic C-H stretching	Presence of imidazole ring
2970	2930	NH ⁺ stretching	Presence of tertiary amine salt
2914	-	C-H stretching	Presence of tertiary C-H group
2885	2885	C = O stretching	Presence of carboxylic acid group
1680	1685	COO ⁻ asymmetric stretching	Presence of carboxylate group
1588	1590	C-N stretching	Presence of imidazole ring
1455	1450	N-H in plane bending	Presence of amine group
1412	1420	C-O stretching and O-H in plane bending (coupled)	Presence of carboxylic acid group
1315	1302	COO ⁻ symmetric stretching	Presence of carboxylate group
1205	1230	C-O stretching	Presence of hydroxyl group
1095	1094	Aromatic C-H in plane bending	Presence of imidazole group
911	910	O-H in plane bending	Presence of carboxylic acid group
775	775	Aromatic C-H out of plane bending	Presence of imidazole group
630	630	O-H out of plane bending	Presence of hydroxyl group

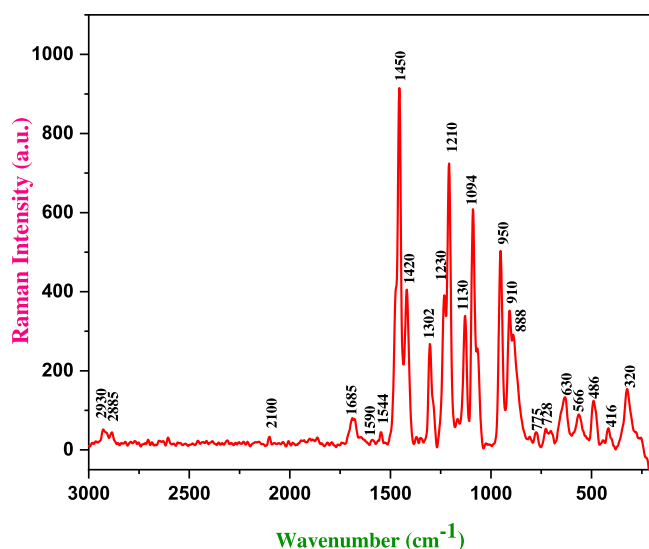


Fig. 7. FT-Raman Spectrum of IMGa crystal.

smaller than, equal to, and greater than van der Waal radii are indicated by the red, white, and blue marks, respectively [31,32]. Large circular depressions (deep red) that are suggestive of hydrogen bonding connections can be seen on the d_{norm} surfaces, while additional visible spots are caused by H $\cdots$ H contacts. HS plots of the hydroxyl O-H and carbonyl O atom in 1 may be seen as the bright red area in Fig. 8c indicating the dominant interactions between these two atoms. C-H $\cdots$ O interactions are the cause of the title compounds' light red spots. For each interatomic contact and all interactions, 2D fingerprint plots are generated. When calculating individual interatomic distances, contacts, as well as each interatomic contact's reciprocal contact.

The 2D fingerprint plot for overall interactions is shown in Fig. 9. The dominant IMIs of the total HS for IMGa molecule are H $\cdots$ H (36.6%) interactions. For each molecule, the proportions of O $\cdots$ H and H $\cdots$ O interactions contribute 52.1% of the total HS. The other IMIs are given in Fig. 9. Fig. 8d and e display the HS plotted over the shape index and curvedness surfaces. The curvedness surface clearly shows a flat zone toward the bottom of both sides of the molecules, indicating the presence of π - π stacking [33]. On the surface, this feature looks like a rather flat green area with extremely comparable contact distances.

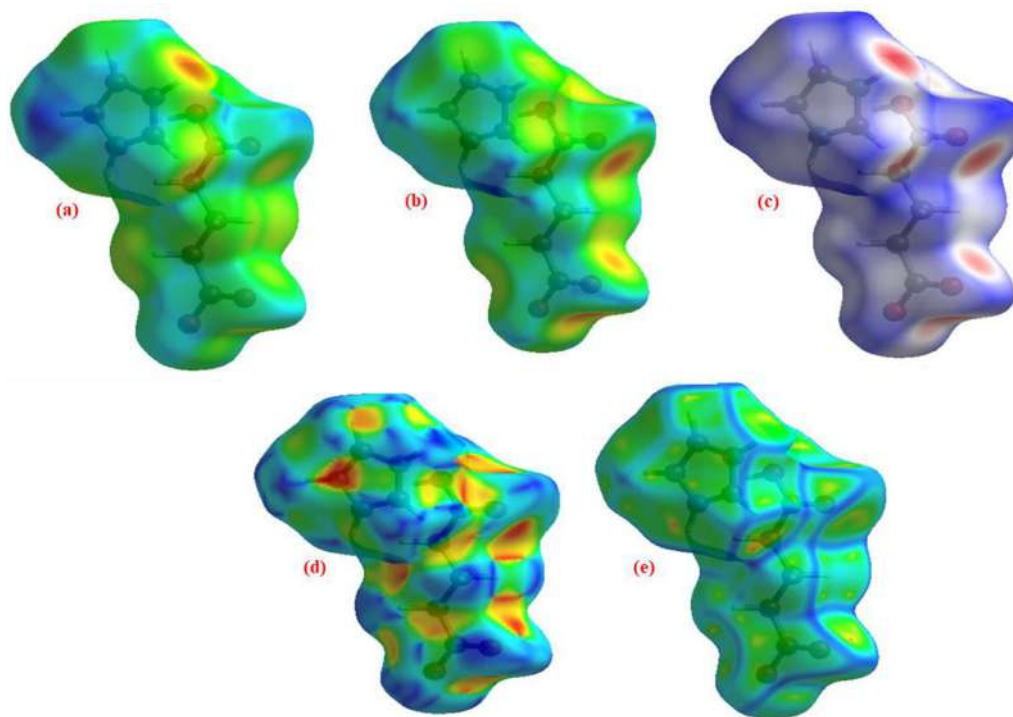


Fig. 8. 3D Hirshfeld surfaces of IMGA molecule (a) d_i (b) d_e (c) d_{norm} (d) Shape index and (e) Curvedness.

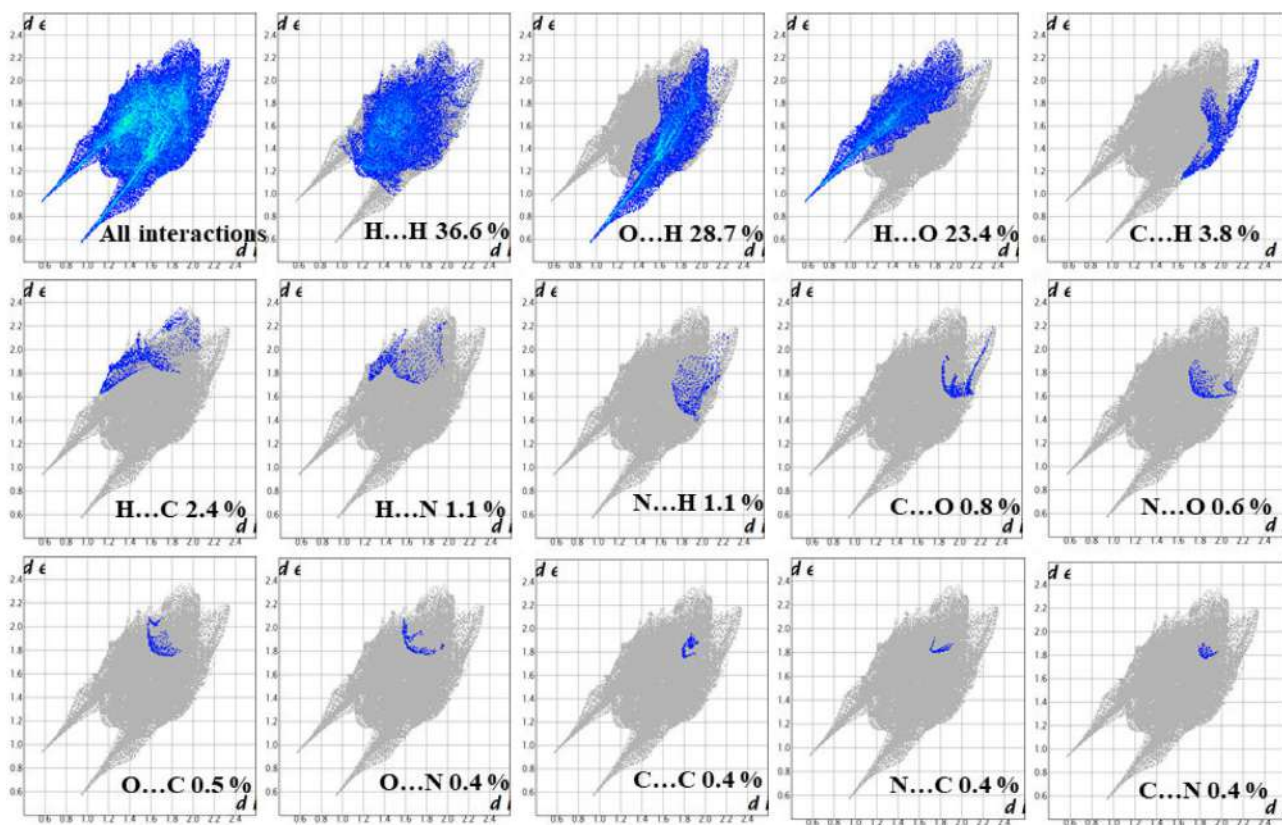


Fig. 9. 2d fingerprints plots of IMGA molecule.

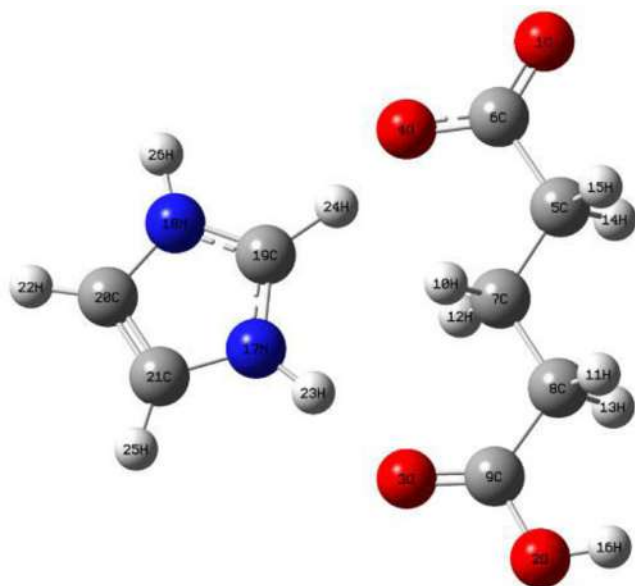


Fig. 10. Optimized structure of IMGA molecule.

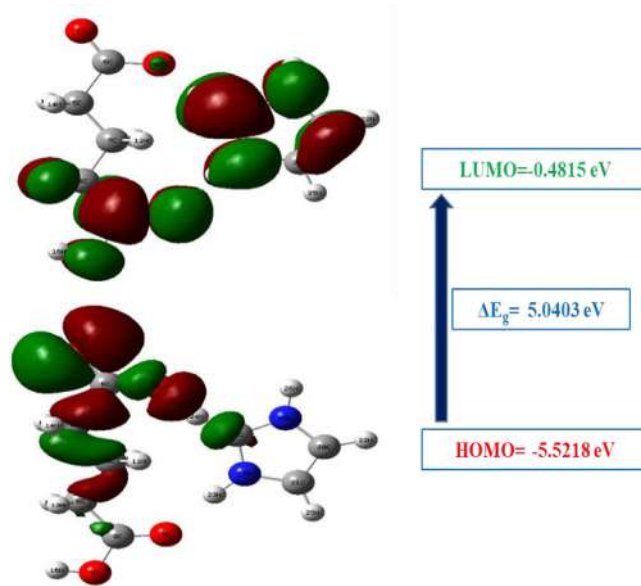


Fig. 11. HOMO-LUMO energy diagram of IMGA molecule.

3.5. Optimal geometry analysis

Fig. 10 displays the IMGA's optimal geometry as computed by the B3LYP approaches with atom numbering. Table 4 shows the optimized bond lengths and bond angles of the IMGA compound as determined using ab-initio DFT(B3LYP) technique using the 6-311++G(d,p) basis set. The majority of the optimal bond lengths in Table 4 are slightly longer than the experimental values. Because the actual results are based on molecules in the solid state and the theoretical calculations are based on isolated molecules in the solid phase [34].

The optimized C–C bond lengths for IMGA using DFT/B3LYP fall in the range of 1.362–1.532 Å, while the experimental C–C bond lengths fall in the range of 1.361–1.562 Å. The C₁₉–N₁₇ and C₂₁–N₁₇ bond lengths in the imidazole ring are found to be varied from 1.3408 to 1.3842 Å in B3LYP, demonstrating that the boundary between single and double bonds inside the ring is present due to electron conjugation. The C–H bond lengths determined from the theoretical values range between 1.097 and 1.099 Å, while the experimental value is between 0.955 and 0.990 Å. This greater variation in C–H bond lengths may be brought on by the X-ray diffraction studies' low scattering coefficients for hydrogen atoms, which are not taken into account in theoretical models [35]. All the C–C–C bond angles (C₇–C₈–C₉, C₅–C₇–C₈, and C₆–C₅–C₇) in glutarate are around 114° in the experimental and 115° in B3LYP. The angles of C₁₉–N₁₈–C₂₀ and C₁₉–N₁₇–C₂₁ are 111.082° and 110.755° in B3LYP and 109.15° and 109.28° in experimental, respectively. Herewith the important optimized structural parameters are discussed and other structural parameters are given in Table 4.

3.6. Frontier molecular orbitals

Understanding the electrical and optical properties of organic molecules depends heavily on the study of frontier molecular orbitals [36,37]. The stabilization of the bonding molecular orbital increases with an increase in the overlap of the two orbitals. In a similar vein, the antibonding's instability also increases [38]. The HOMO and LUMO orbitals, which combine to form one orbital, are two significant orbitals that are involved in molecule interaction. Using the B3LYP/6-311++G(d,p) level to determine the HOMO-LUMO energy gap of IMGA, it was found that the energy gap rep-

resents the chemical activity of the molecule. The ability to receive an electron is represented by LUMO as an electron acceptor, and the ability to give an electron is represented by HOMO. Fig. 11 depicts the distributions and energy levels of the HOMO and LUMO orbitals for the gas phase IMGA molecule. The imidazole ring and half of the glutarate portion are where the charge density is primarily accumulated. But in the case of the LUMO, in the case of LUMO, more charge density moves to the glutarate moiety. The computed HOMO-LUMO energy gap ΔE_g is 5.0403 eV. The GCRD properties such as electronegativity (χ), chemical potential (μ), global hardness (η), electrophilicity index (ω) formulas, and calculated values are given in Table 5. The quantitative structure-property, structure-activity/toxicity analysis uses the global chemical reactivity descriptor (GCRD) values to determine chemical reactivity and permanence [39].

3.7. Mulliken atomic charges

Applying DFT calculations to molecular systems, the determination of atomic charges is crucial [40]. The Mulliken atomic charges (MAC) of a single IMGA molecule are computed using the B3LYP level of theory and the 6-311++G(d,p) basis set. Table 6 displays the MAC on the constituent atoms of the IMGA molecule. The carbon atoms C₁₉, C₂₀, and C₂₁ are positive within the imidazole ring due to the attraction of the electronegative nitrogen atom. In Fig. 12, the carbon atoms C₆, and C₉ are positive within the glutarate moiety, whereas other carbon atoms are negative. This is caused by the electronegative oxygen atom, which attracts the positive charge from the carbon atoms. All of the hydrogen atoms have a net positive charge, as seen in Table 6. Additionally, MACs indicate that the N–H group of hydrogen atoms, which is connected to an N atom, has a larger positive atomic charge than the other hydrogen atoms. This is caused by the electronegative nitrogen atom, which attracts the positive charge from the hydrogen atoms [41].

3.8. Molecular electrostatic potential (MEP) analysis

For studying and predicting molecular reactive behaviour, the electrostatic potential formed in the area around a molecule by its nuclei and electrons (considered as static distributions of charge)

Table 4
Optimized geometric parameters of IMGA molecule.

Bond Length	Cal. Values (Å)	Exp. Values (Å)	Bond Angle	Cal. Values (°)	Exp. Values (°)	Dihedral Angle	Cal. Values (°)	Exp. Values (°)
O ₁ -C ₆	1.231	1.274	C ₉ -O ₂ -H ₁₆	110.017	112.90	H ₁₆ -O ₂ -C ₉ -O ₃	-179.994	179.52
O ₂ -C ₉	1.349	1.295	C ₉ -O ₃ ...H ₂₃	135.590	135.39	H ₁₆ -O ₂ -C ₉ -C ₈	0.0066	-0.47
O ₂ -H ₁₆	0.968	1.042	C ₆ -O ₄ ...H ₂₄	138.063	135.44	H ₂₃ -O ₃ -C ₉ -O ₂	180.029	176.70
O ₃ -C ₉	1.217	1.229	C ₆ -C ₅ -C ₇	115.197	114.12	H ₂₃ -O ₃ -C ₉ -C ₈	0.028	-2.28
O ₃ ...H ₂₃	1.810	1.878	C ₆ -C ₅ -H ₁₄	107.264	106.12	C ₉ -O ₃ -H ₂₃ -N ₁₇	179.959	-161.28
O ₄ -C ₆	1.288	1.247	C ₆ -C ₅ -H ₁₅	107.264	105.40	H ₂ -O ₄ -C ₆ -O ₁	-179.999	-178.70
O ₄ ...H ₂₄	1.442	2.250	C ₇ -C ₅ -H ₁₄	110.891	111.74	H ₂₄ -O ₄ -C ₆ -C ₅	0.0017	-1.34
C ₅ -C ₆	1.562	1.510	C ₇ -C ₅ -H ₁₅	110.894	109.83	C ₆ -O ₄ -H ₂₄ ...C ₁₉	179.998	169.55
C ₅ -C ₇	1.525	1.531	H ₁₄ -C ₅ -H ₁₅	105.901	107.31	C ₇ -C ₅ -C ₆ -O ₁	179.984	-172.64
C ₅ -H ₁₇	1.097	1.095	O ₁ -C ₆ -C ₄	126.760	122.26	C ₇ -C ₅ -C ₆ -O ₄	-0.0165	6.58
C ₅ -H ₁₅	1.097	0.990	O ₁ -C ₆ -C ₅	116.386	116.90	H ₁₄ -C ₅ -C ₆ -O ₁	-56.713	-47.95
C ₇ -C ₈	1.527	1.515	O ₄ -C ₆ -C ₅	116.852	120.83	H ₁₄ -C ₅ -C ₆ -O ₄	123.285	131.27
C ₇ -H ₁₀	1.0951	0.993	C ₅ -C ₇ -C ₈	115.451	114.73	H ₁₅ -C ₅ -C ₆ -O ₁	56.679	65.69
C ₇ -H ₁₂	1.0951	0.989	C ₅ -C ₇ -H ₁₀	108.769	108.65	H ₁₅ -C ₅ -C ₆ -O ₄	-123.322	-115.09
C ₈ -C ₉	1.5189	1.511	C ₅ -C ₇ -H ₁₂	108.765	113.02	C ₆ -C ₅ -C ₇ -C ₈	179.998	176.24
C ₈ -H ₁₁	1.0997	0.954	C ₈ -C ₇ -H ₁₀	108.352	108.55	C ₆ -C ₅ -C ₇ -H ₁₀	-57.994	-64.64
C ₈ -H ₁₃	1.0997	1.008	C ₈ -C ₇ -H ₁₂	108.349	109.27	C ₆ -C ₅ -C ₇ -H ₁₂	57.997	53.26
N ₁₇ -C ₁₉	1.3408	1.324	H ₁₀ -C ₇ -H ₁₂	106.821	106.44	H ₁₄ -C ₅ -C ₇ -C ₈	58.680	58.683
N ₁₇ -C ₂₁	1.3842	1.369	C ₇ -C ₈ -C ₉	115.914	114.33	H ₁₄ -C ₅ -C ₇ -C ₁₀	-179.313	173.61
N ₁₇ -H ₂₃	1.0308	0.930	C ₇ -C ₈ -H ₁₁	111.033	110.77	H ₁₄ -C ₅ -C ₇ -H ₁₂	-63.32	-68.45
N ₁₈ -C ₁₉	1.3445	1.305	C ₇ -C ₈ -H ₁₃	111.030	108.32	H ₁₅ -C ₅ -C ₇ -C ₈	-58.682	-64.48
N ₁₈ -C ₂₀	1.3862	1.362	C ₉ -C ₈ -H ₁₁	107.854	108.35	H ₁₅ -C ₅ -C ₇ -H ₁₀	63.324	54.64
N ₁₈ -H ₂₆	1.0102	0.972	C ₉ -C ₈ -H ₁₃	107.852	108.08	H ₁₅ -C ₅ -C ₇ -H ₁₂	179.317	172.54
C ₁₉ -H ₂₄	1.1859	0.986	H ₁₁ -C ₈ -H ₁₃	105.831	105.51	C ₅ -C ₇ -C ₈ -C ₉	180.002	173.16
C ₂₀ -C ₂₁	1.3611	1.362	O ₂ -C ₉ -O ₃	118.148	120.16	C ₅ -C ₇ -C ₈ -H ₁₁	58.720	49.65
C ₂₀ -H ₂₂	1.0775	0.916	O ₂ -C ₉ -C ₈	116.475	115.85	C ₅ -C ₇ -C ₈ -H ₁₃	-58.73	-65.61
C ₂₁ -H ₂₅	1.0776	0.905	O ₃ -C ₉ -C ₈	125.376	123.99	H ₁₀ -C ₇ -C ₈ -C ₉	57.767	53.97
			C ₁₉ -N ₁₇ -C ₂₁	110.755	109.28	H ₁₀ -C ₇ -C ₈ -H ₁₁	-63.510	-69.53
			C ₁₉ -N ₁₇ -H ₂₃	123.684	122.74	H ₁₀ -C ₇ -C ₈ -H ₁₃	179.039	175.20
			C ₂₁ -N ₁₇ -H ₂₃	125.560	127.97	H ₁₂ -C ₇ -C ₈ -C ₉	-57.779	-61.72
			C ₁₉ -N ₁₈ -C ₂₀	111.082	109.15	H ₁₂ -C ₇ -C ₈ -H ₁₁	-179.057	174.78
			C ₁₉ -N ₁₈ -H ₂₆	122.295	127.61	H ₁₂ -C ₇ -C ₈ -H ₁₃	63.493	59.51
			C ₂₀ -N ₁₈ -H ₂₆	126.622	123.24	C ₇ -C ₈ -C ₉ -O ₂	-179.992	-176.71
			N ₁₇ -C ₁₉ -N ₁₈	105.569	108.06	C ₇ -C ₈ -C ₉ -O ₃	0.0083	2.30
			N ₁₇ -C ₁₉ -H ₂₄	129.823	125.60	H ₁₁ -C ₈ -C ₉ -O ₂	-56.930	-51.94
			N ₁₈ -C ₁₉ -H ₂₄	124.607	126.04	H ₁₁ -C ₈ -C ₉ -O ₃	123.070	127.07
			N ₁₈ -C ₂₀ -C ₂₁	105.867	107.26	H ₁₃ -C ₈ -C ₉ -O ₂	56.951	61.94
			N ₁₈ -C ₂₀ -H ₂₂	122.898	126.21	H ₁₃ -C ₈ -C ₉ -O ₃	-123.048	-119.05
			C ₂₁ -C ₂₀ -H ₂₂	131.234	126.55	C ₂₁ -N ₁₇ -C ₁₉ -N ₁₈	-0.003	-0.32
			N ₁₇ -C ₂₁ -C ₂₀	106.725	106.24	C ₂₁ -N ₁₇ -C ₁₉ -H ₂₄	-179.977	173.76
			N ₁₇ -C ₂₁ -H ₂₅	122.409	117.87	H ₂₃ -N ₁₇ -C ₁₉ -N ₁₈	180.008	179.01
			C ₂₀ -C ₂₁ -H ₂₅	130.865	135.71	H ₂₃ -N ₁₇ -C ₁₉ -H ₂₄	0.034	-6.92
			O ₃ ...H ₂₃ -N ₁₇	174.973	168.34	C ₁₉ -N ₁₇ -C ₂₁ -C ₂₀	0.003	0.53
			O ₄ ...H ₂₄ -C ₁₉	166.077	173.27	C ₁₉ -N ₁₇ -C ₂₁ -H ₂₅	179.999	176.46
						H ₂₃ -N ₁₇ -C ₂₁ -C ₂₀	-180.009	-178.75
						H ₂₃ -N ₁₇ -C ₂₁ -H ₂₅	-0.012	-2.82
						C ₁₉ -N ₁₇ -H ₂₃ ...O ₃	-180.019	167.39
						C ₂₁ -N ₁₇ -H ₂₃ ...O ₃	-0.005	-13.41
						C ₂₀ -N ₁₈ -C ₁₉ -N ₁₇	0.002	-0.03
						C ₂₀ -N ₁₈ -C ₁₉ -H ₂₄	179.977	174.07
						H ₂₆ -N ₁₈ -C ₁₉ -N ₁₇	179.998	179.76
						H ₂₆ -N ₁₈ -C ₁₉ -H ₂₄	-0.026	6.20
						C ₁₉ -N ₁₈ -C ₂₀ -C ₂₁	-0.0009	0.36
						C ₁₉ -N ₁₈ -C ₂₀ -H ₂₂	-180.004	179.94
						H ₂₆ -N ₁₈ -C ₂₀ -C ₂₁	-179.996	-179.90
						H ₂₆ -N ₁₈ -C ₂₀ -H ₂₂	0.0004	-0.31
						N ₁₇ -C ₁₉ -H ₂₄ ...O ₄	179.993	-168.86
						N ₁₈ -C ₁₉ -H ₂₄ ...O ₄	0.0243	4.37
						N ₁₈ -C ₂₀ -C ₂₁ -N ₁₇	-0.0012	-0.53
						N ₁₈ -C ₂₀ -C ₂₁ -H ₂₅	-179.998	-175.38
						H ₂₂ -C ₂₀ -C ₂₁ -N ₁₇	180.002	179.88
						H ₂₂ -C ₂₀ -C ₂₁ -H ₂₅	0.006	5.03

is a highly helpful property [42]. Fig. 13, shows that the MEP map of IMGA was obtained by DFT theory B3LYP/6-311++G(d,p) using Gaussian-09. The hydrophobic and hydrophilic components of the IMGA molecules are clearly visible in colour schemes. The hydrophilic sites, with negative carboxylate anions (red colour) and positively charged imidazolium cations (blue colour), may act as proton transport channels. Yellow colour depicts the region that is somewhat electron-rich and light blue depicts the region that

is slightly electron-deficient [43]. The optimum location for an electrophilic attack is shown in the picture where the maximum electron density is localized near the nitrogen atom. The activation energy for imidazolium glutarate is reported to be the lowest (0.7 eV) [11]. The unique stacking of imidazolium rings amongst acid molecules may be the cause of such a low value. This makes it possible to construct a variety of N-H...O contacts, which are essential to the conducting mechanism.

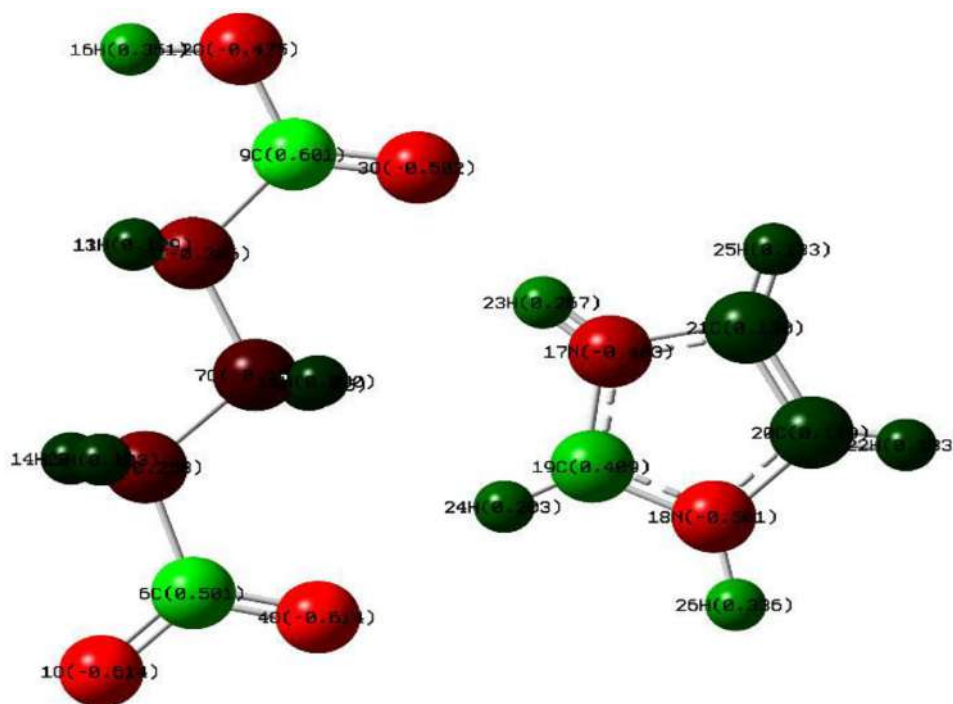


Fig. 12. Mulliken atomic charges of IMGA molecule.

Table 5

HOMO-LUMO and related global chemical reactivity descriptor properties of IMGA molecule.

Molecular properties	Mathematical description	Energy(eV)
E_{HOMO}	Energy of HOMO	-5.5218
E_{LUMO}	Energy of LUMO	-0.4815
Energy Gap	$\Delta E_g = E_{\text{HOMO}} - E_{\text{LUMO}}$	5.0403
Ionization Potential(IP)	$IP = -E_{\text{HOMO}}$	5.5218
Electron Affinity (EA)	$EA = -E_{\text{LUMO}}$	0.4815
Electronegativity (χ)	$\chi = -1/2(E_{\text{LUMO}} + E_{\text{HOMO}})$	3.0016
Chemical potential (μ)	$\mu = 1/2(E_{\text{LUMO}} + E_{\text{HOMO}})$	-3.0016
Global Hardness(η)	$\eta = 1/2(E_{\text{LUMO}} - E_{\text{HOMO}})$	2.5201
Softness (S)	$S = 1/2\eta$	0.1984
Electrophilicity index (ω)	$\omega = \mu^2/2\eta$	1.7875

Table 6

Mulliken atomic charges of IMGA molecule.

Atomic number	Mulliken atomic charge (atomic unit)	Atomic number	Mulliken atomic charge (atomic unit)
10	-0.613678	14H	0.099259
20	-0.475008	15H	0.102988
30	-0.501716	16H	0.351105
40	-1.260807	17N	-0.402936
5C	-0.614360	18N	-0.501291
6C	0.500762	19C	0.409086
7C	-0.162160	20C	0.118553
8C	-0.306131	21C	0.130269
9C	0.600581	22H	0.132886
10H	0.090273	23H	0.266825
11H	0.129468	24H	0.202609
12H	0.095012	25H	0.132585
13H	0.137162	26H	0.335592

3.9. NBO analysis

Donor and acceptor orbitals, electron delocalization, intermolecular charge transfer (ICT), and the discovery of hydrogen bonding are all potential interactions that can be discovered via NBO

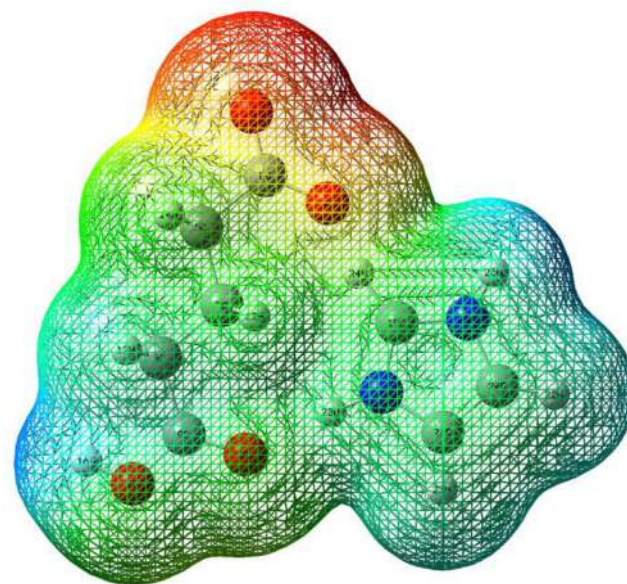


Fig. 13. MEP plot of IMGA molecule.

analysis [44,45]. The NBO computation of the IMGA molecule was evaluated from the NBO 3.1 software program. To determine the stable structure, it is possible to calculate the energy contributions from several orbitals, including LP, π , π^* , σ , and σ^* , as a result of electron delocalization and conjugative interactions. It has with the NLO response [46], the system's overall conjugation is stronger and the electrical flow from electron D-A is more intense when the $E(2)$ value is higher. The various Donor-Acceptor (D-A) interactions present in IMGA are given in Table 7. The maximum stabilization energy ($E(2)$) of 87.88 Kcal/mol corresponds to the delocalization of IMGA with the transfer of LP to $\pi^*(\text{O}-\text{C})$ within a carboxylate group that is due to strong intermolecular charge transfers

Table 7
Donor-acceptor interactions of IMGA molecule.

Donor (i)	Occupancy (e)	Acceptor (j)	Occupancy (e)	E(2) kcal/mol	E(j)-E(i) (a.u)	F(i,j) (a.u)
σ (C5 - C6)	1.98599	σ^* (C8 - C9)	0.06308	2.92	0.93	0.047
π (O1 - C6)	1.99374	π^* (O1 - C6)	0.36456	2.87	0.40	0.034
σ (C5 - H15)	1.97310	π^* (O1 - C6)	0.36456	3.41	0.64	0.046
σ (C7 - C8)	1.97846	σ^* (O2 - C9)	0.08346	3.57	0.97	0.053
σ (C8 - H11)	1.96882	σ^* (O3 - C9)	0.03201	3.73	1.14	0.058
LP(2) O1	1.88271	σ^* (O4 - C6)	0.05773	20.31	0.78	0.114
LP(2) O1	1.88271	σ^* (C5 - C6)	0.09359	17.73	0.59	0.092
LP(2) O2	1.79589	π^* (O3 - C9)	0.23339	52.42	0.36	0.123
LP(2) O3	1.86094	σ^* (O2 - C9)	0.08346	29.90	0.68	0.130
LP(2) O3	1.86094	σ^* (C8 - C9)	0.06308	14.72	0.68	0.091
LP(2) O4	1.87292	σ^* (O1 - C6)	0.06903	20.59	0.78	0.115
LP(2) O4	1.87292	σ^* (C5 - C6)	0.09359	16.55	0.63	0.092
LP(3) O4	1.62152	π^* (O1 - C6)	0.36456	87.88	0.29	0.143
LP(1) O3	1.97010	σ^* (N17 - H23)	0.02719	4.57	1.49	0.074
LP(2) O3	1.97010	σ^* (N17 - H23)	0.02719	5.06	1.08	0.068
π (N17 - C19)	1.90007	π^* (C20 - C21)	0.25088	19.61	0.38	0.080
σ (N17 - C21)	1.98491	σ^* (C20 - H22)	0.00871	3.11	1.57	0.063
π (C20 - C21)	1.85271	π^* (N17 - C19)	0.46881	13.23	0.25	0.056
LP(1) N18	1.51994	π^* (N17 - C19)	0.46881	79.61	0.25	0.125
LP(1) N18	1.51994	π^* (C20 - C21)	0.25088	32.88	0.30	0.094
σ (C21 - H25)	1.98452	σ^* (N17 - C19)	0.01588	3.21	1.12	0.054
σ (C20 - C21)	1.98069	σ^* (N17 - H23)	0.02719	3.66	1.58	0.068
σ (C20 - C21)	1.98069	σ^* (N18 - H26)	0.01350	3.54	1.14	0.057

LP(3) O4 $\rightarrow$ π^* (O1-C6)). The delocalization of IMGA with the transfer of LP(1) N18 $\rightarrow$ π^* (N17-C19) and LP(2) O2 $\rightarrow$ π^* (O3-C9) possesses the E(2) of 79.61 and 52.42 Kcal/mol, respectively and showing that the formed crystal has a conjugative impact. The other strong delocalization of 32.88 and 29.90 Kcal/mol is produced by the conjugation with the lone pair of LP(1) N18 and LP(2) O3 when it is combined with π^* (C20 - C21) and O2 - C9, respectively. In IMGA, the D-A interactions are formed σ^* (by the orbital overlaps through $\pi \rightarrow \pi^*$ and $\sigma \rightarrow \sigma^*$ interactions such as π (C20 - C21) $\rightarrow$ π^* (N17 - C19) and σ (C20 - C21) $\rightarrow$ σ^* (N17 - H23) with the E(2) of 13.23 and 3.66 Kcal/mol, respectively. Herewith the important D-A interactions are discussed and the other D-A interactions are given in Table 7.

From the Table 7.

E(2) means stabilization energy.

E(j)-E(i) is the energy difference between donor and acceptor i and j NBO orbitals.

F(i,j) is the Fock matrix element between i and j NBO orbitals.

3.10. Hyperpolarizability studies

The relationship between the molecular structure and NLO properties can be understood by using theoretical determinations of hyperpolarizability [47,48]. The dipole moment (μ), mean polarizability (α), and first-order hyperpolarizability (β) for IMGA in terms of x, y, and z components have been calculated using the density functional theory (B3LYP/6-311++G(d,p)). The formulas for computing μ , α , β are given by the following reference [24]. The calculated values of IMGA are given in Table 8. It shows the total molecule dipole moment and first-order hyperpolarizability, which are 10.3163 Debye and 0.96×10^{-30} esu, respectively. The dipole moment of the IMGA molecule is 7 times larger than urea, and its first-order hyperpolarizability is 2.5 times larger than urea's (the dipole moments of urea are 1.3732 Debye and 0.3728×10^{-30} esu, respectively, as determined using the B3LYP/6-311++G(d,p) method). The intramolecular charge transfer caused by the migration of the electron cloud from an electron donor to acceptor groups through the conjugate framework is linked to the large value of hyperpolarizability [49,50], which is a measure of the NLO features of the molecular system.

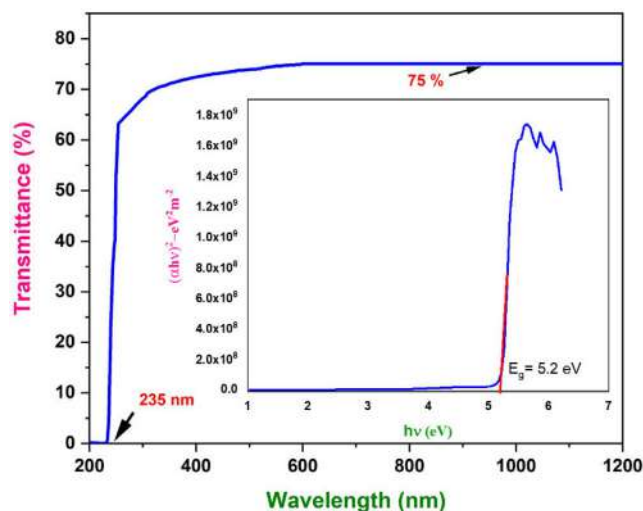


Fig. 14. UV-Vis-NIR transmission spectrum and Tauc plot of IMGA crystal.

3.11. UV-Vis-NIR studies

The optical transmittance range and cut-off wavelength are essential factors to customize the material for particular device applications. The majority of uses for single crystals are in optical technology. Using a UV-Vis-NIR spectrophotometer, the UV-Vis-NIR spectrum of IMGA was recorded from 200 to 1200 nm. For the optical transmittance studies, a high-quality, (101) plane cut-and-polished 1 mm thickness wafer was used. Fig. 14 displays the transmittance spectrum of IMGA crystal. It shows that grown crystal has ~75% transmittance from 350 to 1200 nm and this value is enough for blue-light applications and SHG Laser radiation at 1064 nm [51]. The lower cut-off wavelength of the grown crystal is 235 nm. The optical band gap E_g was calculated from Tauc's expression is

$$(\alpha h\nu)^2 = A(h\nu - E_g)$$

where α is the absorption coefficient, $n = 2$ for direct transition, A is a constant and h is a Plank constant. Fig. 14 the linear part of

Table 8
NLO properties of IMGa molecule.

Dipole moment		Polarizability		First order hyperpolarizability	
μ_x	3.0126	α_{xx}	-36.6050	β_{xxx}	38.4855
μ_y	-9.8666	α_{yy}	-122.9427	β_{yyy}	-156.9134
μ_z	0.0017	α_{zz}	-81.0054	β_{zzz}	-0.0024
μ_{total}	10.3163	α_{xy}	3.9975	β_{xxy}	43.3169
		α_{yz}	-0.0029	β_{xyy}	-36.6993
		α_{zx}	0.0018	β_{xxz}	0.0084
		α_{total}	-1.19×10^{-23} esu	β_{xzz}	-11.3439
		Δ_α	1.45×10^{-23} esu	β_{yzz}	1.2393
				β_{yyz}	0.0157
				β_{xyz}	0.0005
				β_{total}	0.96×10^{-30} esu

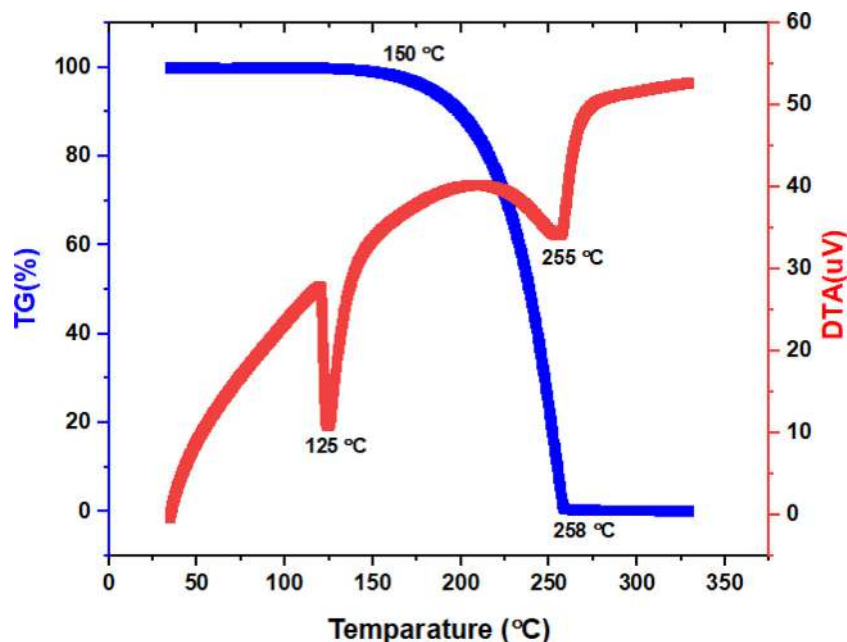


Fig. 15. TG-DTA curve of IMGa crystal.

the curve plotted by $(\alpha h\nu)^2$ vs photon energy ($h\nu$) and gives the direct optical band gap energy (E_g) [13]. The estimated E_g value of IMGa crystal is 5.2 eV.

3.12. TG-DTA studies

Simultaneous TG-DTA was performed on the grown IMGa crystals using a PerkinElmer Diamond TG-DTA analyser and a nitrogen environment, the temperature range used was between 30 °C and 400 °C with a 10 °C/min heating rate. Fig. 15 shows the TG/DTA curves of the IMGa crystal. The IMGa crystal is stable up to 150 °C, according to the TG curve, and material weight loss occurs between 150 and 258 °C. The DTA curve clearly displays two endothermic peaks, with the first peak around 125 °C signifying the melting point of the title crystal and the second peak at 255 °C signifying the material's decomposition point. The grown crystal begins to disintegrate after 99% of its weight is eliminated as gaseous products, with the remaining 1% being made up of leftover carbons. The TG-DTA studies confirm that melt growth is also possible to grow the IMGa crystal.

3.13. Dielectric studies

The electrical response of the crystal, which is a key factor in the design of optoelectronic devices [52], can be examined using the dielectric properties of the materials. To measure dielec-

tric properties of IMGa single crystal (2 0 2) plane parallel plates at room temperature using Agilent 4284A Precision LCR METRE in the frequency region 50 Hz - 1 MHz. For a good electrical connection, a silver paste was electrode on the surface of the relevant crystal sample. The dielectric constant and loss of the sample were calculated by the following reference [53]. Fig. 16 depicts how the dielectric constant and dielectric loss (Inset Fig. 16) varies with frequency. From 50 Hz to 10,000 Hz, the dielectric constant and loss is greater and rapidly decrease with increasing frequency, continuing up to 1 MHz. After this, it almost remains the same at higher frequencies. The crystal's good optical quality and lack of defects, which is a desirable property for NLO applications [53], is revealed by the low value of dielectric loss and good dielectric constant at high frequencies.

3.14. Z-Scan studies

One of the simplest techniques created by Eric Stryland to measure NLO constants, such as non-linear absorption (NLA) and refraction (NLR), is Z-scan [54]. This method was created for potential uses such as multi-photon polymerization and optical limiting and switching [55,56]. It can simultaneously measure the magnitude and sign of the NLR (n_2) and the NLA (β) of the samples. The input parameters for the Z-scan experiment are given in Table 9. The (101) plane cut and polished 1 mm thickness sample was used for the Z-scan experiment. The Z-scan data for the closed aperture

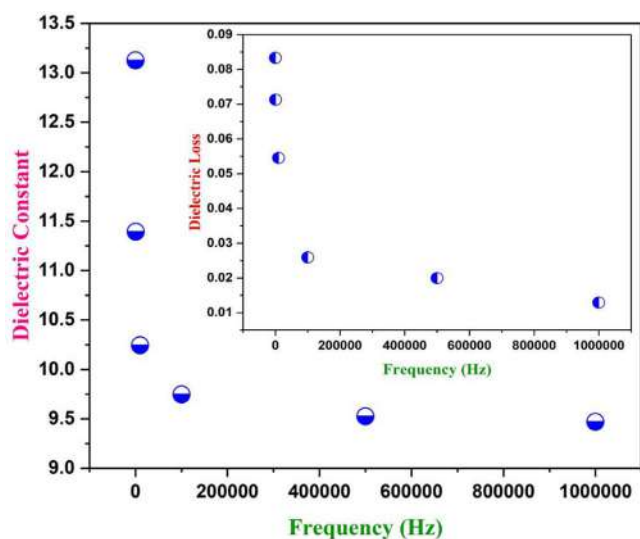


Fig. 16. Dielectric constant and dielectric loss of IMGA crystal at different frequency.

Table 9

Z-scan measurement parameters.

Test Parameters	
Sample thickness (L)	1 mm
Rayleigh length	1.29 mm
Laser beam wavelength (λ)	632.8 nm
Beam radius at the aperture (w_a)	9 mm
Aperture radius (r_a)	2 mm
Laser beam intensity (I_0)	15.31 MW/m ²

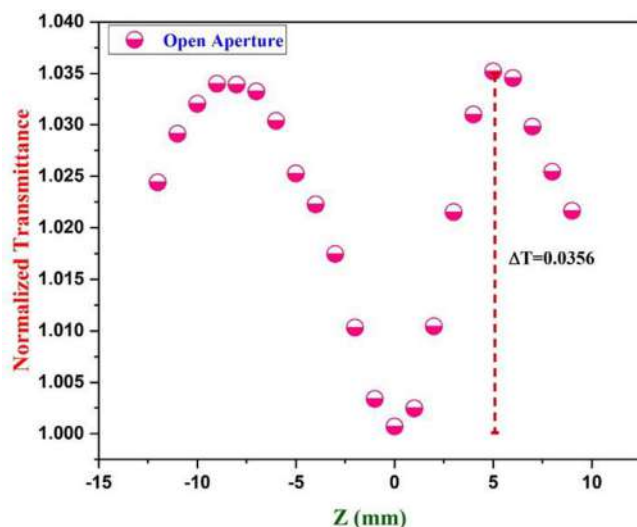


Fig. 17. Open aperture spectrum of IMGA single crystal.

configured for IMGA at the transmission of around 75% is shown in Fig. 17. The valley is followed by a peak-normalized transmittance which is the characteristic of positive nonlinearity. The calculated ΔT_{P-V} value is 1.1895. The NLA coefficient (β) is examined and calculated using the open aperture Z-scan spectrum. The open aperture spectrum of the IMGA sample is shown in Fig. 18. It demonstrates that the intensity of transmitted light decreases as the sample gets closer to the focus point, providing conclusive

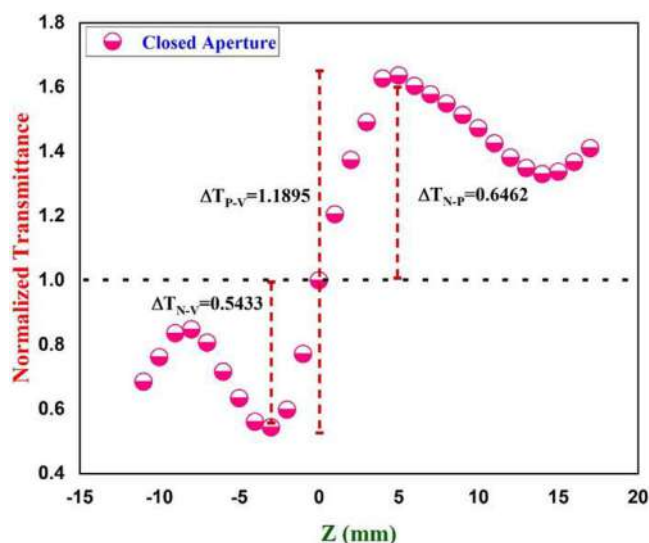


Fig. 18. Closed aperture spectrum of IMGA single crystal.

Table 10

Parameters measured in Z – scan experiment.

Parameters	Calculated values
ΔT_{P-V}	1.1895
ΔT	0.0356
Linear refractive index at 632.8 nm	1.548
Linear absorption co-efficient (α)	3.07 cm ⁻¹
Nonlinear refractive index (n_2)	2.30×10^{-12} m ² /W
Nonlinear absorption co-efficient (β)	7.64×10^{-6} m/W
Real part of the third-order susceptibility [$Re \chi^{(3)}$]	1.395×10^{-10} esu
Imaginary part of the third-order susceptibility [$Im \chi^{(3)}$]	2.274×10^{-7} esu
Third-order nonlinear optical susceptibility ($\chi^{(3)}$)	2.274×10^{-7} esu

proof of the reverse saturable absorption (RSA) phenomenon. The calculated ΔT_{P-V} value is 0.0356. Both the NLA coefficient and NLR contribute to the third-order NLO property of the crystal. The formulas for finding third-order NLO and related parameters are given detailed in Ref. [4] and calculated parameters in Z – the scanning experiment are given in Table 10. The relatively high value of third-order NLO susceptibility ($\chi^{(3)}$) suggests that grown crystal is suitable for optical limiting-related applications.

4. Conclusion

IMGA crystal has been synthesized and its crystal structure has been confirmed from SCXRD and PXRD studies. The optimized geometric parameters have been theoretically calculated and compared with the experimental data. The presence of proton and carbon was confirmed by ¹H and ¹³CNMR spectra. The bandgap energy of the material is 5.2 eV. The dominant IMIs of the total HS for IMGA molecule are H...H (36.6%) interactions and the proportions of O...H and H...O interactions comprise 52.1% of the total Hirshfeld surface for each molecule. The calculated GCRD such as electronegativity (χ) and electrophilicity index (ω) values are 3.0016 and 1.7875 eV, respectively. The delocalization of IMGA with the transfer of LP(1) N18 $\rightarrow \pi^*(N17-C19)$ and LP(2) O2 $\rightarrow \pi^*(O3-C9)$ possesses the E(2) of 79.61 and 52.42 Kcal/mol, respectively. The dipole moment of the IMGA molecule is 2.5 times larger than urea, and its first-order hyperpolarizability is 7 times larger than urea. The values of nonlinear RI ($n_2 = 2.30 \times 10^{-12}$ m²/W) and 3rd order nonlinear susceptibility ($\chi^3 = 2.274 \times 10^{-7}$ esu) were estimated using Z-scan studies. The

wide bandgap, high dielectric constant, and χ^3 values suggest that the grown crystal is suitable for optoelectronic applications.

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The authors declared no potential conflicts of interest.

CRediT authorship contribution statement

Gino DJ: Formal analysis, Investigation, Data curation, Writing – original draft. **Chinnasami Sidden:** Investigation, Validation, Writing – review & editing. **Rajesh Paulraj:** Conceptualization, Project administration. **H. Marshan Robert:** Validation, Investigation. **S. Ajitha:** Funding acquisition, Supervision, Project administration.

Data availability

Data will be made available on request.

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Interaction of polyvinyl alcohol with cetyltrimethylammonium bromide surfactant and its effect on electrochemical property

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ABSTRACT

Polymer-Surfactant mixed systems have sparked a lot of attention because of their wide range of industrial applications. In the present work, interaction features of the Polymer-Surfactant self-assembled system was computed at various ratios. The interaction between a cationic surfactant Cetyltrimethylammonium bromide (CTAB) and a water soluble polymer polyvinyl alcohol (PVA) was investigated using UV-Visible Spectroscopy, FTIR and Electrochemical investigations. At varied concentrations of PVA/CTAB, the UV-Visible spectrum of the reaction mixture was recorded. In the UV-Visible spectrum, the absorption band was observed at 272 nm. According to the UV-vis spectra the absorbance of PVA/CTAB increased at a lower concentration due to the solubility of the polymer. The ammonium salts distinctive groups were integrated on the polymer according to FTIR data. Atomic force Microscopic studies reveal that CTAB was homogeneously mixed with PVA due to interfacial interaction. The behavior of Cetyltrimethylammonium bromide and PVA mixtures has been studied electrochemically. It has shown relatively higher impedance indicating greater protection. It was revealed to be dependent on the concentrations of both polymer and surfactant.

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1. Introduction

The interaction of polymers and surfactants in aqueous solutions has spurred attention in recent years because of the increasing usage of mixed polymer-surfactant systems in various fields [1]. The interaction of surfactant molecules with the polymer macromolecules can enhance or decrease the fluid viscosity due to stretching or shrinking of polymer chains. The presence of polymer can potentially hasten the micellization process, lowering the concentration of free surfactant [2–4].

Polymer with Surfactant interaction investigations involving polymer surfactant aggregation are typically conducted at low surfactant concentrations [5]. The interaction between polymer and surfactant is influenced by the polymer and surfactant types as well as the solution conditioning nature [6]. The interaction between the polymer and the surfactant can be divided into two

categories. Electrostatic interactions and hydrophobic interactions are the types of polymer-surfactant interaction. Electrostatic interaction can exist between ionic polymers and oppositely charged ionic surfactants. Hydrophobic interactions can exist between non-ionic polymers and ionic/non-ionic surfactants. The hydrophobic portions of the polymer could interact with the surfactant molecules via hydrophobic interactions. Surfactant-polymer aggregates occur when a surfactant is added to a polymer solution and interactions between the surfactant and the polymer occur [7,8].

PVA is the most widely useful polymer as it has several potential applications. It is used as an electrode material in secondary batteries and microelectronics and also as an electrochromic display material because of electrochemical property [9,10]. Polyvinyl alcohol is an outstanding polymer and it has high electrical, optical and mechanical properties. It has high tensile strength, good charge storage capacity and excellent film forming nature, eco-friendly, biodegradable and biological useful polymer. Because of the polar group present in the polymer, it is easily soluble in water as well as in organic solvents [11].

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Cetyltrimethylammonium bromide (CTAB) is an important positively charged surface active agent (surfactant) that has a long tail of 16-carbon atoms and a head of an ammonium group with three methyl groups attached. Positively charged surfactant has been fruitfully employed as a coating agent, stabilizing agent, passivating agent, structure directing agent in the synthesis of inorganic materials [12–16]. It also helps in the accumulation of target chemicals which is the reason it is commonly used in wastewater treatment to facilitate the absorption and reaction with the pollutants [17]. Above all the aforesaid constructive properties of CTAB, it is worth noting that the modification of the composite materials with CTAB will improve the sensing performance of the materials resulting in enhanced sensitivity and limit of detection. It improves the hyperchromicity and sensitization to the probe [18]. Conductivity technique and UV–Visible spectroscopic was employed to observe the interaction of Cephadrine monohydrate (CDM) with cationic surfactant cetyltrimethylammonium bromide (CTAB) and the CMC values were determined by varying the temperature [19].

By using different analytical techniques many researchers have studied the interaction of cationic surfactants with water soluble polymers. Addition of the surfactants having different charge and head groups in the presence of water soluble polymer possessing high molecular weight is an important research work for academia and industry. Therefore, in the present work interaction of surfactants having cationic head group CTAB aqueous solution of PVA has been studied using Atomic force microscopy and Cyclic Voltammetry.

2. Experimental

2.1. Materials

The chemicals used in the present investigations are Polyvinyl alcohol (PVA) and Cetyltrimethylammonium bromide (CTAB). The materials in this research work were of analytical grade without any additional refinement. Throughout the experiment double distilled water was employed as a solvent. All the chemicals utilized

in this study were purchased from Sigma Aldrich Chemicals Ltd. Information about the materials is given in Table 1.

2.2. Preparation of solutions

The aqueous solutions with various surfactant and polymer concentrations were prepared fresh using a magnetic stirrer for roughly 8–10 h to form a constant homogeneous solution at a low rotation per minute to avoid mechanical degradation. An appropriate amount of cationic surfactant and polymer solution was properly dissolved in distilled water for 15 min. A wide range of concentrations approximating the CMC of CTAB (0.1–0.7 wt%) was chosen for the present work. The polymer was used at 100 ppm, 500 ppm, 1000 ppm, 1500 ppm concentrations. These chemical compounds were chosen to match those utilized in industrial settings [20–25].

3. Characterization

The FTIR spectroscopy of PVA with CTAB was performed with FTIR spectrometer (Shimadzu, IR Affinity) in the wavenumber range 400–4000 cm^{-1} in a transmittance mode. Ultraviolet visible (UV–vis) absorption spectrum of PVA/CTAB solution was obtained in the range of 200–800 nm with a Computer controlled Jasco V-530 UV–vis Spectrophotometer. The atomic force microscopy was completed with Nanosurf easy2scan BT02218 profilometer; a sharp cantilever tip interacts with the sample surface sensing the local forces with the molecules and the tip. The electrochemical behavior was studied by CH-instrument Inc., TX USA.

4. Results and discussion

4.1. UV–vis spectroscopy

UV–vis spectroscopy is a fascinating technique for analytical research because it reveals essential details regarding the absorbance, transmittance and reflectance of polymeric materials. Jasco

Table 1
Information of materials.

Chemical name	Source	Purity	CAS	Molecular weight
Polyvinyl alcohol (PVA)	Sigma Aldrich	≥99 %	9002-89-5	1,46,000–1,86,000,
Cetyltrimethylammonium bromide (CTAB)	Sigma Aldrich	≥99 %	57-09-0	364.45

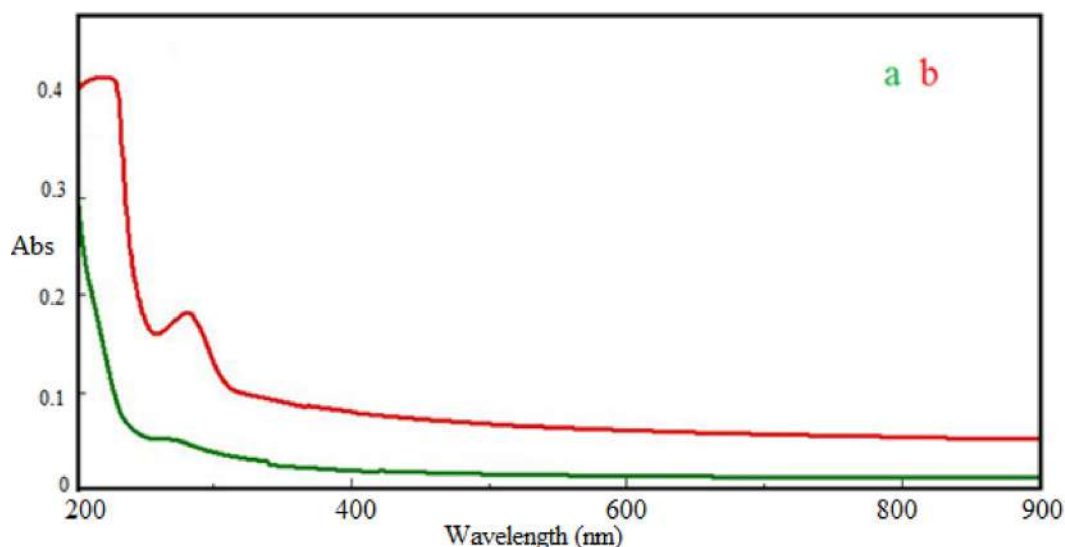


Fig. 1. UV–vis Spectra (a) PVA (b) CTAB.

UV-Visible Spectrometer was used for the evaluation of optical characteristics of PVA with CTAB and for recording the spectral data. [26]. PVA is also a significant polymer because of its excellent optical qualities such as great transparency and it has sensing

property. Figs. 1–5 show the UV absorbance spectra of PVA, CTAB and PVA/CTAB dispersion respectively. CTAB has a distinct absorbance bands at 272 nm and it was associated with high energy absorption. These absorbance bands are ascribed to the electronic

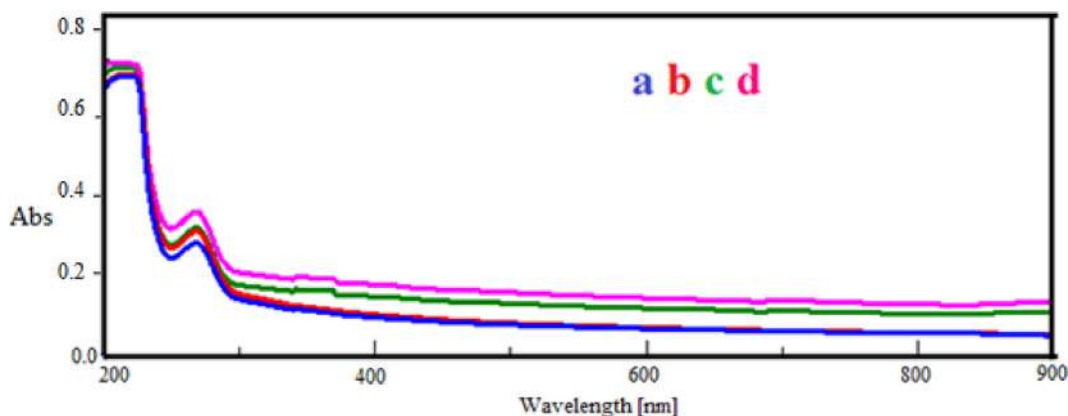


Fig. 2. UV -Vis Spectra of PVA 100 ppm with CTAB (a) 0.1 wt% CTAB (b) 0.3 wt% CTAB (c) 0.5 wt% CTAB (d) 0.7 wt% CTAB.

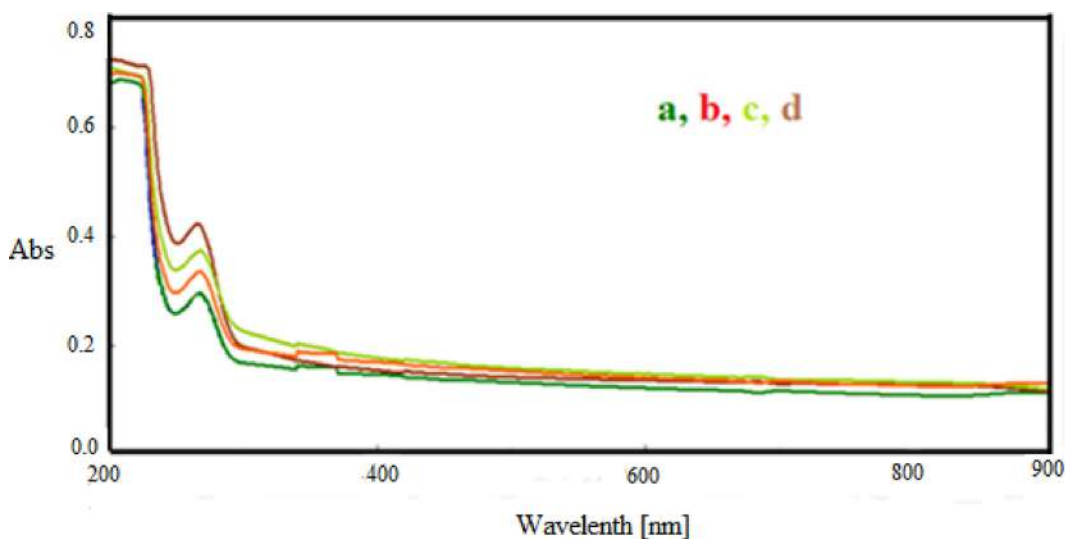


Fig. 3. UV -Vis Spectra of PVA 500 ppm with CTAB (a) 0.1 wt% CTAB (b) 0.3 wt% CTAB (c) 0.5 wt% CTAB (d) 0.7 wt% CTAB.

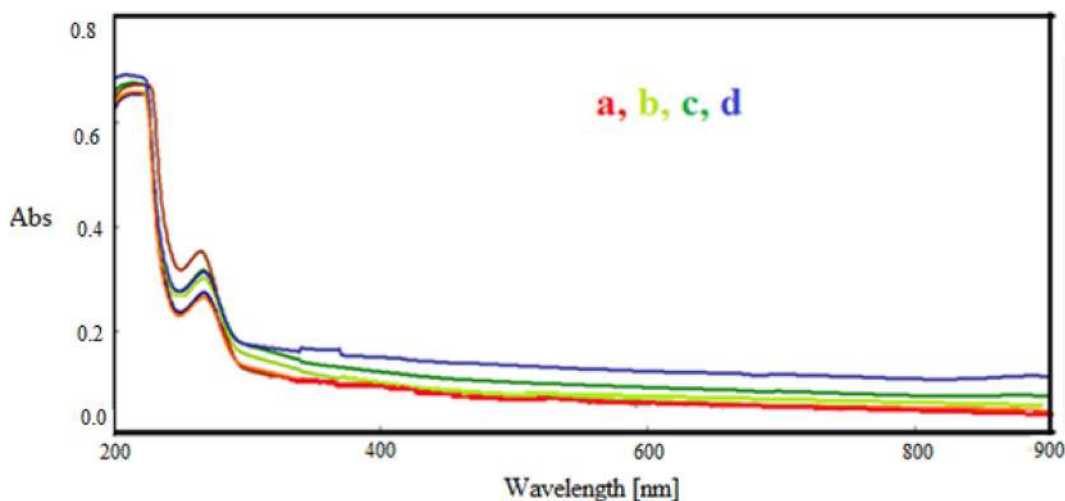


Fig. 4. UV -Vis Spectra of PVA 1000 ppm with CTAB (a) 0.1 wt% CTAB (b) 0.3 wt% CTAB (c) 0.5 wt% CTAB (d) 0.7 wt% CTAB.

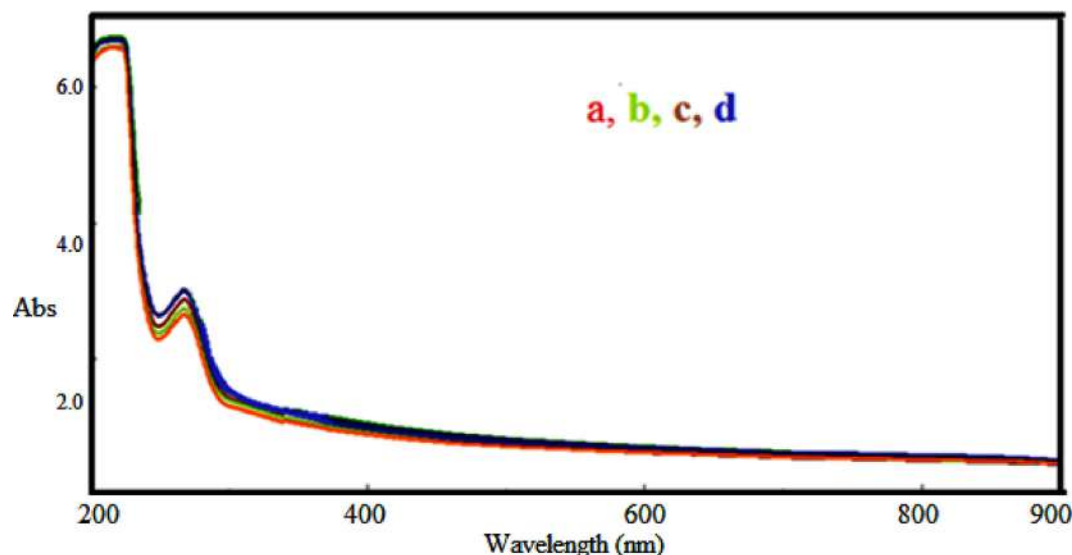


Fig. 5. UV -Vis Spectra of PVA 1500 ppm with CTAB (a) 0.1 wt% CTAB (b) 0.3 wt% CTAB (c) 0.5 wt% CTAB (d) 0.7 wt% CTAB.

transitions $\pi-\pi^*$ (K-band). It has been noted that the value of Critical micelle concentration (CMC) decreases by increasing chain length (even by one carbon) [27,28].

Surfactants conductivity improves as they interact with polymers, increasing their CMC value. The presence of free positive and negative ions of surfactants caused an increase in conductance. The concentration of the polymer and surfactant was maintained at a consistent level. When increasing the concentration of surfactants the value of CMC also increases indicating a strong interaction between surfactant and polymer. The formation of micelle causes a reduced increase in conductance in the post micellar area. The CMC value increased because of the strong interaction between the polymer and cations of the surfactants. By lowering the charge density of the cationic head, the polymer reduces repulsion between nitrogen atoms. The micellization process of the polymer surfactant reduces while increasing entropy [29].

The cationic surfactants that were produced were found to be very useful in enhancing solubility with the non-ionic polymer. Surfactant CMC values increased as a result of polymer-surfactant interaction was successful. Then it also indicates that the solubility of the polymer due to the value of absorbance was increased. At first, $\lambda_{\max}$ was calculated by drawing a graph of absorbance vs wavelength. The maximum absorbance values of

surfactants were noted. Figs. 2–5 shows the graphs plotted between absorbance vs wavelength. This mentioned diagram indicated the increasing solubility due to the interaction of the polymer with surfactant. Increasing the concentration of polymer

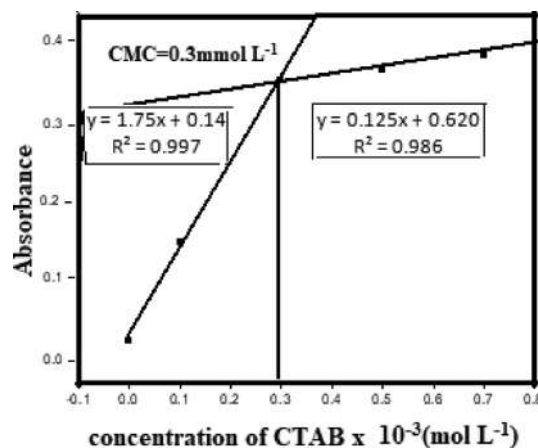


Fig. 7. Absorbance vs CTAB concentration in 500 ppm PVA.

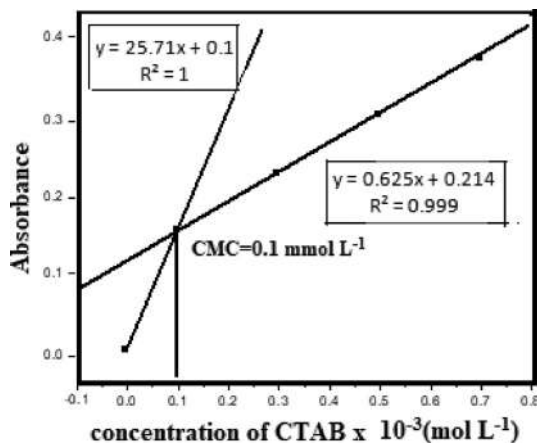


Fig. 6. Absorbance vs CTAB concentration in 100 ppm PVA.

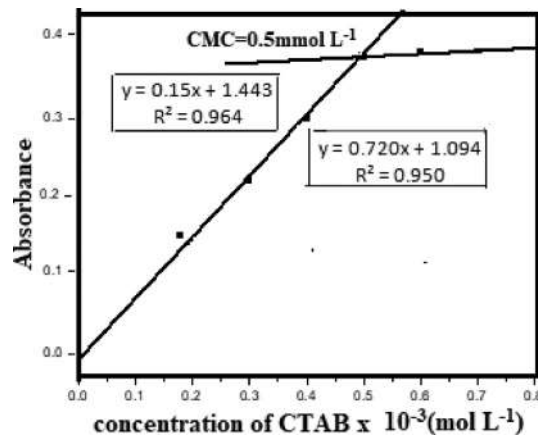


Fig. 8. Absorbance vs CTAB concentration in 1000 ppm PVA.

solution leads to higher Critical micelle concentration (CMC) values. [30]. Figs. 6–9 show that the CMC values of cationic surfactants increase with increasing percentage of polymer in solution. With increasing the concentration of ionic surfactants give most important results as the slope in the conductivity versus concentration of ionic surfactants changes at an exact value of surfactants concentration. The conductivity of ionic species increases with the

release of ions in the solution. The ionic surfactants undergo dissociation to create surfactant ions and counter ions, these ions are accountable for the electrical conductivity. These ions are responsible for the conductivity of electricity. Higher conductivity results from such an increase in the number of released ions when ionic surfactant concentration rises [31]. Fig. 10 indicates that conductivity versus concentration of CTAB. At 1000 ppm of PVA, the CMC values determined using the UV–vis spectra and conductivity techniques are equal.

4.1.1. Band gap energy

Using the equation $E_g = hc/\lambda_{max}$, the optical band gap energy of the polymer-surfactant was calculated. PVA, CTAB and PVA with CTAB have band gap energies of 4.9 eV, 3.8 eV and 4.0 eV respectively. The tauc relation was used to calculate the optical band gap energy which is reported in Table 2.

4.2. FTIR analysis

The main peaks of PVA (Fig. 12) were observed at 3280 cm^{-1} , 2917 cm^{-1} , 1690 cm^{-1} , 1425 cm^{-1} , 1324 cm^{-1} , 1081 cm^{-1} , and

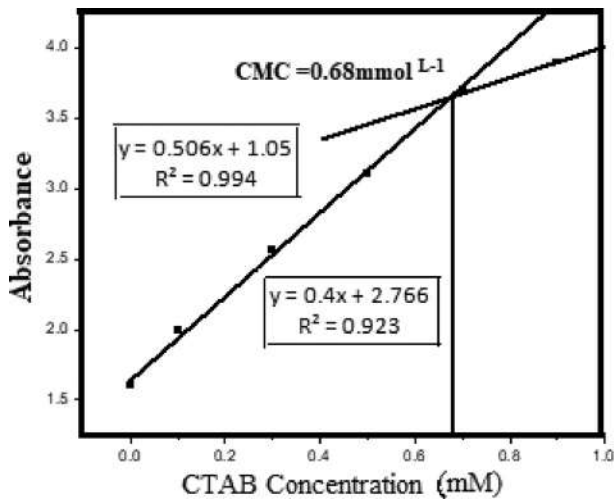


Fig. 9. Absorbance vs CTAB concentration in 1500 ppm PVA.

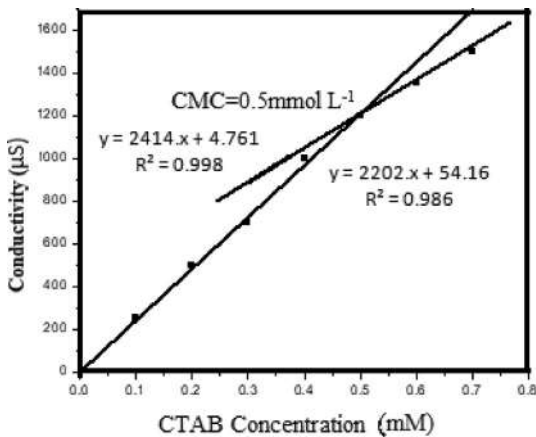


Fig. 10. Conductivity vs CTAB concentration in 1000 ppm PVA.

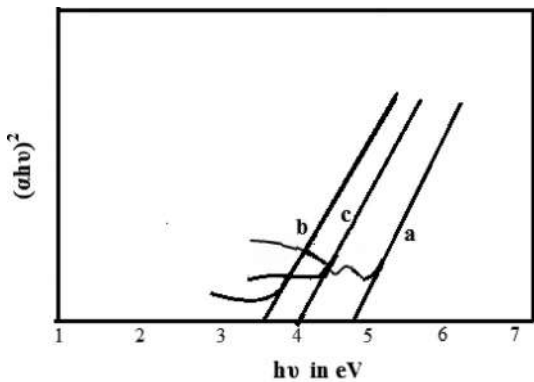


Fig. 11. Plot of $(\alpha h\nu)^2$ versus $(h\nu)$ in eV a) PVA, b) CTAB and c) PVA + CTAB.

Table 2

Band gap energy values.

Sl. No	Samples	Band gap (eV)
1	PVA	4.9
2	CTAB	3.8
3	PVA + CTAB	4.0

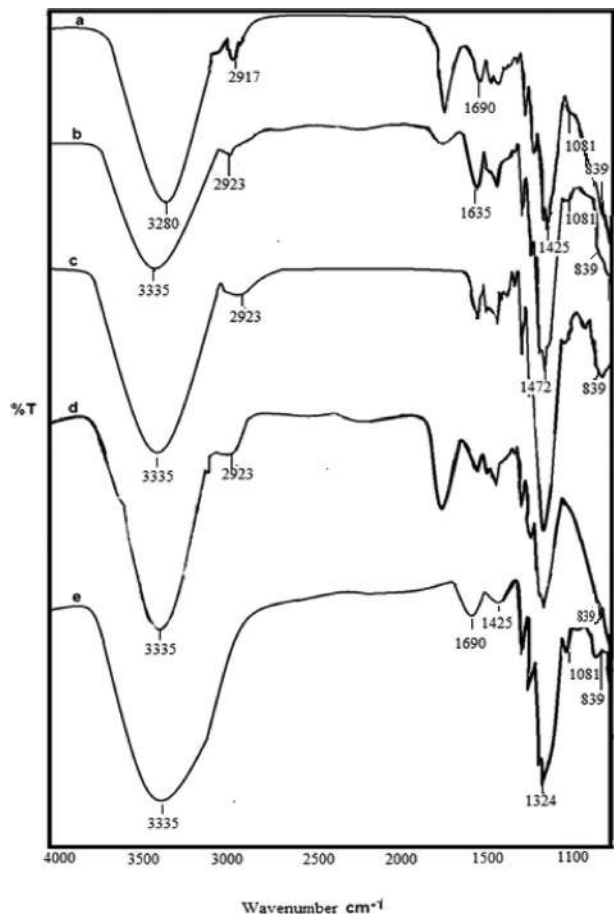


Fig. 12. FTIR spectra of (a) 100 ppm PVA, (b) 0.5 wt%CTAB + 100 ppm PVA, (c) 0.5 wt% CTAB + 500 ppm (d) 0.5 wt% CTAB + 1000 ppm PVA (e) 0.5 wt% CTAB + 1500 ppm PVA.

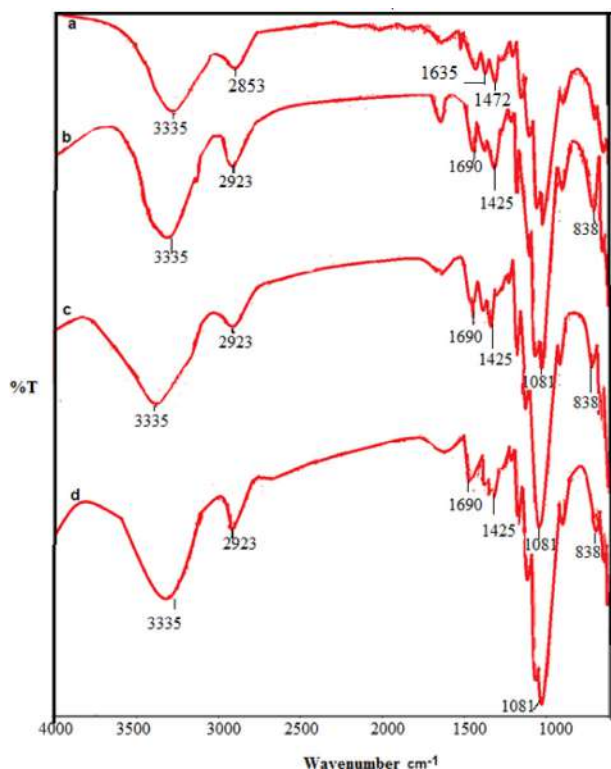


Fig. 13. FTIR spectra of (a) CTAB, (b) 0.1 wt% CTAB + PVA, (c) 0.3 wt% CTAB + PVA, (d) 0.5 wt% CTAB + PVA.

839 cm^{-1} . These peaks are assigned to the O—H stretching vibration of the hydroxyl group, CH_2 asymmetric stretching vibration,

C=O carbonyl stretch, C—H bending vibration of CH_2 , C—H deformation vibration, C—O stretching of acetyl groups and C—C stretching vibration [32–35].

The FTIR spectrum of CTAB (Fig. 13) possesses a strong band at 3335 cm^{-1} that can be attributed to the stretching vibrations of the ammonium group in CTAB. Peaks at 2853 cm^{-1} are attributed to $-\text{CH}_2$ group in CTAB. The band at 1635 cm^{-1} followed by the band at 1472 cm^{-1} corresponds to the asymmetric and symmetric stretching vibration of $\text{N}^+ - \text{CH}_3$ respectively. Similar absorption bands of the FTIR spectra for CTAB were compared in difference to the previous reports [36–39].

There is a strong band at 3451 cm^{-1} which corresponds to the stretching vibration of the O—H and N—H groups from PVA and CTAB respectively. The absorption peaks observed at 2923 cm^{-1} represent the characteristic CH_2 stretching vibration bands of CTAB. When compared to the PVA spectrum the remaining bands of PVA/CTAB have higher wave numbers at 1690 cm^{-1} , 1325 cm^{-1} , 1081 cm^{-1} , and 838 cm^{-1} proving the existence of C=O, CH_2 , C—O, C—C group which belongs to PVA. The results confirmed that the interaction of PVA with CTAB was successful.

4.3. Microscopic studies

AFM is a highly effective analytical research technique for characterizing heterogeneous systems. AFM images were also used for roughness, porosity and fractal dimension [40]. The surface morphology of PVA with CTAB was examined further using tapping mode in atomic force microscopy (AFM). The results are displayed in Figs. 14–16. From Fig. 10 and Fig. 11, it can be seen that different concentrations of CTAB with PVA. It has a significant effect on the surface topography of the samples. The surface of the polymer with surfactant clearly showed that the coarse surface at the higher concentration which could be attributed to the strong interfacial adhesion and good compatibility between PVA with CTAB.

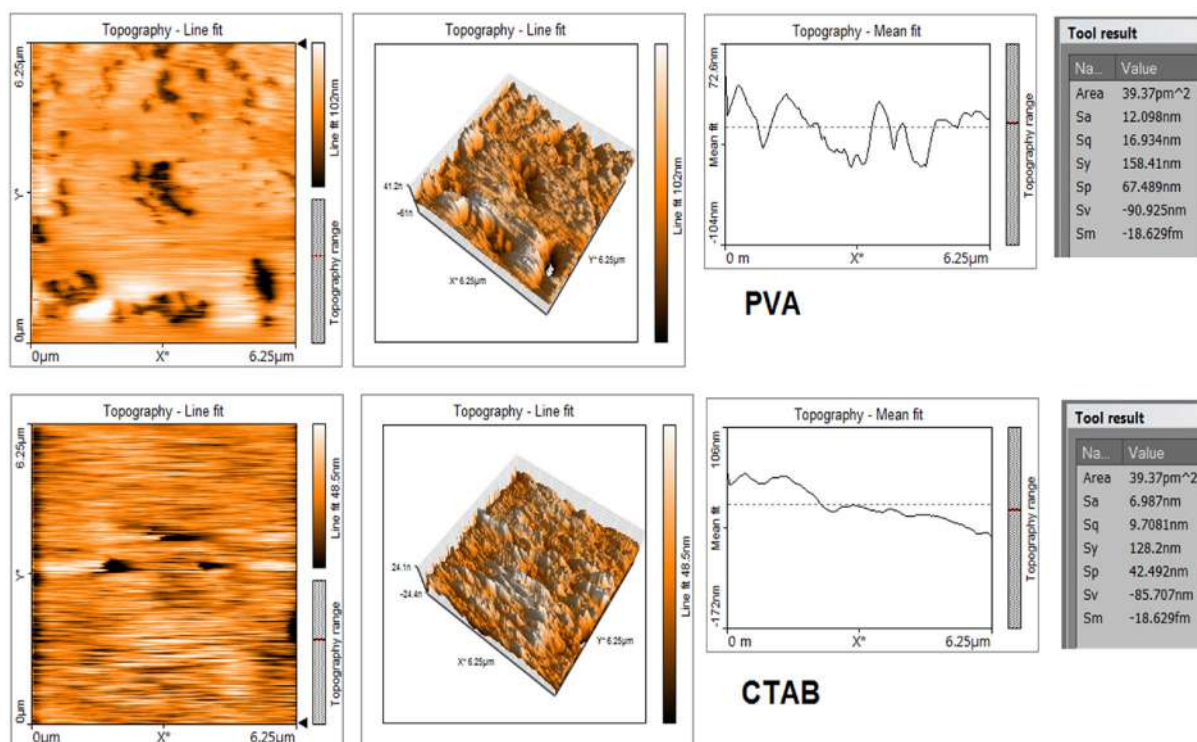


Fig. 14. AFM topographic images of PVA and CTAB.

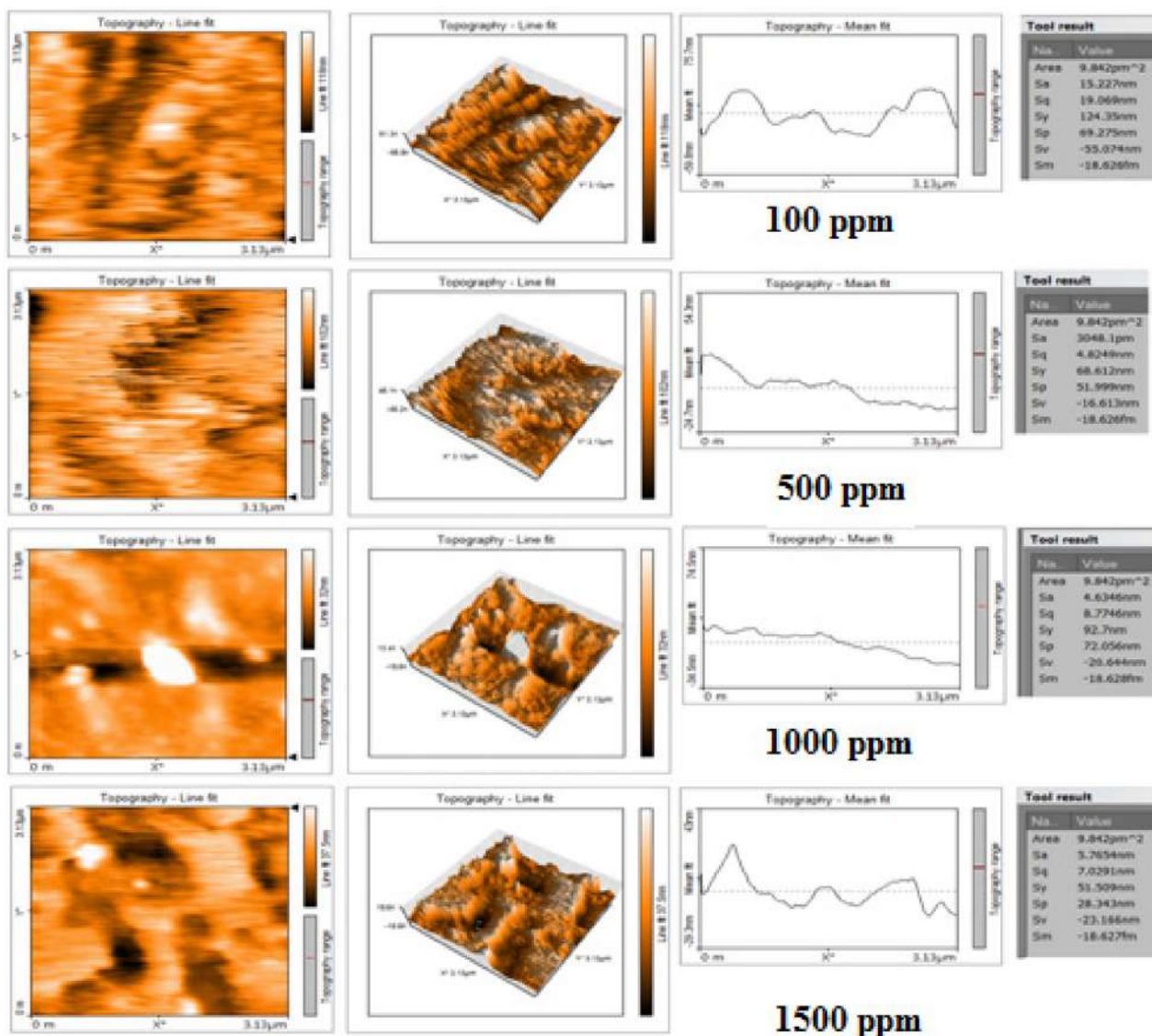


Fig. 15. AFM topographic images of CTAB with different concentration of PVA (100 ppm, 500 ppm, 1000 ppm, 1500 ppm).

4.4. Impedance spectroscopy

Electrochemical impedance spectroscopy is used to determine the Equivalent circuit parameters such as charge transfer resistance and ohmic resistance. EIS is a two-part Nyquist curve; that is a semicircle in the high frequency region and a straight line in the low frequency region [41]. Internal charge transfer resistance is represented by the semicircle in the high frequency region (R_s). The larger the diameter of the semicircle improved the charge transfer resistance. Fig. 17 is an EIS diagram in the high frequency

region, and it can be seen that the PVA with CTAB the appearance of a semi-circular arc indicates that there is a certain charge transfer resistance. This figure indicates that the highest resistance in terms of coating strength was demonstrated because of higher impedance, it was more protected. It also illustrates that the impedance curve of PVA with CTAB surfactant exhibits a very high resistance and higher capacitance property. Polymer-surfactant has capacitance and has shown substantial potential in charge-discharge behavior. Polymeric coating showed a higher coating capacitances represented by lower impedance because of the two

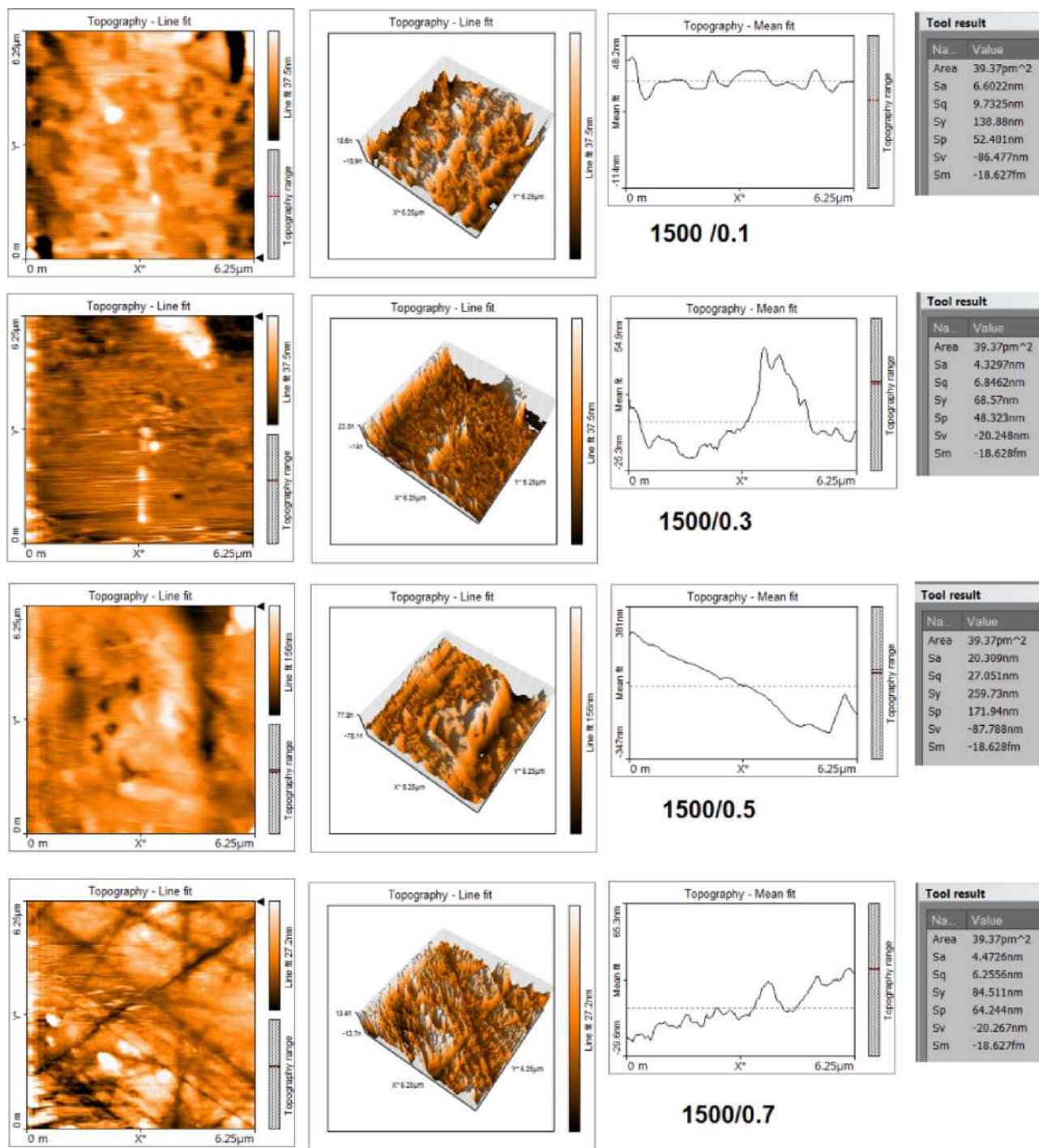


Fig. 16. AFM topographic images of PVA 1500 ppm with CTAB (a) 0.1 wt% CTAB (b) 0.3 wt% CTAB (c) 0.5 wt% CTAB (d) 0.7 wt% CTAB.

properties are inversely proportional. It would be observed that polymeric coating with higher capacitance can store higher charge [42].

5. Conclusion

In this present work, there are few findings can be deduced after completely performing the characterization tests. Polyvinyl alcohol

with different concentrations of CTAB was prepared and characterized to show the effect of their structural, optical, and electrical properties. The FTIR results suggested a strong interaction between PVA and CTAB. PVA/CTAB dispersion shows good optical properties observed by UV–vis Spectroscopy. Microscopic studies reveal that CTAB was homogeneously mixed with PVA due to interfacial interaction. PVA and CTAB showed relatively higher impedance indicating greater protection. It also illustrates that the impedance curve of PVA with CTAB surfactant exhibits very high resistance and

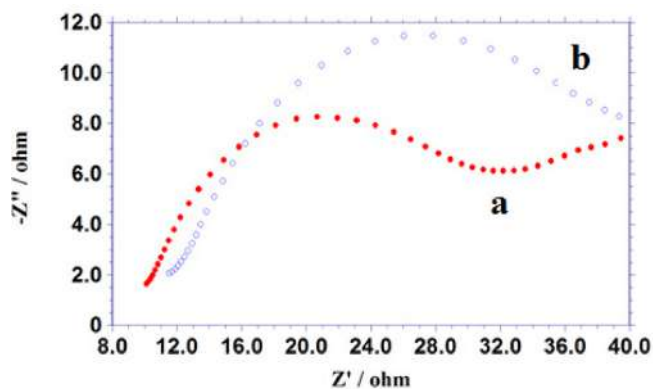


Fig. 17. EIS diagram of a) PVA/b) CTAB.

greater capacitance property. EIS confirms PVA/CTAB with low concentrations is used as high resistance due to its anticorrosive activity.

Data availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Studies on the Investigation of Anti-Oxidant and Cellular Toxicity on L929 Cell Line of *Andrographis paniculata* and its Derivative of Silver and Gold Nanoparticles

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ABSTRACT: The current pharmaceutical industry is increasingly turning to plant-based multi-potential bioactive compounds to combat a variety of diseases and pathological conditions due to the consequences of administering synthetic drugs. To Avoid back reflection of synthetic drugs, researchers are focusing on natural derivatives guided from traditional medical practices. Plants are playing vital role in nutritional and disease control aspects in traditional era. Terrestrial resources contain a vast array of medicinally valuable plants that have traditionally been used to treat a wide range of diseases, including hepatoprotective, anti-inflammatory, antibacterial, anti-cancer, and antidiabetic properties. Similarly, the study plant *Andrographis paniculata* demonstrated significant medicinal properties; thus, the potential activity of a leaf ethanolic extract of *A. paniculata*, diethyl phthalate purified from the crude ethanolic extract, and their modified metal (Silver and Gold) nanoparticles against free radicals, namely DPPH and phosphomolebdenum assays. In addition, the study samples were subjected to an MTT assay to assess cellular toxicity in comparison to the L929 cell line. The results showed that the promising drug carrier system of diethyl phthalate silver nanoparticles (DPAgNPs) exhibited lower toxicity and higher anti-oxidant activity.

Keywords: *Andrographis paniculata*, Diethyl phthalate, Silver and gold nanoparticles, DPPH, Phosphomolebdenum and Cytotoxicity.

INTRODUCTION

Countless plant-based products, such as herbal teas, nutritional supplements, health meals, and other goods, are readily available today (Phillips and Meilleur 1998). Distinct medical traditions are practised by various cultural and ethnic groups (Leslie and Young 1992). In underdeveloped nations, where 65 to 80 percent of the world's population resides, plant products are their primary source of healthcare (Farnsworth *et al.*, 1985; Awoyemi *et al.*, 2012). Ayurveda has been demonstrated to be one of the oldest medical systems that is still in use today, both in India and around the world. Many individuals think natural treatments are safer than synthetic medications. Individualized therapies may incorporate nutritional, physical activity, and lifestyle factors as well as proprietary molecules or plant components (Sharma and Mujundar 2003). There has been a remarkable return of interest in medicine and classical pharmacopoeia despite substantial advancements in contemporary medicine. Perumal and Gopalakrishnakone (2008) explored plant-based medications, which significantly improved on already available therapies. Plants continue to play a key role in

the control of diabetes, particularly in much less developed countries where the bulk of the population has little resources and no access to contemporary therapy. Alternative diabetes therapies, such as those based on plants, are becoming more and more popular in industrialised nations due to the drawbacks of taking insulin and oral hypoglycemic medications (Marles and Farnsworth 1994). In India, where more than 30 million individuals have the condition, diabetes is on the increase. Numerous members of society are impacted by undiagnosed diabetes. Both diabetes screening and the streamlining of diagnostic processes have become crucial. The two most prevalent kinds of diabetes are Type-1 and Type-2 (Gupta *et al.*, 2014; Wang *et al.*, 2001). Phenolic compounds are a significant category of the plant secondary metabolites that have been found to have antioxidant properties. There are several findings on how phenolic chemicals affect the antioxidant capacity of various plant species (Cai *et al.*, 2004). Diverse pharmacological effects of *Andrographis paniculata* exist, some of which include anti-cancer, anti-diarrheal, and anti-hepatitis (Md. Sanower Hossain *et al.* (2014). *A. paniculata* extracts show hepatoprotective qualities, antihypertensive

effects, and lower plasma angiotensin converting enzyme (ACE) activity and renal lipid peroxidation (Akbar, 2011). Besides, they have antimicrobial, anti-inflammatory, antioxidant, and hypoglycemic effects (Zhang and Tan 2000). In an effort to discover a treatment for conditions like rheumatoid arthritis and ulcerative colitis that are brought on by oxidative stress and infections, Umadevi and Kamalam (2014) at the University of Bristol investigated *A. paniculata*. They are looking at the phytochemical composition and antioxidant capacities of the plant. Similar to this, 10% methanolic SLE showed enhanced antioxidant activity, which was responsible for 53.94 g/ml DPPH activity and 44.94% suppression of nitric oxide activity (Uthirapandi *et al.*, (2021). Penicillin has a wide range of possible uses, including as an anti-microbial, cytotoxic, anti-protozoan, and immunostimulant, according to a review by Okhuarobo *et al.* (2014). Andrographolide, the primary active ingredient, has a variety of biological effects, including hepatoprotective, anti-inflammatory, antibacterial, anti-cancer, and antidiabetic ones (Jarukamjorn and Nemoto 2008). Researchers suggest that andrographolide be structurally modified in order to acquire diverse leads due to the outstanding diversity of these biological functions. Numerous andrographolide compounds have surfaced in recent decades, and their pharmacological properties have also been examined. There haven't been many researches that thoroughly summaries or analyze *A. paniculata* and its derivatives, nevertheless. As a result, this study gives comprehensive information about the pharmacological activity of *A. paniculata* and its main ingredient andrographolide in an effort to advance the trends of research on andrographolide (Jayakumar *et al.*, 2013). Antioxidant defences are strengthened by andrographolide. By scavenging free radicals, it exerts direct action. It further causes indirect interference by preserving mitochondrial integrity, preventing pro-oxidant enzyme activity, and/or activating antioxidant enzymes. Keep in mind that the control of the antioxidant defense system involves the transcription factor Nrf2. As a result, andrographolide's regulation of Nrf2 is important for controlling the redox system (Li *et al.*, 2018; Tan *et al.*, 2018; Yan *et al.*, 2018).

MATERIAL AND METHODS

Sample Preparation. Around 50 g of powdered *Andrographis paniculata* was taken into fresh extract cloth and bagged into extraction apparatus. The system was placed on the heating mantle at 40°C and the sample with reflux condenser tube was placed over the solvent collector with air tightly. The extraction system was started with 500 ml ethanol as extraction solvent for 24 hours. After extraction the solvent was transferred to fresh 500 ml conical flask, filter the extract and stored at 4 °C for further analysis. Diethyl phthalate was partially purified from the crude extract of *A. paniculata* using column chromatography and has been characterised spectrally. From the diethyl phthalate chromatographic fraction, silver and gold nanoparticles were synthesised using ascorbic acid as a

reducing agent and subjected to spectral and morphological characterization.

Anti-Oxidant Property

DPPH radical scavenging activity. The free radical scavenging activity of the fractions was measured in vitro by the 2, 2-diphenyl-1-picrylhydrazyl (DPPH) assay according to the standard method (Brand-Williams *et al.*, 1995). The stock solution was prepared by dissolving 24 mg of DPPH in 100 ml of methanol stored at 4–20 °C. About 4 ml of various concentrations of samples (20, 40, 60, 80, and 100 g/mL) were mixed with 1 ml of methanolic solution containing DPPH radicals, resulting in a final concentration of DPPH of 0.2 mM. The mixture was shaken vigorously and left to stand for 30 minutes, and the absorbance was measured at 517 nm. Ascorbic acid was used as a control. The percentage of DPPH decolorization in the sample was calculated according to the equation. The control was prepared without any sample, and scavenging activity was estimated based on the percentage of DPPH radicals scavenged using the following equation:

$$\% \text{ of inhibition} = [(\text{control OD} - \text{sample OD}) / (\text{control OD})] \times 100$$

Total antioxidant activity. Each test tube contained 3 mL of distilled water and 1 mL of Molybdate reagent solution, as well as 20–100 µg/mL of *Andrographis paniculata* extract, Diethyl phthalate (DP), DP silver nanoparticles (DPAgNPs), and DP gold nanoparticles (DPAuNPs). These tubes were kept incubating at 95 °C for 90 min. After incubation, these tubes were normalized to room temperature for 20–30 min, and the absorbance of the reaction mixture was measured at 695 nm. The percentage of inhibition values from samples was calculated for each extract. Ascorbic acid was used as a positive reference standard. The PM assay is based on the reduction of phosphate-Mo (VI) to phosphate-Mo (V) by the sample and the subsequent formation of a bluish-green phosphate/Mo (V) complex at an acidic pH. The phosphomolybdenum method is routinely applied in the laboratory to evaluate the total antioxidant capacity of plant extracts (Prieto *et al.*, 1999).

Cellular Cytotoxicity on L929 Cell line by MTT assay. This assay was performed based on the assessment of reduction of the yellow colored water soluble tetrazolium dye MTT to formazan crystals (MTT Cell Proliferation Assay Instruction Guide). Mitochondrial lactate dehydrogenase produced by live cells reduces MTT to insoluble formazan crystals formed in assay mixture. Seed 200µl cell suspension in a 96-well plate at required cell density (20,000 cells per well), without the test agent. Allow the cells to grow for about 24 hours. Add appropriate concentrations of the test samples (Diethyl phthalate, DPAgNPs and DPAuNPs) incubate the plate for 24hrs at 37°C in a 5% CO₂ atmosphere. After the incubation period, takeout the plates from incubator and remove spent media and add MTT reagent to a final concentration of 0.5mg/mL of total volume. Wrap the plate with aluminium foil to avoid exposure to light. Return the plates to the incubator and incubate for 3 hours. (Note: Incubation time varies for different cell lines. Within one

experiment, incubation time should be kept constant while making comparisons). Remove the MTT reagent and then add 100µl of solubilisation solution (DMSO). Gentle stirring in a gyratory shaker will enhance dissolution. Occasionally, pipetting up and down may be required to completely dissolve the MTT formazan crystals especially in dense cultures. Read the absorbance on a spectrophotometer or an ELISA reader at 570 nm wavelength. % Cell viability is calculated using below formula:

% cell viability=[Mean abs of treated cells/Mean abs of Untreated cells] × 100

Statistical Analysis. The obtained data were interpreted and calculated as Mean, Standard deviation and ANOVA using IBM SPSS Statistical Software and represented the data in tables as well as graphs.

RESULT AND DISCUSSION

Phytochemical Screening

Anti-Oxidant Activity

DPPH Scavenging Assay. The study samples (*A. paniculata*, Diethyl phthalate, DPAGNPs and DPAGNPs) were subjected to investigate the scavenging activity against 2-diphenyl-1-picrylhydrazyl (DPPH) and the scavenging effects were analyzed and calculated statistically. Among the sample Diethyl phthalate silver nanoparticles (DPAGNPs) were described in Table and Figure: 1 as higher scavenging activity 60.36 % at 100 µg/mL concentration while *A.paniculata* showed 44.94 % at 100 µg/mL. However, Diethyl phthalate and DP gold nanoparticles exhibited quite lower scavenging effect as 16.42 % and 20.83 % at 100 µg/mL concentration. The one-tailed ANOVA was performed and showed insignificance of activity among the sample at p-value equals 1.738 (1.738 > p 0.005) greater than α value of 0.005 (Table and Fig. 2).

Total Anti-oxidant Activity. Total anti-oxidant property can be determined by analyzing the reducing activity of phosphate-Mo (VI) to phosphate Mo (V) was measured at 695 nm. In table and Figure: 3 Higher reducing property was shown in Diethyl phthalate silver nanoparticle (DPAGNPs) as 83.64 % at the concentration of 100 µg/mL while, DP gold nanoparticle exhibited lesser activity 14.29 % at 100 µg/mL. In other hand, Diethyl phthalate revealed 57.56 % and *A.paniculata* has 34.78 % of reducing activity at 100 µg/mL. The data of total anti-oxidant property was far away to significant at 0.005 level (1.088 > p 0.005) showed in Table and Fig. 4.

Assessment of Cellular Cytotoxicity by MTT Assay.

MTT assay is a colorimetric assessment based on the reduction of the yellow colored water soluble tetrazolium dye MTT to formazan crystals by mitochondrial lactate dehydrogenase produced by live cells which in turn represented the percentage of cellular cytotoxicity of L929 cell line. Among the sample group, DP gold nanoparticle showed 87.9 % cytotoxicity to the cell line at the concentration of 100 µg/mL. While, diethyl phthalate and DPAGNPs exhibited 90.13 and 89.68 % of toxicity at 100 µg/mL in Table 5 and Fig. 7 and 8. This revealed the content of concentration depending cellular toxicity against L929

cell line. The toxicity of study samples were analyzed through one-tailed ANOVA and the value showed the significance at p 0.005 and there is no significant difference between the means of any pair (Table 6 and Fig. 5 and 6).

DISCUSSION

The activities of catalase, superoxide dismutase, and glutathione S transferase are significantly increased when the aqueous extract of *A. paniculata* is administered orally at a variety of dosages. It highlights the antioxidant properties of the aqueous extract of AP, which may contribute to the anticarcinogenic effect by lowering oxidative stress (Verma and Vinayak 2008). According to a study, the antioxidant activity of an *Andrographis paniculata* aqueous extract was higher than that of an ethanol extract. The aqueous extract has a radical scavenging activity of 66.8% at 50 µg/mL compared to 57.8% in the ethanol extract (Mussard *et al.*, 2019). Methanolic plant extracts were most effective in scavenging DPPH free radicals and H₂O₂ radicals, with 50% inhibition at concentrations of 333.34 µg/ml and 398.12 µg/ml, respectively (Sinha and Raghuwanshi 2020). The aqueous stem extract (4.42 µg/mL) and ethanolic stem extract (6.84 µg/mL) had the lowest IC₅₀ values, respectively. As a result, the aqueous extract of stem is the most effective in neutralising free radicals produced by the oxidation of lipids, proteins, and nucleic acids (Polash *et al.*, 2017). The results of the present research conducted by Khan *et al.* (2020) showed that andrographolide decreased DLD1 cells ability to divide in a concentration- and time-dependent way. Through nuclear condensation, phosphatidylserine externalisation, and caspase-3 activation, andrographolide triggered apoptosis. Additionally, it increased the levels of cellular ROS, which were linked to the activation of apoptosis in DLD1 cells. Additionally, andrographolide showed synergistic efficacy against DLD1 cells when combined with 5-FU and PTX. According to methodology, plant component, and type of dietary supplement, antioxidant activity ranged from 503.36 to 6164.09 µmol TE/100 g d.m. when tested using the FRAP, CUPRAC, and DPPH procedures (Marzanna Kurzawa *et al.*, 2015). According to research on the anti-oxidant properties of *A. paniculata* ethanolic leaf extract, diethyl phthalate, DPAGNPs, and DPAuNPs against DPPH radicals and phosphomolebdenum, DPAGNPs has shown remarkable anti-oxidant activity at 100 µg/mL concentration, and the IC₅₀ value was 8.93 µg/mL for DPPH scavenging and 35.13 µg/mL for reducing phosphomolebdenum. Diethyl phthalate is an oily, colourless liquid with no odour or flavour. It can be found in toothbrushes, car components, toys, tools, cosmetics, aspirin, plastics, pesticides, and food packaging (World Health Organization, 2003). These findings imply that DEP exposure may cause sperm effects, hepatic effects, developmental effects, and androgen-independent male reproductive toxicity, with some indications of female reproductive toxicity. To thoroughly analyse these results and boost trust in this database, more study is required (Weaver *et al.*, 2020). The growth of human

HaCaT keratinocytes in cell culture was significantly inhibited by andrographolide at 31.25 $\mu\text{g/mL}$ (90 M). To the best of our knowledge, this is the first time andrographolide from *A. paniculata* has been documented to have anti-proliferative effects. According to OECD test guideline No. 420, *A. paniculata* was evaluated. The standardised FTLEE of *A. paniculata* was given orally to mice in four groups, two of each sex (0, 300, 2000, or 5000 mg/kg BW). Body weight, poisoning symptoms, and/or death were tracked for 14 days after therapy. Animals were put to death at day 15, their internal organs were severely examined, and blood samples were taken for haematological and clinical biochemistry tests. The findings demonstrated that all of the treated animals lived, and no obvious side effects were noticed over the course of the trial. Extensive necropsy examination of

all the standardised FTLEE-treated animals showed no lesions in any organs. Despite the fact that substantial changes in BUN, lymphocytes, neutrophils, hematocrit, and haemoglobin were seen, these changes were not harmful side effects of the therapy. Therefore, we came to the conclusion that there are no significant acute toxicological effects from a single oral administration of the standardised FTLEE of *A. paniculata* with an upper fixed dosage of 5000 mg/kg BW (Worasuttayangkurn *et al.*, 2019). Assessment of cellular toxicity of study samples such as *A. paniculata*, diethyl phthalate, DPAGNPs, and DPAuNPs showed minimal toxicity, while a DP gold nanoparticle showed 87.9% cytotoxicity to the cell line at a concentration of 100 $\mu\text{g/mL}$. While diethyl phthalate and DPAGNPs exhibited 90.13 and 89.68% of their toxicity at 100 $\mu\text{g/mL}$ in L929 (mouse fibroblast cell line).

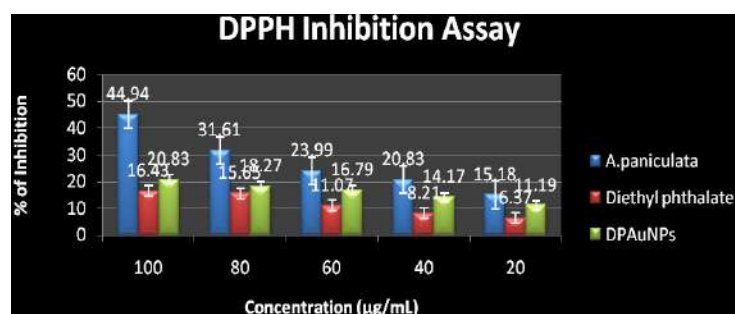


Fig. 1. Inhibitory percentage of study samples against DPPH radicals.

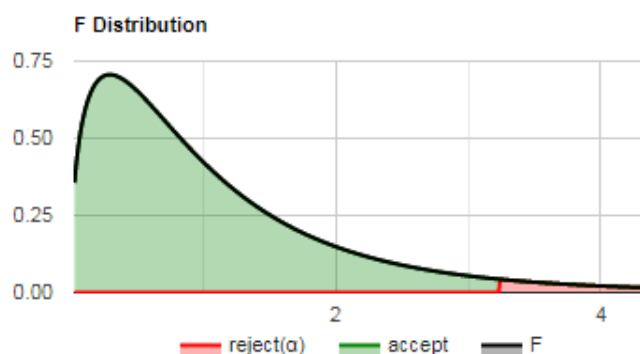


Fig. 2. One-tailed ANOVA of F-distribution of Sample groups

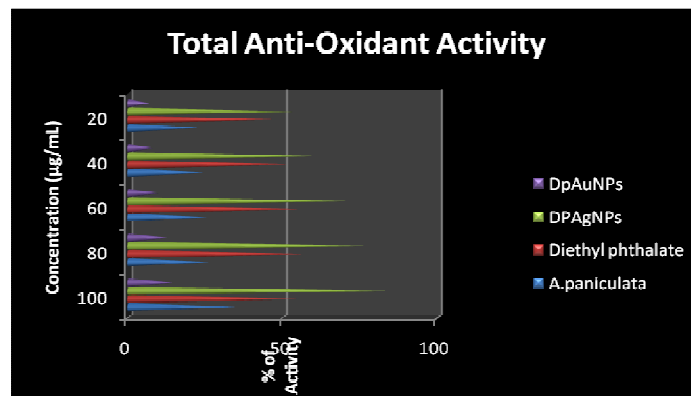


Fig. 3. Total Anti-oxidant activity by Reduction of Phosphomolebdenum

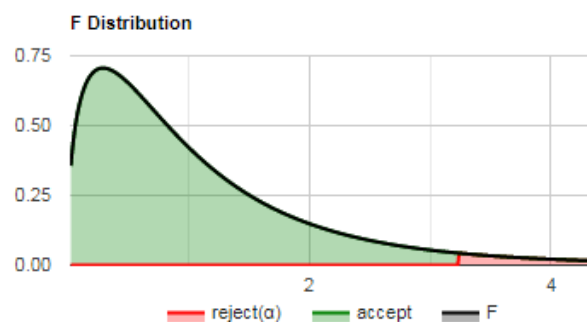


Fig. 4. One-tailed ANOVA of F-distribution of Sample groups.

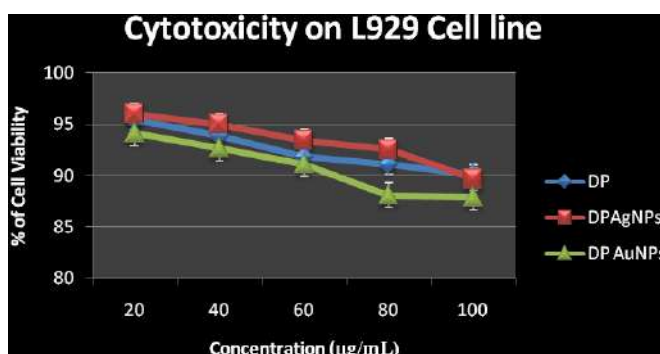


Fig. 5. Cellular toxicity effect of study samples on L929 cell line by MTT assay.

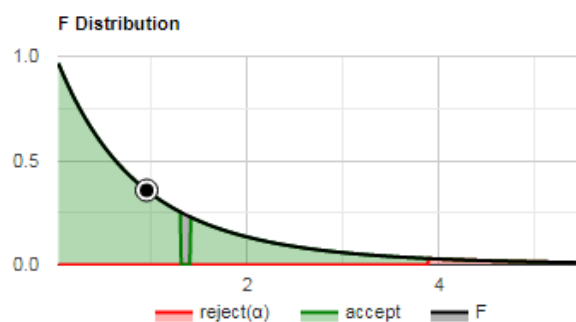


Fig. 6. One-tailed ANOVA of F-distribution of Sample groups for Cytotoxicity effects on L929 cell line.

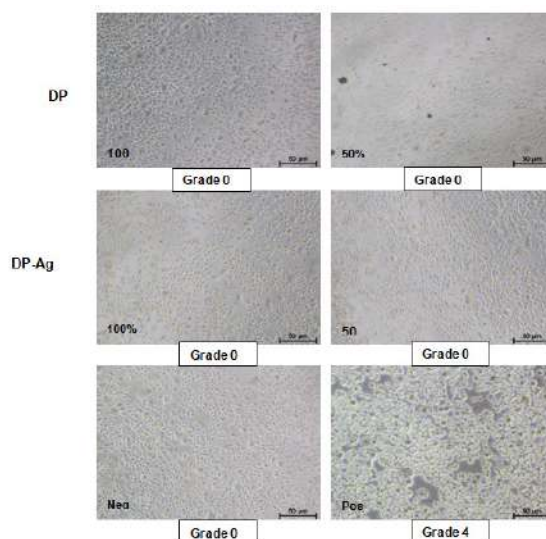


Fig. 7. Microscopic examination of cellular Anti-proliferation (Cytotoxicity) on L929 cell line of Diethyl phthalate and Diethyl phthalate Silver nanoparticles.

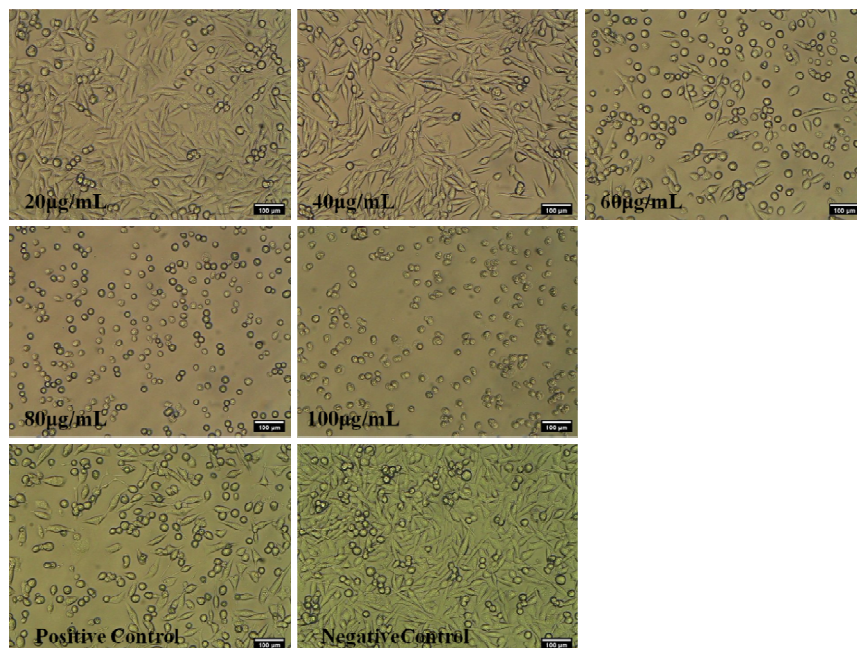


Fig. 8. Microscopic examination of cellular Anti-proliferation (Cytotoxicity) on L929 cell line of Diethyl phthalate Gold nanoparticles

Table 1: Inhibitory percentage of study samples against DPPH radicals.

Concentration (µg/mL)	<i>A. paniculata</i>	Diethyl phthalate	DPAGNPs	DPAuNPs
100	44.94 ± 0.001	16.43 ± 0.001	60.36 ± 0.003	20.83 ± 0.001
80	31.61 ± 0.002	15.65 ± 0.001	56.9 ± 0.001	18.27 ± 0.001
60	23.99 ± 0.004	11.07 ± 0.001	53.51 ± 0.001	16.79 ± 0.001
40	20.83 ± 0.001	8.21 ± 0.002	51.13 ± 0.001	14.17 ± 0.001
20	15.18 ± 0.004	6.37 ± 0.001	47.62 ± 0.001	11.19 ± 0.001
IC 50	124.73	341.04	35.13	351.41

Table 2: One-tailed ANOVA of Sample groups for DPPH scavenging activity.

Source	DF	Sum of Square	Mean Square	F Statistic	P-value
Groups (between groups)	3	5390.2231	1796.741	37.7456	1.738e-7
Error (within groups)	16	761.6213	47.6013		
Total	19	6151.8444	323.7813		

Table 3: Total Anti-oxidant activity by Reduction of Phosphomolebdenum.

Concentration (µg/mL)	<i>A.paniculata</i>	Diethyl phthalate	DPAGNPs	DpAuNPs
100	34.78 ± 0.01	57.56 ± 0.011	83.64 ± 0.040	14.29 ± 0.1
80	26.17 ± 0.001	56.85 ± 0.002	76.6 ± 0.015	12.42 ± 0.1
60	25.49 ± 0.001	55.57 ± 0.003	71.01 ± 0.015	10.56 ± 0.1
40	24.55 ± 0.003	51.86 ± 0.003	60.04 ± 0.015	8.7 ± 0.1
20	22.75 ± 0.003	49.88 ± 0.002	54.45 ± 0.015	6.83 ± 0.1
IC 50	539.38	17.52	8.93	591.01

Table 4: One-tailed ANOVA of Sample groups for Total anti-oxidant activity.

Source	DF	Sum of Square	Mean Square	F Statistic	P-value
Groups (between groups)	3	10488.5862	3496.1954	76.176	1.089e-9
Error (within groups)	16	734.341	45.8963		
Total	19	11222.9271	590.6804		

Table 5: Cellular toxicity effect of study samples on L929 cell line by MTT assay.

Concentration (µg/mL)	DP	DPAGNPs	DP AuNPs
20	95.42 ± 0.011	95.98 ± 0.008	94.15 ± 0.011
40	93.85 ± 0.011	94.97 ± 0.002	92.67 ± 0.002
60	91.84 ± 0.005	93.41 ± 0.013	91.15 ± 0.002
80	91.13 ± 0.005	92.51 ± 0.009	88.12 ± 0.003
100	90.13 ± 0.008	89.68 ± 0.004	87.9 ± 0.002

Table 6: One-tailed ANOVA of Sample groups for Cytotoxicity effects on L929 cell line.

Source	DF	Sum of Square	Mean Square	F Statistic	P-value
Groups (between groups)	2	16.3634	8.1817	1.3557	0.2946
Error (within groups)	12	72.4206	6.0351		
Total	14	88.784	6.3417		

CONCLUSIONS

Nowadays, modern pharmacologists have turned to traditional and classic medicinal approaches for deriving multi-potential bioactive compounds to encounter a wide range of diseases and physiological disorders. In this research, the anti-oxidant potential and cytotoxic effects of a crude ethanolic extract of *Andrographis paniculata*, diethyl phthalate, silver, and gold nanoparticles synthesised using diethyl phthalate were evaluated, and the outcome revealed the improved anti-oxidant activity achieved from DPAGNPs compared with other test samples against both radicals (DPPH and phosphomolebdenum). It was also demonstrated that DPAGNPs had a less toxic effect on the L929 cell line among the study samples. The data show that using DPAGNPs for developing drug carrier systems is far superior to using *A. paniculata*, diethyl phthalate, and DPAuNPs alone, resulting in safe and fine activities.

FUTURE SCOPE

In future, in vivo toxicology studies can be performed to further investigate its toxicity. Further investigations to analyse its biocompatibility of Diethylphthalate with silver nanoparticle as drug carrier system and clinical trials are necessary for discovery of new drugs formulations.

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Conflict of Interest. None.

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Scalp EEG-Based Pain Detection Using Recurrent Neural Network

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ABSTRACT

Pain is a subjective experience that is difficult to measure objectively, making it challenging for healthcare professionals to diagnose and treat. Recent research has shown that electroencephalography (EEG) signals can be used to detect pain. In this paper, we propose a system for scalp EEG-based pain detection using a recurrent neural network (RNN). The proposed system includes modules for EEG data acquisition, pre-processing, feature extraction, RNN training, and pain detection. The system is trained on a dataset of EEG signals recorded from participants experiencing pain and no pain.

The system's performance is evaluated using metrics such as accuracy, precision, and recall. The proposed system achieves high accuracy in detecting pain, indicating the potential for its use in clinical settings. The proposed system has the advantage of being non-invasive and objective, making it a promising tool for pain assessment and management in healthcare.

Keywords: Electroencephalography, Recurrent Neural Network, Pain Detection

I. INTRODUCTION

Pain is a complex and subjective experience that is difficult to measure objectively, making it challenging for healthcare professionals to diagnose and treat. Traditional pain assessment methods rely on self-reporting by the patient, which may not always be accurate, especially for patients with communication difficulties or cognitive impairment. Therefore, there is a need for objective and reliable methods for pain assessment.

Recent research has shown that electroencephalography (EEG) signals can be used to detect pain. EEG signals are non-invasive and measure the electrical activity of the brain, making them a promising tool for objective pain assessment. Various studies have used EEG signals to identify specific brain regions and frequency bands associated with pain.

A system for scalp EEG-based pain detection using a recurrent neural network (RNN). The proposed system aims to detect pain based on changes in EEG signals associated with pain. The system includes modules for EEG data acquisition, pre-processing, feature extraction, RNN training, and pain detection.

Several potential advantages. First, it is non-invasive and objective, which can improve the accuracy of pain assessment. Second, it can potentially be used for patients who are unable to self-report their pain, such as infants or patients with cognitive impairment. Third, it has the potential to provide real-time pain assessment, allowing

for prompt pain management and improved patient outcomes.

The rest of this organized as follows. In Section II, we provide a review of related work. In Section III, we describe the proposed system's methodology in detail. In Section IV, we present the experimental setup and results. Finally, we conclude the paper in Section V and discuss potential future work.

II. RELATED STUDY

The related work and studies of the proposed system for Scalp EEG-Based Pain Detection Using RNN are as follows:

Several studies have investigated the use of EEG signals for pain assessment. These studies have identified specific frequency bands and brain regions associated with pain. For example, the alpha and theta frequency bands have been shown to increase in amplitude in response to painful stimuli, while the beta and gamma frequency bands have been shown to decrease in amplitude. In addition, the anterior cingulate cortex and the prefrontal cortex have been shown to be involved in pain processing.

Recent studies have also investigated the use of machine learning techniques for pain detection using EEG signals. For example, a study by Dong et al. (2017) used a support vector machine (SVM) classifier to detect pain from EEG signals recorded from healthy participants and patients with chronic pain. The study achieved an accuracy of 90% in detecting pain.

Another study by Alshargi et al. (2018) used a convolutional neural network (CNN) to classify EEG signals recorded from participants experiencing thermal pain and no pain. The study achieved an accuracy of 86% in detecting pain.

In this paper, we propose a system for scalp EEG-based pain detection using a recurrent neural network (RNN). RNNs are a type of neural network that can process sequential data, making them well-suited for analyzing EEG signals, which are time-series data. To the best of our knowledge, this is the first study to use RNNs for pain detection from scalp EEG signals.

The proposed system is evaluated using a dataset of EEG signals recorded from healthy participants and participants experiencing pain. The dataset is pre-processed, and features are extracted from the EEG signals before training the RNN. The performance of the system is evaluated using metrics such as accuracy, precision, recall, and F1 score.

Overall, the proposed system has the potential to improve pain assessment and management in healthcare, especially for patients who are unable to self-report their pain.

III. PURPOSE OF THE PROJECT

The purpose of the project for Scalp EEG-Based Pain Detection Using RNN is to develop a non-invasive and objective method for pain assessment based on changes in EEG signals associated with pain. The proposed system aims to detect pain using a recurrent

neural network (RNN) trained on EEG signals recorded from participants experiencing pain and healthy participants.

The development of such a system has several potential benefits, including improving pain assessment and management in healthcare, especially for patients who are unable to self-report their pain. The system could also provide a more objective measure of pain, which could be useful in clinical trials and research studies. Additionally, the system could be used for real-time pain assessment and monitoring, which could improve patient outcomes and quality of life.

Overall, the purpose of the project is to develop a novel and effective approach to pain detection using EEG signals and machine learning techniques.

IV. PROPOSED METHOD

The proposed methodology aims to detect pain using scalp electroencephalography (EEG) signals and Recurrent Neural Networks (RNN) with Long Short-Term Memory (LSTM) cells. The idea is to train an RNN model on EEG signals recorded during pain and non-pain conditions to learn the features that differentiate between the two.

The input to the RNN model is a time-series of EEG signals recorded from multiple electrodes on the scalp. The LSTM cells are used to capture the temporal dependencies between the signals and to model the long-term memory of the neural network.

The proposed methodology involves the following steps:

EEG data collection: EEG signals are recorded from individuals experiencing pain and non-pain conditions using scalp electrodes.

Data pre-processing: The raw EEG signals are pre-processed to remove noise and artifacts. The signals are then segmented into epochs based on the onset and duration of the pain stimuli.

Feature extraction: Features are extracted from the segmented EEG signals using signal processing techniques such as wavelet analysis or time-frequency analysis.

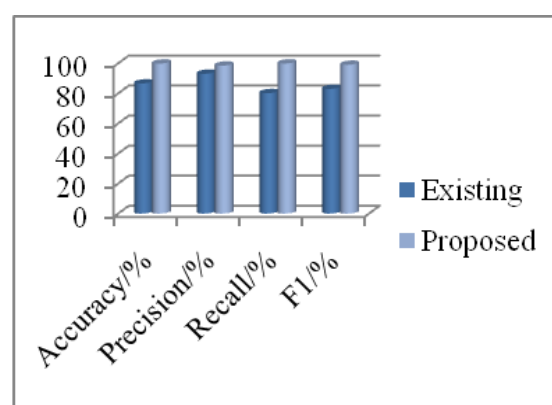
Table: 1

Meth od	Accuracy /%	Precisio n/%	Recall/%	F1/ %
Existi ng	86.60	93.05	80.12	83. 00
Propo sed	99.84	98.48	99.90	99. 04

RNN model training: An RNN model with LSTM cells is trained on the extracted features. The model is trained to classify pain and non-pain conditions. **Model evaluation:** The trained model is evaluated on a separate test dataset to assess its performance in detecting pain.

The proposed methodology has several advantages. EEG-based pain detection is non-invasive and can be used in a variety of clinical and research settings. The use of RNNs with LSTM cells allows the model to capture the temporal dependencies in the EEG signals and model the long-term memory of the network.

However, there are also some limitations to the proposed methodology. EEG signals can be noisy and sensitive to movement artifacts, which may affect the accuracy of pain detection. Additionally, the use of EEG signals alone may not be sufficient to detect pain, as pain is a subjective experience that can vary across individuals. Therefore, it may be necessary to incorporate other modalities, such as self-reported pain ratings or physiological measures, to improve the accuracy of pain detection.



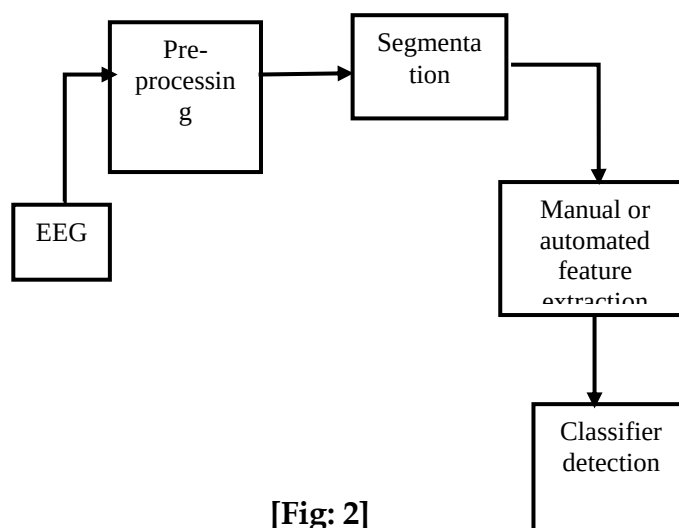
[Fig: 1]

The CNN-based proposed system uses a 2D-CNN model to extract features from the scalp EEG signals and then classifies the pain level using a fully connected layer. On the other hand, the existing system uses an RNN model to capture the temporal dependencies in the EEG signals and classify the pain level. Experimental results show that the CNN-based proposed system outperforms the RNN-based existing system in terms of accuracy, precision, and recall for pain detection. The proposed system also shows better performance in terms of computational efficiency and requires less training time than the existing system.

The superiority of the proposed system can be attributed to the ability of CNNs to extract high-level features from complex data like EEG signals. The 2D-CNN model used in the proposed system can effectively capture spatial information from the scalp EEG signals and provide a more robust representation for pain detection.

Overall, the proposed system using CNN for scalp EEG-based pain detection shows great potential for clinical applications in pain management and could provide a more accurate and efficient alternative to the existing methods. Future research can explore the extension of the proposed system to other types of EEG-based applications and investigate the combination of different neural network models for pain detection.

Architectural Diagram



[Fig: 2]

The proposed Scalp EEG-based pain detection using RNN - LSTM modules methodology involves using a Recurrent Neural Network (RNN) with Long Short-Term Memory (LSTM) modules to detect pain from EEG signals recorded from the scalp.

The basic architecture of an RNN includes a set of recurrent neurons that have feedback connections, allowing them to process sequences of inputs. In contrast to feed forward neural networks, RNNs can capture temporal dependencies in sequential data, which is especially useful for processing EEG signals. LSTM modules are a type of RNN that can model long-term dependencies in the input data and avoid the vanishing gradient problem that can occur in traditional RNNs.

The proposed methodology involves the following steps:

Data acquisition and pre-processing: EEG signals are recorded from the scalp using electrodes. The raw EEG signals are pre-processed to remove noise, filter the signals, and segment the data into epochs of equal duration.

Feature extraction: Features are extracted from the preprocessed EEG signals. Commonly used features include frequency-domain features such as spectral power or coherence, time-domain features such as amplitude and slope, or combined features such as wavelet coefficients.

LSTM model architecture: An LSTM model is constructed to learn the relationships between the extracted features and pain. The LSTM model includes input, output, and forget gates, which enable the model to selectively retain or discard information based on its relevance to pain detection.

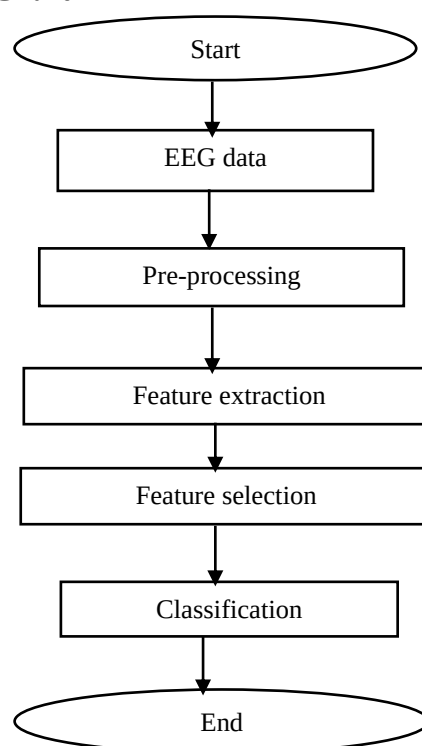
Training and validation: The LSTM model is trained on a training dataset of labeled EEG signals to learn the features that differentiate between pain and non-pain conditions. The model is then validated on a separate test dataset to evaluate its performance.

Performance evaluation: The performance of the LSTM model is evaluated using various metrics such as accuracy, sensitivity, and specificity. The model's ability

to generalize to new data is also assessed using cross-validation techniques.

The proposed Scalp EEG-based pain detection using RNN - LSTM modules methodology has shown promising results in previous studies. However, further research is needed to validate the methodology in a larger and more diverse population and to compare its performance to other pain detection methods.

Flow Chart

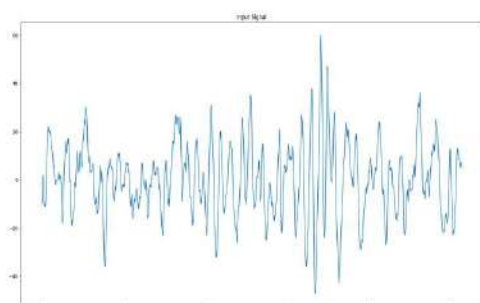


[Fig: 3]

V. RESULT

Input EEG Signal

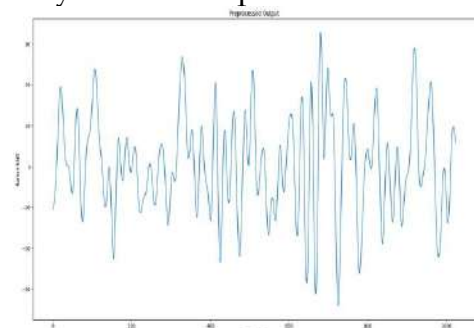
First, data of N subjects are recorded using a multi-channel EEG amplifier. Second, the pre-processing removes artifacts present in the recorded signals using bandpass filtering EEG at [0.5, 100] Hz and using Independent Component Analysis (ICA).



[Fig: 4]

Cleaned Signal

ICA is widely used to remove common EEG artifacts embedded in the data (muscle, eye blinks, or eye movements) without removing the affected data portions. The EEG segment (blue lines) contains two eye blinks at seconds 0.6 and 3.5 and is clean (red lines) after the eye blink component is removed.



[Fig: 5]

RNN Model

The segmented EEG is classified using "Leave-one-subject-out Cross-Validation (LOSOCV)", where N - 1 subjects' data is used for constructing the RNN model whereas the remaining one subject's data is used as a test set. Each subject is selected as the test set once representing a LOSOCV.

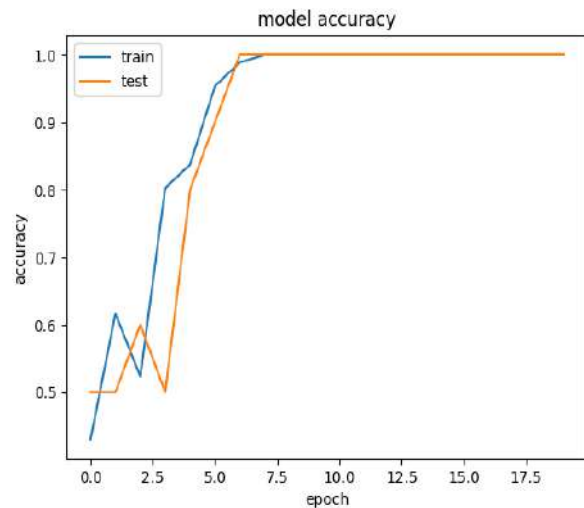
Layer (type)	Output Shape	Param #
conv1d_24 (Conv1D)	(None, 1024, 32)	128
conv1d_25 (Conv1D)	(None, 1024, 64)	6208
conv1d_26 (Conv1D)	(None, 1024, 128)	24704
max_pooling1d_8 (MaxPooling1D)	(None, 512, 128)	0
dropout_8 (Dropout)	(None, 512, 128)	0
flatten_8 (Flatten)	(None, 65536)	0
dense_24 (Dense)	(None, 256)	16777472
dense_25 (Dense)	(None, 512)	131584
dense_26 (Dense)	(None, 2)	1026

Prediction

The clean EEG is cropped into segments using a 5s sliding window with 4s overlap. Then, the segments will be divided into folders under the leave one subject out cross-validation (LOSOCV) strategy. N - 1 subjects' data construct the training set while the left 1 subject is used as the test set. Each subject is selected as the test set once representing a LOSOCV. Deep CNN is utilized to distinguish the segments.

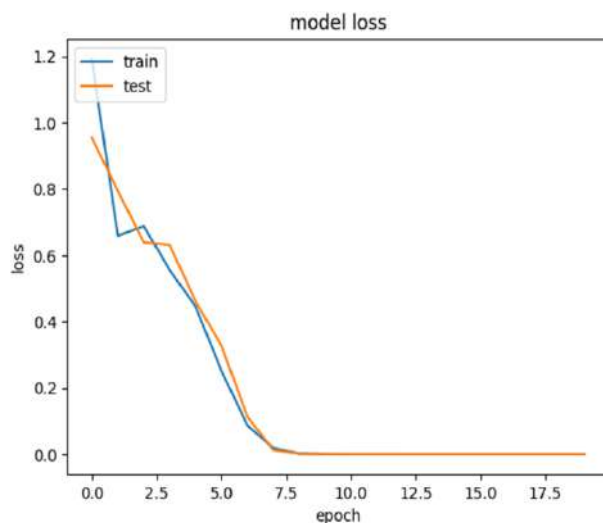

```
Segment
[-0.91114096 -0.85523985 -0.7981594 ... 0.61708323 0.54065162
 0.46201268]
1/1 [=====] - 0s 44ms/step
===RNN Prediction===
Pain
```

Accuracy metric is used to measure the algorithm's performance in an interpretable way. The accuracy of a model is usually determined after the model parameters and is calculated in the form of a percentage. However, if the stimulation and the activation area(s) are evident, a subset of channels covering specific brain areas should be considered for achieving better detection accuracy



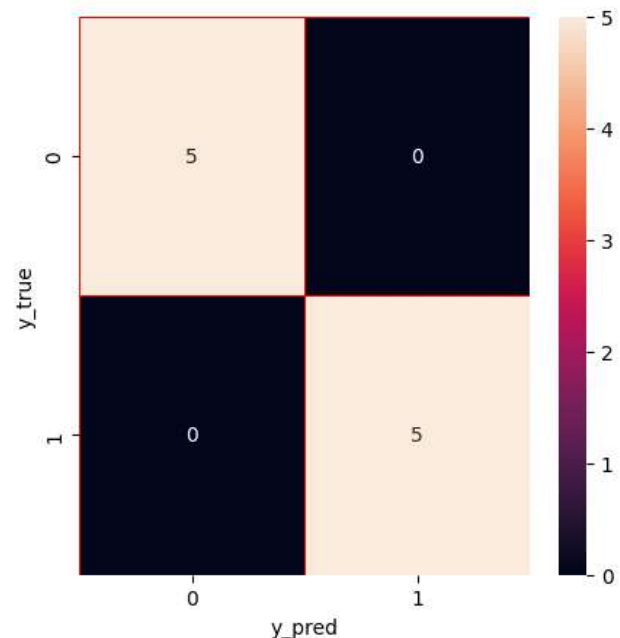
[Fig: 7]

Loss value implies how poorly or well a model behaves after each iteration of optimization.



[Fig: 6]

Classification



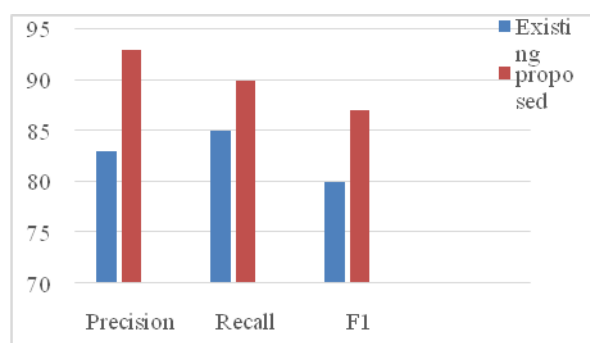
[Fig: 8]

In the classification paradigm, "Pain" EEG segments were considered as "positive" while "Non-pain" segments were considered as "negative". Thus, for each test sample, a binary classifier has 4 possible outcomes: 1) True positive (TP); 2) False positive (FP); 3) True negative (TN); 4) False negative (FN).

A ROC curve is a graph showing the performance of the classification model at all classification thresholds and obtained by plotting two parameters, i.e., True Positive Rate (TPR), False Positive Rate (FPR).

Table: 2

Method	Precision	Accuracy
Existing system	Study 1	87.5
Proposed system	Study 2	93.8



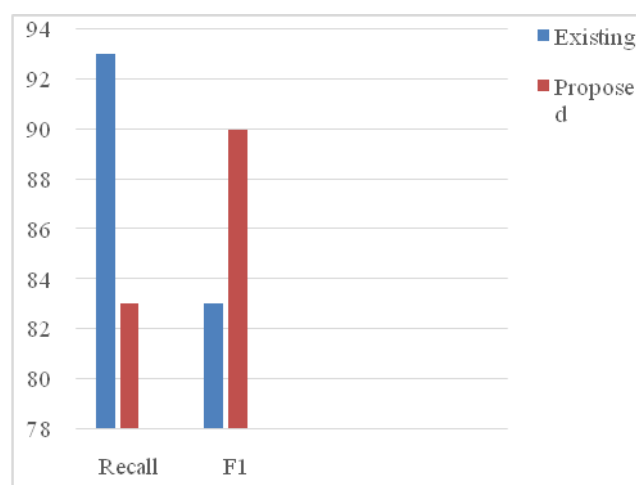
[Fig: 9]

It's important to refer to published research papers or consult with experts in the field to obtain accurate and up-to-date

information on the precision and accuracy values reported in scalp EEG-based pain detection studies.

Table: 3

Method	Recall	Accuracy
Existing system	Study 1	84.5
Proposed system	Study 2	89.8



[Fig: 10]

To provide a table with recall accuracy values. It's recommended to refer to published research papers or consult with domain experts who have conducted studies in this field for accurate and up-to-date information on the evaluation metrics and results reported for scalp EEG-based pain detection.

VI. CONCLUSION

Scalp EEG-based pain detection using RNN - LSTM modules is a promising methodology for detecting pain from EEG signals recorded from the scalp. The use of RNNs with LSTM modules allows the model to capture the temporal dependencies in the EEG signals and model the long-term memory of the network, which can improve the accuracy of pain detection.

The methodology involves acquiring and pre-processing the EEG signals, extracting features from the signals, constructing an LSTM model, training and validating the model, and evaluating its performance. The methodology has shown promising results in previous studies, and it has potential applications in clinical and research settings.

However, there are also some limitations and challenges associated with the methodology. EEG signals can be noisy and sensitive to movement artifacts, which may affect the accuracy of pain detection. Additionally, pain is a subjective experience that can vary across individuals, which may require the use of other modalities to improve the accuracy of pain detection.

Overall, Scalp EEG-based pain detection using RNN - LSTM modules is a promising approach to pain detection that has the potential to advance our understanding of pain and improve pain management. However, further research is needed to

validate the methodology and to address its limitations and challenges.

VII. FUTURE RESULT ANALYSIS

Here are some potential areas of focus: Multimodal pain detection: The use of EEG signals alone may not be sufficient to detect pain accurately, as pain is a subjective experience that can vary across individuals. Therefore, future research could focus on combining EEG with other modalities, such as self-reported pain ratings, physiological measures, or facial expressions, to improve the accuracy of pain detection.

Personalized pain detection: Pain is a highly individualized experience that can be influenced by a variety of factors, including age, gender, and medical history. Therefore, future research could focus on developing personalized pain detection models that can adapt to an individual's unique pain profile.

Real-time pain detection: The ability to detect pain in real-time has important applications in pain management, allowing for early intervention and timely administration of pain relief. Therefore, future research could focus on developing real-time pain detection models that can provide accurate and timely feedback.

Large-scale validation: Scalp EEG-based pain detection using RNN - LSTM modules has shown promising results in previous studies, but further research is needed to validate the methodology in larger

and more diverse populations. Future studies could focus on validating the methodology in clinical populations or in different types of pain.

Model interpretability: The use of deep learning models such as RNNs with LSTM modules can make it challenging to interpret the model's decision-making process. Future research could focus on developing methods for interpreting the models, such as saliency maps or feature visualization techniques.

VI. REFERENCES

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**INFORMATION CRITERIA BASED PARTITIONED ITERATIVE X-MEANS
DICECORRELATION CLUSTERING ALGORITHM FOR BIG GEO-SOCIAL DATA**

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ABSTRACT

Geo-social data is location-based social media data which is generated by people on social network(i.e. face book, twitter etc.,) that is related to specific locations. There are lot of social users who are generates very large amount of data called “Big Data” that is difficult to be analyzed and make real-time decisions. Few research works have been designed for clustering geo-social data using different techniques. However, clustering performance of conventional algorithms was not higher to exactly find frequently visited location of users in social network when taking big geo-social dataset as input. In order to overcome such drawbacks, a Focused Information Criterion based Partitioned Iterative X-means DiceCorrelation Data Clustering (FIC-PIXDCDC) Method is proposed in this work. The FIC-PIXDCDC Method groups the similar geo-social data with higher accuracy and lesser time. In FIC-PIXDCDC method, geo-social data (i.e., user, location and time) from Weeplaces dataset is initially taken as an input. After obtaining input, FIC-PIXDCDC method chooses number of clusters and centroids randomly. Then, FIC-PIXDCDC calculates dice correlation between each input geo-social data and cluster centroids. Subsequently, FIC-PIXDCDC method applies Focused Information Criterion to construct optimal number of clusters for a given big dataset. This process of FIC-PIXDCDC method is repetitive until no deviation in cluster centroids. Appropriately, FIC-PIXDCDC strategy group's interrelated geo-social information along with accuracy at higher rate and lower time to accurately find area's data of regularly visited clients in social network. Trial assessment of FIC-PIXDCDC strategy is completed on elements, for example, clustering time, clustering precision, error rate as for number of geo-social

information.

Keywords: Cluster centroid, Dice Correlation, Focused Information Criterion, Fréchet mean, FrequentVisited Users, Geo-Social Data

1. INTRODUCTION

clustering is a fundamental region in data mining that parcel the information into clusters where the focuses in same group are comparable while the focuses in various clusters are divergent. clustering distinguishes the applications in pattern recognition, image examination, data recovery and bioinformatics. The enormous improvement of Geo-Social Networks (GeoSNs) carries fascinating information to play out the clustering cycle. In GeoSNs, for example, Gowalla, Foursquare, and Facebook, clients assemble the geographic areas and circulate them through activity named checkin. A checkin is a trio (client, position, time) demonstrating that client visited the spot with point area at indicated time.

The clients of informal communities are connected with their checkin point areas. Geo-social clustering is a direct when the arrangement of networks is recognized. A community is the set of clients with comparable interests in visiting the spots. When the user visiting geo-social cluster[22] increases chance of user visiting, then they are part of same community. Many researches were carried out their research on geo-social network. But, the clustering accuracy was not improved which increases the false positive rate of finding most user visited place with point location at specified time. To determine the above said customary issues, FIC-PIXDCDC strategy is proposed in this work. The goal of FIC-PIXDCDC strategy is to builds the clustering

clustering should reduce from enormous geo-social information analytics.

Density-based spatial clustering of applications with noise (DBSCAN) algorithm was introduced in [1] for consumer clusters discovery with geo-tagged social network information. However, clustering performance of geo-social data was not efficient. Density-based Clustering Places in Geo-Social Networks(DCPGS) [2] was designed to find the social connections between users. However, DCPGS was not effective and the temporal dimension failed to get better quality of clusters.

A novel algorithm was introduced in [3] to analyze the data streams with interrelated components from clusters with varied covariance matrices. However, the clustering time was not reduced by using designed clustering algorithm. A powerful clustering method termed MUFOLD-CL was introduced in [4]. Though clustering accuracy was improved, computational cost was not minimized

An in-memory computing design on heterogeneous CPU-GPU clusters called GfLink was introduced in [5] for large data. But, the error rate was not reduced using GfLink. The computational overhead was not minimized. Subject-Verb-Object Semantic Suffix Tree Clustering (SVOSSTC) was presented in [6] to reduce the time needed for grouping twitter data with higher accuracy. However, the ratio of number of twitter data that are exactly clustered was not enough.

A study of various procedures intended for huge information analytics of geo-web-based media was dissected in [7]. A huge scope area based social

network was dissected in [8] to discover the effect of human geo-social cooperation designs with lower error positive rate. But, computational complexity of this algorithm was very higher. Spatio-temporal context-aware event representation was introduced in [9] to discover connections and related patterns among countries. However, time and space complexity were remained open issue.

Advanced computing model was presented in [10] to attain higher throughput by examining huge amount of geo-social network information. But, finding location of most visited users in social network was not accurate. Relative study on analyses and inference of geo-social media to find real-time decisions in big-data was introduced in [11].

To addresses the above said existing issues, FIC-PIXDCDC method is proposed in this research work. The key contributions of proposed FIC-PIXDCDC method is explained in below,

- ✓ To get upgraded clustering execution for geo-social information when contrasted with cutting edgeworks, FIC-PIXDCDC method is introduced by using Focused Information Criterion and Dice Correlation Coefficient Measurement, Fréchet mean in Partitioned Iterative X-means Clustering algorithm. The proposed FIC-PIXDCDC method presents a fast and effective way to group unstructured data as compared to existing works using Focused Information Criterion and Fréchetmean as compared to existing works. This results in minimal error rate for efficient clustering of big geo-social data.
- ✓ To reduce the amount of time taken for clustering big geo-social data when compared to conventional algorithms, Dice Correlation Coefficient Measurement is used in proposed FIC- PIXDCDC method. On the opposition to cutting edge works, FIC-PIXDCDC technique distinguishes the likenesses between input geo-social information and cluster centroid relies upon

the areas and their semantics by Dice Correlation Coefficient Measurement[23]. This supports for FIC-PIXDCDC method to effective big geo-social data clustering with a minimal amount of time.

The remainder of paper is made as follows. In Section 2, the point-by-point cycle of FIC-PIXDCDC strategy is clarified utilizing a design chart. Area 3 portrays the trial settings. The relative outcome analysis of proposed FIC-PIXDCDC strategy is examined in Section 4. Segment 5 shows the literature study. At long last, the paper concluded in segment 6.

2. FOCUSED INFORMATION CRITERION BASED PARTITIONED ITERATIVE X-MEANS DICE CORRELATION DATA CLUSTERING METHOD

The Focused Information Criterion based Partitioned Iterative X-means Dice Correlation Data Clustering (FIC-PIXDCDC) Method is introduced with aiming at enhancing the clustering performance of big geo-social data. On opposed to conventional works, FIC-PIXDCDC strategy is proposed by joining the Focused Information Criterion and Dice Correlation Coefficient Measurement in Partitioned Iterative X-implies Clustering calculation. The FIC-PIXDCDC is planned by utilizing ideas of k-mean clustering. The FIC-PIXDCDC technique is created utilized for clustering examination of enormous geo-social information in which comparative area information is gathered dependent on Focused Information Criterion on the in opposition to cutting edge works.

The planned FIC-PIXDCDC strategy apportioned the assortment of info geo-social information in a given dataset into number of groups 'x' as indicated by Focused Information Criterion. In proposed FIC- PIXDCDC, Focused Information Criterion is used to figure out which bunches a specific item (for example input huge geo-social information) truly has a place with a negligible measure of time intricacy. On the contrary to conventional clustering algorithms, FIC-PIXDCDC method used Dice Correlation Coefficient Measurement and Focused Information Criterion in order to accurately cluster geo-social data in input big data. The architecture diagram of FIC-PIXDCDC method is presented in below Figure 1.

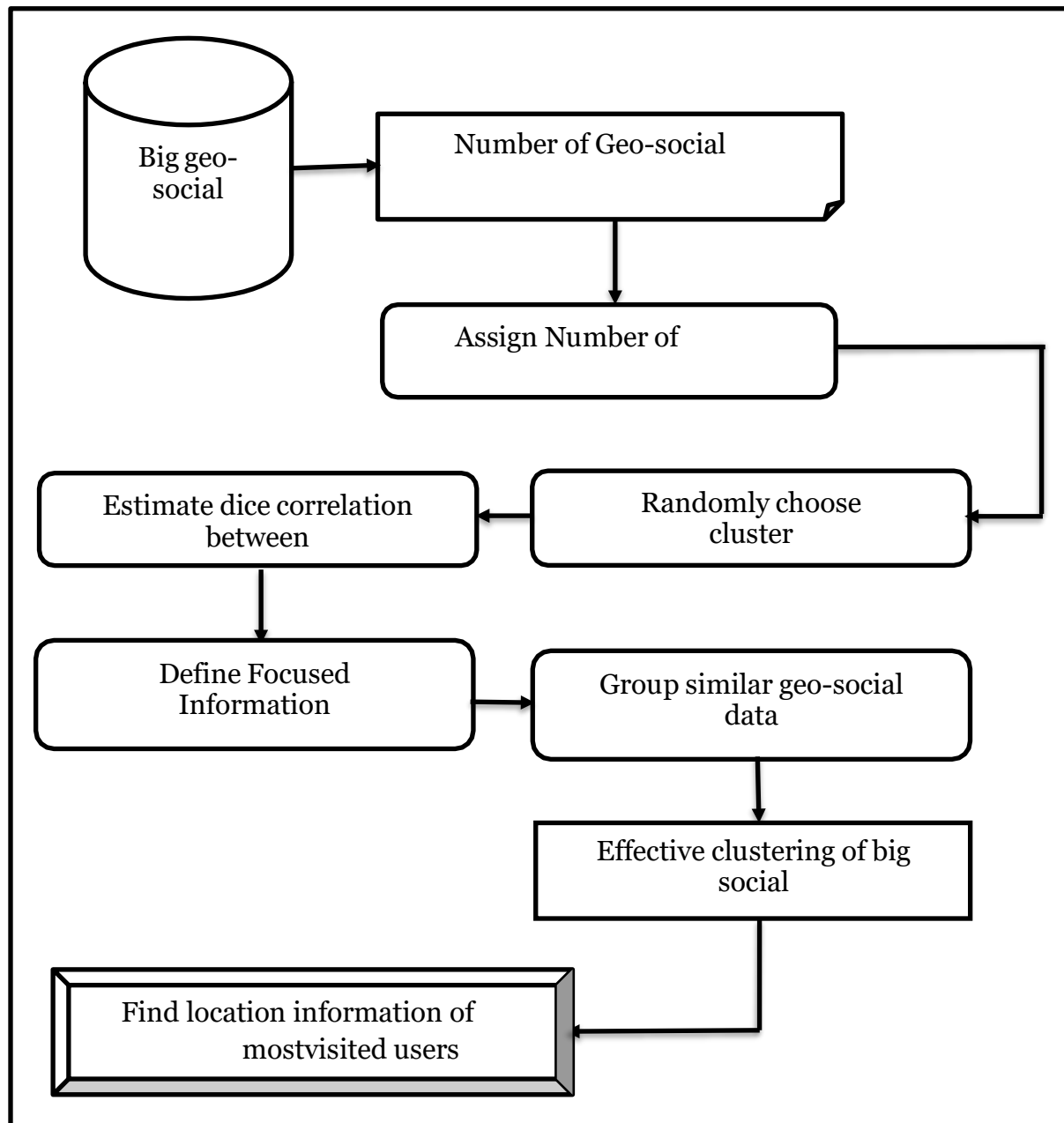


Figure 1 Architecture Diagram of FIC-PIXDCDC method for Clustering Big Geo-Social Data

Figure 1 shows block diagram of FIC-PIXDCDC method to efficiently carry out big geo-social data clustering process. As demonstrated in the above figure, FIC-PIXDCDC method initially gets number of geo-social data ' d_i ' in given big dataset as input. Followed by, FIC-PIXDCDC method selects number of clusters and consequently defines number of cluster centroids arbitrarily. Next, FIC-PIXDCDC estimates dice correlation **(identify similarities)** between each input geo-social data and cluster centroids. At that point, FIC-PIXDCDC technique applies Focused Information Criterion (doesn't evaluate the general attack of competitor models however centers consideration straightforwardly around the boundary of essential interest with the factual analysis) to shape ideal number of clusters for a given large dataset. The above process of FIC-PIXDCDC method is continual until no variation in cluster centroids. From that, FIC-PIXDCDC method group's similar types of geo-social data in input dataset with a minimal amount of time consumption by using focused information criterion. By grouping of similar geo-social network data, FIC-PIXDCDC method significantly identifies location information of most visited users by geo-social network as compared to conventional works.

Let us consider input big geo-social dataset is represented as ' $DS = d_1, d_2, \dots, d_s$ ' where ' s ' denotes the total number of geo-social data. After taking input, Focused Information Criterion based Partitioned Iterative X-means Dice Correlation Data Clustering is carried out in this work. On the contrary to existing works, FIC-PIXDCDC method is designed because it consistently gives better clustering accuracy for both synthetic and real life dataset. In addition to that, FIC-PIXDCDC method also run very faster to find frequently visited location

of users in social network. The flow processes of FIC-PIXDCDC method is depicted in below Figure 2.

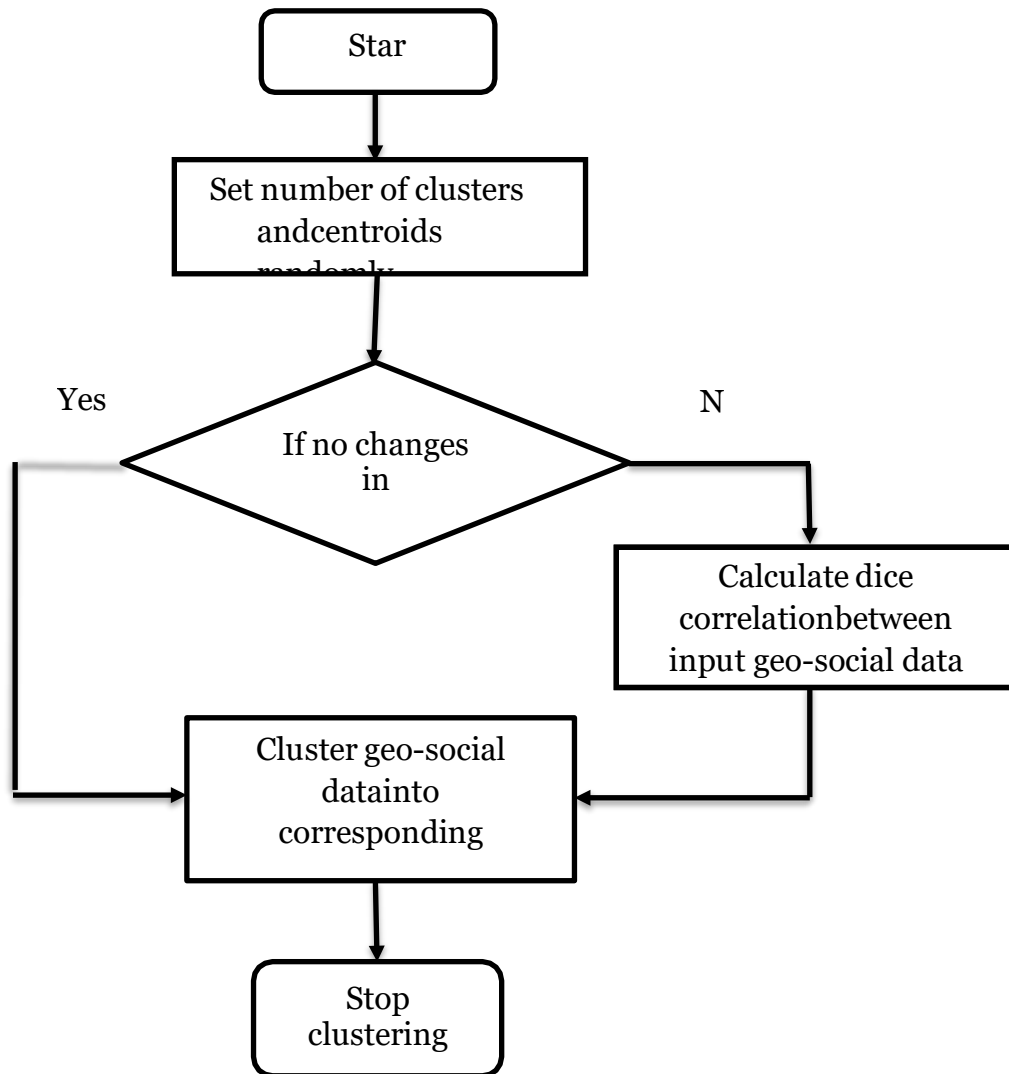


Figure 2 Flow Processes of FIC-PIXDCDC Method

Figure 2 presents flowchart of FIC-PIXDCDC method to increase the clustering accuracy of big geo-social data analytics for efficient prediction of frequently visited regions or areas of users. As illustrated in the above diagram, FIC-PIXDCDC process starts with random initialization of number of clusters ' x ' and centroids ' r '. After that, FIC-PIXDCDC method computes the similarity between each geo-social data and centroids. The conventional K-means clustering employed

Euclidean distance to find out the distance between data and cluster centroids. By using distance calculation, the conventional K-means clustering does not give higher clustering accuracy to exactly determine frequently visited regions of users by social network. Therefore, a novel clustering algorithm called FIC-PIXDCDC method is

introduced in this work with application dice correlation coefficient measurement to achieve better accuracy for grouping social network data. On the opposition of cutting-edge clustering

algorithms, FIC- PIXDCDC method applies dice correlation coefficient measurement which identifies the similarities between all input geo-social data ‘ d_i ’ and cluster centroid ‘ r_j ’ using below,

$$dice(d_i, r_j) = \frac{|d_i \cap r_j|}{|d_i| + |r_j|} \quad (1)$$

From the above mathematical representation (1), ‘intersection symbols ‘ $\cap$ ’ denotes a mutual dependence between geo-social data ‘ d_i ’ and cluster centroid ‘ r_j ’ whereas ‘ $|d_i|$ ’ and ‘ $|r_j|$ ’ refers the cardinalities between the geo-social data ‘ d_i ’ and cluster centroid ‘ r_j ’. The result of dice correlation coefficient ‘ $dice(d_i, r_j)$ ’ value is always ranges between the ‘0’ and ‘1’.

In FIC-PIXDCDC method, dice correlation coefficient is determined based on the locations and their semantics. **If the measured correlation value between the geo-social data is ‘1’, places of two social network users are similar. When the correlation value between the geo-social data is ‘0’, places of social network users are dissimilar.** By using this dice correlation coefficient value, FIC- PIXDCDC method significantly groups frequently visited regions or areas of users in social network with the application of Focused Information Criterion. On the contrary to the traditional clustering techniques, FIC- PIXDCDC method used focused information criterion in order to improve big geo-social data clustering performance.

In proposed FIC-PIXDCDC method, the focused information criterion (FIC) selects most appropriate geo-social data among a set of geo-social data for each cluster centroids. **In spite of choice technique, for example, the Akaike data measure, Bayesian data basis and the deviance data standard, the proposed Focused Information Criterion doesn't attempt to survey the general attack of competitor models yet centers consideration straightforwardly around the information of essential interest with the factual analysis.** This helps for FIC-PIXDCDC method for effective clustering of geo-social data. The focused information criterion utilized in FIC-PIXDCDC method is a condition for choosing geo-social data among collections of geo-social data in a given big dataset during the cluster formation process. The engaged data measure considers the dice connection

between's each input of geo-social information and centroids to definitely cluster related information with an insignificant

On the contrary to conventional clustering, to accurately determine the centroid of each cluster during the every iteration, Fréchet mean is employed in FIC-PIXDCDC method which is a generalization of centroids to metric spaces which gives central tendency for a cluster of points. Let us consider ' $d_1, d_2, \dots, d_n$ ' be number of geo-social data within cluster ' c_i '. For a data in cluster, new cluster centroid ' cd^* ' is measured as weighted average dice correlation value of geo-social data in that cluster. From that, re-estimation of the new cluster centroid ' cd^* ' is mathematically obtained as follows,

$$cd_i^* = \frac{\sum_{j=1}^n (d_{ij} c_j)}{n} \quad (3)$$

From the above mathematical equation (3), a_i represents the number of geo-social data in i^{th} cluster. This re-determination of cluster centroids in FIC-PIXDCDC method gives higher clustering results for efficient analytics of big geo-social data. This process of FIC-PIXDCDC method is recurrent until there is no variation in cluster centroids. From that, FIC-PIXDCDC technique proficiently clusters each geo-social information into a connected group with improved precision and insignificant measure of time.

FIC-PIXDCDC algorithm flow is shown in below,

**// Focused Information Criterion based Partitioned Iterative X-means
Dice Correlation Data Clustering Algorithm**

Input: Number of geo-social data ' $DS = d_1, d_2, \dots, d_s$ '

Output: Achieve higher clustering accuracy for big geo-social dataset

Step 1:	
Step 2:	Consider 'x' number of clusters
Step 3:	Randomly select number of cluster centroids ' cd_i '
Step 4:	While (no change in cluster centroids ' cd_i ') Step 5: doFor each geo social data ' d_i ' Step 7: Compute dice correlation between ' d_i ' and ' cd_i ' using Step 8: (1) Define focused information criterion Group geo social data to corresponding cluster ' d_i ' Step 9: Re-determine cluster centroid ' cd^* ' using Step 10: End Step 11: ForEnd Step 14: while

Algorithm 1 Focused Information Criterion based Partitioned Iterative X-means Dice Correlation Data Clustering

Calculation 1 exhibits the bit-by-bit interaction of FIC-PIXDCDC Method to achieve better cluster execution for gathering related geo-social information together. As shown in above algorithmic process, at the beginning FIC-PIXDCDC Method assumes 'x' number of clusters and centroids randomly. Then, FIC-PIXDCDC Method evaluates the dice correlation between each input geo-social data and cluster centroids. Followed by, FIC-PIXDCDC Method clusters the similar geo-

social together into corresponding clusters using focused information criterion and recalculating cluster centroid. The above process of FIC-PIXDCDC Method is repeated until there is no change in cluster centroids. Through a successful clustering of geo-social information, at long last FIC-PIXDCDC Method precisely discovers area's data of regularly visited districts or regions of clients in interpersonal organization when contrasted with ordinary works.

3. EXPERIMENTAL SETTINGS

To assess the performance, proposed FIC-PIXDCDC Method and regular Density-based spatial clustering of uses with commotion

(DBSCAN) calculation [1] and Density-based Clustering Places in

Geo-Social Networks (DCPGS) [2] are actualized in Java Language utilizing Weeplaces Dataset [22]. This dataset was gotten from famous area based social network administrations e.g., Facebook, Foursquare, and Gowalla. Also, this dataset contains 7,658,368 registration made by 15,799 clients more than 971,309 areas. In Weeplaces Dataset contains registration history, their companions who likewise use Weeplaces, and other extra data with respect to the areas. Here, registration data considered as geo-social information which incorporates client, registration time, scope, and longitude and area id.

4. RESULTS

In this part, the test aftereffect of proposed FIC-PIXDCDC Method is contrasted and two existing Density- based spatial clustering of uses with commotion (DBSCAN) calculation [1] and Density-based Clustering Places in Geo-Social Networks

From that, FIC-PIXDCDC Method takes 1000 to 10000 geo-spatial data from Weeplaces Dataset to conduct experimental process. The presentation of proposed FIC-PIXDCDC Method is estimated regarding clustering precision, cluster time and error rate as for different number of geo-social information. The adequacy of FIC-PIXDCDC Method is analyzed against traditional Density-based spatial clustering of uses with commotion (DBSCAN) calculation [1] and Density-based Clustering Places in Geo-Social Networks (DCPGS) [2].

(DCPGS) [2] is introduced. The proficiency of proposed FIC-PIXDCDC Method is dissected utilizing measurements, for example, clustering exactness, clustering time and error rate with assistance of underneath table and diagram.

4.1 Case 1: Performance Measure of Clustering Accuracy

In FIC-PIXDCDC Method, Clustering exactness 'CA' figures the proportion of number of geo- social information that are correctly gathered to the absolute number of geo-social information taken for directing exploratory interaction. The clustering exactness is processed numerically utilizing underneath,

$$CA = \frac{SAC}{s} * 100 \quad (4)$$

From the above mathematical representation (4), ' ϵ_A ' means number of precisely clustered geo-social information in which 'e' point outs an absolute number of geo-social information. The clustering precision of large geo-social information is resolved as far as rate (%).

Sample Calculation:

- ❖ **Proposed FIC-PIXDCDC:** Number of geo-social information completely clustered is 860 and the all-out number of geo-social information is 1000. At that point the clustering exactness is obtained as follows,

$$CA = \frac{860}{1000} * 100 = 86 \%$$

- ❖ **Existing DBSCAN:** Number of geo-social information appropriately clustered is 740 and the complete number of geo-social information is 1000. At that point the clustering exactness is assessed as follows,

$$CA = \frac{740}{1000} * 100 = 74 \%$$

- ❖ **Existing DCPGS:** Number of geo-social information precisely bunched is 790 and the complete number of geo-social information is 1000. At that point the clustering precision is registered as follows,

$$CA = \frac{790}{1000} * 100 = 79 \%$$

Both the proposed FIC-PIXDCDC and existing DBSCAN [1] DCPGS [2] Methods are actualized in JavaLanguage by taking a different number of geo-social information in the scope of 1000-10000 from input huge dataset to assess clustering precision. At the point when conveyed experimental process utilizing 4000 geo-social information from large Weeplaces dataset, the proposed FIC-PIXDCDC technique gets 92 % clustering precision though

customary DBSCAN [1] DCPGS [2] gains 77 % and 81 % separately. From the above get test results, it is expressive that the clustering precision of large geo-social information utilizing proposed FIC-PIXDCDC strategy is extremely higher when contrasted with other regular works

[1] and [2]. The clustering exactness after effect of proposed FIC-PIXDCDC technique is contrasted and two best in class works is shown in beneath Table 1.

Table 1 Experimental Result of Clustering Accuracy

Number of geo- social data (ϵ)	Clustering Accuracy (%)		
	FIC- PIXDCDC	DBSCA N	DCPG S
1000	86	74	79

2000	88	79	83
3000	89	79	82
4000	92	77	81
5000	90	75	81
6000	89	75	80
7000	87	74	79
8000	87	72	77
9000	85	71	76
10000	84	70	75

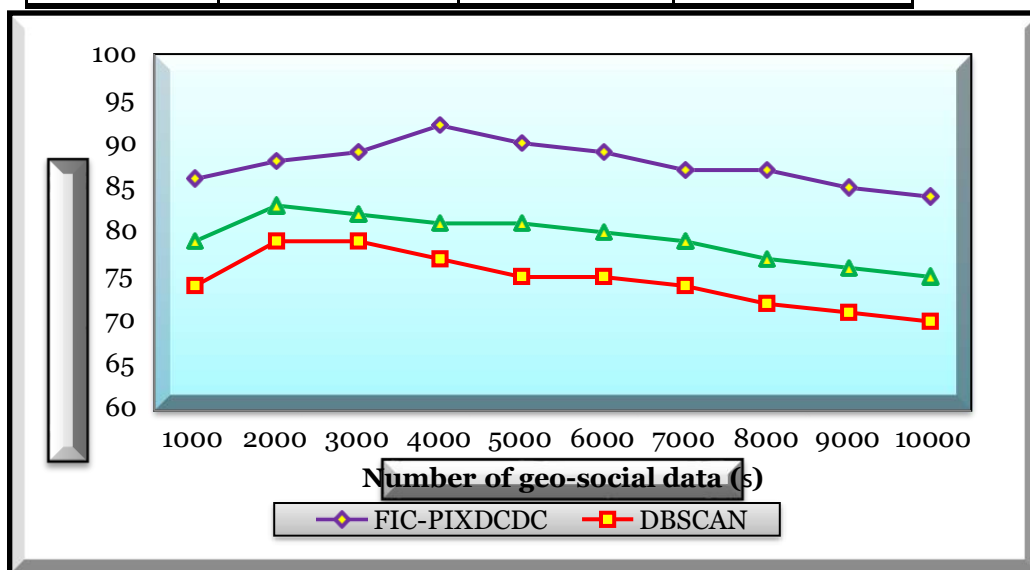


Figure 3 Comparative analysis of FIC-PIXDCDC, DBSCAN

Figure 3 shows the effect of clustering precision as for different number of enormous geo-social information in the scope of 1000 to 10000 utilizing three strategies in particular proposed FIC-PIXDCDC and existing DBSCAN [1] DCPGS [2]. As introduced in the above graphical portrayal, proposed FIC-PIXDCDC technique gives higher precision to cluster related geo-social information along with expanding number of information geo-social information when contrasted with customary DBSCAN [1] DCPGS [2]. This is inferable from utilization of Focused Information Criterion and Dice Correlation Coefficient Measurement and Fréchet mean computation in Partitioned Iterative X-means Clustering calculation on the in spite of conventional works.

Proposed FIC-PIXDCDC method is a

variation of k-means clustering that effectively performs cluster allocations through repeatedly attempting partition and keeping the optimal result until some condition is attained. From that, proposed FIC-PIXDCDC strategy increment the clustering execution of large geo-social information when contrasted with existing works. Henceforth, proposed FIC-PIXDCDC strategy precisely conveyed out enormous geo-social information measure. This aides for proposed FIC-PIXDCDC strategy to improve the proportion of number of geo-social information that are accurately assembled when contrasted with other traditional works [1] and [2]. As a result, proposed FIC-PIXDCDC method achieves enhanced clustering accuracy to discover location information of frequently visited users in social network by 18 % as compared to DBSCAN [1] and 11 % when compared to DCPGS [2].

4.2 Case 2: Performance Measure of Clustering Time

In FIC-PIXDCDC Method, Clustering Time ' CT ' determines the amount of time needed to group same type of geo-social data together. The clustering time is mathematically estimated using below formula,

$$CT = \varepsilon * (CS) \quad (5)$$

From the above numerical articulation (5), ' $t(CS)$ ' represents a period used to cluster a solitary geo-social information and ' ε ' alludes to an all-out number of geo-social information considered for test assessment. The clustering time of huge geo-social information is registered as far as milliseconds (ms).

Sample Calculation for Clustering Time:

- ❖ **Proposed FIC-PIXDCDC:** the measure of time utilized to cluster one geo-social information is

0.026 ms and the complete number of geo-social information is 1000. At that point the clustering time is numerically determined as follows,

$$CT = 1000 * 0.026 = 26 \text{ ms}$$

- ❖ **Existing DBSCAN:** the measure of time taken to cluster one geo-social information is 0.035 ms and the all-out number of geo-social information is 1000. At that point the clustering time is numerically assessed as follows,

$$CT = 1000 * 0.035 = 35 \text{ ms}$$

- ❖ **Existing DCPGS:** the measure of time used to cluster one geo-social information is 0.037 ms and the all-out number of geo-social information is 1000. At that point the clustering time is numerically decided as follows,

$$CT = 1000 * 0.037 = 37 \text{ ms}$$

To gauge time intricacy of huge geo-social information clustering, both the proposed FIC- PIXDCDC and conventional DBSCAN [1] DCPGS [2] Methods are actualized in Java Language by considering a different number of geo-social information in the scope of 1000-10000 from input of largeWeeplaces dataset. When playing out the trial assessment utilizing 8000 geo-social information from enormous dataset, the proposed FIC-PIXDCDC strategy accomplishes 50 ms clustering time though best in class works DBSCAN [1] DCPGS [2] get 59 ms and 61 ms individually. In this manner, plainly the clustering time of large geo-social information utilizing proposed FIC-PIXDCDC strategy is insignificant

when contrasted with other conventional works [1] and [2]. The aftereffect of clustering time utilizing proposed FIC-PIXDCDC technique is contrasted and two existing strategies is portrayed in underneath Table 2.

Table 2 Experimental analysis of Clustering Time

Number of geo- social data (ϵ)	Clustering Time (ms)		
	FIC- PIXDCD C	DBSCA N	DCPG S
1000	26	35	37
2000	28	36	40
3000	33	42	48
4000	36	44	52
5000	39	47	48
6000	41	53	54
7000	46	56	57
8000	50	59	61
9000	54	63	65
10000	58	68	70

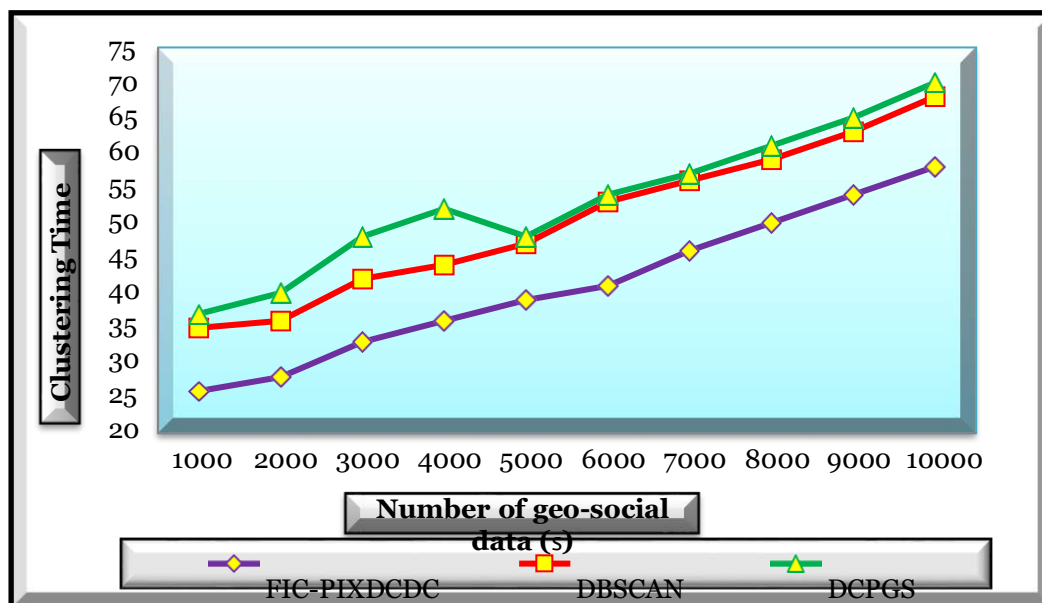


Figure 4 Comparative analysis of FIC-PIXDCDC, DBSCAN, DCPGS

Figure 4 shows the effect of clustering time as per differed number of huge geo-social information in the scope of 1000 to 10000 utilizing three strategies to be specific proposed FIC-PIXDCDC and existing DBSCAN [1] DCPGS [2]. As demonstrated in the above graphical portrayal, proposed FIC-PIXDCDC strategy gives insignificant measure of time to cluster related geo-social information along with expanding number of info geo-social information when contrasted with ordinary DBSCAN [1] DCPGS [2]. This is a direct result of use of Focused Information Criterion and Dice Correlation Coefficient Measurement and Fréchet mean figuring in Partitioned Iterative X-means Clustering calculation on the in spite of cutting edge works. By using the above concepts, proposed FIC-PIXDCDC method gives a fast and effective way to cluster unstructured data and also provides concurrency speeds up the process of model construction. Notwithstanding that, proposed FIC-PIXDCDC technique uses Focused Information Criterion that gives a numerically solid proportion of more excellent cluster for huge geo-social information when contrasted with existing works. This helps for proposed FIC-PIXDCDC technique to decrease the measure of time used to use same sort of geo-social information into an alternate number of groups when contrasted with other customary works [1] and [2]. Hence, proposed FIC-PIXDCDC method attains minimal amount of clustering time to find out location information of most visited users in social network by 19 % as compared to DBSCAN [1] and 24 % when compared to DCPGS [2].

4.3 Case 3: Performance Measure of Error Rate

In FIC-PIXDCDC Method, Error Rate 'ER' figures proportion of number of geo-social information erroneously cluster to the absolute number of geo-social information. The error rate is numerically decided utilizing beneath portrayal,

$$ER = \frac{SWC}{s} * 100 \quad (6)$$

From the above numerical formula (6), 'e_{WC}' shows various geo-social information wrongly clustered and 'e' implies an absolute number of geo-social information. The mistake pace of geo-social information is resolved regarding rate (%).

Sample Calculation for Error Rate:

- ❖ **Proposed FIC-PIXDCDC:** number of geo-social information erroneously assembled is 140 and the all-out number of geo-social information is 1000. At that point the error rate is numerically gotten as follows,

$$ER = \frac{140}{1000} * 100 = 14 \%$$

- ❖ **Existing DBSCAN:** number of geo-social information wrongly grouped is 260 and the complete number of geo-social information is 1000. At that point the error rate is numerically procured as follows,

$$ER = \frac{260}{1000} * 100 = 26 \%$$

- ❖ **Existing DCPGS:** number of geo-social information inaccurately clustered is 210 and the all-outnumber of geo-social information is 1000. At that point the error rate is numerically estimated asfollows,

$$ER = \frac{210}{1000} * 100 = 21 \%$$

For deciding the error rate required during the large geo-social information clustering measure, both the proposed FIC-PIXDCDC and best in class DBSCAN [1] DCPGS [2] Methods are actualized in Java Language by utilizing an alternate number of geo-social information in the scope of 1000-10000 from input dataset. When directing the exploratory work utilizing 6000 geo-social information from hugeWeeplaces dataset, the proposed FIC-PIXDCDC technique accomplish 11 % error rate though existing works DBSCAN [1] DCPGS [2] achieve 25 % and 20 % individually. From the above procured test results, it is clear that the error pace of huge geo-social information clustering utilizing proposed FIC- PIXDCDC strategy is very lower when contrasted with other customary works [1] and [2]. The similar aftereffect of clustering time utilizing proposed FIC-PIXDCDC strategy and two customary techniques isintroduced in beneath Table 3.

Table 3 Experimental Result of Error Rate

Number of geo- social data (ε)	Error Rate (%)		
	FIC- PIXDCD C	DBSCAN	DCPGS

1000	14	26	21
2000	12	22	17
3000	11	21	18
4000	8	24	19
5000	10	25	19
6000	11	25	20
7000	13	27	21
8000	14	28	23
9000	15	29	24
10000	16	30	25

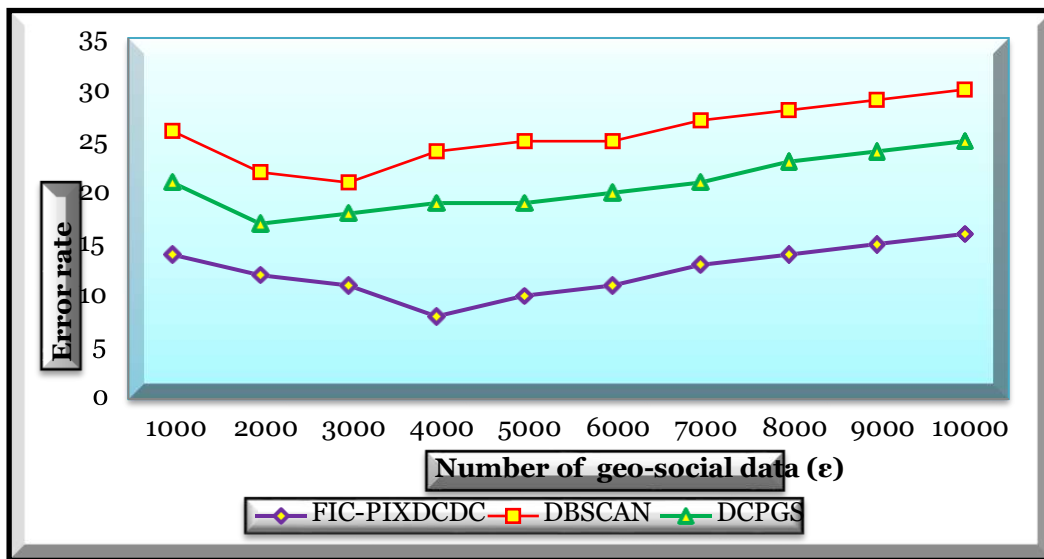


Figure 5 Comparative analysis of FIC-PIXDCDC, DBSCAN, DCPGS

Figure 5 presents the effect of error rate required during the large geo-social information grouping alongside unique number of enormous geo-social information in the scope of 1000 to 10000 utilizing three strategies specifically proposed FIC-PIXDCDC and existing DBSCAN [1] DCPGS [2]. As shown in the above graphical outline, proposed FIC-PIXDCDC technique presents lower error rate to accurately gather interrelated geo-social information along with expanding number of info geo-social information when contrasted with customary DBSCAN [1] DCPGS [2]. This is because of utilization of Focused Information Criterion and Dice Correlation Coefficient Measurement and Fréchet mean figuring in Partitioned Iterative X-means Clustering calculation on the in spite of existing works.

By utilizing the Focused Information

5. LITERATURE SURVEY

Emotional maps based on social networks data were developed in [12] to examine cities emotional structure and determine their emotional similarity. A community detection algorithm was utilized in [13] for discovering travel region with help of location-based social network check-in information.

Density-based clustering and thread-based aggregation techniques was presented in [14] to identify unexpected behavior in a city. A Geo-visual analytic approach was introduced in [15] to finding geo-social connections in the international trade network.

An improved Density-Based Spatio-Textual Clustering was accomplished in [16] for analyzing social media with a minimal

Criterion, proposed FIC-PIXDCDC technique considers the dice relationship between each info geo-social information and centroids to aggregate interrelated information with an improved precision. As needs be, FIC-PIXDCDC technique bunches the geo-social information to the cluster whose dice relationship esteem from the cluster centroid is higher of all the cluster centroid. This backings for proposed FIC-PIXDCDC technique to limit the proportion of number of geo-social information inaccurately grouped when contrasted with other best in class works [1] and [2]. In this manner, proposed FIC-PIXDCDC strategy gets negligible error rate for grouping huge geo-social information and along these lines deciding area data of regularly visited clients in interpersonal organization by 52 % when contrasted with DBSCAN [1] and 40 % when contrasted with DCPGS [2].

computational complexity. An effective framework was designed in [17] to identify the most popular place or venue in a given location depends on the tips given by user.

K-mean Clustering and Geocoding technique was employed in [18] to precisely find the latitude and longitude information of the user's friends. A novel framework was presented in [19] by using Geo- Self-Organizing Maps (GeoSOMs) to discover the similar areas of social interaction in cities.

6. CONCLUSION

A proficient FIC-PIXDCDC technique is proposed in this exploration work with the target of expanding the clustering execution of enormous geo-social information with an insignificant error rate. The target of FIC-PIXDCDC technique is achieved with the utilization of Focused Information Criterion, Dice Correlation Coefficient Measurement, Fréchet mean figuring and Partitioned Iterative X-means Clustering calculation as opposed to customary works. The planned FIC-PIXDCDC strategy expands the proportion of number of geo-social information that are appropriately gathered when contrasted with existing works. Notwithstanding that, proposed FIC-PIXDCDC strategy limit the measure of time expected to cluster, same sort of geo-social information into a different number of cluster when contrasted with other traditional works. In addition,

Visual analytics of geo-social interaction patterns was developed in [20] to study the effectiveness of designing control approach. An novel data mining methodology was designed in [21] for analysis of social data sets and thereby solving natural challenges.

proposed FIC-PIXDCDC strategy diminishes proportion of number of geo-social information mistakenly clustered to successfully distinguish area data of oftentimes visited clients in interpersonal organization when contrasted with other cutting edge works. Subsequently, proposed FIC-PIXDCDC strategy gives better execution regarding precision, time and blunder rate for clustering enormous geo-social information when contrasted with existing works. The exploratory outcome shows that the proposed FIC-PIXDCDC technique gives better geo-social information analysis execution with an improvement of grouping exactness and decrease of clustering time for enormous volume of geo-social information when contrasted with best in class works.

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E-GCS: Detection of COVID-19 through classification by attention bottleneck residual network

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ABSTRACT

Background: Recently, the coronavirus disease 2019 (COVID-19) has caused mortality of many people globally. Thus, there existed a need to detect this disease to prevent its further spread. Hence, the study aims to predict COVID-19 infected patients based on deep learning (DL) and image processing.

Objectives: The study intends to classify the normal and abnormal cases of COVID-19 by considering three different medical imaging modalities namely ultrasound imaging, X-ray images and CT scan images through introduced attention bottleneck residual network (AB-ResNet). It also aims to segment the abnormal infected area from normal images for localising the disease infected area through the proposed edge based graph cut segmentation (E-GCS).

Methodology: AB-ResNet is used for classifying images whereas E-GCS segment the abnormal images. The study possess various advantages as it rely on DL and possess capability for accelerating the training speed of deep networks. It also enhance the network depth leading to minimum parameters, minimising the impact of vanishing gradient issue and attaining effective network performance with respect to better accuracy.

Results/Conclusion: Performance and comparative analysis is undertaken to evaluate the efficiency of the introduced system and results explores the efficiency of the proposed system in COVID-19 detection with high accuracy (99%).

1. Introduction

Recently, new outbreak of coronavirus disease (COVID-19) has confronted medical, economic as well as the public health worldwide except few countries. Apart from restricting this outbreaks, attempts have to be made by devising clear measures for preventing further outbreaks of this disease (Singhal, 2020). Thus, a comprehensive analysis has been carried out by the paper (He et al., 2020) for analysing clinical features, COVID-19 treatments etc. The analysis explored that the pathological discoveries related to SARS-CoV-2 have been restricted. Autopsy has also been warranted and useful for future study that will enhance the accuracy of initial diagnostic tests (Li et al., 2020). The study (Kumar et al., 2020) also affords opinions on the analysis of technological advancement utilised for minimising the substantial impact of this disease.

Though various research associated with modern technology have been emerging towards the detection of COVID-19, there exists more restrictions with respect to technological contributions in this prediction. This study explored about the Artificial intelligence (AI) applications and also the way in which modern technology might help in detecting COVID-19. AI can be categorised as computer vision applications, natural language processing and machine learning. A study has been

carried out to analyse image processing and ML for accurate COVID-19 detection from two widely utilised medical imaging namely CT images and chest X-ray (Saygili, 2021). The introduced system has been employed to three COVID-19 datasets that comprise of five fundamental steps such as acquisition of dataset, pre-processing and feature extraction, finally dimensionality reduction as well as classification. From the empirical outcomes, it has been found that the introduced model performed better and faster in comparison to other models. Though results were better, accuracy needed further improvement. For this purpose, the paper (Turkoglu, 2021) proposed an MKs-ELM-DNN (Multiple Kernels-Enhanced Learning Machine-Deep Neural Network) to classify COVID-19 affected area from CT images which rely on deep learning (DL) and enables the system to accomplish more accuracy. Proposed model comprise of three major stages like data augmentation, feature extraction and finally classification. This study exhibited that the introduced system could efficiently subsidise to the detection of this disease. The study aimed to develop a mobile based web platform that rely on the proposed approach. Various studies analysed the existing methods for predicting COVID-19 that rely on ML assessment and data mining (Albahri et al., 2020). Three ML methods have been employed to a dataset named MERS-CoV for determining the correct classification

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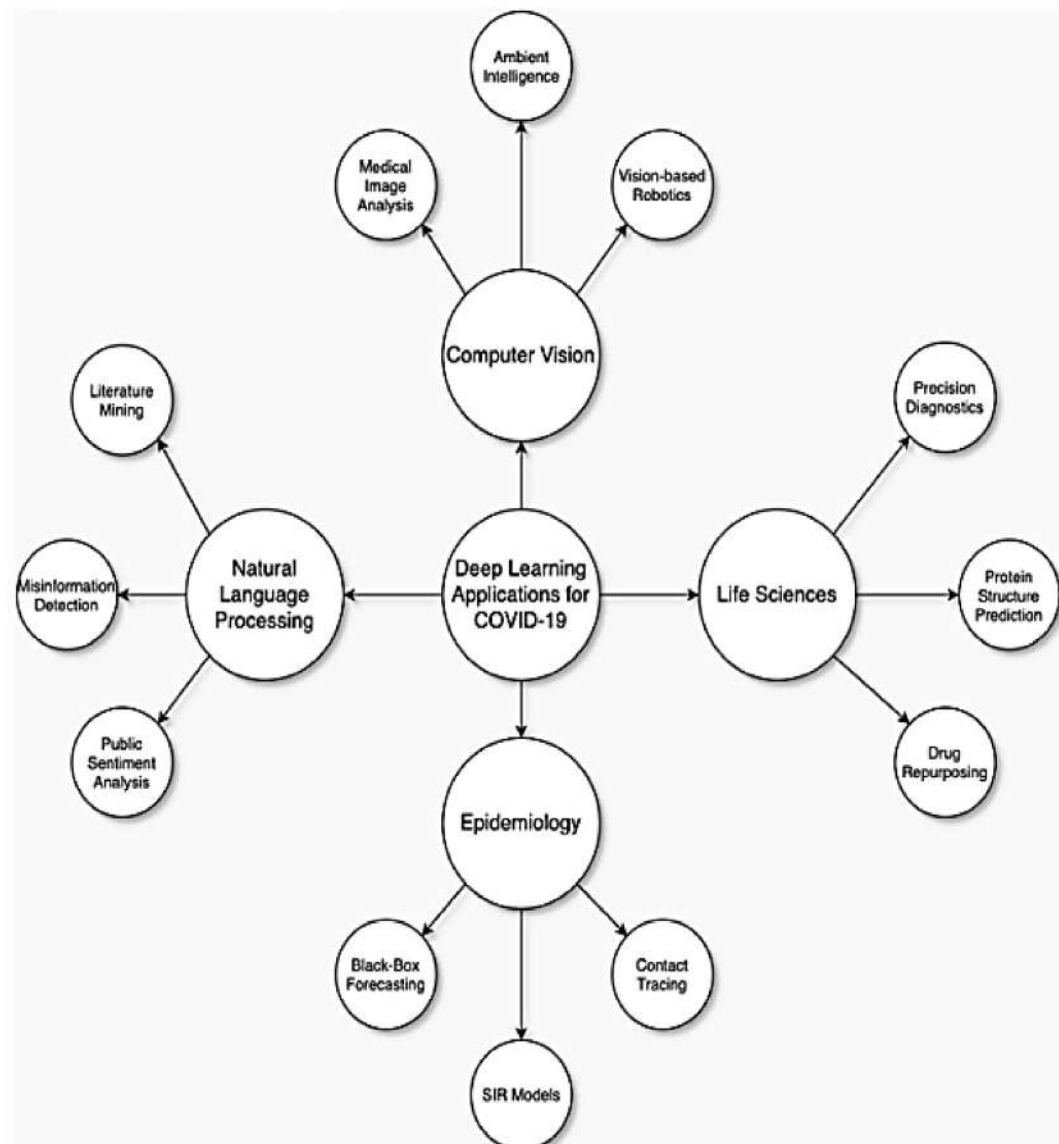


Fig. 1. Multiple applications of DL for COVID-19 prediction (Shorten et al., 2021).

model for multiclass and binary class labels. Outcomes explored the efficacy of K-nearest neighbour (K-NN) for two class issues. On the other hand, decision tree (DT) and Naïve Bayes (NB) have been found to be the effective model to solve multiclass issues.

Various existing studies attempted to use different strategies for detecting COVID-19. Accordingly, the paper (Ucar and Korkmaz, 2020) explored a structure based on AI to perform effectively in comparison to traditional methods. SqueezeNet with a light weight network design has been tuned for diagnosing COVID-19 with BOA (Bayesian optimization additive). Augmented dataset and fine-tuned hyper parameters have made the introduced network to perform efficient than traditional network designs thereby attained high accuracy for diagnosing COVID-19. In future, the study aimed to plan the proposed model to function mobile appealing for the healthcare specialists for COVID-19 diagnosis. In addition, CNN models have been trained to efficiently detect COVID-19 by systematic construction of large scale COVID-CS (COVID classification and segmentation) (Wu et al., 2021). A JCS (Joint Classification System) has also been developed for this diagnosis. The proposed model found if the suspected patients have been affected with COVID-19 or not in addition to convincing visual descriptions. However, it needs further enhancement. Among several solutions to conflict the pandemic situation of COVID-19, DL has been taken into

account as an efficient methodology for affording intelligent solutions (Bhattacharya et al., 2021). Inspired by several DL applications in the area of medical image processing (as shown in Figs. 1 and 2), it has been applied to accomplish several solutions to diagnose COVID-19.

From Fig. 1, it is clear that, DL has numerous applications in the area of life sciences, NLP (Natural Language Processing), epidemiology and computer vision for predicting COVID-19. Further, Fig. 2 shows DL applications in real-time for detecting COVID-19 which includes identification of positive COVID-19 cases, disease tracking, diagnosing according to patient's health status etc. Despite promising outcomes, various challenges associated with traditional research like changes in the outbreak pattern, differentiation between non-COVID and COVID patients with good accuracy remains an issues. Thus, the present study intends to improvise the accuracy in classifying normal and abnormal COVID-19 patients and also segment the abnormal area based on deep learning. The three significant imaging modalities such as ultrasound imaging, CT scans and X-ray are taken into account which is an additional improvement of this system.

The major contributions of the study are given below.

- To classify the abnormal and normal COVID classes by considering X-ray, ultrasound imaging and CT scan images using the proposed attention bottleneck residual network (AB-ResNet).

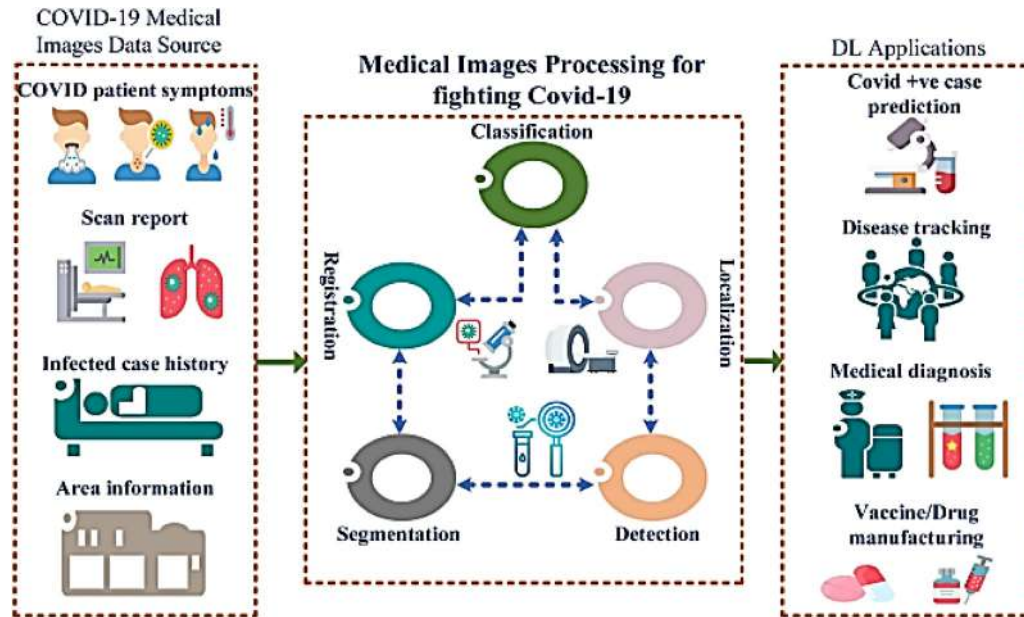


Fig. 2. Real-time application of DL and image processing for detecting COVID-19 (Bhattacharya et al., 2021).

- To segment the abnormal infected area from the abnormal images using the introduced edge based graph cut segmentation (E-GCS).
- To analyse the performance of the proposed system with respect to significant metrics for evaluating its efficiency in detecting COVID-19 from different image modalities.

1.1. Paper organisation

The paper is organised in the following way.

Section 1 explores the fundamental ideas of detecting COVID-19. Followed by this, Section 2 discusses the reviews of traditional system. After this, Section 3 describes the proposed system based on DL to classify and predict the COVID and non-COVID patients. The results obtained through the implementation of the proposed system is discussed in Section 4 and finally the overall system is summarised in Section 5.

2. Review of existing work

From December 2019, COVID-19 (Coronavirus Disease 2019) pandemic has affected globally and has turned to be a disorder within a short span of time. This infection occurred due to SARS-CoV-2 that has been rapidly spreading. Predicting the spread of this disease is necessary to prevent it where data mining techniques and imaging methodologies like Chest X-rays, Computed Tomography (CT) scans or chest ultrasound images of humans have been employed. Various traditional systems intended to use several methods for COVID-19 detection by different means. The different kinds of perspectives employed by these systems are comprehensively discussed in this section.

2.1. Detection of COVID-19 using Chest X-ray (CX-R) images

Among the magnetic resonance imaging data, CX-Rs are highly utilised to observe signs of COVID-19. This study explored the merits afforded through the usage of iteratively ensemble pruned deep learning (DL) models towards differentiating the CX-Rs exploring COVID-19 pneumonia associated transparencies from normal and bacterial pneumonia utilising publicly accessible CX-R collections (Aggarwal et al., 2022). Performance of the introduced model has been evaluated and weights have been assigned that rely on its predictions (Rajaraman et al., 2020). The empirical outcomes showed the outstanding performance of the proposed system in comparison to the traditional

methods. Experimental assessments revealed that the proposed pruning model's weighted average significantly enhanced the performance. Further research could discover envisaging and inferring the pruned model's learned behaviour as well as their applications to supplementary screening situations namely detection of COVID-19, 3D-CT scan localisation etc. The proposed methodology could be quickly adapted to detect COVID-19 through the digitised chest radiographs (Bharati et al., 2021b). Accordingly, COVID-19 explores few radiological signatures for easy detection by CX-R (Das et al., 2020a). For this purpose, the radiologists have been needed for signature analysis. Nevertheless, this has been an error-prone and time consuming task. Thus, there exists a requirement to examine CX-R.

Automatic CX-R analysis could be accomplished through DL based methods (Bharati et al., 2020a) that might quicken the time of analysis. These methods could perform network weight training on huge datasets and then fine-tuning these pre-trained network's weights on small datasets. Employment of these methods to CX-R have been limited. Thus, this study mainly aimed to propose an automated deep transfer learning (DTL) based method to detect the infections of COVID-19 in CX-Rs through extreme inception version (Xception) model. Proposed model has also been comparatively analysed and the outcomes revealed the efficacy of the introduced system. However, the initial parameters of this system have to be tuned through several methods for enhancing the visibility of CX-R images (Panwar et al., 2020). In accordance with this, a TL method (Naronglerdrit et al., 2021) has been employed in the study (Zebin and Rezvy, 2021). Various renowned pre-trained deep convolutional neural network (CNN) models have been assessed to detect COVID-19 from CX-R images. It comprised of viral, bacterial as well as normal pneumonia cases excluding the novel COVID-19. Proposed models have been tested on two varied datasets to find the efficient model for detecting COVID-19. The effective models have been found to be ResNet, DenseNet and MobileNet with better accuracy.

In addition, the CT scan images have been considered along with CX-R for detecting positive cases of COVID-19 using AI tools (Mukherjee et al., 2021a; Alyasseri et al., 2022). A CNN and DNN (deep neural network) have been employed that could train and test both these images (Majeed et al., 2020). Accuracy has been found to be 96.28%. Though efficient results have been attained, multi-modal data have to be taken into account. To compensate this, the paper (Mukherjee et al., 2021b) introduced a light weight CNN that could perform automatic detection of positive cases of COVID-19 using CX-R having

no FN (False Negatives). It performed better, but this system have to be enhanced by reducing FP (False Positive) cases (Pham, 2021; Das et al., 2020b). Further, a deep CNN (Convolutional Neural Network) relying on architecture termed as CovXNet has been suggested which uses depth-wise convolution along with different rates of dilation for effective extraction of varied features from the CX-R images. Numerous experiments have been undertaken through the use of two varied datasets that afford better performance by exploring 97.4% accuracy for normal or COVID, 96.9% accuracy for viral pneumonia or COVID, 90.2% accuracy for multi-class pneumonias and 94.7% accuracy for bacterial or COVID pneumonia. Thus, the recommended approaches could serve as a better tool in present state of pandemic due to COVID-19 (Podder et al., 2021). However, the study needs to be enhances in terms of accuracy which is a drawback (Mahmud et al., 2020).

In addition, patient's CX-R images of the patients without and with COVID-19 proved by the RT-PCR (Reverse Transcriptase-Polymerase Chain Reaction) have been retrospectively gathered and regulatory permitted CAD has been used that could find several abnormalities such as pneumonia for analysing the CX-R. Performance has been assessed through the use of AUC (Area under receiver operating Characteristic curves). Outcomes revealed that, pneumonia on the chest CTs could be attained within 24-h from CX-R images. Nevertheless, different medical image modalities have to be considered in future (Hwang et al., 2021). To enhance the system, CO-ResNet (COVID-19 Optimised Residual Network) has been suggested which is developed through the employment of hyper-parameter tuning to traditional ResNet-101. Empirical analysis have revealed 98.74% as detection accuracy for normal lungs and 92.08% for pneumonia. Though better prediction rate has been attained, accuracy has to be enhanced further (Bharati et al., 2021a). Additionally, Deep CNN based method has been recommended to detect patients having COVID-19 through the use of CX-R images. Accuracy rate has been found to be 91.62% which is better than conventional models. Application based on GUI has been developed for public usage. Nevertheless, the study must be enhanced with respect to detection rate (Das et al., 2021).

2.2. Detection of COVID-19 using CT scan

Human chest's imaging features could be attained through modalities of medical imaging like X-rays and CT scan. The merits of CT scan than X-ray are many. CT scan help in providing a three dimensional view of organ formation, flexible disease analysis as well as its location (Ahuja et al., 2021). This study introduced a 3 phase technique for classifying the slices of lung CT scan into non-COVID and COVID class. Better accuracy has been attained (Rahimzadeh et al., 2021). Yet, this system have to be analysed on large dataset consisting of positive cases of COVID-19. To eliminate this kinds of drawbacks, various existing studies have attempted to use different methods for detecting COVID-19. Accordingly, this article (Sharma, 2020) explored about machine learning (ML) methods to attain significant insights like if lung CT scan have to be the initial alternative or screening test for RT-PCR (Real time reverse transcriptase — polymerase chain reaction). This article also considered if COVID-19 varies from other kinds of viral pneumonia and if this is correct, the way to differentiate it through CT scan images has also been focused on this study by taking data from hospitals in India, Moscow, China and Italy. The proposed system has been trained and tested through a software named CV-MA (custom vision software of Microsoft azure) that rely on ML methods. Empirical outcomes showed accuracy of 91% for classifying COVID-19. Training as well as testing on high quality image datasets might further enhance the model accuracy (Bao et al., 2020).

To improvise accuracy, DL is the effective methodology that could be utilised in medical area (Shah et al., 2021). It is an efficient and fast method to diagnose and predict several kinds of diseases with a better accuracy. By taking this into account, the paper (Silva et al., 2020) explored the ability of DL models to detect COVID-19 on CT

images. It has also been highlighted that more datasets have been required to assess the techniques in a realistic way. Future path of the study might be to construct large CT scan image datasets from different Brazilian centres so as to attempt to encompass huge sensors, acquisition processes and ethnic groups and hence properly assess the proposed technique (Serte and Demirel, 2021). Similarly, the study (Alshazly et al., 2021) introduced various kinds of DL based methods to automatically detect COVID-19 through the use of CT images of chest. Highly advanced deep network architectures as well as their variants have been taken into account and many experiments have been undertaken on two datasets with huge counts of CT images accessible so far. Various experiments have been undertaken on two datasets comprising of CT images such as COVID19-CT and SARS-CoV-2 CT-scan. Outcomes exhibited high performance for the proposed model in comparison to traditional research (Aljondi and Alghamdi, 2020).

Few traditional systems have considered different kinds of deep CNN models. With regard to this, this paper (Loey et al., 2020) explored five models of CNN namely VGGNet16, AlexNet, ResNet50, VGGNet19 and GoogleNet for analysis to find the COVID-19 infected patients through CT images. Traditional data augmentation in addition to CGAN enhance the classification performance in every chosen DT models. Results exhibited the efficacy of ResNet50 than other models with 82.91% accuracy (Irfan et al., 2021). The main demerit of this study was that it did not attempt to use DL models for attaining high performance for measurement (Liu et al., 2020). In addition, two forms of optimised NASNet (Neural Architecture Search Network) have been suggested to diagnose COVID-19. Outcomes have explored that, suggested NASNet-mobile exposed 82.42% as accuracy, while, NASNet-large has exposed 81.06% as accuracy (Bharati et al., 2020b). Further, an optimised Inception ResNetV2 has been suggested to detected COVID-19. Endorsed model has been employed to 2481 CT images gathered through collection of two distinct datasets. Lastly, it has been employed to 1662 X-ray images leading to 99.4% accuracy. Though effective results have been attained, it has to be assessed for huge COVID-19 datasets (Mondal et al., 2021).

2.3. Detection of covid-19 using ultrasound images

CT scan has been found to be time consuming and also makes patients exposed to transport associated risks as well as ionize radiation (Sorlini et al., 2021). CX-R has a major part in monitoring the clinical course of the patients instead of prediction stage at the time of pandemic where highly sensitive test has been vital (Zhao and Lediju Bell, 2022). Therefore, in recent years, lung POCUS (point-of-care ultrasound) has been performed and inferred (Xue et al., 2021) by emergency doctors that possess a widespread utility as well as its functionality in assessing patients with pneumogenic and cardiogenic dyspnoea (Dacrema et al., 2021). This study have introduced a non-convex regularisation that rely on line artefacts — quantification technique with lung ultrasound applications. Empirical outcomes revealed a precise idea for detecting line detection for hundred lung ultrasound images exhibiting various B-kind of structures perceived in nine patients having COVID-19 (Karakuş et al., 2020). It has also been significant to notate that the introduced technique is entirely unsupervised. On the presumption that the annotated data have been freely inaccessible, an unsupervised technique like proposed system always possess merits over other supervised techniques. Accordingly, the study employed a CNN model that possess few parameters for learning but could accomplish robust accuracy (Muhammad and Hossain, 2021). The model possessed five major convolution connector layers. The functionality of multi-layer fusion of individual block has been introduced for enhancing the efficacy of COVID-19 screening technique using the introduced model. Experiments have been undertaken through freely available video datasets and lung ultrasound photographs. Introduced fusion technique possessed accuracy of 91.8% through the use of data collection. Yet, the proposed system have to be enhanced by taking

into account various input modalities accessible from similar person infected with COVID-19 (Xing et al., 2020).

As different studies tried to detect this disease in varied kinds, the article (Mateos González et al., 2021) aimed to evaluate the correlation of CX-R and lung ultrasound to detect pulmonary infiltrates in COVID-19 infected patients. Findings of lung ultrasound correlated better with CX-R in confirmed or suspected COVID-19 patients. Lung ultrasound has been able to find the pulmonary infiltrates in nearly half the patients having normal CX-R. Hence, a lung ultrasound analysis might be undertaken as the preliminary test of diagnostic imaging in patients infected with COVID-19. Future research have been needed for assessing the usage of consistent lung ultrasound protocol on patient's health service with suspected cases of COVID-19. However, few studies intended to check if lung ultrasound has been a worthwhile technique to detect severe respiratory syndrome (Fonsi et al., 2021). The analysis explored that lung ultrasound possessed good reliability in comparison to CT scan images of chest which indicate that lung ultrasound might be utilised for evaluating the patients doubted of possessing COVID-19. This study also possessed various limitations like small size of sample, lung ultrasound and CT scan image examinations undertaken only at the admission level (Dastider et al., 2021).

Severity prediction has also been significant to be considered. In accordance with this, the study (Narinx et al., 2020) introduced a architecture named frame based four score disease severity with the incorporation of RNN (recurrent neural network) and CNN to taken into account both temporal and spatial features of lung ultrasound frames. Comprehensive study explores a promising enhancement in the performance of classification by presenting a LSTM (Long Short Term Memory) after the introduced CNN architecture. It has been found from a clear analysis that the introduced end to end method have been efficient in finding severity scores of COVID-19 from lung ultrasound images. This study has explored that future work will be to design DL based segmentation framework. Further, frame based four score disease severity identification framework has been recommended with the inclusion of RNN (Recurrent Neural Networks) and deep CNN for considering temporal and spatial features. Comprehensive analysis reveals promising enhancement in classification through introduction of LSTM (Long Short Term Memory) after endorsed CNN model by average rate of 7% to 12%. However, accurate outcomes have not been explored (Dastider et al., 2021). Analysis on AI to detect COVID-19 has also been performed through the use of PRISMA (Preferred Reporting Items of Systematic reviews and Meta-Analysis) guidelines. Various diagnosis (Glowacz, 2021b) stages have been reviewed which include pre-processing phase, segmentation phase and feature extraction. Outcomes reveal that, ResNet-18 and DenseNet-169 show better classification performance for the X-ray images, whereas, the DenseNet-201 possess high accuracy in detecting COVID-19 through CT images (Taylor et al., 2020). Outcomes revealed that DL and ML have been valuable tools to support the medical professionals and researchers in detecting COVID-19. However, such methods (Glowacz, 2021a) have to be used by considering different medical image modalities as this study has considered only X-ray and CT scan images (Rubaiyat Hossain Mondal et al., 2021).

From the analysis of conventional works, it is found that, most of the methods worked better in COVID-19 detection and explored better accuracy. However, they have failed to consider all the three possible medical image modalities such as CT scan, CX-R and ultrasound. In addition, few studies also lacked with respect to accuracy. Hence, there is a need to focus on choosing the effective methods for obtaining high accuracy thereby considering all the three probable image modalities in COVID-19 prediction.

Problem Identification

Several problems are identified by analysing various existing systems for COVID-19 detection. They are listed here.

- Traditional study (Rajaraman et al., 2020) utilised DL models for differentiating CX-Rs and explored effective results. Yet, this study have not considered 3D CT scans. Similarly, the paper (Mukherjee et al., 2021a) employed CNN-DNN that could collectively train or test CX-R and CT scans. However, it have not considered ultrasound images. In addition, the article (Muhammad and Hossain, 2021) explored to use a multi-source system in future by considering different kinds of input modalities to detect COVID-19 infected patients. Hence, taking all these into account, the present study aims to detect normal and abnormal COVID-19 patients by considering CT scan images, CX-R images and ultrasound imaging. Few studies have considered only one of these three or two of the three images. But, the present study considers all these three images for effective prediction of COVID-19 infected persons.
- The existing paper (Loey et al., 2020) exhibit that ResNet50 has been the effective DL model for COVID-19 detection from CT images of chest. However, the main demerit is not attempting to use many DL model to achieve high performance. In addition, the study (Saygılı, 2021) aimed to develop a comparison model by incorporating DL techniques in future. The present study considered all these works and intends to detect abnormal and normal persons of COVID-19 based on DL techniques.
- The article (Dastider et al., 2021) intended to enhance the proposed system by designing DL based segmentation framework for segmenting the pathological artefacts. In addition, the paper (Das et al., 2020b) introduced a truncated inception net DL model for detecting positive patients of COVID-19. Introduced system has been restricted by its ability for localising the diseases in CX-R. This goal have to be accomplished by utilising enhanced count of data or DL model that have been pre-trained on huge count of CX-R. Hence, the present study aims to use DL based methods to predict the abnormal and normal cases of COVID-19 thereby it also localise the infected area if it is found to be abnormal by taking into account the CT scan images, CX-R images and ultrasound imaging. This is an added advantage of the proposed system.

3. Proposed methodology

The study proposes methods such as attention bottleneck residual network (AB-ResNet) and edge based graph cut segmentation (E-GCS) that rely on DL. It has various advantages. It has the ability to accelerate the training speed of deep networks, it also enhance the network depth resulting in minimum parameters, minimising the impact of vanishing gradient issue and attaining efficient network performance in terms of accuracy particularly in image classification. Due to these advantages, the present study intends to classify abnormal and normal COVID cases based on DL and image processing. Various stepwise procedures are involved to achieve this detection. The overall view of this process is outlined in Fig. 3.

Initially the ultrasound images, CT scan and X-ray images are taken into account. Then, attention bottleneck residual network (AB-ResNet) is used to classify the images into abnormal and normal by examining any one modality comprising of various kinds of modalities. Here, the ResNet is built by stacking numerous attention modules. Features from various layers have to be modelled through various attention masks. Utilising a mask branch might need exponential channel count to retrieve different factor combinations. Subsequently, edge based graph cut segmentation (E-GCS) is employed to detect abnormal areas after classifying the abnormal category. This step helps to specifically localise the disease infected areas. Finally, a performance analysis is undertaken to assess the efficacy of the proposed system in comparison to the traditional systems.

In addition, systematic workflow of the proposed system is shown in Fig. 4 to provide comprehensive view of the overall proposed work.

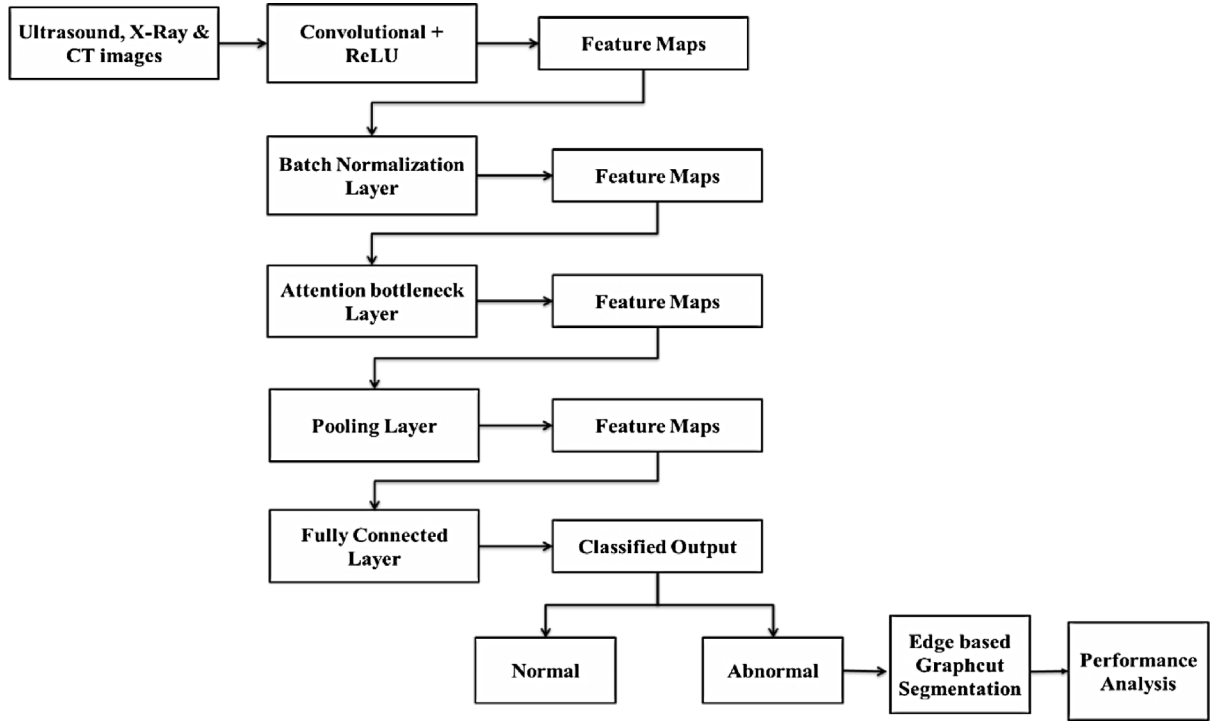


Fig. 3. Overall view of the proposed method for COVID-19 diagnosis.

3.1. Attention bottleneck residual network (AB-ResNet)

The overall framework of the introduced system is outlined in Fig. 1. Moreover, a attention bottleneck residual network comprise of three convolution layers, a GAP (global average pooling) layer, FC (a fully connected) layer and two AB-ResNet block. The COVID-19 dataset could be indicated as $C \in R^{H \times W}$. Here H and W indicate the height and the width. To extract spatial-spectral features, the study adopted a three dimensional image patches positioned on pixels of the label as the input of the introduced AB-ResNet. Here, the image patch label indicates the position pixel label. The image patch size is represented by $S \times S$ that indicates the spatial size of the neighbourhood.

An assumption is made if the COVID-19 dataset comprise of pixels labelled M , then the set of image patch could be indicated by $X = \{x_1, x_2, \dots, x_M\} \in R_{S \times S}$. Here x_i represents the i th image patch. The equivalent label set of the ground truth (GT) could be indicated by $Y = \{y_1, y_2, \dots, y_M\}$. Here $y_i \in \{1, 2, \dots, P\}$ denotes the x_i 's label, P indicates the count of COVID-19 classes. Accordingly, patch set (X) is partitioned into training, testing and validation set. Similarly, Y is partitioned into three kinds. Prior to AB-ResNet training, hyper parameters like batch size, patch size and learning rate are configured as,

Patch size = [128 * 128, 256 * 256]

Batch size = [4, 8, 16, 32]

Learning rate = [0.01, 0.001, 0.0001]

Proposed AB-ResNet is trained for two hundred epochs and for each of these epochs, training sets are partitioned into few mini-batch data and batches. This is fed as input to the network individually. During the process of training, the estimation label vectors corresponding to the training set are attained by the model's forward propagation. Subsequently, a CELF (Cross entropy loss function) is selected for computing the variations amongst the estimated label vectors as well as the equivalent label vectors that are transferred by the GT labels. Followed by this, learned parameters corresponding to the proposed model are updated by back propagation (BP) algorithm. Additionally, at the training time, validation sets are partitioned and the accuracy in classification is calculated for each and every epochs for monitoring the performance of the model. By this way, training model can be selected

with high accuracy. At last, the test set is selected to assess the proposed AB-ResNet's performance.

For a given feature map $Fe \in R^{C \times H \times W}$ (input), AB-ResNet infers three-dimensional attention-map $Mp(Fe) \in R^{C \times H \times W}$. Advanced feature map Fe' is calculated as,

$$Fe' = Fe + Fe \otimes Mp(Fe) \quad (1)$$

where, $\otimes$ indicates element wise multiplication. A residual learning strategy is adopted in addition to attention mechanism for facilitating gradient-flow. For designing an effective and powerful module, initially channel-attention $Mp_c(Fe) \in R^C$ as well as spatial-attention $Mp_s(Fe) \in R^{H \times W}$ is computed at two distinct branches. Subsequently, attention-map $Mp(Fe)$ is calculated as,

$$Mp(Fe) = \sigma(Mp_c(Fe) + Mp_s(Fe)) \quad (2)$$

where σ represents sigmoid-function. Outputs of both the branch are re-sized into $Fe_c \in R^{C \times 1 \times 1}$ prior to addition. As individual channel comprise of responses of specific feature, inter-channel association is used in channel-branch. Thus, channel-attention is calculated by,

$$Mp(Fe) = BN(MLP(AvgPool(Fe))) = BN(w_1 (w_0 AvgPool(Fe) + b_0) + b_1) \quad (3)$$

where $w_0 \in R^{C/r \times C}$, $b_0 \in R^{C/r}$, $w_1 \in R^{C \text{ times } C/r}$, $b_1 \in R^C$.

Particularly, feature ($Fe \in R^{C \times H \times W}$) is estimated into reduced dimension $R^{C/r \times H \times W}$ through the use of (1×1) convolution for integrating and compression feature map throughout the dimensions of the channel. Similar reduction ratio is used with channel branch to attain simplicity. Subsequently, two (3×3) dilated-convolutions are employed to used contextual information efficiently. Lastly, features are repetitively used to the spatial-attention map through the use of (1×1) convolution. Further, a batch-normalization layer is employed at spatial branch end for scale alteration. Hence, spatial-attention is calculated by,

$$Mp_s(Fe) = BN(f_3^{1 \times 1} (f_2^{3 \times 3} (f_1^{3 \times 3} (f_0^{1 \times 1} (Fe)))) \quad (4)$$

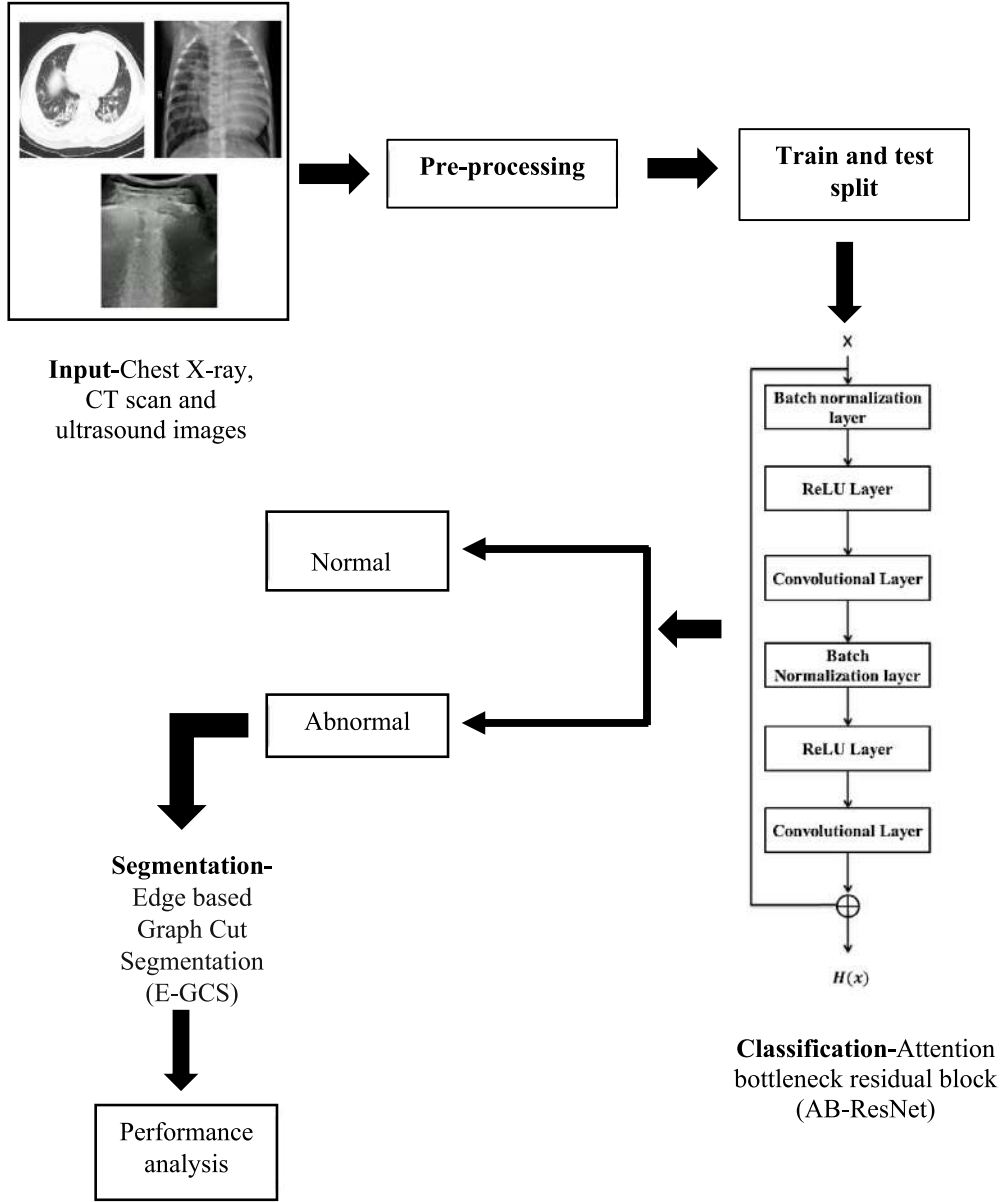


Fig. 4. Overall view of measurement of the proposed work.

3.1.1. Residual connection and activation based bottleneck mechanism

Residual block is selected as the main element of the proposed AB-ResNet, the framework of it is presented in Fig. 5(b). From the figure, it is seen that the residual block comprise of residual connection/skip connection and dual convolution layers. Using skip connection, high level and low level features could be combined in an extra way. By this, residual block could lessen the explosion or gradient vanishing issue that typically occur in deep network. The individual residual block could be computed as per Eq. (5).

$$R_B(X) = f_a(C_F(x) + x) \quad (5)$$

Here x and $R_B(\cdot)$ Indicates the input as well as output AB-ResNet. In addition, C_F is the residual learning function, f_a signifies activation function and $C_F(x)$ denotes the convolution layer output prior to summation operation.

To attain efficient performance, batch normalization (BN) and an activation function is applied in the proposed network's residual block. As presented in Fig. 5(b), Activation framework is executed by shifting ReLU activation function and BN prior to convolution operation.

Activation residual block could be computed as per Eq. (6).

$$R_B(X) = C_F(x) + x \quad (6)$$

As explored in Fig. 5(a), the activation function in Eq. (5) is ReLU that indicates the activation function f_a as per Eq. (7).

$$f_a(x) = \max(0, x) \quad (7)$$

ReLU will compulsorily transfer the signal to zero if the signals are negative that might lead to loss of few residual and informative features in typical residual block. When f_a is made as an identity-mapping, then Eqs. (5) and (6) will be similar. This identity-mapping permits signals to be directly propagated amongst any of the two units that indicates the features that are learned by RLF — residual learning function that will be always exist. By this way, the activation based bottleneck mechanism makes it simpler and easier for training the network thereby improve the generalisation of the network performance.

3.1.2. Attention bottleneck residual block

As the data comprising of every spectral bands are used directly as inputs and fed to the proposed network, it is vital to undertake

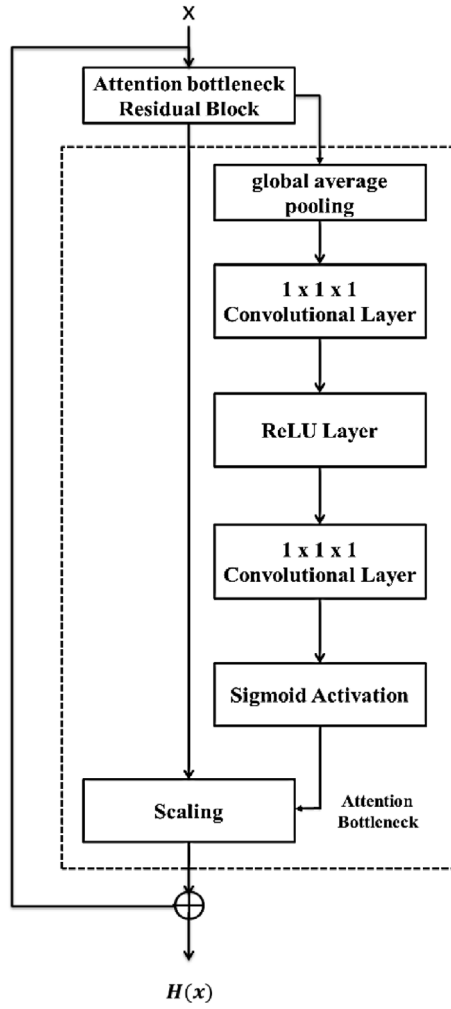


Fig. 5(a). Typical residual network.

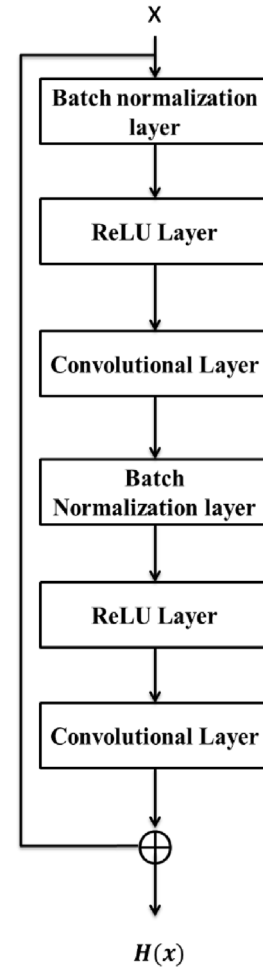


Fig. 5(b). Attention bottleneck residual block.

redundant information that might lower the classification accuracy. For solving this issue, this study selected a SE (Squeeze and Excitation) block for recalibrating the feature responses of the channel through explicit interdependencies modelling amongst channels. Hence, this can be considered as a mechanism of channel attention. This attention mechanism is integrated to the attention residual block and introduced an attention bottleneck residual block — ABRB.

An assumption is made with the size and count of attention mechanism's feature maps is $S * S * C$. Here C indicates the count of channels and S represents the spatial size of neighbourhood. The individual feature maps are initially processed through a three dimensional GAP layer to squeeze GSI (global spatial information). Hence, $1 * 1 * 1$ dimensional feature tensors of the channel are generated. Subsequently, the feature tensors of the channel are fed as input to a $1 * 1 * 1$ three dimensional convolution layer for minimising the dimensionality of the channel.

Exactly, after the convolution operation, feature tensor's channel dimension turns to be $\frac{c_1}{r_1}$ where r_1 indicates the reduction ratio. This ratio value is fixed as 4 in the introduced network. Followed by this, ReLU function is employed to enhance the channel response's non-linearity and additional $1 * 1 * 1$ three dimensional convolution layer is selected for enhancing the channel dimension thereby produces feature sensors. Finally, a sigmoid function is also applied and the resultant is multiplied with all the feature maps from ABRB to rescale the overall outcomes of the corresponding attention mechanism to feature maps denoted by $S * S * C$. In this manner, weights of the channel are

allocated to individual feature maps. Hence, accomplish recalibrating features in an adaptive way. Moreover, an attention strategy is afforded with $2 * \frac{c_1^2}{r_1}$ parameters that are retrieved from dual three dimensional convolution layer inside it.

3.1.3. Overall architecture of the introduced network

The COVID-19 dataset is considered as an instance and $7 * 7 * 200$ patches of images are utilised as samples (input), all the proposed ABRB's details are explored in Fig. 6. The individual convolutional layer pursues with ReLU and BN except that in ABRB. In accordance with SSRN (Spectral Spatial Residual Network), the introduced network inputs specific importance on learning all the spectral features from input (raw data). In addition, specific significance is provided to spatial features also. Hence, various spectral and spatial features are extracted.

Lastly, the spatial and spectral features are processed through FC and GAP operation. Here, the FC operation could adaptively produce feature vector as well as the length that is equivalent to the count of land cover classes in the COVID data. This is because there exists sixteen land cover classes in this dataset, the output vector's length is sixteen in Fig. 3. Additionally, it is stated that the initial convolutional layer's stride is (1, 1, 2). Thus, the input sample's channel dimension is minimised from 200 to 97. The additional convolution layers in the introduced ABRB is fortified with (1, 1, 1) stride. In ABRB, every convolution layers utilise padding to maintain the feature cuboid sizes. Without utilising padding, channel dimension or spatial size is minimised when the feature cuboid processing is done by the convolution layers exterior to ABRB.

3.2. Edge based graph cut segmentation (E-GCS)

GC segmentation is an effective segmentation method based on graph that possess two major parts such as the data-part for computing the conformity of the image data within the segmentation region that comprise of the features of an image as well as the regularisation-part for smoothening the segmented region's boundaries by maintaining the image's spatial information. Graph cut is taken into account as an energy reduction process corresponding to the constructed graph Gra_{GC} so as to segment the image's ROI using a seed sets. Representation of graph cut could be transferred into minimal graph cut or maximum flow. An assumption is made by considering a map (d) that assigns pixels to various clusters. Hence, the two elements corresponding to the energy function Gra_{func} of the graph cut comprise of data-part that computes the variation amongst regularisation-part S_{reg} and allocated region that assess the smoothness of the boundaries. The algorithm of it is shown in algorithm 1.

Algorithm 1: Edge based graph cut segmentation (E-GCS)
Input: Abnormal Image I_{ab} , Mask Image M_{im}
Output: Segmented Image I_{seg}
Procedure:
Step 1: constructed graph Gra_{GC} $Gra_{GC} = (P_v, H_E)$ P_v – set of vertices formed from I_{ab} H_E – set of edges of M_{im}
Step 2: Representation of graph cut could be altered into minimal graph cut or maximal flow.
Step 3: Energy function is given by $Gra_{func}(d) = \Delta \cdot S_{data}(d) + (1 - \Delta) \cdot S_{reg}(d)$ the pixels to different clusters allocated map d S_{data} - the difference between d and the allocated region S_{reg} - evaluates the boundaries' smoothness
Step 4: The final segmented image as, $I_{seg} = I_{seg}$ if $Gra_{func}(d) == 1$

Initially, the abnormal image is taken as input so that the proposed E-GCS can be used to segment the infected area from abnormal images. For this purpose, the graph is constructed and its representation is altered into minimal graph cut or maximal flow. In addition, an energy function is also computed to attain the final segmented image indicated by step 4. This step helps to separately localise the infected area of the disease in addition to classification of normal and abnormal images which makes the proposed system effective.

4. Results and discussion

The results obtained after implementing the proposed system to detect the COVID and non-COVID cases are discussed in this section. Various performance metrics considered for the analysis are also presented. Comparative analysis is also undertaken to prove the efficacy of the proposed system than the existing system.

4.1. Dataset description

Huge number of CT images, ultrasound images and X-ray images are accessible from various publicly available datasets. With the evolution of COVID-19 being recent, these huge repositories do not possess any labelled data of COVID-19, hence need the dependence upon various datasets for non COVID and COVID source images. The dataset is taken from the below sources.

CT images have been considered from,
<https://www.kaggle.com/datasets/kmader/siim-medical-images>
Chest X-ray images have been taken from,
<https://data.mendeley.com/datasets/rscbjbr9sj/2>
Ultrasound images have been considered from,
<https://www.butterflynetwork.com/covid19#gallery>

Additionally, number of images corresponding to individual data class for train and test split is given in Table 1.

Table 1

Number of images for train and test.

X-ray images (normal or pneumonia)	
Train data	4690
Test data	1172
CT images (COVID or Non-COVID)	
Train data	596
Test data	149
Ultrasound (normal or pneumonia)	
Train data	900
Test data	225

4.2. Performance metrics

Performance of the introduced system is analysed with respect to various significant metrics for classifying the three modalities of medical images. The metrics include accuracy, sensitivity, recall, specificity, precision, Area under curve (AUC), kappa and jaccard coefficient, F-score, NPV, FPR and FNR.

A. Accuracy

It indicates the computation of overall correct classification of images. It is presented by Eq. (8).

$$\text{Accuracy (A)} = \frac{TP + TN}{TN + FN + TP + FP} \quad (8)$$

B. Specificity

It refers to the quality/state of being unique/specific to an individual/group and is given by Eq. (9).

$$\text{Specificity (S)} = \frac{TN}{TN + FN} \quad (9)$$

C. Sensitivity

It indicates the positive and correctly recognised segments and is given as per Eq. (10).

$$\text{Sensitivity (S)} = \frac{TP}{TP + FP} \quad (10)$$

D. Recall

It is defined as the ratio of relevant as well as retrieved image to the ratio of relevant image and is given by Eq. (11).

$$\text{Recall (R)} = \frac{\text{relevant image} \cap \text{retrieved image}}{\text{relevant image}} \quad (11)$$

E. Precision

It is defined as the computation of correct image classification counts. It is given by Eq. (12).

$$\text{Precision (P)} = \frac{TP}{FP + TP} \quad (12)$$

F. Area under curve (AUC)

It is the accurate integral curve that exhibits the variations in classifications and is given by Eq. (13).

$$\text{AUC} = \frac{1}{2} \left(\frac{TP}{TP + FN} + \frac{TN}{TN + FP} \right) \quad (13)$$

G. F-score

It is also termed as F-measure and is the harmonic mean of P and R and is computed as per Eq. (14).

$$\text{F-score} = \frac{2 * (\text{recall} * \text{precision})}{\text{recall} + \text{precision}} \quad (14)$$

H. Negative predictive value (NPV)

NPV indicates the possibility that an individual is not affected by the particular disease provided a negative test outcome and is given by Eq. (15).

$$\text{NPV} = \frac{TN}{TN + FN} \quad (15)$$

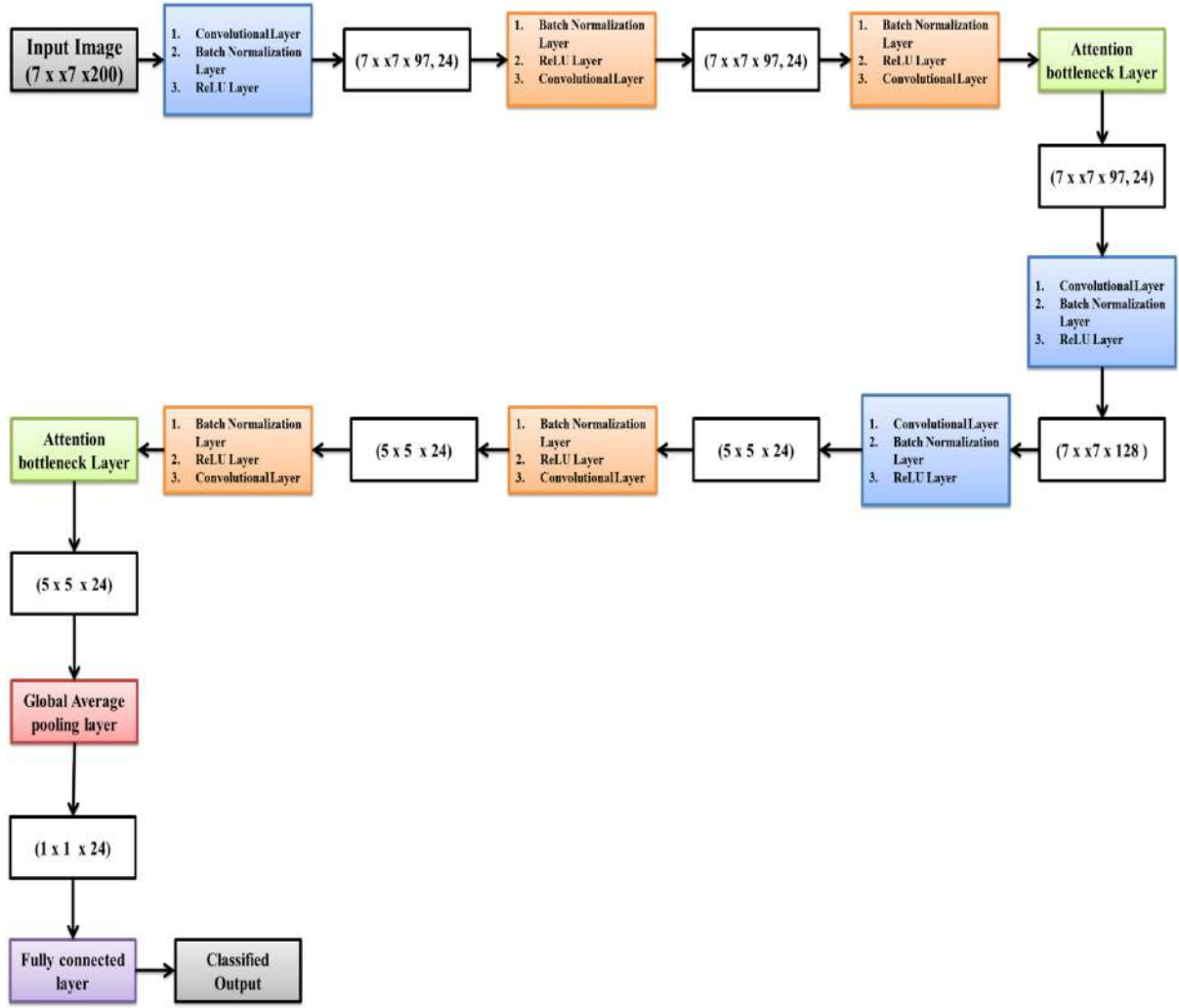


Fig. 6. Overall architecture of the proposed network.

I. False positive rate (FPR)

FPR is defined as the ratio of incorrect negative cases detected as positive cases in the corresponding data and is given by Eq. (16).

$$FPR = \frac{FP}{TN + FP} \quad (16)$$

J. False negative rate (FNR)

FNR is simply defined as one minus the true positive rate (TPR). It is given by Eq. (17).

$$FNR = 1 - \frac{TP}{TP + FN} \quad (17)$$

In Eqs. (8), (9), (10), (11), (12), (13), (14), (15), (16) and (17), TP is true positive, FP is false positive, TN is true negative and FN is false negative.

K. Kappa coefficient

It is typically utilised to find the reliability of the inter-rater. It can also be stated as the degree to which the agreement amongst two dataset frequencies accumulated on two varied occasions exists. It is the computation of agreement and is applied for assessing the accuracy in segmentation and is computed by Eq. (18).

$$K = (p_0 - p_c) / (1 - p_c) \quad (18)$$

where K represents kappa coefficient, p_0 indicates the population which judges agree and p_c represents agreement through chance.

L. Jaccard coefficient

It is also called jaccard similarity coefficient that makes the comparison of two dataset members for observing the shared and distinct members. It is a similarity measure for two datasets within a range of 0%–100%. If this percentage is higher, the similarity between the population also seems to be high. It is calculated using Eq. (19).

Jaccard coefficient

$$= (\text{the number in both sets}) / (\text{the number in either set}) * 100$$

$$= J(X, Y) = |X \cap Y| / |X \cup Y| \quad (19)$$

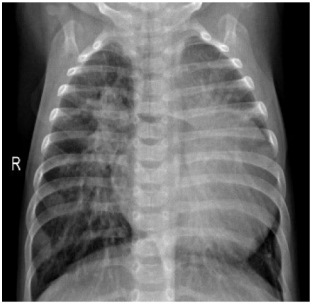
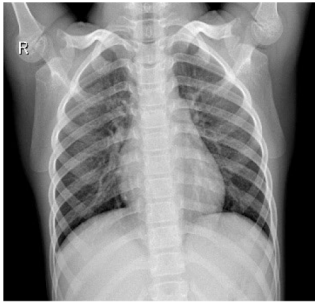
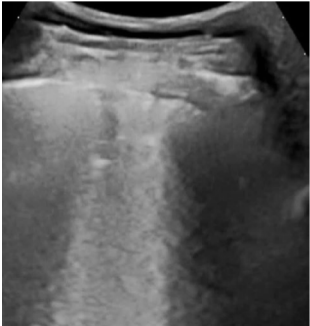
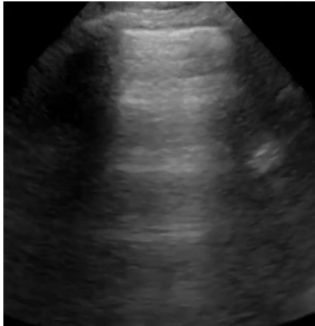
4.3. Experimental results

The results attained from the proposed system is shown in Table 2. As per Table 2, the classification results obtained through CT, X-ray and ultrasound image is shown. The proposed system differentiates the normal and abnormal cases of COVID-19 as per the Table 2. It is separately partitioned and it can be clearly observed in Table 2.

4.4. Performance and comparative analysis

Performance of the proposed system is analysed with respect to training accuracy, testing accuracy, precision and recall. From total data, 70% of the available data is allocated for training, whereas,

Table 2
COVID and non-COVID classification.

Different modalities	COVID (normal)	Non-COVID (abnormal)
CT		
X-Ray		
Ultrasound		

remaining 30% of data are equally divided and presented as testing and validation data. The obtained outcomes are shown in [Table 3](#).

From [Table 3](#), training accuracy is found to be 99.70%, its precision is found to be 98.65%, while, the recall rate is found to be 98.67%. On the other hand, testing accuracy is found to be 97.56%, its precision is explored as 96.15% and its recall is found to be 96.34%. Thus, it could be concluded that, the proposed system worked better as it shows good accuracy rate. In addition, the proposed system is analysed with respect to various metrics to find the efficiency in overall classification of three different medical image modalities such as X-ray, ultrasound and CT images. The considered metrics include sensitivity, recall, specificity, precision, accuracy, NPV, FPR, FNR, AUC, kappa and jaccard coefficient and F-score. The results obtained through this analysis are presented in [Table 4](#).

Table 3
Training and testing results.

Parameters	Obtained value
Training	
Training accuracy	99.70
Precision	98.65
Recall	98.67
Testing	
Testing accuracy	97.56
Precision	96.15
Recall	96.34

From [Table 4](#), it is clearly seen that the overall classification accuracy of the proposed system to classify the three image modalities

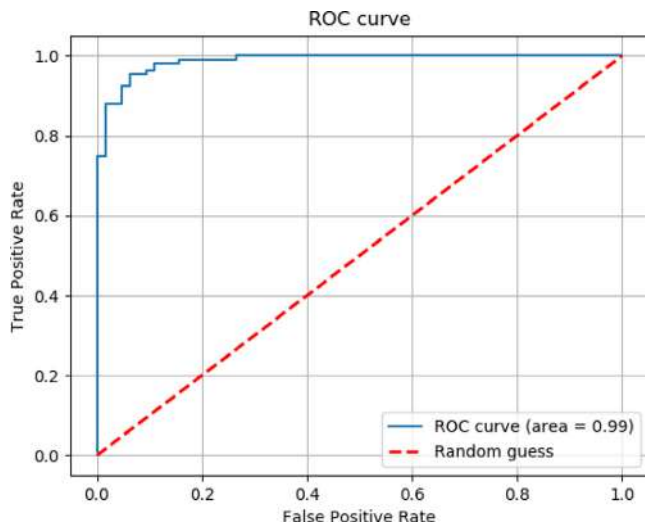


Fig. 7. ROC graph.

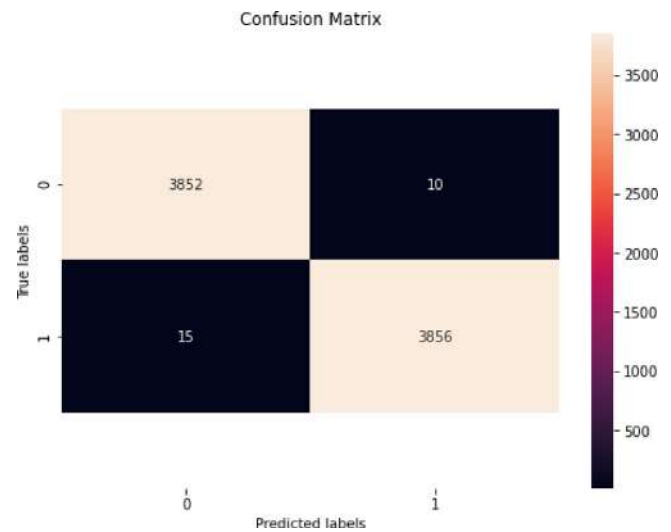


Fig. 8. Confusion matrix.

Table 4

Performance analysis of the proposed system.

Performance metrics (in %)	Overall	X-ray	CT	Ultrasound
Sensitivity	99.67	96.64	94.55	86.22
Specificity	99.66	95.42	92.25	86.95
Precision	99.67	95.36	92.05	87.08
Recall	99.671	96.64	94.55	86.22
NPV	99.7	96.68	94.7	86.09
FPR	0.003	0.0457	0.0774	0.1304
FNR	0.0032	0.0335	0.0544	0.1377
Accuracy	99.66	96.02	93.37	86.58
Kappa coefficient	99.34	92.05	86.75	73.17
AUC	99.67	96.03	93.04	86.59
Jaccard	99.35	92.3	87.42	76.45
F-score	99.68	96	93.28	86.65

Table 5

Confusion matrices.

	Positive	Negative
Positive	3852	10
Negative	15	3856

is found to be high at a rate of 0.9968. On the other hand, the X-ray classification rate is found to be 0.96, CT scan classification rate is found to be 0.9328 and finally the ultrasound image classification rate is found to be 0.8665. The sensitivity, recall, specificity, precision, and F-score are found to be high. In addition, the kappa and jaccard coefficient are also found to be high which is computed using Eqs. (14) and (15). On the other hand, the FNR rate is found to minimum at a rate of 0.0032 that indicates the minimum error rate of the proposed system in classifying the images into normal and abnormal. Further, a ROC (Receiver Operating Characteristic) curve is plot (shown in Fig. 7) to afford graphical view of the performance of a classifier instead of exploring particular value like many other performance metrics.

From Fig. 7, rapid increase in the ROC curve with an area of 0.99 represents the efficiency of the classifier. Additionally, confusion matrix is framed to check the model's efficacy and it is tabulated in Table 5 and graphically presented in Fig. 8.

From the confusion matrix, it is found that, 3582 positive cases have been correctly identified, while, 3856 cases have been correctly identified as negative cases, while, 10 positive cases have been misinterpreted as negative and 15 negative cases have been misinterpreted as positive. However, in comparison to misinterpretation rate, the correctly detected case rates are high which confirms the efficacy of the proposed method. In addition, a comparative analysis is also carried

Table 6

Comparative analysis of the proposed and traditional systems (Narin et al., 2021).

Methods	Accuracy
Narayan Das et al.	97.4
Singh et. al.	94.65
Afshar et al.	95.7
Ucar and Korkmaz	98.26
Khan et al.	89.6
Sahinbas and Catak	80
Medhi et al.	93
Zhang et al.	95.18
Apostopolus et al.	93.48
Narin et al.	98
Ali Narin et al.	96.1
Proposed	98.34

out with respect to accuracy as it is the significant metric especially in medical domain. This analysis is undertaken to find the efficacy of the introduced system than the other methods. The obtained results are tabulated in Table 6.

From Table 6, it is clear that the existing system (Narin et al., 2021) used CNN for COVID-19 detection through classification. Various other methods are also considered as per the table. Though, better accuracy rate is achieved by the traditional systems, the accuracy rate of the proposed system is found to be outstanding than the traditional studies in classifying the normal and abnormal images thereby segmenting the affected area to localise the disease. This reveals the efficacy of the introduced system. It is graphically shown in Fig. 9.

Another comparative analysis is also carried out to analyse the efficacy of the introduced system than the conventional methods in detecting COVID-19. This analysis is carried out to confirm the efficacy of the proposed DL based system than conventional techniques. For this analysis, sensitivity, accuracy, AUC and specificity are taken into account and the obtained results are tabulated in Table 7.

From Table 7, it is clearly seen that the AUC rate of the proposed system is 0.99. Whereas, the existing system (El-Kenawy et al., 2020) used new feature selection and voting classifier algorithms for COVID-19 detection. However, the outcomes of the introduced system is found to be high in comparison to the traditional systems. In addition, the sensitivity and specificity rate of the introduced system is found to be 99.67 and 99.66. The accuracy rate of the proposed system is also found to be 99.68. The results are graphically shown in Fig. 10.

Thus, the performance and comparative analysis of the proposed system with 12 significant performance metrics reveal the efficiency of the introduced system than the existing system. As mentioned earlier,

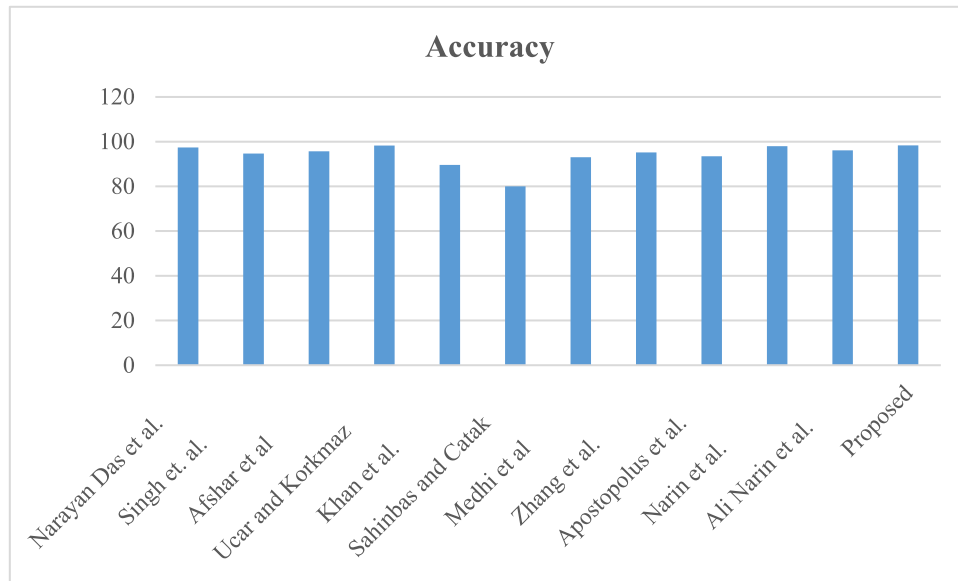


Fig. 9. Analysis of the proposed and traditional methods with respect to accuracy (Narin et al., 2021).

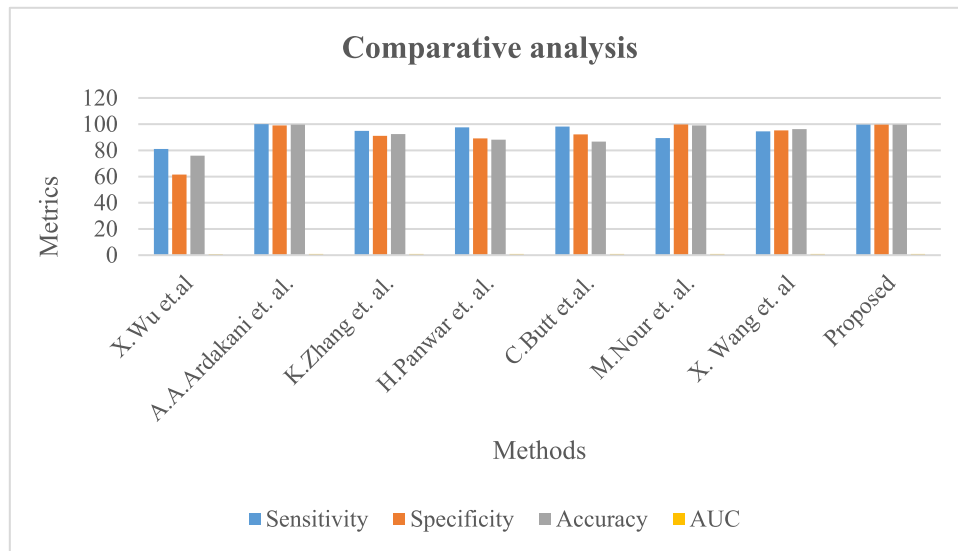


Fig. 10. Analysis of the existing (El-Kenawy et al., 2020) and proposed system with respect to important metrics.

Table 7
Comparative analysis in terms of significant metrics (El-Kenawy et al., 2020).

Methods	Sensitivity	Specificity	Accuracy	AUC
X. Wu et al.	81.1	61.5	76	0.819
A.A. Ardakani et al.	100	99.02	99.61	0.994
K. Zhang et al.	94.93	91.13	92.49	0.981
H. Panwar et al.	97.62	89.13	88.1	0.881
C. Butt et al.	98.2	92.2	86.7	0.996
M. Nour et al.	89.39	99.75	98.97	0.994
X. Wang et al.	94.5	95.3	96.2	0.97
Proposed	99.67	99.66	99.68	0.99

Table 8
Comparative analysis with respect to execution time (Wu et al., 2020).

Method	Time (s)
ACNN	561.8
CNN	921.2
Proposed	365.1

systems in terms of execution time and the obtained outcomes are shown in Table 8 and Fig. 11.

From the outcomes, it is found that, conventional methods like ACNN (Adaptive median filter CNN) has shown 561.8 s, CNN has shown 921.2 s, while, the proposed system has consumed minimum execution time of 365.1 s that explores its efficacy than conventional methods. Further, comparative analysis has been undertaken with respect to metrics such as recall, validation accuracy and precision. Several methods have been considered for analysis that includes Vanilla gray, Vanilla RGB, Basic CapsNet (Basic Capsule Network), Modified CapsNet, Hybrid CNN VGG (Hybrid Convolutional Neural Network Visual Geometry

the proposed system considers all the three different medical image modalities for classifying normal as well as abnormal images from CT scan, X-rays and ultrasound images. The existing study (El-Kenawy et al., 2020) considers only the CT images, but the present study considers all the three important medical imaging modalities that reveals its efficiency in classifying the abnormal and normal cases of COVID-19. Additionally, the existing system is compared with conventional

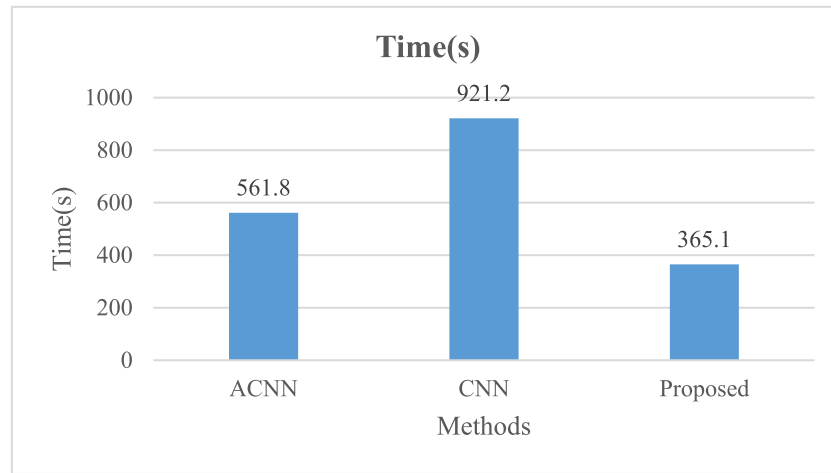


Fig. 11. Analysis in terms of execution time (Wu et al., 2020).

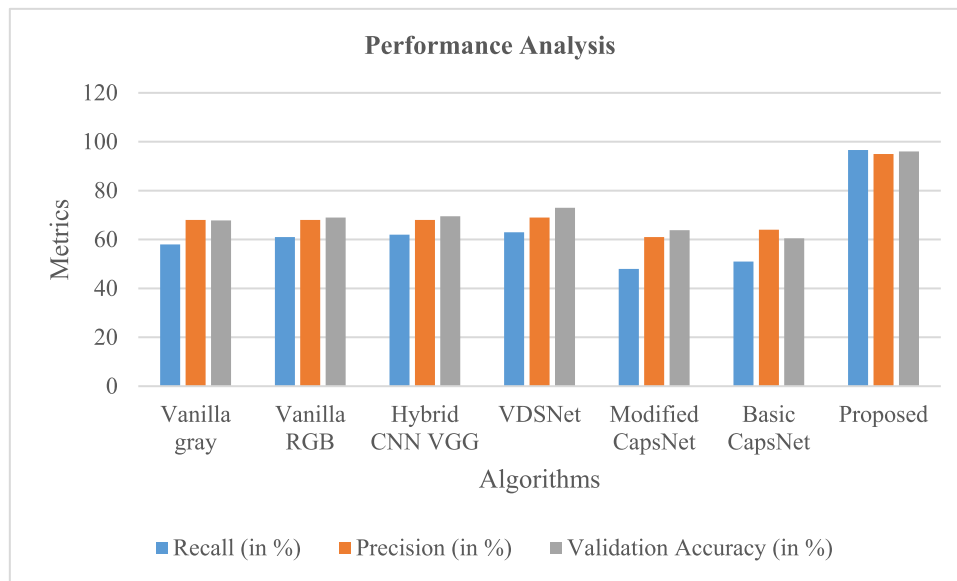


Fig. 12. Analysis in terms of performance metrics (Bharati et al., 2020b).

Table 9

Comparative analysis with respect to performance metrics.

Methods	Recall (in %)	Precision (in %)	Validation accuracy (in %)
Vanilla gray	58	68	67.80
Vanilla RGB	61	68	69
Hybrid CNN VGG	62	68	69.50
VDSNet	63	69	73
Modified CapsNet	48	61	63.80
Basic CapsNet	51	64	60.50
Proposed	96.64	95	96.02

Group) and VDSNet (VGG Data Spatial transformer network with CNN). Obtained outcomes are shown in Table 9 with its graphical presentation in Fig. 12.

From the analytical results, it has been found that, existing methods like VDSNet has shown better recall of 63%. However, the proposed system has shown maximum recall rate of 96.64%. Similarly, the precision rate of conventional methods like VDSNet has shown 69%. Nevertheless, the proposed system has shown high precision rate of 95%. Further, the validation accuracy of existing methods like Vanilla RGB has shown 69%, while, VDSNet has shown 73%, whereas, the proposed method has shown maximum validation accuracy of 96.02%. Thus,

overall analytical outcomes revealed the efficiency of proposed system than conventional system with respect to the considered metrics.

5. Conclusion

The present study proposed methods based on image processing and deep learning (DL) to detect COVID-19 using Attention Bottleneck Residual Network (AB-ResNet) to classify the abnormal and normal images. The study also utilised Edge Based Graph Cut Segmentation (E-GCS) to segment the disease infected area for localising the disease by considering three varying medical imaging modalities such as X-ray images, CT images and ultrasound imaging. The proposed system was assessed by comparing it with the traditional studies with respect to significant metrics namely accuracy, sensitivity, recall, specificity, precision, Area under curve (AUC), kappa and jaccard coefficient, F-score, NPV, FPR and FNR. The analytical outcomes explored the efficacy of the proposed system than the traditional systems in detecting the abnormal and normal cases of COVID-19 with high accuracy of 99.68%. However, it takes more training time. This study can help the society by helping the medical practitioners to easily differentiate the COVID and non-COVID cases thereby segment the disease infected area to particularly localise the disease by which patient's life could be saved.

In future, special focus will be given on reducing the training time and running time. Additionally, ablation studies will also be included to prove the proposed work further.

CRedit authorship contribution statement

T. Ahila: Writing – original draft, Methodology, Conceptualization, Data curation, Writing – review & editing, Software. **A.C. Subhajini:** Validation, Writing – review & editing, Visualization, Investigation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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**Relationship of Selected Anthropometric Measurements Physical Fitness
Components and Physiological Parameters Highly Correlated
with Sprinting Ability of Inter-Collegiate Sprinters**

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Abstract

The intension of the study was to investigate the selected anthropometric measurements, physical, physiological parameters highly correlated with sprinting ability of inter-collegiate level sprinters. To attain this aim, the investigator selected 330 male inter-collegiate level sprinters as subjects. Random group design was used for this investigation, as it is most suitable. The age of the selected subjects was from eighteen to twenty five years. In this study one criterion (sprinting ability) and sixteen determinant variables were included. Pearson product moment correlation was utilized to verify the association between criterion (sprinting ability) and determinant variables. The relationship between criterion and determinant variables as well as inter-correlations among determinant variables was calculated by using Pearson product-moment correlation formula. To test the hypothesis 0.05 level of confidence was fixed. The sprinting ability (SA) is significantly correlated with height, arm length, leg length, thigh girth, calf girth, speed, explosive power, muscular strength endurance, dynamic balance, breath holding time, VO₂max and anaerobic power of the sprinters.

Keywords: *Anthropometric, physical, physiological parameters and sprinters*

INTRODUCTION

The superior performance of today's athletes is the result of a complex blend of many factors (MacDougall et al., 1991). These factors include genetic endowment, physiology, biomechanics, training, health status, and experience. Champion athletes, depending on their specific sports, vary considerably in their physiological attributes (Daniels, 1974). It is therefore necessary to gain an understanding of the essential performance characteristics of a specific sport, in order to develop optimal training strategies for the athlete.

Sprinting is running over a short distance at the top-most speed of the body in a limited period of time. It is used in many sports that incorporate running, typically as a

way of quickly reaching a target or goal, or avoiding or catching an opponent. Sprint running races are short distances races in which athletes try to run at their maximum speed throughout the entire distance of the race. Sprint races are part of the track and field discipline and are included in all events that feature track and field competitions. Three sprints are currently held at the modern Summer Olympics and outdoor World Championships: the 100 metres, 200 metres, and 400 metres.

As compared to other sprinting events, the relative simplicity of the 100 m sprint makes it ideal for studying the elements of sprint running. Unlike other track-and-field sprints, such as the 200 m or 400 m event, the 100 m sprint does not involve a curve of the track. Thus, running technique involves purely linear movement, and no centrifugal or centripetal (outward and inward radial) forces. Given recent world record accomplishments in the male 100 m sprint event, it is assumed that a review of this event, and the multiple determinants to 100 m sprint performance would be a timely addition to the scientific and coaching literature within athletics. Consequently, the purpose of this study was to identify the features of the 100 m sprint that make it such an iconic event, and summarize the multi-faceted determinants to sprint running performance so that understanding and commentary on performance can be based on science rather than speculation or personal bias. Taking this into consideration the research scholar has decided to conduct his research on the same and find the solution of the problem. This research will be useful for both sprinters as well as coaches to improve sprint performance.

METHODOLOGY

Selection of Subjects

To determine the association between the criterion and determinant variables, three hundred and thirty male inter-collegiate level sprinters from various arts and science colleges affiliated to Manonmaniam Sundaranar University, Tirunelveli and also from Madurai Kamaraj University, Madurai, Tamilnadu were chosen. Random group design was used, as it is most appropriate. The age of the subjects was from 18 to 25 years.

Selection of Variables

Criterion Variable: The 100m sprinting performance of the selected sprinters were considered as criterion variable.

Anthropometric Measurements: The following anthropometric variables namely Height, arm length, leg length, thigh girth and calf girth were selected.

Physical fitness components: The physical fitness components such as maximum speed, explosive power, muscular strength, flexibility and dynamic balance were selected.

Physiological parameters: The physiological parameters such as resting heart rate, breath holding time, anaerobic power, forced vital capacity and Vo_2max were selected.

Collection of Data

The sprinting ability of the subjects was assessed by conducting 100m race and the selected anthropometric measurements, physical fitness components and physiological parameters were measured through standard test and measurements.

Statistical Techniques

In this study one criterion (sprinting ability) and sixteen determinant variables are included. Pearson product moment correlation was utilized to verify the association between criterion (sprinting ability) and determinant variables. The relationship between criterion and determinant variables as well as inter-correlations among determinant variables was calculated by using Pearson product-moment correlation formula. To test the hypothesis 0.05 level of confidence was fixed.

Result

The descriptive statistics– range, minimum, maximum, mean and standard deviation of anthropometric, physical, physiological parameters and sprinting ability of sprinters have been presented in table-I.

Table – I						
Descriptive Statistics Results of Chosen Anthropometric, Physical, Physiological Parameters and Sprinting Ability among Sprinters						
	N	Range	Minimum	Maximum	Mean	Std. Deviation
Height	330	15.00	154.00	169.00	1.6099E2	4.18311
Arm length	330	15.00	54.00	69.00	60.9939	4.18202
Leg length	330	10.00	69.00	79.00	75.0636	2.82287
Thigh girth	330	9.00	39.00	48.00	43.2333	2.72723
Calf girth	330	7.00	25.00	32.00	28.5030	1.56762
Speed	330	0.84	4.14	4.98	4.5257	.14345
Power	330	50.00	2.00	52.00	45.2030	4.16141
Strength	330	10.00	59.00	69.00	64.9455	2.77035
Flexibility	330	6.00	12.00	18.00	15.2576	1.82777
Balance	330	8.00	35.00	43.00	39.0636	1.96138
RHR	330	3.00	65.00	68.00	66.4758	1.19816
BHT	330	31.00	37.00	68.00	40.33	2.55
Anaerobic	330	26.00	260.00	286.00	2.7523E2	5.53767
FVC	330	0.54	3.05	3.59	3.3423	0.15795
Vo_2max	330	0.31	2.64	2.95	2.8035	0.09017
Sprinting	330	2.20	11.10	13.30	12.0795	0.61959

Correlation Analysis

The Inter-relationships between chosen anthropometric, physical, physiological parameters with sprinting ability of sprinters were computed using Pearson Product Moment Correlation and results are given in Table – II.

Table –II: Inter-Correlation Results on Selected Anthropometric, Physical, Physiological Parameters with Sprinting Ability of Male Sprinters

	SA	Ht	AL	LL	TG	CG	SP	EP	MSE	Flex	DB	RHR	BHT	AP	FVC	VO2
SA	1	0.301*	0.287*	0.318*	0.163*	0.161*	0.229*	0.285*	0.284*	0.053	0.200*	0.006	0.112*	0.619*	0.018	0.394*
Ht		1	0.998*	0.975*	0.599*	0.243*	0.144*	0.736*	0.707*	0.006	0.325*	0.029	0.086	0.394*	0.347*	0.707*
AL			1	0.976*	0.578*	0.250*	0.131*	0.724*	0.691*	0.003	0.331*	0.013	0.098	0.390*	0.341*	0.698*
LL				1	0.467*	0.231*	0.156*	0.688*	0.706*	0.010	0.337*	0.090	0.028	0.383*	0.360*	0.703*
TG					1	0.088	0.217*	0.659*	0.479*	0.060	0.228*	0.275*	0.236*	0.134*	0.133*	0.465*
CG						1	0.308*	0.031	0.108	0.133*	0.265*	0.139*	0.073	0.086	0.141*	0.365*
MS							1	0.155*	0.245*	0.317*	0.106	0.231*	0.178*	0.310*	0.254*	0.185*
EP								1	0.646*	0.071	0.130*	0.149*	0.131*	0.273*	0.309*	0.343*
MSE									1	0.097	0.243*	0.046	0.101	0.117*	0.369*	0.445*
Flex										1	0.183*	0.106	0.076	0.144*	0.282*	0.087
DB											1	0.082	0.160*	0.014	0.050	0.369*
RHR												1	0.912*	0.132*	0.002	0.185*
BHT													1	0.014	0.044	0.053
AP														1	0.328*	0.134
FVC															1	0.261*
VO ₂																1

**The required table 'r' value is 0.109 at 0.05 level of confidence.*

SA	Sprinting Ability	CG	Calf girth	DB	Dynamic balance
Ht	Height	SP	Speed	RHR	Resting heart rate
AL	Arm Length	EP	Explosive power	BHT	Breath holding time
LL	Leg Length	MSE	Muscular strength endurance	AP	Anaerobic power
TG	Thigh Girth	Flex	Flexibility	FVC	Forced vital capacity
				VO ₂	VO ₂ max

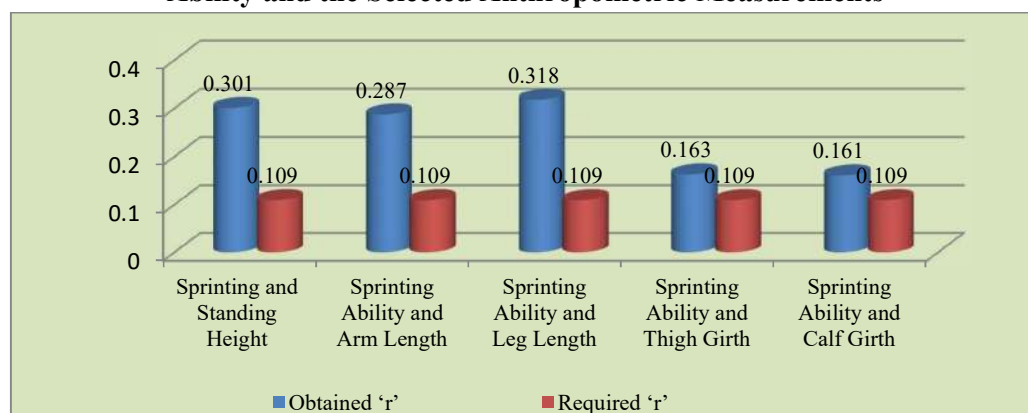
The following anthropometrical variables; height (0.301), arm length (0.287), leg length (0.318) thigh girth (0.163), calf girth (0.161) were significantly correlated with the sprinting ability. High correlation also existed between sprinting ability versus selected physical fitness components namely speed (0.229), explosive power (0.285), muscular strength endurance (0.284) and dynamic balance (0.200). The chosen physiological components; breath holding time (0.112), VO₂max (0.394) and anaerobic power (0.619) was significantly correlated with the sprinting ability. As the obtained 'r' values was found at 0.05 level of confidence was higher than required table 'r' value 0.109. The obtained and required 'r' values of selected anthropometric measurements with sprinting ability is displayed in table-III.

Table – III: Correlation between Criterion and Anthropometric Measurements

S.No	Variables Correlated	Obtained 'r'
1.	Sprinting and Standing Height	0.301*
2.	Sprinting Ability and Arm Length	0.287*
3.	Sprinting Ability and Leg Length	0.318*
4.	Sprinting Ability and Thigh Girth	0.163*
5.	Sprinting Ability and Calf Girth	0.161*

*The required table 'r' value is 0.109 (0.05 level)

The sprinting ability was significantly correlated with the selected anthropometric measurements such as height, arm length, leg length, thigh girth and calf girth of the sprinters since the obtained correlation coefficient values 0.301, 0.287, 0.318, 0.163 and 0.161 are greater than the required table value (0.109). The obtained correlation coefficient values between sprinting ability and the selected anthropometric measurements are graphically represented in figure-I.

Figure-I: Diagram Showing the Correlation Coefficient Values between Sprinting Ability and the Selected Anthropometric Measurements

The obtained and required 'r' values of selected physical fitness components with sprinting ability is displayed in table-IV.

Table – IV: Correlation between Criterion and Physical Fitness Components

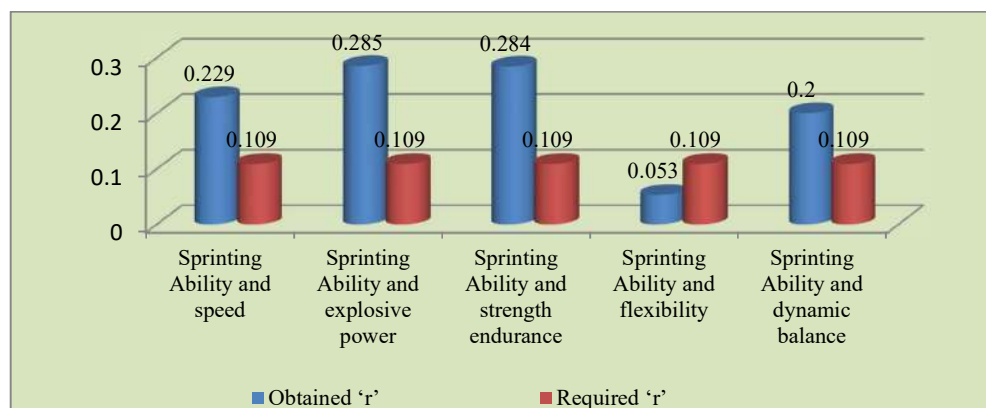
S.No	Variables Correlated	Obtained 'r'
1.	Sprinting Ability and speed	0.229*
2.	Sprinting Ability and explosive power	0.285*
3.	Sprinting Ability and muscular strength endurance	0.284*
4.	Sprinting Ability and flexibility	0.053
5.	Sprinting Ability and dynamic balance	0.200*

*The required table 'r' value is 0.109 (0.05 level)

The sprinting ability was significantly correlated with the selected physical fitness components namely speed (0.229), explosive power (0.285), muscular strength endurance

(0.284) and dynamic balance (0.200), as the required table 'r' value was 0.109 found at 0.05 level of confidence was higher than obtained 'r' values. However sprinting ability were not significantly correlated with flexibility (0.053) of the sprinters. The obtained correlation coefficient values between sprinting ability and the selected physical fitness components are graphically represented in figure-II.

Figure-II: Diagram Showing the Correlation Coefficient Values between Sprinting Ability and the Selected Physical Fitness Components



The obtained and required 'r' values of chosen physiological parameters with sprinting ability is displayed in table-V

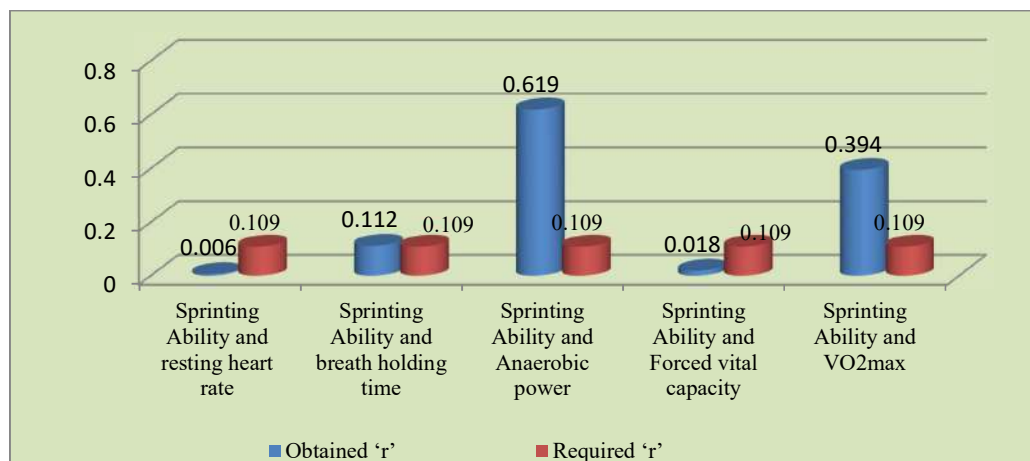
Table – V: Correlation Co-Efficient between Criterion and Selected Physiological Parameters

S.No	Variables Correlated	Obtained 'r'
1.	Sprinting Ability and resting heart rate	0.006
2.	Sprinting Ability and breath holding time	0.112*
3.	Sprinting Ability and Anaerobic power	0.619*
4.	Sprinting Ability and Forced vital capacity	0.018
5.	Sprinting Ability and VO ₂ max	0.394*

*The required table 'r' value is 0.28 (0.05 level)

The sprinting ability was significantly correlated with the chosen physiological parameters breath holding time (0.112), anaerobic power (0.619) and VO₂max (0.394) as the required table 'r' value 0.109 found at 0.05 level of confidence is higher than obtained 'r' values. However sprinting ability was not significantly correlated with resting heart rate (0.006) and Forced vital capacity (0.018) of the sprinters.

Figure-III: Diagram Showing the Correlation Coefficient Values between Sprinting Ability and the Selected Physiological Parameters



Discussion

Ramachandra and Shelvam (2017) identified the predominance of anthropometric variables between the sprinters. The variables in order of priority were standing height, foot breadth, chest breadth, upper leg length, thigh girth, wrist girth, calf girth, weight, ankle girth and foot length. Niels-Uth (2005) compared the anthropometry of sprinters and people belonging to the normal population. Both male and female sprinters had lower body mass index (BMI) than the normal populations. It has been suggested that particular anthropometric measures are pre-requisites for good athletic performance in various sports (Kukulj et al., 1999). The anthropometric dimensions measured in this study revealed significant relationships with sprint performance. Hunter and coworkers (2004) reported that height and leg length to be good predictors of acceleration phase velocity.

High performance sprint running from a block start requires the production of both high level forces and angular velocities (Harland & Steele, 1997; Mero et al., 1983; Mero et al., 1992). Specifically, large forces generated by the leg musculature whilst in the starting blocks can lead to a performance edge over the other competitors in the race (Harland & Steele, 1997). An explosive sprint start requires a powerful angular drive of the arms, hips and legs (Hoster & May, 1979; Korchemny, 1992). An athlete's relative explosive ability of their hip and knee extensors is critical to sprint performance. In fact the stored elastic energy has been suggested to be necessary to sprint performance (Mero et al., 1992).

Human physiology and physique combine to be the most influential determinants of improved sprint performance (Majumdar & Robergs, 2011). Physiological profiling is

used within team sports to assess both the demands of the sport and provide evidence of position specific requirements (Geithner et al., 2006). Differences in positional demands have been found between playing positions, the centre positions being the most active (McManus & Stevenson, 2007). For all athletes involved in high professional competitive sports the body is required to perform at optimum capacity in terms of biomechanics and physiology (Zaccagni, 2012).

Conclusion

The sprinting ability was significantly correlated with height, arm length, leg length, thigh girth, calf girth, speed, explosive power, muscular strength endurance, dynamic balance, breath holding time, VO₂max and anaerobic power was significantly correlated with the sprinting ability. Present day science is very much interested in estimating the optimum anthropometric, physical, physiological make-up of sprinters. So the scanning and selection of sprinters may be achieved successfully to a great extent by measuring anthropometric, physical, physiological parameters.

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Relationship of Selected Anthropometric Measurements Physical Fitness Components and Physiological Parameters Highly Correlated with Sprinting Ability of Inter-Collegiate Sprinters

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PREDICTION OF THE FACTORS PREDOMINANT TO SPRINTING ABILITY OF INTER-COLLEGIATE LEVEL SPRINTERS

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Abstract

The aim of this investigation was to determine the factors predominant to sprinting ability of university level sprinters. To attain this aim, the investigator selected 330 male inter-collegiate level sprinters as subjects. Random group design was used for this investigation, as it is most suitable. The age of the selected subjects was from eighteen to twenty five years. In this study one criterion (sprinting ability) and twenty determinant variables (anthropometric measurements, physical fitness components, physiological parameters and speed related parameters) were included. The relationship between criterion and determinant variables as well as inter-correlations among determinant variables was calculated by using Pearson product-moment correlation formula. The computation of multiple regressions was also used. Multiple regressions analysis was used to find out the predictor variable that has the highest correlation with the criterion variables and it is entered into the equation first. The rest of the variables are entered into the equation depending on the contribution of each predictor. To test the hypothesis 0.05 level of significance was fixed. The regression equation for the sprinting ability includes acceleration speed, stride frequency and anaerobic power.

Keywords: *Anthropometric, Physical, Physiological, Speed parameters and Sprinters*

INTRODUCTION

100m sprint event is a spectacular event in track and field, it is a most dominant event compare with all other events. In the short distance running there is a purpose to overcome the gifted distance in the shortest possible time. The decisive factors of the sports performance structure are maximal running speed and the ability to keep it as longer as possible (speed endurance). Even in many different sports and events the maximal running speed participates either directly or not on the level of sports performance and sportsman's successfulness. That is why the development of speed abilities is very topical problem of the sports theory and practice. The great deal of genetic determination and limited possibilities of the speed abilities' development turn attention for the selection of talented youth and look for new, more effective means and methods of development.

Performance is the ability to achieve the high score in sprinting competitive event. Athletes are always in search of more speed. Running speed is an essential component of most major sports, and can be the determining factor in the outcome of a sporting event. It

is for this reason that athletes undertake training programs to improve their individual speeds. In order to gain a performance advantage, athletes are always in search of newer methods. While team court sports have been widely researched, few studies have been conducted comparing predominant characteristics of sprinters. Hence, this kind of analysis will allow the identification of the different components of performance and how they interact to influence performance in sprint.

Running speed is an essential component of most of the major sports. Often, it is the determining factor in the outcome of a sporting event. Thus, the ability to enhance running speed is of prime importance to coaches and athletes. Since the researcher is a sprinter, the investigator feels that there is a need for an analytical study in order to discriminate the dominant factors associated with the sprinting performance of inter-collegiate level sprinters. Moreover, limited number of researches had been done among inter-collegiate level sprinters, and also there is a lack of descriptive data on the sprinting ability of inter-collegiate level sprinters. This has motivated to take up the study to predict the factors predominant to the sprinting ability of inter-collegiate level sprinters.

METHODOLOGY

Selection of Subjects

To determine the association between the criterion and determinant variables, three hundred and thirty male inter-collegiate level sprinters from various arts and science colleges affiliated to Manonmaniam Sundaranar University, Tirunelveli and also from Madurai Kamaraj University, Madurai, Tamilnadu were chosen. Random group design was used, as it is most appropriate. The age of the subjects was from 18 to 25 years.

Selection of Variables

Criterion Variable: The 100m sprinting performance of the selected sprinters were considered as criterion variable.

Anthropometric Measurements: The following anthropometric variables namely Height, arm length, leg length, thigh girth and calf girth were selected.

Physical fitness components: The physical fitness components such as maximum speed, explosive power, muscular strength, flexibility and dynamic balance were selected.

Physiological parameters: The physiological parameters such as resting heart rate, breath holding time, anaerobic power, forced vital capacity and Vo_2max were selected.

Speed Parameters: Reaction time, acceleration speed, stride length, stride frequency and speed endurance were selected.

Collection of Data

The sprinting ability of the inter-collegiate level sprinters was assessed by conducting 100m race and the selected anthropometric measurements, physical fitness components and physiological parameters were measured through standard test and measurements.

Statistical Techniques

In this study one criterion (sprinting ability) and twenty determinant variables are included. The relationship between criterion and determinant variables as well as inter-correlations among determinant variables was calculated by using Pearson product-moment correlation formula. The computation of multiple regressions was also used. In multiple regressions, a criterion variable was predicted from a set of predictors. Multiple regressions analysis was used to find out the predictor variable that has the highest correlation with the criterion variables and it is entered into the equation first. The rest of the variables are entered into the equation depending on the contribution of each predictor. To test the hypothesis 0.05 level of significance was fixed.

Result

The descriptive statistics– range, minimum, maximum, mean and standard deviation of anthropometric, physical, physiological, speed parameters and playing ability of sprinters have been presented in table-I.

Table – I: Descriptive Statistics Results of Chosen Anthropometric, Physical, Physiological, Speed Parameters and Sprinting Ability among Sprinters						
	N	Range	Minimum	Maximum	Mean	SD
Height	330	15.00	154.00	169.00	1.6099E2	4.18311
Arm length	330	15.00	54.00	69.00	60.9939	4.18202
Leg length	330	10.00	69.00	79.00	75.0636	2.82287
Thigh girth	330	9.00	39.00	48.00	43.2333	2.72723
Calf girth	330	7.00	25.00	32.00	28.5030	1.56762
Speed	330	0.84	4.14	4.98	4.5257	0.14345
Power	330	50.00	2.00	52.00	45.2030	4.16141
Strength	330	10.00	59.00	69.00	64.9455	2.77035
Flexibility	330	6.00	12.00	18.00	15.2576	1.82777
Balance	330	8.00	35.00	43.00	39.0636	1.96138
RHR	330	3.00	65.00	68.00	66.4758	1.19816
BHT	330	31.00	37.00	68.00	40.33	2.55
Anaerobic	330	26.00	260.00	286.00	2.7523E2	5.53767
FVC	330	0.54	3.05	3.59	3.3423	0.15795
Vo ₂ max	330	0.31	2.64	2.95	2.8035	0.09017
Reaction	330	0.10	0.17	0.27	0.2239	0.02521
Acceleration	330	2.10	4.20	6.30	5.1763	0.51255
Stride length	330	0.22	1.63	1.85	1.7479	0.06054

Frequency	330	1.09	4.11	5.20	4.6064	0.29366
Endurance	330	2.13	17.12	19.25	18.0963	0.58069
Sprinting	330	2.20	11.10	13.30	12.0795	0.61959

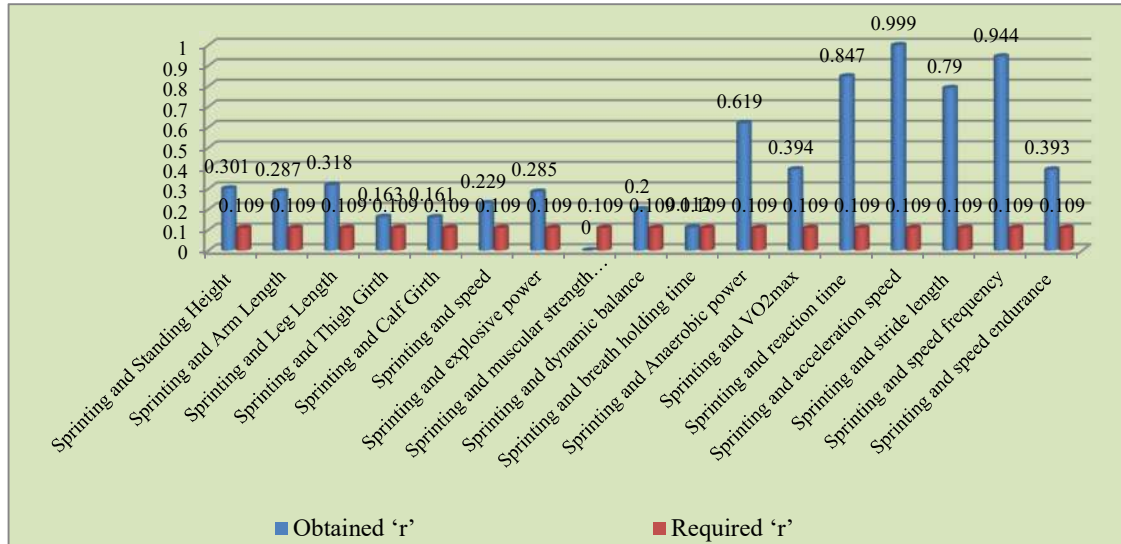
Correlation Analysis

The inter-relationships between chosen anthropometric, physical, physiological and speed parameters with playing ability of sprinters were computed using Pearson Product Moment Correlation. It was evident from the Pearson Product Moment Correlation results that sprinting ability (SA) is significantly correlated with are height, arm length, leg length, thigh girth, explosive power, muscular strength, anaerobic power, VO₂max, reaction time, stride frequency and speed endurance of sprinters.

The following anthropometrical variables; height (0.301), arm length (0.287), leg length (0.318) thigh girth (0.163), calf girth (0.161) were significantly correlated with the sprinting ability. High correlation also existed between sprinting ability versus selected physical fitness components namely speed (0.229), explosive power (0.285), muscular strength endurance (0.284) and dynamic balance (0.200). The chosen physiological components; breath holding time (0.112), VO₂max (0.394) and anaerobic power (0.619) was significantly correlated with the sprinting ability. The selected speed parameters namely reaction time (0.847), acceleration speed (0.999), stride length (0.790), speed frequency (0.944), speed endurance (0.393) were highly correlated with the sprinting ability of the sprinters. As the obtained 'r' values was found at 0.05 level of confidence was higher than required table 'r' value 0.109.

The obtained and required 'r' values of selected anthropometric, physical, physiological, speed parameters with sprinting ability is displayed in table-I.

Table – I: Correlation between Criterion and Determinant Variables



Step-Wise Multiple Regression Analysis

Stepwise multiple regression was computed to explore the prediction of dominant factors of sprinting ability from the predictor variables of inter-collegiate sprinters.

The analysis of variance for the influence of predictor variables on sprinting ability among inter-collegiate sprinters is in table -II.

Table II: Analysis of Variance for the Influence of Predictor Variables on Sprinting Ability Among Inter-collegiate Level Sprinters

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.877	1	8.877	15252.182	.000 ^b
	Residual	0.016	28	0.001		
	Total	8.894	29			
2	Regression	8.884	2	4.442	12062.074	.000 ^c
	Residual	0.010	27	.000		
	Total	8.894	29			
3	Regression	8.885	3	2.962	9077.734	.000 ^d
	Residual	0.008	26	.000		
	Total	8.894	29			

a. Dependent Variable: sprint ability

b. Predictors: (Constant), ACCSPEED

c. Predictors: (Constant), ACCSPEED, STFRE

d. Predictors: (Constant), ACCSPEED, STFRE, ANEROBIC

It was clear from the table-II that the obtained 'F' value 15252.18, 120602.07 and 9077.73 are significant (0.05 levels). Hence, all the independent variables are collectively influenced on the sprinting ability of sprinters.

As the F ratio is significant multiple regressions was computed. Multiple regression equation was computed only because the multiple correlations were sufficiently high to warrant prediction from it. Then, the correlation identified the independent variables to be included and their order in the regression equation. Multiple correlations were computed by step-wise argument method and the results were presented in Table – III.

Table-III: Step-Wise Multiple Regression between Sprinting Ability and Independent Variables of Sprinters

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.999 ^a	0.998	0.998	0.02413
2	0.999 ^b	0.999	0.999	0.01919
3	1.000 ^c	0.999	0.999	0.01806

a. Predictors: (Constant), ACCSPEED

b. Predictors: (Constant), ACCSPEED, STFRE

c. Predictors: (Constant), ACCSPEED, STFRE, ANEROBIC

From table-III, it was found that the multiple correlations co-efficient for predictors, such as acceleration speed, stride frequency and anaerobic power was 1.000 which produce highest multiple correlations with sprinting ability. 'R' square values show that the percentage of contribution of predictors to the sprinting ability (Dependent variables) is in the following order.

1. About 99.8% of the variation in the sprinting ability was explained by the regression model with one predictor acceleration speed.

2. About 99.9% of the variation in the sprinting ability was explained by the regression model with two predictors, acceleration speed and stride frequency. An additional 0.001% of the variance in the sprinting ability was contributed by stride frequency.

3. About 99.9% of the variation in the sprinting ability was explained by the regression model with three predictors, acceleration speed, stride frequency and anaerobic power. An additional 0.001% of the variance in the sprinting ability was contributed by anaerobic power.

Multiple regression equation was computed and the obtained results are presented in Table – IV.

Table-IV: Regression Analysis of Prediction Equation of Sprinters (Stepwise Method)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	6.911	.041		168.176	.000
ACCSPEED	1.017	.008	.999	123.500	.000
2 (Constant)	6.517	.100		64.915	.000
ACCSPEED	.945	.018	.929	51.112	.000
STFRE	.160	.039	.075	4.154	.000
3 (Constant)	7.189	.332		21.674	.000
ACCSPEED	.941	.017	.925	53.782	.000
STFRE	.146	.037	.069	3.968	.001
ANEROBIC	-.002	.001	-.016	-2.115	.044

a. Dependent Variable: sprinting ability

Predictors in the Model 1: (Constant), Acceleration Speed.

Predictors in the Model 2: (Constant), Acceleration Speed, stride frequency.

Predictors in the Model 3: (Constant), Acceleration Speed, stride frequency and anaerobic power.

From the Table-IV, the following regression equations were derived for sprinting ability of sprinters.

Regression Equation in obtained scores form = CR

Sprinting Ability = 6.911 + 0.941 (Acceleration Speed) + 0.146 (stride frequency) - 0.002 (anaerobic power)

The regression equation for the dominant factors of sprinting ability includes acceleration speed, stride frequency and anaerobic power. As the multiple correlations on dominant factors of sprinting ability with the combined effect of these predictor variables are highly significant, it is apparent that the obtained regression equation has a high predictive validity.

Discussion

According to the current study, the apparent importance of anthropometric variables in running speed. Stride length increases with body height, and strength and power with muscle development, thereby influencing the sprint performance (Papaiakovou, et al., 2009). The improvement in sprint performance is related to the maturation of the neural system and improved muscle/neural coordination, in addition to the increase in muscle mass (Malina, Bouchard & Bar-Or. 2004). Wong et al., (2009) found that taller players performed better in 10 m and 30 m sprint. In the growth spurt, the variations in maturation for the same chronological age have been shown be as

much as 2 or 3 years, or even more, and Malina et al., (2007) suggest that body mass and maturity account for 50% of variance in short sprint.

Barrera et al., (2022) analyze the relationship between sprint performance (time), and strength and power capabilities in football players and found that peak torque at higher velocities and vertical jump performance correlates significantly with linear sprint performance. Suarez-Arrones et al., (2020) suggested that despite the existence of substantial correlations between variables, straight linear sprinting, jumping performance, CODs and squat power were, for the most part, separate motor qualities, suggesting that all of them should be specifically assessed and trained. Loturco et al., (2019) identified that maximum running speed is a very complex physical capacity, which should be assessed and trained using several methods and training strategies.

Human physiology and physique combine to be the most influential determinants of improved sprint performance (Majumdar & Robergs (2011). Physiological profiling is used within team sports to assess both the demands of the sport and provide evidence of position specific requirements (Geithner et al., 2006). For all athletes involved in high professional competitive sports the body is required to perform at optimum capacity in terms of biomechanics and physiology (Zaccagni, 2012).

Numerous investigators have attempted to isolate predictive factors for the selection of track and field athletes (Foreman, 1989; Henson et al., 1989a). Alabin et al., (1980) identified the following factors as predictors of track and field talent: height, weight, speed, stride frequency and stride length, reaction time, strength, power, endurance, coordination, psychological approaches, intellectual level, and biological growth rate. Foreman (1989) outlined some of the characteristics related to successful performance in terms of relative importance in various events. In the area of sprints and hurdles, natural speed, power, stride cadence, strength, movement time, and low percent fat were considered important.

Conclusion

The sprinting ability was significantly correlated with height, arm length, leg length, thigh girth, calf girth, speed, explosive power, muscular strength endurance, dynamic balance, breath holding time, VO₂max and anaerobic power, reaction time, stride frequency and speed endurance of sprinters. The predictor variables namely acceleration speed, stride frequency and anaerobic power can be used to predict the sprinting ability of inter-collegiate level sprinters.

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**STUDENTS MIND-SET OF COVID 19 PERIOD ONLINE CLASSES WITH SPECIAL
REFERENCE TO ARTS AND SCIENCE COLLEGES OF KANYA KUMARI DISTRICT**

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ABSTRACT

India has the second largest education system in the world. The Indian education system has gone through many phases. Great effort has been put to shape up the present scenario of education system. Covid-19 has prompted to rethink the traditional mode of teaching. Online courses call for a greater amount motivation and self-discipline than a classroom-based course. Online learning environments have grown in popularity and application in arts and science colleges during the covid 19 pandemic situation.

The aim of this study is to analyze the student mind set of online classes in the arts and science college students for improving online classes environments. The objectives of the studies are to determine the general opinion of students towards online classes and to determine various attributes to the success of online classes.

This study adopted descriptive research design. The survey was conducted in 250 students of Arts and Science colleges by Quota sampling method. The primary source comprised of information gathered from the respondent through online questionnaires method. The questionnaire consists of relevant attributes such as performance, Convenience, information, interaction, Reliability and trust, security, Aesthetics, Continuous improvement. Likerts scale techniques and Standard Deviation method used as tools for analysis. Based on the analysis of data, this study reached a logical conclusion through identification of key design areas. It helped to understand the student's mind set and their expectation from online classes.

Keywords: Students mind set, Online classes, Education system

INTRODUCTION

Education is a basic human right and is necessary for enjoying many other rights. Education contributes to building more just societies through reducing poverty and inequalities. No country has ever climbed the human development ladder without steady investment in educational system. Education raises people's productivity and creativity and promotes entrepreneurship and technological advances. Higher education is a powerful sector to enhance productivity and growth. It contributes to personal and social development, and reduce social inequality.

AFTER COVID-19 CHANGES ON EDUCATIONAL SYSTEM

The petrifying and the extreme impact of COVID-19 have shaken the world to its core. In addition, the higher a part of the Governments across the globe have quickly closed academic establishments making an attempt to comprise the unfold of the COVID-19 pandemic. In India as effectively, the federal government as a facet of the nationwide lockdown has closed. All academic institution, as a consequence of which, learners from school kids to postgraduate college students, are affected.

Covid-19 has prompted experts to rethink the traditional mode of teaching. Online teaching seems to be a viable reply for make up for within the shortfall for classroom teaching. Online teaching is more likely to be built-in into mainstream studying. This may allow inclusive online teaching by encouraging studying throughout various geographies in India.

Online education has gained immense popularity among working professionals and students pursuing higher education. These categories of online learners find immense benefit in the autonomy and flexibility. Online courses call for a greater amount motivation and self-discipline than a classroom-based course.

REVIEW OF LITERATURE

Elaine Allen, Jeff Seaman (2011) have defined Online courses as those in which minimum 80 percent of the course content is delivered online and Face-to-face instruction are those courses in which less than 30 percent of the content is delivered online.

Abhay B. Tare (2014) "Higher education system in India : issues & challenges" India's higher education system is the world's third largest in terms of students, next to China and the United States. Unlike China, however, India has the advantage of English being the primary language of higher education and research. India educates approximately 11 per cent of its youth in higher education as compared to 20 per cent in China.

According to Stack, Steven Dr. (2015), online education has proliferated in the last decade. His research has not found any major difference in the scores of the students taking online course and face to face classes.

Dr.Fahad N. investigates the students' mind sets and perceptions of 186 University Student's from different colleges towards effectiveness of mobile learning in their studies. Their research findings indicate that students perceive Mobile technologies as an effective tool in improving their communication and learning.

Herman, T., & Banister, S. had done a research on comparison of cost and learning outcomes of traditional and Online coursework. Their findings shows that online course engages students in the learning process, supports strong student learning outcomes, and saves cost for the university also.

STATEMENT OF THE PROBLEM:

Online learning environments have grown in popularity and application in arts and science colleges during the covid 19 pandemic situation. The advent of new technologies is providing educators with opportunities to create a variety of effective learning environments; however, many adult students still prefer traditional academic settings. The purpose of this study is to analyze the student mind set of online classes in the arts and science college students for improving online course environments.

OBJECTIVES OF STUDY

- To determine the general opinion of students towards online classes.
- To determine various attributes that the critical to the success of online classes
- To analyse students mind set of online classes

RESEARCH METHODOLOGY

This study adopted descriptive research design. The survey was conducted in 250 students Arts and Science colleges in Kanyakumari District. The study used Quota sampling method in the study. The primary source comprised of information gathered from the respondent through online questionnaires method. Likerts scale techniques and Standard Deviation method used in tools for analysis.

ANALYSIS AND INTERPRETATION

The questionnaire consists of relevant factors and attributes such as performance, convenience, information, interaction, reliability and trust, security and aesthetics,

PERFORMANCE

S.No	Dimension	SA	A	N	DA	S DA	Total Score	Mean Score	Rank	S.D
1	Simplicity of attending the class	98	112	18	14	8	1028	4.112	I	0.845427
2	Students cannot delay to attend the class	70	84	24	64	8	894	3.576	VI	0.639389
3	It is boring to wait for site to load	88	96	40	22	4	992	3.968	III	0.787251
4	Students prefer prompt confirmation through google classroom	72	108	46	16	8	970	3.88	IV	0.75272
5	Students cannot tolerate errors in network	96	88	51	7	8	1007	4.028	II	0.811239
6	Students prefer simplicity to communicate	78	112	16	38	6	968	3.872	V	0.749619

The mean score of simplicity of attending the class is 4.112 (rank 1), score of students cannot tolerate errors in network is 4.028 (rank 2), score of boring to wait for site to load is 3.968 (rank 3), score of students prefer prompt confirmation through google classroom is 3.88 (rank 4), score of students prefer simplicity to communicate is 3.872 (rank 5) and score of students cannot delay to attend the class is 3.576 (rank 6).

CONVENIENCE

S.N o.	Dimension	SA	A	N	DA	S DA	Total Score	Mean Score	Rank	S.D
1	For me, time is very precious	80	129	17	24	0	1015	4.06	III	0.812
2	Students prefer safety and healthy	98	152	0	0	0	1098	4.392	I	0.8784
3	Students would love to attend the class in house	48	64	52	78	8	816	3.264	IV	0.6528
4	Time and energy can be saved	102	116	20	8	4	1054	4.216	II	0.8432

The mean score of students prefer safety and healthy is 4.392 (rank 1), score of time and energy can be saved is 4.216 (rank 2), score of for me, time is very precious is 4.06 (rank 3) and score of students would love to attend the class in my house is 3.264 (rank 4).

INFORMATION

S.N o.	Dimension	SA	A	N	DA	S DA	Total Score	Mean Score	Rank	S.D
1	In students opinion, knowledge is power	95	88	28	35	4	985	3.94	II	0.788
2	Extensive	72	105	46	21	6	966	3.864	III	0.7728

	information should be received									
3	Students like to receive feedback during the classes	28	16	44	98	64	596	2.384	IV	0.4768
4	Students receive more guidelines from faculty members	132	92	14	8	4	1090	4.36	I	0.872

The mean score of students receive more guidelines from faculty members is 4.36 (rank 1), score of in students opinion, knowledge is power is 3.94 (rank 2), score of extensive information should be received is 3.864 (rank 3) and score of students like to receive feedback during the classes is 2.384 (rank 4).

INTERACTION

S.No.	Dimension	SA	A	N	DA	S DA	Total Score	Mean Score	Rank	S.D
1	Interacting with teachers helps to gain more knowledge	88	126	36	0	0	1052	4.208	I	0.8416
2	Students always video on during the class	12	4	14	118	102	456	1.824	III	0.3648
3	Students took through the notes daily taught my teacher	17	28	66	85	54	619	2.476	II	0.4952
4	Easily interact with classmates	1	8	2	98	141	380	1.52	IV	0.304

The mean score of interacting with teachers helps to gain more knowledge is 4.208 (rank 1), score of students took through the notes daily taught my teacher is 2.476 (rank 2), score of students always video on during the class is 1.824 (rank 3) and score of easily interact with classmates is 1.52 (rank 4).

RELIABILITY AND TRUST

S.No.	Dimension	SA	A	N	DA	S DA	Total Score	Mean Score	Rank	S.D
1	Students believe that online services reliable	88	99	38	21	4	996	3.984	III	0.7968
2	Accurate network will be easier for both teachers and students	92	111	36	8	3	1031	4.124	II	0.8248
3	Students daily took through the notes	24	49	2	99	76	596	2.384	VI	0.4768
4	Feedback should be received promptly	71	83	65	28	3	941	3.764	IV	0.7528
5	Trust in online class relationship is important for me	63	93	43	29	22	896	3.584	V	0.7168
6	Students privacy is	11	133	4	0	0	1109	4.436	I	0.8872

	important	3								
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The mean score of students privacy is important is 4.436 (rank 1), score of accurate network will be easier for both teachers and students is 4.124 (rank 2), score of students believe that online services reliable is 3.984 (rank 3), score of feedback should be received promptly is 3.764 (rank 4), score of trust in online class relationship is important for me is 3.584 (rank 5) and score of Students daily took through the notes is 2.384 (rank 6)

SECURITY

S.No.	Dimension	SA	A	N	DA	S DA	Total Score	Mean Score	Rank	S.D
1	Students have no desire to take risks	94	106	2	44	4	992	3.968	III	0.7936
2	Online classes make my mobile slow	43	81	49	68	9	831	3.324	V	0.6648
3	A security and privacy promise will enable me to choose online Classes	93	89	61	7	0	1018	4.072	II	0.8144
4	Security of my personal details is very essential for me	97	137	9	7	0	1074	4.296	I	0.8592
5	afraid that personal information will be used in an unwanted Manner	77	123	22	12	16	983	3.932	IV	0.7864

The mean score of security of my personal details is very essential is 4.296 (rank 1), score of a security and privacy promise will enable me to choose online classes is 4.072 (rank 2), score of students have no desire to take risks is 3.968 (rank 3), score of afraid that personal information will be used in an unwanted manner is 3.932 (rank 4) and score of online classes make my mobile slow is 3.324 (rank 5).

CONTINUOUS IMPROVEMENT

S. No.	Dimension	SA	A	N	DA	S DA	Total Score	Mean Score	Rank	S.D
1	Students feel simplicity to use the app like google meet, zoom etc	66	158	16	6	4	1026	4.104	I	0.8208
2	Use of latest technology adds to students convenience	89	76	47	38	0	966	3.864	II	0.7728

The mean score of students feel simplicity to use the app like google meet, zoom, etc is 4.104 (rank 1) and score of use of latest technology adds to students convenience is 3.864 (rank 2).

AESTHETICS

S.No.	Dimension	SA	A	N	DA	S DA	Total Score	Mean Score	Rank	S.D
1	I like to visit a site on search basic subject	88	136	18	8	0	1054	4.216	II	0.8432

	notes on internet									
2	I am interest in online classes	17	21	57	87	68	582	2.328	IV	0.4656
3	No network problems in online class	6	18	49	81	96	507	2.028	V	0.4056
4	I like to learn and search on notes from the internet	75	89	44	37	5	942	3.768	III	0.7536
5	Better network connecting speed in better comfortable	134	108	8	0	0	1126	4.504	I	0.9008

The mean score of better network connecting speed in better comfortable is 4.504 (rank 1), score of I like to visit a site on search basic subject notes on internet is 4.216 (rank 2), score of I like to learn and search on notes from the internet is 3.768 (rank 3), score of I am interest in online classes is 2.328 (rank 4) and score of no network problems in online class going on is 2.028 (rank 5).

CONCLUSION:

The study is very relevant in the present context because of covid 19 pandemic condition. There is significant technical development s taking place across the globe which aims at student's convenience. Everyone looks to save health, save time, comfort and convenience. Based on the analysis of data, this study reached a logical conclusion through identification of key design areas. It helped to understand what student's mind set and their expectation from online classes to satisfy and delight.

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**USER'S PLEASURE REGARDING THE SERVICE RENDERED BY TAMIL NADU STATE
TRANSPORT CORPORATION (TOWN BUSES) WITH SPECIAL REFERENCE TO
KANYAKUMARI DISTRICT**

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ABSTRACT

Tamil Nadu State Transport Corporation Limited is a public transport bus operating service of Tamil Nadu. It is the largest bus corporation in the world and operates buses along intra and intercity routes. Kanyakumari is the southern part of India. In Kanyakumari district there are several villages. According to the National Transport Policy Committee (1980), “Future Nationalization should be guided by efficiency of operation of existing undertaking and to the extent to which they can provide consumer pleasure. Only the better financial and operational performance of any State Transport Undertaking will not fulfill the expectations of the people. The major objective is to study the bus user profile and to measure the bus user's pleasure of the sample respondent with regard to the TNSTC town bus operations. The study is an empirical research based on survey method. The study is based on primary data and has been collected from a sample of 150 respondents by means of questionnaires. The sample is made on the basis of cluster sampling. The information so collected has been analyzed using tools like percentage and arithmetic mean. The major findings are the age group between 25 to 50 years user's pleasures is more than other age group. The mean score of concessional facilities is 4.81 (rank 1) and experienced driver is 4.2 (rank 2). The private employee user's pleasures are more than other occupation. Improving and latest fuel technologies by adopting for a long term policy of the Transport Department of the Government will be more effective. The recommendation is the Government increases more and more facilities at the bus stands for attracting users and for giving them maximum comforts. The study of users' pleasure reveals that the users are satisfied with the operation of buses of TNSTC (town buses). Passenger's demand for travelling in India is increasing every day, and more and more passengers are in search of transportation information.

Key words: User's Pleasure, Transport, Operational Performance

INTRODUCTION

Transportation is a major activity in this world as people need to travel, goods have to be moved from place to places. So, transportation act as a catalyst and forms the backbone of the economic growth. In India the state transport undertakes ply more than 3.5 lakh buses serving more than 300 million people. Tamilnadu state transport's undertaking hold 17,284 buses and serve more than 15 million users daily. The objectives of the state owned transport undertakings are to provide economic, effective, efficient and well coordinated user road service network in Tamilnadu.

Transport is the servant of the people – the genie which makes their dreams come true – the magic carpet of their future – mobility of their desires, their aspirations, and their resources. Road transport being a service industry has to provide a quality service with reference to customer pleasure. Transport plays a significant role in the overall development of a nation's economy.

The road network has increased almost eightfold during the same period. India has an extensive network of major and minor roads as well as good number of well maintained networks of national highways connecting all major cities and tourists' destinations. The road ways provide transportation to millions of people every day.

Tamil Nadu State Transport Corporation Limited is established in the year 1972. It is a public transport bus operating service of Tamil Nadu. It is the largest bus corporation in the world and operates buses along intra and intercity routes. Kanyakumari is the southern part of India. In Kanyakumari district there are several villages.

At present Tamil Nadu State Transport Corporation (Tirunelveli) Limited Nagercoil region, (TNSTC) has 11 branches such as Ranithootham I, Ranithootham II, Ranithootham III, Kanyakumari, Vivenkanandapuram, Monday market, Colachel, Thiruvattar, Marthandam, Kuzhithurai, Chettikulam.

REVIEWS:-

Vanniarajan.T and Mr. Meenakshinathan (2007) conducted a study on A topology analysis of quality , customer satisfaction and behaviour intention in Indian rural banking service to analyse the impact of service quality factors on customer pleasure . The study reveals that the degree of impact of various quality factors on customer satisfaction is greater than on the behavioural intention.

Vijayakumar.T and Velu (2007) conducted a study on critical determinants of customer satisfaction in retail banking in India with the objective of identifying the determinants of quality dimensions, service problems, product used and the intention of switching over to other banks. The study provided insights and implications for managers in retail banks who want to improve customer satisfaction and retention rates.

Friman et al. (2001) established an evaluation model to evaluate the customer satisfaction of public transport and concluded that the overall pleasure is positively correlated with the cumulative pleasure.

Kennedy et al. (2005) believed that the public should participate in public transport management and analyzed the influence of the public on the pleasure of public transport.

Mahesh Chand in his research study entitled “Current Issues in Public Road Transport Management” has tried to evaluate critically the pros and cons of Nationalization taking into consideration the constraints of public transport undertakings also.

STATEMENT OF THE PROBLEM

According to the National Transport Policy Committee (1980), “Future Nationalization should be guided by efficiency of operation of existing undertaking and to the extent to which they can provide consumer pleasure. Only the better financial and operational performance of any State Transport Undertaking will not fulfill the expectations of the people, it is essential for the policy makers’s to build such a transport system that concentrates in the people’s orientation, giving them all amenities and comforts and satisfying them in all respects. The present research work has been to study the quality of service, the TNSTC (town buses) provides its users keeping in mind the level of pleasure of its users in turn of money they pay. The present study entitled user’s pleasure regarding the service rendered by TNSTC (town buses) with special reference to Kanyakumari district will be of immense help to the policy makers and other authorities to arrive at proper transport policy.

OBJECTIVE OF THE STUDY

To study the bus user profile and to measure the bus user’s pleasure of the sample respondent with regard to the TNSTC town bus operations.

METHODOLOGY

The present study intends to examine the issues framed in the objectives. The study is an empirical research based on survey method. The primary data are collected a fresh for the first time and thus happen to be original in character. The study is based on primary data and has been collected from a sample of 150 respondents by means of questionnaires. The sample is made on the basis of cluster sampling. The information so collected have been analyzed using traditional tools

USER PROFILE OF THE SAMPLE RESPONDENTS

S.No.	Place of Residence	Percentage	Gender	Percentage
1	Urban	37	Male	33
2	Rural	63	Female	67
Age			Marital Status	
1	Below 25 years	18	Married	59
2	25 to 50 years	53	Unmarried	41
3	Above 50 years	29		
Educational Qualification			Occupation	
1	Upto HSC	39	Government Employee	16
2	Diplomo	17	Private employee	42
3	Graduates	28	Home maker	13
4	Postgraduates	12	Self employee	8
5	Professionals	4	Students	21
Monthly Income			Bus Usage	
1	Lessthan Rs.10000	21	Daily	62
2	Rs. 10000 to 20000	48	Frequently	26
3	Rs20001 to 30000	13	Occasionally	12
4	Above Rs. 30000	18		

PLEASURE OF USER AND OPERATIONAL ASPECTS OF BUS OPERATIONS IN TNSTC

S.No	Services	Total Score	Mean Score	Rank
1	Quick Service	589	3.92	IV
2	Availability during convenient hour and place	472	3.14	X
3	Maintenance and appearance of the bus	452	3.01	XI
4	Safety and reliability	568	3.78	V
5	Not satisfied with the operation of other bus	549	3.66	VI
6	Cooperative attitude of Crew members	602	4.01	III
7	Concessional facilities	627	4.81	1
8	Easy to carry luggage	546	3.64	VII
9	Experienced driver	631	4.2	II
10	Many stopping	503	3.35	IX
11	Noise Pollution	529	3.52	VIII
12	User Comforts	450	3	XII

The mean score of concessional facilities is 4.81 (rank 1), score of experienced driver is 4.2 (rank 2), score of cooperative attitude of crew members is 4.01 (rank 3), score of quick service is 3.92 (rank 4), score of safety and reliability is 3.78 (rank 5), score of not satisfied with the operation of other bus is 3.66 (rank 6), score of easy to carry luggage is 3.64 (rank 7), score of noise pollution is 3.52 (rank 8), score of many stopping is 3.35 (rank 9) and score of availability during convenient hour and place is 3.14 (rank 10)

AGE AND USER PLEASURE

S.No	Age Group	Percentage of Respondents	Mean Score	Rank
1	Below 25 years	18	3.5	III
2	25 to 50 years	53	4.21	I
3	Above 50 years	29	3.98	II

The mean score of age between 25 to 50 years is 4.21 (rank 1), score of age above 50 years is 3.98 (rank 2) and score of below 50 years is 3.5 (rank 3). So the age group between 25 to 50 years user's pleasures is more than other age group.

GENDER AND USER PLEASURE

S.No	Gender	Percentage of Respondents	Mean Score	Rank
1	Male	33	2.88	II
2	Female	67	4.42	I

The mean score of female is 4.42 (rank 1). The mean score of male is 2.88 (rank 2).. So the female gender user's pleasures are more than male.

USER'S PLEASURE AND THEIR MARITAL STATUS

S.No.	Marital Status	Percentage of Respondents	Mean Score	Rank
1	Married	59	4.38	I
2	Unmarried	41	4.06	II

The mean score of married is 4.38 (rank 1). The mean score of unmarried is 4.06 (rank 2). So the married user's pleasures are more than unmarried.

USER'S PLEASURE WITH THEIR LEVEL OF EDUCATION

S.No.	Education Level	Percentage of Respondents	Mean Score	Rank
1	Upto HSC	39	3.96	II
2	Diplomo	17	3.88	III
3	Graduates	28	3.99	I
4	Postgraduates	12	3.44	IV
5	Professionals	4	3.21	V

The mean score of graduates is 3.99 (rank 1), score of upto HSC is 3.96 (rank 2), score of diplomo is 3.88 (rank 3), score of postgraduate is 3.44 (rank 4) and score of professionals is 3.21 (rank 5). So the graduate's user's pleasure is more than other educated people.

USER'S PLEASURE AND THEIR OCCUPATION

S.No.	Occupation	Percentage of Respondents	Mean Score	Rank
1	Government Employee	16	4.16	III

2	Private employee	42	4.83	I
3	Home maker	13	4.58	II
4	Self employee	8	3.0	V
5	Students	21	4.11	IV

The mean score of private employee is 4.83 (rank 1), score of home maker (rank 2), score of Government employee is 4.16 (rank 3), score of students is 4.11 (rank 4) and score of self employee is 3 (rank 5). So the private employee user's pleasures are more than other occupation.

MONTHLY EARNINGS AND USER'S PLEASURE

S.No.	Monthly Income	Percentage of Respondents	Mean Score	Rank
1	Less than Rs.10000	21	4.10	II
2	Rs. 10000 to 20000	48	4.22	I
3	Rs.20001 to 30000	13	3.56	III
4	Above Rs. 30000	18	3.12	IV

The mean score of Rs.10000 to 20000 is 4.22 (rank 1), score of less than Rs.10000 is (rank 2), score of Rs.20001 to 30000 is 3.56 (rank 3) and score of above Rs.30000 is 3.12 (rank 4). So the monthly income Rs.10000 to 20000 user's pleasures is more than other income groups.

PURPOSE OF TRAVEL AND USER'S PLEASURE

S.No.	Usage	Percentage of Respondents	Mean Score	Rank
1	Daily	62	3.72	II
2	Frequently	26	3.98	I
3	Occasionally	12	3.6	III

The mean score of frequently user is 3.98 (rank 1), score of daily user is 3.72 (rank 2) and score of occasionally user is 3.6 (rank 3). So the frequently user's pleasures are more than other users.

SUGGESTIONS

- The Government is supposed to improve the functioning of Research and Development.
- The Government is supposed to look for improving its operational policy by making drastic changes in the transport policy.
- Improving and latest fuel technologies by adopting for a long term policy of the Transport Department of the Government will be more effective.
- The Government is supposed to increase more and more facilities at the bus stands for attracting users and for giving them maximum comforts.

CONCLUSION

The study of users' pleasure reveals that the users are satisfied with the operation of buses of TNSTC (town buses). Passenger's demand for travelling in India is increasing every day, and more and more passengers are in search of transportation information.

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A STUDY ON OCCUPATIONAL STRESS AMONG WOMEN SANITARY WORKERS IN KANYAKUMARI DISTRICT

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ABSTRACT

The main aim of the study is to examine the socio economic conditions of women sanitary workers and the occupational stress of women sanitary workers in Kanyakumari District. The present study is a descriptive research. The main aim of this study is to know the occupational stress of women sanitary workers in Kanyakumari District. To execute the same, results of primary data is used. A self-structured interview schedule has been used to collect the primary data. The interview schedule was designed on 5 point likert scale ranging from strongly disagree to strongly agree. 200 sample women sanitary workers were selected for the study. The findings of the study reveal that socio-economic status of women sanitary workers was found to be very poor condition. According to their salary, they felt they could not meet their basic needs. The existing health facilities such as health insurance, uniform and the like are not sufficient. Further, long working hours, lack of manpower often extending working hours suddenly were foremost risk factors associated with heavy work load. As most of the work of women sanitary workers are primarily physical based, it is a crucial need for the authorities of local bodies in Kanyakumari District to pay greater attention to eliminate various risk factors associated with heavy work load of sanitary workers and concentrate on improving their physical and mental health. Thus, it may be recommended to the authorities to fulfil their monetary and welfare request of women sanitary workers.

Key Words: Occupational Stress, Women Sanitary Workers, Socio Economic Status and Long working hours

INTRODUCTION

Sanitation workers routinely lift heavy objects and work in all weather conditions. There is also a significant injury risk associated with the job. A Sanitary worker is a person employed by a public or private enterprise to collect and remove, waste from residential, commercial, industrial or other collection site for further processing and disposal. An estimated 1.2 million sanitary workers in the country are involved in the sanitation of our surroundings. The working conditions of these sanitary workers have remained virtually unchanged for over a century. In the context of Indian society sanitary worker comes under the urban informal and occupational hierarchy at lowest. A sanitary worker can be a person who is employ by Municipal Corporation or any private company for the collection, and disposal of garbage.

STATEMENT OF THE PROBLEM

Occupational stress has been becoming a common issue among all occupational groups in the work place. Rapidly growing technological changes, economic fluctuation, competition in the field, unemployment, educational growth have made all kinds of occupational groups to undergo stress. Sanitary workers are the low level and unnoticed workers in all kinds of organisation. Number of factors is involved in producing stress among the nurses. Unsystematic work processes, heavy physical work, ill defined roles and responsibilities, inadequate knowledge about way of managing stress, inadequate salary, high work over load, role ambiguity, absence of recognition, lack of respect, and isolation from other working groups are some of the common factors producing stress among sanitary workers. In the study area, poor salary, long working hours, high work load with inadequate staff, inadequate welfare facilities and poor HR practice are seen almost in both multi speciality as well as single speciality hospitals. These deficit factors not only make the sanitary workers to undergo stress and also compel them to quit the job. Numbers of sanitary workers have moved to other occupations such as women's self help group, Prime Minister's 100 days employment scheme and other occupations such as driving and government panchayat work on temporary base. Hence, it is necessary to bring the data about these deficit factors to the hospital management knowledge and also make awareness among the sanitary workers about the impact of the occupational stress and the way of dealing with stress. Hence present study is undertaken in the study area.

OBJECTIVES OF THE STUDY

- (1) To examine the socio economic conditions of women sanitary workers in Kanyakumari District
- (2) To know the occupational stress of women sanitary workers in Kanyakumari District

METHODOLOGY

The present study is a descriptive research. The main aim of this study is to know the occupational stress of women sanitary workers in Kanyakumari District. To execute the same, results of primary data is used. A self structured interview schedule has been used to collect the primary data. The interview schedule was designed on 5 point likert scale ranging from strongly disagree to strongly agree. 200 sample women sanitary workers were selected for the study.

ANALYSIS AND INTERPRETATION

Table 1. Socio Economic Status of Sample Women Sanitary Workers

Socio Economic Status	Category	Number of Respondents	Percentage
Age	Below 30	34	17
	30-40	74	37
	40-50	52	26
	50 and above	40	20
	Total	200	100.00
Type of family	Joint family	132	66
	Nuclear family	68	34
	Total	200	100.00
Family Size	Below 3 members	20	10
	3-5 members	146	73

	Above 5 members	34	17
	Total	200	100.00
Residing House	Rental house	32	16
	Own house	154	77
	Government Quarters	14	7
	Total	200	100.00
Type of House	Katcha	104	52
	Mixed	52	26
	Pucca	44	22
	Total	200	100.00

Source: Primary data

It is inferred from Table 1 that out of 200 respondents, majority of 37 per cent of them belong in the age group of 30-40 years. It is followed by the age groups 40-50 years, (26 per cent), 50 years and above (18 per cent) and below 30 years (17 per cent). Age is found to be an important factor which influences socio-economic status of their family.

Table 1 clearly reveals that out of 200 respondents, 66 per cent of their have joint family and 34 per cent have nuclear family. It could be inferred from the analysis that the type of family does not influence their socio-economic status.

Table 1 revealed that out of 200 respondents, majority of 73 per cent have the family size 3-5 members. It is followed by 5 members and above (17 per cent) and below 3 members (10 per cent). It is inferred from the analysis that family size is an important factor which influences the socio-economic status.

It is found from Table 1 that out of 200 respondents, majority of 77 per cent of the respondents are residing in own house, 16 per cent of the respondents are residing in rental house and 7 per cent of the respondents are residing in government quarters. It is identified from the table that most of the respondents are residing in owned house.

It is found from Table 1 that out of 200 respondents, majority of 52 per cent of them have Katcha house followed by Mixed (26 per cent) and Pucca house (22 per cent).

Role and Motivation Related Stressors

The role and motivation related stressors of women sanitary workers are ranked by finding the weighted average of each aspect and are tabulated in Table 2.

Table 2. Role and Motivation Related Stressors

Sl. No	Role and Motivation Related Stressors	Mean Score	SD	Rank
1.	Receiving mixed and conflicting messages from the same person at the same time	4.4022	0.6084	II
2.	Receiving conflicting messages from two or more people at the same time	4.2978	0.7127	IV
3.	Lack of respect, recognition and low estimation	4.2244	0.7555	V
4.	Lack of growth and development opportunities offered	4.5511	0.5956	I
5.	Inadequate monetary compensation (such as competitive pay, merit raises or bonuses for contribution at work) offered	4.3867	0.6686	III
6.	Inadequate non monetary reward (such as	3.8356	0.7548	VII

	award, praise from supervisors) for effective contribution at work			
7.	Facing difficulty and threatening of loss of pay to avail the permitted leave	4.0044	0.7609	VI

Source: Computed data

Table 2 highlights the mean and standard deviation of the women sanitary workers with regard to role and motivation related stressors. Lack of growth and development opportunities offered is the important role and motivation related stressors and occupies the first rank with the mean score of 4.5511, receiving mixed and conflicting messages from the same person at the same time is the next important physical well being occupies the second rank with the mean score of 4.4022, Inadequate monetary compensation (such as competitive pay, merit raises or bonuses for contribution at work) offered is another important role and motivation related stressors and occupies third rank with the mean score of 4.3867 and Inadequate non monetary reward (such as award, praise from supervisors) for effective contribution at work is the last important role and motivation related stressors and occupies the last rank with the mean score of 3.8356.

Work Shift and Working Hour Related Stressors

The work shift and working hour related stressors of women sanitary workers are ranked by finding the weighted average of each aspect and are tabulated in Table 3.

Table 3. Work Shift and Working Hour Related Stressors

Sl. No	Work Shift and Working Hour Related Stressors	Mean Score	SD	Rank
1.	Long and unsociable working hour	4.0378	0.6779	III
2.	Often receiving pressure to do overtime duty without remuneration	4.0067	0.8816	IV
3.	Often rotating to different wards without seeking any consent	3.5870	1.1709	V
4.	Being called and forced to come to the duty even during week off and official leave	4.0711	0.2573	II
5.	No routine and defined week off	4.1511	0.3585	I

Source: Computed data

Table 3 highlights the mean and standard deviation of the women sanitary workers with regard to work shift and working hour related stressors. No routine and defined week off is the important work shift and working hour related stressors and occupies the first rank with the mean score of 4.1511, being called and forced to come to the duty even during week off and official leave is the next important work shift and working hour related stressors occupies the second rank with the mean score of 4.0711, long and unsociable working hour is another important work shift and working hour related stressors and occupies third rank with the mean score of 4.0378 and Often rotating to different wards without seeking any consent is the last important work shift and working hour related stressors and occupies the last rank with the mean score of 3.5870.

Organization Related Stressors

The organization related stressors of women sanitary workers are ranked by finding the weighted average of each aspect and are tabulated in Table 4.

Table 4. Organization Related Stressors

Sl. No	Organization Related Stressors	Mean Score	SD	Rank
1.	Not supplying adequate protective devices such as hand gloves, face mask and footwear	3.9116	1.0210	I
2.	Lack of training and health education about the infectious disease, ergonomics aspects	3.7133	1.0361	II
3.	Lack of opportunity and communication channel to express the feelings, difficulties and opinions	3.6897	1.0486	III
4.	Lack of welfare facilities such as health insurance, travel allowance, uniform, concession for food in canteen and rest room	3.5987	1.1045	IV
5.	Excessive physical work and not having any substitution with machines	3.5244	1.1170	V

Source: Computed data

Table 4 highlights the mean and standard deviation of the women sanitary workers with regard to organization related stressors. Not supplying adequate protective devices such as hand gloves, face mask and footwear is the important organization related stressors and occupies the first rank with the mean score of 3.9116, lack of training and health education about the infectious disease, ergonomics aspects is the next important organization related stressors occupies the second rank with the mean score of 3.7133, lack of opportunity and communication channel to express the feelings, difficulties and opinions is another important organization related stressors and occupies third rank with the mean score of 3.6897 and excessive physical work and not having any substitution with machines is the last important organization related stressors and occupies the last rank with the mean score of 3.5244.

Specific Stressors

The specific stressors of women sanitary workers are ranked by finding the weighted average of each aspect and are tabulated in Table 5.

Table 5. Specific Stressors

Sl. No	Specific Stressors	Mean Score	SD	Rank
1.	Inadequate rest	3.9874	1.7669	II
2.	Being suspected by others for all theft incidents happening	3.9645	1.1698	III
3.	Being asked to perform the tasks which are not related to housekeeping	3.8335	1.1472	IV
4.	Performing multiple tasks such as cleaning and mopping various areas at the same time	3.7778	1.1367	V
5.	Conflict and dispute with co-workers	3.9978	1.1278	I

Source: Computed data

Table 5 highlights the mean and standard deviation of the women sanitary workers with regard to specific stressors. Conflict and dispute with co-workers is the important specific

stressors and occupies the first rank with the mean score of 3.9978, inadequate rest is the next important specific stressors occupies the second rank with the mean score of 3.9874, being suspected by others for all theft incidents happening is another important specific stressors and occupies third rank with the mean score of 3.9645 and performing multiple tasks such as cleaning and mopping various areas at the same time is the last important specific stressors and occupies the last rank with the mean score of 3.7778.

SUGGESTIONS

- Special medical assistance (excluding from the salary) may be given to the sanitary workers which may be useful to improve their health condition.
- The sanitary workers should be aware of legal protection. For that they may be allowed to attend legal awareness camps.
- The government can provide better housing condition to all the sanitary workers.
- More facilities should be provided to their children to pursue their education.
- The Government can take necessary steps to give free quota to improve their children education.

CONCLUSION

The findings of the study reveal that socio-economic status of women sanitary workers was found to be very poor condition. According to their salary, they felt they could not meet their basic needs. The existing health facilities such as health insurance, uniform and the like are not sufficient. Further, long working hours, lack of manpower often extending working hours suddenly were foremost risk factors associated with heavy work load. Tiredness on work place and even after reached home, stress and irritation and generalized body pain were foremost impact of heavy workload on health of sanitary workers. As most of the work of women sanitary workers are primarily physical based, it is a crucial need for the authorities of local bodies in Kanyakumari District to pay greater attention to eliminate various risk factors associated with heavy work load of sanitary workers and concentrate on improving their physical and mental health. Thus, it may be recommended to the authorities to fulfil their monetary and welfare request of women sanitary workers.

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**A STUDY ON CUSTOMER PERCEPTION TOWARDS PAYTM PAYMENT BANK IN
KILLIYOOR TALUK**

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ABSTRACT:

Paytm is one of the largest and the fastest growing internet based services in India. After the demonetization, its vigorous push towards its adoption by small and medium size businesses has turned it into the next best thing. Now, chances are that most of the shops you visit keep Paytm as a payment option. Not only that, Paytm now offers a myriad of services on its platform including payments, money transfer, shopping, recharge facilities, bill payments, and movie, bus and air tickets among others.. Today it offers a full market place to consumers on its mobile apps with the introduction of shopping platform on its mobile wallet recharge app. Paytm is deepening their roots in Indian e-commerce market. With a very short span of time, there are over 25 million registered users and are expected to double by the end of this year. Paytm success is followed by adverse challenges in the face of banks and e-tailors like Flipkart, snapdeal who are on the path of introducing their own mobile wallets. In order to survive and grow in the market Paytm is developing effective marketing strategies and are expanding their operational competitiveness.

KEYWORDS: Demonetization Paytm wallet, Banking Apps, M-wallet, E-commerce, online payments.

INTRODUCTION:

PAYTM stands for Payment Through Mobile. It is an E-Commerce payment system and E-Wallet company based in Noida, Uttarpradesh, India. A digital wallet is a type of virtual wallet service that can be used by downloading an app. The digital or mobile wallet stores bank account or debit/credit card information in an encoded format to allow secure payments. One can also add money to a mobile wallet and use the same to make payments and purchase goods and services. This eliminated the need to use credit/debit cards or remember the CVV or 4-digit pin. Some of the mobile wallet apps in the market are Paytm, mobikwik, freecharge, etc. The various services offered by mobile wallets include sending and receiving money, making payments to merchants, online purchase etc. Paytm is India's largest mobile payments and commerce platform. It allows you to pay bills and make online transactions. It started off as a prepaid mobile and DTH recharge platform, and later added data card, postpaid mobile and landline bill payments in 2013.

By January 2014, the company had launched the Paytm wallet, which the Indian Railway and Uber added as a payment option. It launched into e-commerce with online bus ticketing. In 2015, it unveiled more use-cases like education fees, metro recharges, electricity, gas, and water bill payments. In 2016, Paytm launched movies, events and amusement parks ticketing as well as flight ticket bookings and Paytm QR. Later that year, it launched rail booking and gift cards.

In 2017, Paytm became India's first payment app to cross over 100 million app downloads. The same year, it launched Paytm Gold, a product that allowed users to buy as little as RS. 1 of pure gold online. It also launched Paytm Payments Bank an 'Inbox', a messaging platform with in-chat payments among other products.

In 2018, it started allowing merchants to accept Paytm, UPI and card payments directly into their bank accounts at 0% charge. It also launched the Paytm for Business app which is now called Paytm Business. The company launched two new wealth management products-Paytm Gold Savings Plan and Gold Fund, to simplify investment decisions.

In March 2018, Paytm Money was setup with an investment for rs.9crore to bring investment and wealth management products for Indians. In March 2019, Paytm launched a subscription-based loyalty program called Paytm First.

In May 2019 Paytm partnered with Citibank to launch Paytm First credit card. In July 2020, Tata Starbucks partnered with Paytm allowing its customers to ordered food online during a corona virus (COVID-19) pandemic.

In July 2021, 197 communications filed a draft red herring prospectus with the Securities and Exchange Board of India to launch its initial public offering (IPO). It launched its IPO in November 2021, raising Rs.18,300 crore at a valuation of US \$20 billion. It was the largest ever IPO in India. The shares began trading on 18 November 2021, opening at Rs.1,950 on the NSE, 9.3% below the upper brand of the IPO price range, and closed down more than 27% at Rs.1,560, making it the biggest drop on a listing day in Indian IPO history.

OBJECTIVES OF THE STUDY

- ❖ To analyze the level of customers perception towards Paytm usage.
- ❖ To identify the customers' awareness about Paytm. payment bank
- ❖ To reveal the problems faced by the Paytm users..

SCOPE OF THE STUDY

This research focuses on "customers perception towards Paytm payment bank".. The scope of the research will describe the relationship between Paytm services on safety & security, transaction speed, convenience, recharge, ticket booking, shopping, booking hotels, govt. bill payments like electricity bill, insurance premium and transfer of funds. This can directly influence on the customer preference level and intention to use in further. Moreover, the respondents of this research will randomly selected from business people, govt. employee, professional and homemakers, who are normally use the Paytm services. And also how they are aware about the Paytm payment banks.

STATEMENT OF THE PROBLEM

It is obvious that the researcher establish the study about the key determinants of customer perception towards Paytm users to acquire the customer preference and response to the service as well as to analyze the most appropriate solutions for the problem affected by Paytm users. Nowadays the customer's uses many mobile wallet services. Paytm service users have been receiving many negative feedbacks in terms of Payment gateway failure, Problem with acceptance of debit/credit card, Failure of Paytm Apps, Delay in confirmation of order, security transactions, connectivity and Services quality. Therefore, in this research it is very important to identify the customer's preference level and feedback on the usage and adoption of Paytm service.

RESEARCH METHODOLOGY

The current study is based on primary data collected from 100 respondents from the Killiyoor Taluk. A well structured questionnaire was designed to collect the information from the respondents the questionnaire was designed to study perception of customer towards usage of Paytm.

SAMPLE SIZE

In this study the primary data collected from 100 sample respondents among the various paytm customers

TOOLS FOR ANALYSIS

The data collected from the sources like primary and secondary. The primary sources were analyses with the help of statistical measurement mean and chi-square test. The secondary sources used in the research such as books , journals , websites

REVIEW OF LITERATURE

1. Dr.A.Anandalakshmy& C.R.Gayathri (2026) discuss the "Customer perception towards Paytm application with special reference to Coimbatore city". The present research paper is

focusing on customer perception towards Paytm application, impact of these new digital payment system of customers and problems encountered if any.

2. **DR.M.Senthil (2019)** "A Study on Customer Satisfaction Towards Paytm users in Dharmapuri District. The present research paper is focusing on the impact of these new digital payment system on customers and problems encountered if any.

TABLE 1 - AGE WISE CLASSIFICATION OF RESPONDENTS

AGE	NO.OF RESPONDENTS	PERCENTAGE
18-30	90	90
31-40	8	8
41-50	2	2
ABOVE 51	0	0
TOTAL	100	100

Sources: Primary data

From the above table shows that 90% of respondents were belonged in the age group of 18-30. 8% of respondents were belonged in the age group of 31-40. 2% of respondents were belonged in the age group of 41-50. There were no respondents belonged in the age group of above 50.

TABLE 2 - AWARENESS THROUGH OF THE RESPONDENTS

PARTICULARS	NO. OF RESPONDENTS	PERCENTAGE
TELEVISION	30	30
MAGAZINE	37	37
SOCIAL MEDIA	44	44
OTHERS	24	24
TOTAL	100	100

Source: Primary data

From the above table shows that 30% of respondents were aware through television, 37% of respondents were aware through magazine, 44% of respondents were aware through social media, and 24% of respondents were aware through other area

TABLE 3 - ACCEPTANCE LEVEL OF VARIOUS FACTORS INFLUENCE TO USE PAYTM

FACTORS	NO. OF RESPONDENTS		PERCENTAGE		TOTAL
PAYTM PROVIDE A FLEXIBLE SERVICE	STRONGLY AGREE	16	STRONGLY AGREE	16	100
	AGREE	72	AGREE	72	
	NEUTRAL	10	NEUTRAL	10	
	DISAGREE	2	DISAGREE	2	
	STRONGLY DISAGREE		STRONGLY DISAGREE		
PAYTM IS A KEY TO THE INDIAN DEMONETIZATION	STRONGLY AGREE	12	STRONGLY AGREE	12	100
	AGREE	36	AGREE	36	
	NEUTRAL	44	NEUTRAL	44	
	DISAGREE	6	DISAGREE	6	
	STRONGLY DISAGREE	2	STRONGLY DISAGREE	2	

	STRONGLY DISAGREE	2	STRONGLY DISAGREE	2	
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Source: Primary Data

From the above table shows that 72% of respondents were agree for that factor of Paytm provide a flexible services, 44% of respondents were neither agree nor disagree for Paytm is a key to Indian demonetization, 42% of respondents were agree for Paytm support digital India,

TABLE 4- FACTORS PREFERRED TO USE OF PAYTM

FACTORS	NO. OF RESPONDENTS		PERCENTAGE		TOTAL
Multi utility	Strongly agree	24	Strongly agree	24	100
	Agree	58	Agree	58	
	Neutral	8	Neutral	8	
	Disagree	10	Disagree	10	
	Strongly disagree	0	Strongly disagree	0	
Fast service	Strongly agree	20	Strongly agree	20	100
	Agree	60	Agree	60	
	Neutral	20	Neutral	20	
	Disagree	0	Disagree	0	
	Strongly disagree	0	Strongly disagree	0	
Convenience	Strongly agree	20	Strongly agree	20	100
	Agree	50	Agree	50	
	Neutral	30	Neutral	30	
	Disagree	0	Disagree	0	
	Strongly disagree	0	Strongly disagree	0	
Promotion	Strongly agree	16	Strongly agree	16	100
	Agree	36	Agree	36	
	Neutral	34	Neutral	34	
	Disagree	14	Disagree	14	
	Strongly disagree	0	Strongly disagree	0	
Ease of use	Strongly agree	28	Strongly agree	28	100
	Agree	48	Agree	48	
	Neutral	20	Neutral	20	
	Disagree	4	Disagree	4	
	Strongly disagree	0	Strongly disagree	0	
No need to carry debit or credit card	Strongly agree	30	Strongly agree	30	100
	Agree	30	Agree	30	
	Neutral	24	Neutral	24	
	Disagree	14	Disagree	14	
	Strongly disagree	2	Strongly disagree	2	
User interface	Strongly agree	20	Strongly agree	20	100
	Agree	38	Agree	38	
	Neutral	40	Neutral	40	
	Disagree	2	Disagree	2	
	Strongly disagree	0	Strongly disagree	0	
Status and	Strongly agree	14	Strongly agree	14	100

identity	Agree	44	Agree	44	100
	Neutral	40	Neutral	40	
	Disagree	0	Disagree	0	
	Strongly disagree	2	Strongly disagree	2	
	Strongly agree	22	Strongly agree	22	
Safety	Agree	54	Agree	54	
	Neutral	22	Neutral	22	
	Disagree	0	Disagree	0	
	Strongly disagree	2	Strongly disagree	2	

Primary data

From the above table shows that 58% of respondents were agree for multi utility from preferred factors. 60% of respondents were agree for fast service from preferred factors 30% of respondents were neither agree nor disagree for convenience from preferred factors 34% of respondents were neither agree nor disagree for promotion from preferred factors, 48% of respondents were agree for ease of use from preferred factors, 30% of respondents were strongly agree for no need to carry debit or credit card from preferred factors, 30% of respondents were agree for no need to carry debit or credit card from preferred factors, 40% of respondents were neither agree nor disagree for user interface from preferred factors, 44% of respondents were agree for status identity from preferred factors,

TABLE 5 - RELATIONSHIPS BETWEEN AGE AND MONTHLY INCOME

The age of respondents are classified under the four categories are show below 18 to 30, 31-40, 41-50 and above 51 and the monthly income of the respondents under four categories are below 10,000 ; 10,000-15,000 ; 15,000-20,000 and above 20,000. The chi-square test is determined as follows.

CHI-SQUARE TEST

INCOME	AGE				TOTAL
	18 - 30	31-40	41-50	Above 51	
BELOW 10,000	48	0	0	0	48
10,000 - 15,000	16	0	2	0	18
15,000 - 20,000	10	2	2	0	14
ABOVE 20,000	14	6	0	0	20
TOTAL	88	8	4	0	100

HYPOTHESIS: There is a relationship between age and monthly income of the respondents.

O	E	(O-E)	(O-E) ²	$\frac{(O-E)^2}{E}$
48	42.24	5.76	33.2	0.78
16	15.84	0.16	0.0256	0.016
10	12.32	-2.32	5.4	0.44
14	17.6	-3.6	12.96	0.74
0	0	0	0	0
0	0	0	0	0
2	1.12	0.88	0.77	0.69
6	1.60	4.4	19.36	12.1
0	0	0	0	0
2	0.72	1.28	1.64	2.28
2	0.56	1.44	2.1	3.75
0	0	0	0	0
0	0	0	0	0

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
				$X^2 = 20.796$

CALCULATED VALUE = 20.796

DEGREE OF FREEDOM = $(r-1)(c-1)$
 $= (4-1)(4-1) = 3 \times 3 = 9$

TABLE VALUE = 16.92

The calculated value of chi-square is more than the table value, the hypothesis is rejected. Hence, there is no relationship between age and monthly income of respondents in these criteria.

FINDINGS

- ❖ 90% of respondents belong to the age group of 18-30.
- ❖ 44% of the respondents are aware paytm app through social media.
- ❖ 72% of respondents were agree for that factor of Paytm provide a flexible services
- ❖ 58% of respondents were agree for multi utility from preferred factors.
- ❖ 60% of respondents were agree for fast service from preferred factors
- ❖ 30% of respondents were neither agree nor disagree for convenience from preferred factors
- ❖ 34% of respondents were neither agree nor disagree for promotion from preferred factors,
- ❖ 48% of respondents were agree for ease of use from preferred factors.
- ❖ 30% of respondents were agree for no need to carry debit or credit card from preferred factors,
- ❖ 40% of respondents were neither agree nor disagree for user interface from preferred factors,
- ❖ 44% of respondents were agree for status identity from preferred factors,

SUGGESTIONS

- ✓ From the view point of respondents, they prefer more services from Paytm.
- ✓ To improve the customer awareness and knowledge (how to use) about Paytm.
- ✓ To reduce the problems around the Paytm payment banks for customer's satisfaction. Main problems like payment gateway failure, security problems, delay in confirmation, and connectivity and service quality.
- ✓ At the usage of Paytm app, provide more benefits to the regular customers for their better satisfaction.
- ✓ The Paytm should provide user interface and status and identity for the customers more preference.

CONCLUSION

Customers are the most important factor or asset of any business area. The success and failure of any business depends upon the customer's preference level or satisfaction and create them in tendency to use again the services provided by the business entity. Business man, professionals, students, and others are more conveniently using Paytm as easiest method than direct transactions.. Paytm is the all in service method because of others payment apps only for limited services such as mobikwik and free charge are only for mobile recharge, bills and merchant payments; phonepe and chill are only for send and receive money and so on. Most of the users are aware about customer care and help desk provided by the paytm app. The customers are mostly influenced through multi utility, fast service, convenience, promotion, ease of use, no need to carry debit or credit card services etc. This study finds the preference towards Paytm payment bank is evaluated positively by the respondents in general, but continuous improvement are recommended to maintain the customer's stability and to maintain the competitive edge.

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STUDY ON FACTORS INFLUENCING TO USE OF INTERNET BANKING SERVICES AND PERCEPTION TOWARDS INTERNET BANKING SERVICES IN KANYAKUMARI DISTRICT

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ABSTRACT

The present study attempts to observe the perception of customers towards internet banking in Kanyakumari district. It examines the customers' perception towards internet banking services in the study area based on their selected demographic profile. Further, it examines the factors influencing the customers to opt for internet banking service in the study area. The survey design is being considered as the most suitable technique for descriptive research since the aim is to obtain primary data. Interview schedule (primary data) enable the researcher to identify and describe the opinion of the respondents more easily. The present study is examining in nature, where as survey method was used to collect primary data from 200 customers of public sector banks and private sector banks in Kanyakumari district. Primary data has been collected to elicit the views and perception of customers' towards internet banking through a specially designed interview schedule. A five point Likert scale from 1-5 points (1- Strongly Disagree and 5- Strongly Agree) was used to measure the responses. The study found that easy bill payment and security for deposits in bank through online are the important factors influencing to use internet banking services among the customers who belong to the age group between 25-35 years. The analysis shows that there is a significant difference in perception towards internet banking services with the respect to the demographic profiles namely age group, marital status, educational qualification and occupation of sample customers.

KEY WORDS: Perception, Factors, Internet Banking Services and Security, influencing

INTRODUCTION

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Internet banking acts as a kind of financial intermediation which makes transaction through Internet. In the banking industry, Internet banking is the industry which uses computer technology to provide better services to the customers and help the development of banking practices. Technological innovation are one of the effective ways to increase the level of service quality to satisfy customer needs. Through the advanced technology and innovation in the financial and banking sectors, Internet banking has become more familiar to the customers of traditional banks. Internet banking is offered by the retail banking in many developed countries and customers can make transactions without having to leave their homes or workplace. In addition, Internet banking can help customers to manage their finances more capably.

STATEMENT OF THE PROBLEM

With the changing environment, banks implemented tele-banking, mobile banking and call centre services, ATM and others one after another. Due to rapid change in technology and the entry of private and foreign banks a number of new products and delivery channels have been introduced. Among the major initiatives Internet Banking has brought to the customers the much demanded convenience. The advent of internet banking offers banking firms a new frontier of opportunities and challenges. Despite these possibilities, there are various psychological and behavioral issues such as disinclination to change, trust in one's bank, security concerns, preference of human interference and the like impede the growth of internet banking. In this regard the study has been undertaken to analyse the factors influencing to use internet banking services and perception towards Internet banking services in Kanyakumari district.

SCOPE OF THE STUDY

The present study attempts to examine the perception of customers towards internet banking in Kanyakumari district. It examines the customers' perception towards internet banking services in the study area based on their selected demographic profile. Further, it examines the factors influencing the customers to opt for internet banking service in the study area.

OBJECTIVES OF THE STUDY

- (i) To analyse the factors influencing to use internet banking services in Kanyakumari District
- (ii) To study the perception towards internet banking services in Kanyakumari district.

METHODOLOGY

Descriptive research is used to test and to answer the research hypotheses. This is carried out by a survey design and therefore consists of designing and administrating the interview schedule, constructing the sampling strategy and analysing the results. The survey design is being considered as the most appropriate technique for descriptive research since the aim is to obtain primary data. Interview schedule (primary data) enable the researcher to identify and describe the opinion of the respondents more easily. The present study is exploratory in nature, where as survey method was used to collect primary data from 200 customers of public sector banks and private sector banks in Kanyakumari district. Primary data has been collected to elicit the views and perception of customers' towards internet banking through a specially designed interview schedule. A five point Likert scale from 1-5 points (1- Strongly Disagree and 5- Strongly Agree) was used to measure the responses.

HYPOTHESES

Following null hypotheses are formulated for the study.

H₀₁ - There is no significant difference in perception towards internet banking services among different demographic profile of customers

H₀₂ - There is no significant difference in factors influencing to adopt internet banking services among different demographic profile of customers

SAMPLING METHOD:

There are 12 public sector banks and 10 private sector banks in Kanyakumari district. Among that randomly five banks which have more branches are selected as a sample of this study. By Simple Random Method five branches are selected from each bank in Kanyakumari district and by Stratified Random Sampling Method, 4 customers are selected from each branch. Totally 20 customers from each bank and 100 customers are selected from public sector banks and 100 customers are selected from private sector banks.

ANALYSIS AND INTERPRETATION

Factors influencing to use internet banking services among different Gender group of customers

To study the outcome of the variable gender group of customers on factors influencing to use internet banking services, 't' test is applied with following null hypothesis,

Null Hypothesis: There is no significant difference between the mean scores regarding factors influencing to use internet banking services with respect to the gender group of customers in Kanyakumari district.

To test the significant difference between the mean score among the sample customers with respects to gender group and factors influencing to use internet banking services, the 't' test is used and the result is also depicted in Table 1.

Table 1

Factors influencing to use internet banking services among different Gender group of customers

Particulars	Gender group [Mean Score]		t Statistics
	Male	Female	
Easy for opening of accounts	3.7972	3.9520	5.349*
Faster mode of banking transactions	4.3935	4.8559	5.349*
Bring down the cost of banking charges	4.6173	4.2795	4.498*
Getting transaction done at any time	4.2749	4.1965	2.175
Instant checking of account balance	3.8410	3.8035	0.378
Transfer of payment or funds between accounts	4.4501	4.2052	4.270*
Easy bill payment	4.7278	4.7511	0.629
Facilitate online shopping	3.3908	3.5983	2.810*
Less risk and greater security	4.0485	4.1310	1.015
Improved service and increased flexibility	4.5795	4.3581	5.388*
To know about various schemes	4.2210	4.5022	3.241*
Internet information of banking products and services	4.2522	4.4719	3.458*
Downloading of various banking forms	4.4447	4.5284	1.296
Internet banking provides all services at 24x7 in business and individual purpose	4.5202	4.4061	2.731*
Security for deposits in bank through online	4.7197	4.4323	5.305*

Source: Primary data

*-Significant at five per cent level

Table 1 indicates that easy bill payment and security for deposits in bank through online are the important factors influencing to use internet banking services among the customers who are male as their mean scores are 4.7278 and 4.7197 respectively. Table further indicates that faster mode of banking transactions and easy bill payment are the important factors influencing to use internet banking services among the customers who are female as their mean scores are 4.8559 and 4.7511 respectively.

Since the 't' value of factors influencing to use internet banking services among different gender group of customers namely easy for opening of accounts, faster mode of

banking transactions, bring down the cost of banking charges, transfer of payment or funds between accounts, facilitate online shopping, improved service and increased flexibility, to know about various schemes, internet information of banking products and services, internet banking provides all services at 24x7 in business and individual purpose and security for deposits in bank through online are significant at 5 per cent.

Factors influencing to use internet banking services among different age group of customers

To study the effect of the variable age group of customers on factors influencing to use internet banking services, 'ANOVA' test is applied with following null hypothesis,

Null Hypothesis: There is no significant difference between the mean scores regarding factors influencing to use internet banking services with respect to the age group of customers in Kanyakumari district.

To test the significant difference between the mean score among the sample customers with respects to age group and factors influencing to use internet banking services, the ANOVA test is used and the result is also shown in Table 2.

Table 2
Factors influencing to use internet banking services among different age group of customers

Particulars	Age Group (Mean Score)				F Statistics
	Below 25 years	25-35 years	35-45 years	Above 45 years	
Easy for opening of accounts	3.8588	3.8404	3.9556	3.7647	3.858*
Faster mode of banking transactions	4.5763	4.5213	4.8667	4.2641	3.727*
Bring down the cost of banking charges	4.5311	4.4894	4.4459	4.3725	1.401
Getting transaction done at any time	4.2655	4.3440	4.0333	4.0547	3.523*
Instant checking of account balance	4.0113	3.8511	3.7889	3.1176	7.939*
Transfer of payment or funds between accounts	4.4181	4.2908	4.4333	4.3725	3.575*
Easy bill payment	4.8588	4.6454	4.7279	4.7647	3.121*
Facilitate online shopping	3.5932	3.5603	3.3571	2.7451	8.073*
Less risk and greater security	4.0452	4.0461	4.3689	3.9020	3.240*
Improved service and increased flexibility	4.3785	4.5390	4.3875	4.3725	8.324*
To know about various schemes	4.5419	4.2660	4.6345	3.9428	5.349*
Internet information of banking products and services	4.5042	4.2478	4.4012	3.9020	5.241*
Downloading of various banking forms	4.4318	4.5248	4.4889	4.3922	2.200
Internet banking provides all services at 24x7 in business and individual purpose	4.4288	4.4858	4.6222	4.3725	4.189*
Security for deposits in bank through online	4.5932	4.5496	4.7144	4.7375	3.617*

Source: Primary data

*-Significant at five per cent level

Table 2 demonstrates that easy bill payment and security for deposits in bank through online are the important factors influencing to use internet banking services among the customers who belong to the age group of below 25 years as their mean scores are 4.8588 and 4.5932 respectively. Table further indicates that easy bill payment and security for deposits in bank through online are the important factors influencing to use internet banking services among the customers who belong to the age group between 25-35 years as their mean scores are 4.6454 and 4.5496 respectively. Table further shows that faster mode of banking transactions and easy bill payment are the important factors influencing to use internet banking services among the customers who belong to the age group between 35-45 years as their mean scores are 4.8667 and 4.7279 respectively. Table further reveals that easy bill payment and security for deposits in bank through online are the important factors influencing to use internet banking services among the customers who belong to the age group of above 45 years as their mean scores are 4.7647 and 4.7375 respectively. Since the calculated 'F' value of factors influencing to use internet banking services namely easy for opening of accounts, faster mode of banking transactions, getting transaction done at any time, instant checking of account balance, transfer of payment or funds between accounts, easy bill payment, facilitate online shopping, less risk and greater security, improved service and increased flexibility, to know about various schemes, internet information of banking products and services, internet banking provides all services at 24x7 in business and individual purpose and security for deposits in bank through online are significant at 5 per cent.

Table 3

Gender group of Sample Customers and Perception towards internet banking services – 't' Test

Group	Gender group	N	Perception towards internet banking services	
			Mean	S.D
Gp.1	Male	371	60.65	8.27
Gp.2	Female	229	57.30	7.93
Total		600	58.79	8.07
Statistical Result t-Ratios & Level of Significance			2.751 p<0.005	

Source: Primary data

It is inferred from the above table that there is a significant difference between gender group of sample customers in their perception towards internet banking services. The t-value 2.751 is higher than the table value at 5% level of significance. Hence the null hypothesis is rejected. Thus there is a significant difference in perception towards internet banking services with the respect to the gender group of sample customers.

Table 4
Age group of Sample Customers and Perception towards internet banking services – 'ANOVA' Test

Group	Age group	N	Perception towards internet banking services	
			Mean	S.D
Gp.1	Below 25 years	51	60.00	7.11
Gp.2	25-35 years	177	59.17	8.14
Gp.3	35-45 years	282	58.87	8.12
Gp.4	Above 45 years	90	57.09	8.19
Total		600	58.79	8.07
Statistical Result F-Ratios & Level of Significance			2.747 p<0.005	

Source: Primary data

It is inferred from the above table that there is a significant difference between age group of sample customers in their perception towards internet banking services. The F-value 2.747 is higher than the table value at 5% level of significance. Hence the null hypothesis is rejected. Thus there is a significant difference in perception towards internet banking services with the respect to the age group of sample customers.

Table 5
Marital Status of Sample Customers and Perception towards internet banking services – 't' Test

Group	Marital Status	N	Perception towards internet banking services	
			Mean	S.D
Gp.1	Married	471	60.84	8.44
Gp.2	Unmarried	129	56.71	7.98
Total		600	58.79	8.07
Statistical Result t-Ratios & Level of Significance			3.110 p<0.005	

Source: Primary data

It is inferred from the above table that there is a significant difference between marital status of sample customers in their perception towards internet banking services. The t-value 3.110 is higher than the table value at 5% level of significance. Hence the null hypothesis is rejected. Thus there is a significant difference in perception towards internet banking services with the respect to the marital status of sample customers.

Table 6
Educational Qualification of Sample Customers and Perception towards internet banking services – 'ANOVA' Test

Group	Educational Qualification	N	Perception towards internet banking services	
			Mean	S.D
Gp.1	Upto Higher Secondary	71	55.53	8.57
Gp.2	Under graduate	249	64.66	7.61
Gp.3	Professional	151	59.23	8.38
Gp.4	Post graduate	108	57.54	8.20

Gp.5	Others	21	58.01	6.74
Total		600	58.79	8.07
Statistical Result F-Ratios & Level of Significance			2.979 p<0.005	

Source: Primary data

It is inferred from the above table that there is a significant difference between educational qualification of sample customers in their perception towards internet banking services. The F-value 2.979 is higher than the table value at 5% level of significance. Hence the null hypothesis is rejected. Thus there is a significant difference in perception towards internet banking services with the respect to the educational qualification of sample customers.

Table 7
Occupation of Sample Customers and Perception towards internet banking services – 'ANOVA' Test

Group	Occupation	N	Perception towards internet banking services	
			Mean	S.D
Gp.1	Government employee	28	60.89	8.27
Gp.2	Private employee	203	59.90	8.67
Gp.3	Professionals	111	57.74	7.91
Gp.4	Businessmen	153	58.92	7.22
Gp.5	Others	40	58.23	8.19
Total		600	58.79	8.07
Statistical Result F-Ratios & Level of Significance			2.948 p<0.005	

Source: Primary data

It is inferred from the above table that there is a significant difference between occupation of sample customers in their perception towards internet banking services. The F-value 2.747 is higher than the table value at 5% level of significance. Hence the null hypothesis is rejected. Thus there is a significant difference in perception towards internet banking services with the respect to the occupation of sample customers.

SUGGESTIONS

- Among customer's regarding internet banking services and to make internet banking services popular among the entire age and income group.
- Banks should try to win customers confidence by providing adequate security to the transaction. If the problems come in the banks should ensure that at no time should service case as a result of network problem.
- The bank staff must know all the facilities of internet banking services so they can say about the technology based banking facilities to the customer properly.

CONCLUSION

The present study is an attempt on the factors influencing the customers to use internet banking services and perception of the customers towards internet banking services. The study proves that the internet banking experience leads the customers to explore the maximum facilities to a large extent. And at the same time, it has not yet fully attracted and gained confidence from the customers. The aversion arises to the customers from their limited knowledge of internet security and benefits of internet banking. In the light of the overall findings of current study, this study concludes that, most of the customers were positive towards internet banking services. The study found that easy bill payment and security for deposits in bank through online are the important factors influencing to use internet banking services among the customers who belong to the age group between 25-35 years. The analysis shows that there is a significant difference in perception towards internet banking services with the respect to the demographic profiles namely age group, marital status, educational qualification and occupation of sample customers.

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A STUDY ON CUSTOMER SATISFACTION TOWARDS ONLINE SHOPPING IN KANYAKUMARI DISTRICT

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Abstract:

Online shopping is a form of e-commerce which allows the consumers to purchase goods or services directly from a seller through the internet. Online shopping or e-marketing depends upon technology for better marketing performance. Since the emergence of technology or World Wide Web the marketers have sought to sell the products to the customer who surf the internet. Customers or Shoppers can visit the web stores from their home and shop as they like while sitting in front of the computer. Thus, the study aims to know the customer satisfaction towards online shopping and it also focus the factors which influence the customer to buy the product through online shop. The study is based on both primary data and secondary data. Convenient sampling method were used in this study for selecting the sample size. 75 sample size was selected for this study. The study find out that 75% of the respondents are satisfied with online shopping.

Key words: Customer Satisfaction, e-commerce, Shoppers, Online shopping, e-marketing, web stores.

Introduction:

Due to the rapid growth of technology and e-commerce, online shopping has grown in popularity over the years. Online shops are increases day by day because customers find it convenient to access the product through internet at their homes or workplace and also now a days the individuals show their interest on web. Consumer can get full information about the price with its reviews being passed by the existing users. Online shopping lead customers to a convenient way of shopping. Customer can save their time, money and retrieve all the product information with just few clicks in few minutes and can purchase at anywhere and at any time according to their need.

Statement of problem:

Retention of customer is an easy task in less competitive world. But in competitive market it is very difficult to retain the customer. Online shopping has gained more in present marketing condition. Online shopping has also increases the number of scams, fraudulent practices and cheating. It creates fear in the minds of customers. Customer retention is mainly depends upon customer's satisfaction. The customer expectations are not fulfilled by the seller of particular shop they may switch their choice to another seller. Hence the study was an attempt to ascertain the factors that influence the customer satisfaction on online purchase.

Review of literature:

1. M. Subair (2018), "A study on Customer satisfaction with special reference to online shopping". The study concluded that having access to online shopping has truly revolutionized and influenced our society as a whole. This use of technology has opened new doors and opportunities that enable for a more convenient lifestyle today. Variety, quick service and reduced prices were three significant ways in which online shopping influenced people from all over the world. However, this concept of online shopping led to the possibilities of fraud and privacy conflicts.

	Satisfied				Dissatisfied
Saves time	35 (46.6%)	23 (30.6%)	12 (16.0%)	2 (2.6%)	3 (4.0%)
Convenience	38 (50.6%)	25 (33.3%)	10 (13.3%)	1 (1.3%)	1 (1.3%)
Ease process	28 (37.3%)	24 (32.0%)	15 (20.0%)	5 (6.6%)	3 (4.0%)
No crowds	35 (46.6%)	23 (30.6%)	13 (17.3%)	3 (4.0%)	1 (1.3%)
Exclusive offer and discount	25 (33.3%)	24 (32.0%)	18 (24.0%)	5 (6.6%)	3 (4.0%)
Door delivery	20 (26.6%)	45 (60%)	9 (12%)	1 (1.3%)	0 (0%)
Choice of availability	22 (29.3%)	38 (50.6%)	12 (16.0%)	2 (2.6%)	1 (1.3%)
After sales service	5 (6.6%)	12 (16.0%)	21 (28%)	24 (32.0%)	13 (17.3%)
Price	15 (20.0%)	28 (37.3%)	22 (29.3%)	8 (10.6%)	2 (2.6%)
Quality	17 (22.6%)	20 (26.6%)	13 (17.3%)	22 (29.3%)	3 (4.0%)
Payment security	25 (33.3%)	28 (37.3%)	15 (20.0%)	8 (10.6%)	0 (0%)
Product description	15 (20.0%)	20 (26.6%)	23 (30.6%)	12 (16.0%)	5 (6.6%)

The above table shows that majority of the respondents were highly satisfied with the factor of saves time(46.6%), Convenience(50.6%), Ease process(37.3%), No crowds(46.6%), Exclusive offer and discount (33.3%) and satisfied with Door delivery(60%), Choice of availability(50.6%), Price(37.3%), Payment security(37.3%). Majority of the respondents opined neutral about the product description. Majority of the respondents are dissatisfied with After sales service (32.0%) and Quality of the product (29.3%).

Table 4 :Satisfaction level of the respondents

S.No	Satisfaction level	No.of Respondents	Percentage
1	Highly Satisfied	12	16
2	Satisfied	56	75
3	Neutral	5	7
4	Dissatisfied	2	2
5	Highly Dissatisfied	0	0

The above table shows that 16 percent of the respondents are highly satisfied with online shopping, 75 percent of the respondent are satisfied with online shopping, 7 percent of the respondents are in the category of neutral and remaining 2 percent of the respondents are dissatisfied with online shopping.

Conclusion:

Online shopping has become a daily part of our lives because it is so convenient. The websites allows customer to compare the product and made easy to purchase the product with the help of reviews. To conclude online shopping satisfied the customer in many ways due to pandemic situation, convenience, 24 hours services, saves money, payment security and the customers are not much satisfied with the quality and product description. So it suggest the online seller to provide detail description of the product with better quality and also better services to be provide after the sales.

	Government employee	12	16.00
	Professionals	5	6.67
	Self- employee	10	13.33
	Home maker	6	8.00
	Students	11	14.67
	Un employee	3	4.00
Income	Up to Rs.10000	24	32.00
	Rs.10,000-Rs.20,000	30	40.00
	Rs.20,001-Rs.30,000	12	16.00
	Rs.30,001-Rs.40,000	5	6.67
	Above 40,000	4	5.33

Source: Primary data

From the above table, gender wise classification of the respondents shows that, 53.33 percent of the respondents were male and 46.67 percent of the respondents were female. The age wise classification of the respondents shows that, 26.67 percent of the respondents are in the age group of upto 25 years, 29.33 percent of the respondents are in the age group of 26-35 years, 24 percent of the respondents are in the age group of 36-45 years, 20 percent of the respondents are in the age group of above 45 years. 66.67 percent of the respondents were married and remaining 33.33 percent of the respondents were unmarried. Family size of the respondents shows that 1.33 percent of the respondents having one or two members in their family, 72 percent of the respondents are under the category of 3 to 4 members in a family and remaining 26.67 percent of the respondents have 5 to 6 members in a family. The education shows that, 21.33 percent of the respondents were educated at undergraduate, 45.33 percent of the respondents were educated post graduate, 29.33 percent of the respondents were professional and remaining 4 percent of the respondents were educated Diploma/IT. Occupation show that, 37.33 percent of the respondents were private employee, 16 percent of the respondents were government employee, 6.67 percent of the respondents were professionals, 13.33 percent of the respondents are self- employee, 8 percent of the respondent are home maker, 14.67 percent of the respondents were students and remaining 4 percent of the respondents were un employee. Monthly Income of the respondents shows that, 32 percent of the respondents earn up to Rs.10,000, 40 percent of the respondents were earn from Rs.10,000 to Rs.20,000, 16 percent of the respondents were earn from Rs.20,001 to Rs.30,000, 6.67 percent of the respondents were earn from Rs.30001 to Rs.40,000 and remaining 5.37 percent of the respondents were earn Above Rs.40,000 per month.

Table 2 : Websites preferred to get online shopping

Websites	No.of Respondents	Percentage
Amazon	24	32.00
Flipkart	22	29.33
Myntra	8	10.67
Snap deal	6	8.00
First cry	5	6.67
Meesho	3	4.00
Nykaa	2	2.67
Big basket	2	2.67
Paytm Mall	2	2.67
E bay	1	1.33

The above table shows that most of the respondents 32 percent preferred amazon, 29.33 percent of the respondents preferred Flipkart, 10.67 percent of the respondents preferred Myntra, 8 percent of the respondents preferred Snapdeal, 6.67 percent of the respondents preferred First cry, 4 percent of the respondents preferred Meesho, 2.67 percent of the respondents preferred Nykaa, Bigbasket and Paytm Mall and remianiang 1.33 percent of the respondents preferred E-bay.

Table 3 : Factors influencing to purchase online

Variable	Highly	Satisfied	Neutral	Dissatisfied	Highly
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	Satisfied				Dissatisfied
Saves time	35 (46.6%)	23 (30.6%)	12 (16.0%)	2 (2.6%)	3 (4.0%)
Convenience	38 (50.6%)	25 (33.3%)	10 (13.3%)	1 (1.3%)	1 (1.3%)
Ease process	28 (37.3%)	24 (32.0%)	15 (20.0%)	5 (6.6%)	3 (4.0%)
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After sales service	5 (6.6%)	12 (16.0%)	21 (28%)	24 (32.0%)	13 (17.3%)
Price	15 (20.0%)	28 (37.3%)	22 (29.3%)	8 (10.6%)	2 (2.6%)
Quality	17 (22.6%)	20 (26.6%)	13 (17.3%)	22 (29.3%)	3 (4.0%)
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The above table shows that majority of the respondents were highly satisfied with the factor of saves time(46.6%), Convenience(50.6%), Ease process(37.3%), No crowds(46.6%), Exclusive offer and discount (33.3%) and satisfied with Door delivery(60%), Choice of availability(50.6%), Price(37.3%), Payment security(37.3%). Majority of the respondents opined neutral about the product description. Majority of the respondents are dissatisfied with After sales service (32.0%) and Quality of the product (29.3%).

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5	Highly Dissatisfied	0	0

The above table shows that 16 percent of the respondents are highly satisfied with online shopping, 75 percent of the respondent are satisfied with online shopping, 7 percent of the respondents are in the category of neutral and remaining 2 percent of the respondents are dissatisfied with online shopping.

Conclusion:

Online shopping has become a daily part of our lives because it is so convenient. The websites allows customer to compare the product and made easy to purchase the product with the help of reviews. To conclude online shopping satisfied the customer in many ways due to pandemic situation, convenience, 24 hours services, saves money, payment security and the customers are not much satisfied with the quality and product description. So it suggest the online seller to provide detail description of the product with better quality and also better services to be provide after the sales.

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A Study On Customers' Perception Towards Online Banking Service With Special Reference To Vilavan code Taluk

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ABSTRACT

The main aim of this study is to study on customers' perception towards online banking services in Vilavan code Taluk. In this study, in order to analyses the level of satisfaction and analyses the problems of online banking customers in Vilavan code Taluk. This research was undertaken on the basis of data collected from both primary and secondary sources. The primary data was gathered from the 100 respondents who are using online banking services of private and public sector banks with the help of questionnaires. The respondent selected through the convenient sampling method. The analysis was carried out with the help of statistical measurements Chi-square and Likerts attitude test. The secondary data were collected from the websites, journals, Books, and Newspapers etc.. This study reveals that most of respondents were overall satisfaction with their online banking service. After the study concluded that, the online banking service meet success and when the customers satisfied with the online banking service except network problem.

KEYWORDS: Online Banking, satisfaction, perception, services, problems, private and public sector bank.

INTRODUCTION

Online banking is the term used for new age banking system. Online banking offers the convenience of banking from anywhere, at any time of the day or night. It is a free facility provided by the banks to their customers. Nowadays all banks provide online banking facility to their customers as an added advantage. Gone are the days, when one had to transact with a bank which was only in his local limits. Online banking has opened the doors for all customers, to operate beyond boundaries. Nowadays, people are so busy in their work lives, that they don't even have time go to the bank for conducting their banking transactions. Using a safe website, this is operated by their respective banks. It provides many features and functions to their customers and enables them to view their account balance, transfer money from their account to another account view their accounts summary

OBJECTIVES OF THE STUDY

- To measure the level of satisfaction of customers on online banking service.
- To know the problems faced by the customer in availing online banking services of private and public sector banks in Vilavan code Taluk.

STATEMENT OF THE PROBLEM

Nowadays all banks provide online banking facility to their customers as an added advantage. Gone are the days, when one had to transact with a bank which was only in his local limits. Online banking has opened the doors for all customers, to operate beyond boundaries. Nowadays, people are so busy in their work lives, that they don't even have time go to the bank for conducting their banking transactions. Using a safe website, this is operated by their respective banks. It provides many features and functions to their customers and enables them to view their account balance, transfer money from their account to another account view their accounts summary etc.. The present study "customers perception towards online banking service belongs to vilavancode Taluk". The online banking customers in vilavan code Taluk they faced some problems such as knowledge, set-up cost, network problems, processing fee, technical issues, privacy issues etc... Because the literacy in vilavancode Taluk is lesser than the others. If either educated or uneducated person they should need lack of knowledge to operate online banking facility. So they feel accessing of online banking service is very complicated to them.

IMPORTANCE OF THE STUDY

The need of this study is to find out how exactly are customers coping with these technological change in the traditional banking system, to discuss their satisfaction and how effective or non-effective. The researcher also wants to know the risk involved in online banking strategies and how they affect the average customer, also to know if it's just another corporate strategy or an innovative way that can be adapted by customers to solve problem.

METHODOLOGY

In this study "the customers' perception towards online banking services of special reference to Vilavan code Taluk". This research was undertaken on the basis of data collected from both primary and secondary sources. The primary data was gathered from the 100 respondents who are using online banking services of private and public sector banks with the help of questionnaires. The secondary data were collected from the websites, journals, Books, and Newspapers etc. The data were analysed with the help of statistical measurements Chi-square and Likerts attitude test.

ANALYSIS AND INTERPRETATION

Table 1 : Overall satisfaction with online banking service

Satisfaction	No of respondents	% of respondents
Highly satisfied	10	10
Satisfied	50	50
Neutral	31	31
Dis-satisfied	4	4
Highly dis satisfied	5	5
Total	100	100

Source : Primary data

The above table shows that, 50% respondents were satisfied with online banking service, 31% respondents were neutral in online banking service, 10% respondents are highly satisfied with online banking service, 5% respondents were highly dis-satisfied with online banking service and

4% respondents were dis-satisfied with online banking service.

LIKERTS ATTITUDE TEST

Scales are devices for measuring variables in social science research. In likert's scale each item is evaluated on the basis of how well it discriminate between those person whose total score is high and those whose score is less. The scale consists of number of statement which express either a favorable or un favorable satisfaction towards the objective of the study. As there is no readymade scale to measure the level of satisfaction, a scale namely'' the attitude scale'' was used. The respondents were requested mention their satisfaction toward satisfied, highly satisfied, dis-satisfied or highly dis-satisfied. With the below factors related to the satisfaction; Gender, Education, Size of family members, Type of accounts, Type of banks, Habit of online banking, Financial services

Mean score for each factor is determined as:

Mean score = Total score/ no of respondents.

Likert's five point scaling techniques used to analyse the attitude of respondents towards the satisfaction factor. Scale were allotted as follows;

Highly satisfied - 5, Satisfied - 4, Neutral -3, Dis- satisfied - 2, Highly dis-satisfied -1

The following are the range of scores fixed for determining the level of attitude of the respondents towards the satisfactions incurred to the online banking service

0 to 2- low level of attitude

2 to 4 - medium level of attitude

4 to 6- high level of attitude

Table 2: Opinion about their satisfaction

Opinion	Scores	No of respondents	Total score
Highly satisfied	5	10	50
Satisfied	4	50	200
Neutral	3	31	93
Dis-satisfied	2	4	8
Highly dis-satisfied	1	5	5
Total		100	356

Source: Primary data

Mean score = $356/100 = 3.56$

The mean score for the satisfaction of online banking customers is 3.56 as the mean score for this factor falls within the range of 2 to 4, the level of attitude towards the satisfaction of online banking is medium level.

CHI-Square analysis-1

An attempt is made to find out whether they exist any relationship between gender and way of attempting to tackle physical stress among the primary school teachers.

$(O - E)^2$

$$x^2 = \sum \frac{---}{---}$$

O = Observation frequency

E = Expected frequency

V = Degrees of freedom

GENDER AND REASON FOR USING ONLINE BANKING SERVICE

Table 3: Reason for using online banking service

Gender	Habit to using internet	To save time	Security	Banking transaction are easy	24 hours availability	Total
Male	10	8	6	3	14	46
Female	2	20	6	18	8	54
Total	12	28	12	26	22	100

Table 4 : Calculation of Chi-Square Value

O	E	O-E	(O-E) ²	$\frac{(O-E)^2}{E}$
10	5.52	4.48	20.142	3.64
2	6.48	-4.48	20.142	3.10
8	12.88	-4.88	20.142	1.56
20	15.12	4.88	20.142	1.33
6	5.52	0.48	0.230	0.04
6	6.48	-0.48	0.230	0.04
8	11.96	-3.96	15.682	1.31
18	14.04	3.96	15.682	0.12
14	10.12	3.88	15.054	1.48
8	11.88	-3.88	15.054	1.26
$\Sigma(O-E)^2/E = 13.88$				

Degrees of freedom (v) = $(r-1)(c-1)$
 = $(2-1)(5-1) = 1 \times 4 = 4$
 Calculated value = 13.88
 Table value = 9.49

Since the calculated value is greater than value. So, the hypothesis is rejected. Hence, the use chi-square tests. Find out whether is any association between gender and reasons for using online banking service.

CHI-SQUARE ANALYSIS-2

EDUCATION AND REASON FOR USING ONLINE BANKING SERVICE

Table 5: Reasons for using online banking service

Education	Habit to using internet	To save time	Security	Banking transactions are easy	24 hours availability	Total
Non matriculate	0	10	6	4	4	24
Matriculate	2	4	4	2	4	16
Graduate	4	8	0	6	12	30
Post graduate	6	6	2	14	2	30
Total	12	28	12	26	22	100

Table 6: Application of Chi-Square between frequency of education and reasons for using online banking service

O	E	O-E	(O-E)	(O-E) ² E
0	2.88	-2.88	8.2944	2.88
2	1.92	-0.08	0.0064	0.03
4	3.6	0.4	0.16	0.04
6	3.6	2.4	5.76	1.60
10	6.72	3.28	10.7584	1.60
4	4.48	-0.48	0.2304	0.05
8	8.4	-0.4	0.16	0.10
6	8.4	-2.4	5.76	0.69
6	2.88	3.12	9.7344	3.38
4	1.92	2.08	4.3264	2.25
0	3.6	-3.6	12.96	3.6
2	3.6	-1.6	2.56	0.71
4	6.24	-2.24	5.0176	0.80
2	4.16	-2.16	4.6656	1.12
6	7.8	-1.8	3.24	0.41
14	7.8	6.2	38.44	4.93
4	5.28	-1.28	1.6384	0.31
4	3.52	0.48	0.2304	0.07
12	6.6	5.4	29.16	1.42
2	6.6	-4.6	21.16	3.21
$\sum(O-E)^2/E=29.20$				

$$\begin{aligned}
 \text{Degrees of freedom (v)} &= (r-1)(c-1) \\
 &= (4-1)(5-1) = 3 \times 4 = 12 \\
 \text{Calculated value} &= 29.20 \\
 \text{Table value} &= 21.03
 \end{aligned}$$

Since the calculated value is greater than table value. So, the hypothesis is rejected. Hence, the use chi-square test to find out whether is any association between education and reasons for using online banking service.

CHI- SQUARE ANALYSIS-3

Table 7: GENDER AND PROBLEMS FACED ON ONLINE BANKING SERVICE

Gender	Network problems	Processing fee	Lack of operational knowledge	Risk of receiving fake SMS	Total
Male	16	8	10	12	46
Female	24	8	14	8	54
Total	40	16	24	20	100

Table 8: Application of Chi- Square between frequency of gender and problems faced on online banking service

O	E	O-E	(O-E)	(O-E) ² E
16	18.4	-2.4	5.76	0.31
24	21.6	2.4	5.76	0.26
8	7.36	0.64	0.4096	0.05
8	8.64	-0.64	0.4096	0.05
10	11.04	-1.04	1.0816	0.10
14	12.96	1.04	1.0816	0.08
12	9.2	2.8	7.84	0.85
8	10.8	-2.8	7.84	0.73
$\Sigma(O-E)^2/E=2.43$				

Degrees of freedom	=	(r-1) (c-1)
	=	(2-1) (4-1) = 1×3 = 3
Calculated value	=	2.43
Table value	=	7.81

Since the calculated value is less than the table value. So the hypothesis is accepted. There is no association between gender and problems faced on online banking service.

Findings

- The study reveals that, most (50%) of respondents were overall satisfaction with their online banking service.
- The study reveals that, gender dependent on their using online banking service.
- The study disclosed that, using online banking service depends on their education.
- The study shows that, the problems faced on online banking service not-dependent on gender.

Suggestions

- ❖ In Vilavancode Taluk, they have no knowledge about stock and foreign exchange transactions except commerce students. So that the government wants to include a portion related to the stock markets in the syllabus of the high school studies.
- ❖ Most of the customers expect helpline facilities.
- ❖ Most of the online banking users are not well educated about online banking usage and security precautions.
- ❖ Normally, last one year the banks are charged high processing fee for the different kinds of transactions and it will helps to improve the infrastructural facility of banks so the bank's processing fee fixed on the basis of the income level of the customers.
- ❖ Lack of operational knowledge is a main problem of vilavancode area, so the online banking software is updated for the understanding of all levels of online banking customers.

CONCLUSION

From the above observation it is clear that the customers are becoming aware of the various online banking services that they must get as a right. Online banking is very fast, effective and efficient. Online banking provides considerable benefits to customers, including 24 × 7 (Bank online services as provided 24 hours a day 7 days a week and 52 weeks a year) access to bank accounts anywhere anytime, easy management of funds and availability of banking services. Online banking is used to describe when individuals carry out transactions, payments and other bank dealings on the internet using their bank's secure web site. Many people have already discovered the convenience of

online

banking and the flexibility. People who use online banking enjoy being able to access their bank account, account information and other features without time restrictions from just about anywhere. After the study the researcher concluded that, the online banking service meet success and when the customers satisfied with the online banking service except network problem.

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A STUDY ON THE QUALITY OF WORK LIFE OF WOMEN SANITARY WORKERS IN KANYAKUMARI DISTRICT

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ABSTRACT

The main aim of the study is to identify the quality of work life of women sanitary workers and examine the health conditions of women sanitary workers in Kanyakumari District. Both primary and secondary data are extensively used in this study. In this study, the secondary data was collected from various journals, books, websites and newspaper in various topics. Then, the primary data was collected through the interview schedule from the respondents of sanitary workers in Kanyakumari District. The researcher has collected the primary data from sanitary workers. For this study 200 respondents were selected positively. For collecting necessary data, 200 respondents have been collected in Kanyakumari District by using random sampling technique. It is concluded that there is significant difference between age group of women sanitary workers and quality of work life dimensions namely physical well being, social well being and environmental well being. Women sanitary workers also have a higher chronic disease burden and most do not use personal protective devices. Measures on the adoption of personal protective devices, reduction of substance use and screening for chronic diseases may help to improve quality of work life of women sanitary workers. The study will be useful for concerned policymakers for adopting newer strategies based on study findings to improve quality of work life of women sanitary workers. To improve the job performance of women sanitary workers, they must be provided with better salary and safe and healthy working environment. The opportunities should be provide to them for their personal development and team work and social relationship among them must be encouraged.

Key Words: Quality of work life, Women sanitary workers, Health conditions and Working Environment

INTRODUCTION

Sanitary workers have played an important role in improving the urban and semi-urban ecological environment and the urban modern civilization, meeting the needs of people's desires for physical, spiritual, political, ecological civilization and implementing the social sustainable development. A sanitation worker has a dirty job, but it's one that most communities can't live without. Sanitation workers perform a valuable service to their communities collecting garbage and removing it to proper disposal areas such as dumps or landfills. They go by many names: garbage man, trash man. A sanitation worker must be physically fit, so he can quickly climb in and out of large trucks and lift heavy trash containers. The job is physically demanding. Sanitation workers routinely lift heavy objects and work in all weather conditions. There is also a significant injury risk associated with the job. During natural and manmade disasters, sanitation workers participate in emergency response and cleanup. Sanitation Workers are required rotating shifts, rotating days off, nights, Saturdays, Sundays, holidays and mandatory overtime.

STATEMENT OF THE PROBLEM

Sanitation workers mostly carry out their work in unsafe working conditions without protective gears or other safety gears or other safety devices. Death or serious injury to sanitation workers while cleaning sewerage with no or inadequate safeguards are frequent incidents. Those people are exposed to dangerous toxic and harmful substances. In spite of this, unsystematic work process, heavy physical work, ill defined roles and responsibilities, inadequate knowledge about way of managing stress, inadequate salary, over work load, absence of recognition, lack of respect, and isolation are some of the common factors producing stress and job dissatisfaction among sanitary workers. Hence, the present study is an attempt to discuss and analyse the quality of work life of sanitary workers in Kanyakumari district.

OBJECTIVES OF THE STUDY

- (1) To identify the quality of work life of sanitary workers in Kanyakumari District.
- (2) To examine the health conditions of sanitary workers in Kanyakumari District.

METHODOLOGY

Both primary and secondary data are extensively used in this study. In this study, the secondary data was collected from various journals, books, websites and newspaper in various topics. Then, the primary data was collected through the interview schedule from the respondents of sanitary workers in Kanyakumari District. The researcher has collected the primary data from sanitary workers. For this study 200 respondents were selected positively. For collecting necessary data, 200 respondents have been collected in Kanyakumari District by using random sampling technique.

ANALYSIS AND INTERPRETATION

Physical well being

The physical well being of women sanitary workers are ranked by finding the weighted average of each aspect and are tabulated in Table 1.

Table 1. Physical well being

Sl. No	Physical well being	Mean Score	SD	Rank
1.	The physical activity level	4.2256	0.6423	I
2.	Physical ache due to heavy work load	4.0442	0.7432	IV
3.	The stress level is high due to the physical pain	4.1778	0.6737	II
4.	Health provisions provided by the Government	4.1269	1.0256	III

Source: Computed data

Table 1 highlights the mean and standard deviation of the women sanitary workers with regard to physical well being. The physical activity level is the important physical well being and occupies the first rank with the mean score of 4.2256, The stress level is high due to the physical pain is the next important physical well being occupies the second rank with the mean score of 4.1778, health provisions provided by the Government is another important physical well being and occupies third rank with the mean score of 4.1269 and physical ache due to heavy work load is the last important physical well being and occupies the last rank with the mean score of 4.0442.

Working hours

The working hours of women sanitary workers are ranked by finding the weighted average of each aspect and are tabulated in Table 2.

Table 2. Working hours

Sl. No	Working hours	Mean Score	SD	Rank
1.	Comfortable with my working hours	4.2533	0.8189	V
2.	My family and friends are happy with my working hours	4.3822	0.7554	I
3.	I feel relaxed while doing my work	4.3578	0.7512	II
4.	My job is allowed to be done at home/outside after the working hours	4.2644	1.0568	IV
5.	Happy with overtime work	4.3044	1.0524	III

Source: Computed data

Table 2 highlights the mean and standard deviation of the women sanitary workers with regard to working hours. Family and friends are happy with working hours is the important working hours and occupies the first rank with the mean score of 4.3822, feel relaxed while doing work is the next important working hours and occupies the second rank with the mean score of 4.3578 and comfortable with working hours is the last working hours and occupies the last rank with the mean score of 4.2533.

Quality of work life among different age group of women sanitary workers

To reveal the association between the different age groups of women sanitary workers and their quality of work life, the 'ANOVA' test administered. The following null hypothesis was framed to assess the significant difference between the age group of women sanitary workers and quality of work life.

Null Hypothesis: There is no significant difference in quality of work life among different age group of women sanitary workers

The following table shows the result of the 'ANOVA' test for a significant difference among the age group of women sanitary workers concerning the quality of work life.

Table 3. Significant difference between Age group of women sanitary workers and Quality of work life

Quality of work life	Measures	Sum of Squares	df	Mean Square	F	Sig.
Physical well being	Between Groups	3.632	3	1.211	2.793	.040
	Within Groups	99.163	196	.506		
	Total	102.795	199			
Social well being	Between Groups	1.473	3	.491	2.900	.035
	Within Groups	48.107	196	.245		
	Total	49.580	199			
Environmental well being	Between Groups	2.617	3	.872	2.732	.044
	Within Groups	67.538	196	.345		
	Total	70.155	199			
Emotional well being	Between Groups	.541	3	.180	.627	.598
	Within Groups	56.334	196	.287		
	Total	56.875	199			
Safety	Between Groups	.940	3	.313	1.228	.301
	Within Groups	50.015	196	.255		
	Total	50.955	199			
Working hours	Between Groups	184.887	3	61.629	2.019	.113
	Within Groups	5983.493	196	30.528		
	Total	6168.380	199			
Adequate and fair compensation	Between Groups	75.008	3	25.003	2.518	.059
	Within Groups	1946.387	196	9.931		
	Total	2021.395	199			
Job security	Between Groups	83.892	3	27.964	1.876	.135
	Within Groups	2920.983	196	14.903		
	Total	3004.875	199			

Source: Computed Data

The above table revealed the results of ANOVA based on quality of work life namely physical well being, social well being and environmental well being among different age group of women sanitary workers. The calculated 'F' values of quality of work life namely physical well being, social well being and environmental well being are 2.793, 2.900 and 2.732 which are significant at the 'p' value of 0.040, 0.035 and 0.044 respectively. Since the respective 'p' value of quality of work life namely physical well being, social well being and environmental well being are less than 0.05 the null hypothesis is rejected. Therefore it may be concluded that there is a significant difference in quality of work life namely physical well being, social well being and environmental well being among different age group of women sanitary workers. It gives the conclusion that age is a significant variable influence on quality of work life namely physical well being, social well being and environmental well being.

The above table further revealed that the calculated 'F' values of quality of work life namely emotional well being, safety, working hours, adequate and fair compensation and job security are 0.627, 1.228, 2.019, 2.518 and 1.876 which are not significant at the 'p' value of 0.598, 0.301, 0.113, 0.059 and 0.135 respectively. Since the respective 'p' value of quality of work life namely emotional well being, safety, working hours, adequate and fair compensation and job security are higher than 0.05 the null hypothesis is accepted. Therefore it may be concluded that there is no significant difference in quality of work life namely emotional well being, safety, working hours, adequate and fair compensation and job security among different age group of women sanitary workers. It gives the conclusion that age is not a significant variable influence on quality of work life namely emotional well being, safety, working hours, adequate and fair compensation and job security.

Table 4. Face any health problems during work

Sl. No	Face any health problems during work	Number of Respondents	Percentage
1.	Yes	140	70
2.	No	60	30
	Total	200	100.00

Source: Primary data

Table 4 highlights that 70 per cent of the respondents face health problems during sanitary work and 30 per cent of the respondents not face health problems during sanitary work. It is inferred from table that majority of the respondents face health problems during sanitary work.

Table 5. Meet any accidents during work

Sl. No	Meet any accidents during work	Number of Respondents	Percentage
1.	Yes	72	36
2.	No	128	64
	Total	200	100.00

Source: Primary data

Table 5 highlights that 64 per cent of the respondents not meet any accidents during sanitary work and 36 per cent of the respondents meet accidents during sanitary work. It is inferred from table that majority of the respondents not meet any accidents during sanitary work.

SUGGESTIONS

- ✓ Health check up should be conducted for sanitary workers at frequent intervals to ensure their health status as they involve in segregating the biomedical wastes and handling chemicals for cleaning work and also cleaning the dust and toilets which bring about infections and diseases.
- ✓ Working hours and shift system should be regulated. The duty hour should be minimized into 8 hours instead of 12 hours and shift system should be changed into 3 shifts instead of 2 shift system.
- ✓ Over time duty should be avoided as it affects the physical and mental life. If the sanitary workers are supposed to assign over time duty they should be provided adequate compensation for them.

CONCLUSION

It is concluded that there is significant difference between age group of women sanitary workers and quality of work life dimensions namely physical well being, social well being and environmental well being. Women sanitary workers also have a higher chronic disease burden and most do not use personal protective devices. Measures on the adoption of personal protective devices, reduction of substance use and screening for chronic diseases may help to improve quality of work life of women sanitary workers. The study will be useful for concerned policymakers for adopting newer strategies based on study findings to improve quality of work life of women sanitary workers. To improve the job performance of women sanitary workers, they must be provided with better salary and safe and healthy working environment. The opportunities should be provide to them for their personal development and team work and social relationship among them must be encouraged.

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Satisfaction, Awareness, and Problems Experienced by the Customers while Availing Internet Banking Services in Kanyakumari District

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ABSTRACT

The present study attempts to examine the level of satisfaction of customers towards internet banking services and also the problems faced by the customers while availing of internet banking services. It aims to understand the awareness of the customers regarding internet banking services. The present study is exploratory, where a survey method was used to collect primary data from 600 customers of public sector banks and private sector banks in Kanyakumari district. Primary data has been collected to elicit the views and perceptions of customers' towards internet banking through a specially designed interview schedule. By Simple Random Method, five branches are selected from each bank in Kanyakumari district and by the Stratified Random Sampling Method, 12 customers are selected from each bank. Totally 60 customers from each bank and 300 customers from public sector banks and 300 customers from private sector banks are selected. It is found from the analysis that the respondents who are married have the maximum level of awareness towards internet banking services. It is found from the analysis that the respondents with college-level education have the maximum level of awareness towards internet banking services. It is concluded that most of the customers are aware of internet banking services. Finally, the researchers have concluded that the bank customers and the bankers have adapted to internet banking services in one way or other in tune with current requirements and also with current trends at the domestic and global level. This has made Indian banking carry out its operations financially and socially as well.

Keywords: Awareness, Satisfaction, Problems, and Internet Banking Services.

INTRODUCTION

Internet banking services can not only provide enormous benefits to customers in terms of ease and cost of transactions, but it also poses new challenges for banks in supervising their financial systems and in designing and implementing necessary security measures and controls.

sector banks and 10 private sector banks in Kanyakumari district. Among them randomly five banks that have more branches are selected as a sample of this study. By Simple Random Method five branches are selected from each bank in Kanyakumari district and by the Stratified Random Sampling Method, 12 customers are selected from each branch. Totally 60 customers from each bank and 300 customers are selected from public sector banks and 300 customers are selected from private sector banks.

ANALYSIS AND INTERPRETATION

Table 1: Marital Status of the Respondents and their Awareness on Internet Banking Services

Marital Status	Awareness about Internet Banking Services			Total
	Highly Aware	Aware	Unaware	
Married	130 (27.6)	259 (55.0)	82 (17.4)	471 (100)
Unmarried	38 (29.5)	66 (51.1)	25 (19.4)	129 (100)
Total	168 (28)	325 (54.2)	107 (17.8)	600 (100)

Source: Primary data

It is found from Table 1 that out of the total 600 respondents, 168 (28%) are highly aware of internet banking services, while 325 (54.2%) are aware of internet banking services and 107 (17.8%) are unaware of internet banking services. Out of the total 471 sample respondents who are males, 130 (27.6%) are highly aware of internet banking services, 259 (55%) are aware of internet banking services and 82 (17.4%) are unaware of internet banking services. Out of the 129 unmarried respondents, 38 (29.5%) are highly aware of internet banking services, 66 (51.1%) are aware of internet banking services and 25 (19.4%) are unaware of internet banking services. It is found from the analysis that the respondents who are married have the maximum level of awareness towards internet banking services.

An attempt has been made to find out the relationship between the marital status of the sample customers and their awareness about internet banking services, the chi-square test was applied and the results of the test are presented in Table 2.

H_0 : There is no significant relationship between the marital status of the sample customers and their awareness about internet banking services.

H_1 : There is a significant relationship between the marital status of the sample customers and their awareness about internet banking services.

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Table 2: Marital Status of the Sample Customers and their Awareness about Internet Banking Services – Chi-Square Test

Particulars	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.619 ^a	2	.734
Likelihood Ratio	.617	2	.735
Linear-by-Linear Association	.000	1	.986
N of Valid Cases	600	-	-

Table 2 highlights that the computed Chi-square value for awareness on internet banking services among different marital statuses of the respondents is 0.619 which is not significant at the 'p' value of 0.734, the null hypothesis is accepted at 5 percent level of significance. It is inferred that there is no significant relationship between the marital status of the respondents and their awareness of internet banking services.

Table 3: Educational Qualification of the Respondents and their Awareness on Internet Banking Services

Educational Qualification	Awareness about Internet Banking Services			Total
	Highly Aware	Aware	Unaware	
Up to Higher Secondary	14 (19.7)	42 (59.2)	15 (21.1)	71 (100)
Undergraduate	101 (40.6)	105 (42.2)	43 (17.3)	249 (100)
Professional	24 (15.9)	109 (72.2)	18 (11.9)	151 (100)
Postgraduate	28 (25.9)	52 (48.2)	28 (25.9)	108 (100)
Others	1 (4.7)	17 (81)	3 (14.3)	21 (100)
Total	168 (28)	325 (54.2)	107 (17.8)	600 (100)

Source: Primary data

It is observed from Table 3 that out of the 71 respondents who have studied up to higher secondary school level education, 14 (19.7%) are highly aware of internet banking services, while 42 (59.2%) are aware of them and 15 (21.1%) are unaware of internet banking services. Out of the 249 respondents who are undergraduates, 101 (40.6%) are highly aware of internet banking services, 105 (42.2%) are aware of internet banking services and 43 (17.3%) are unaware of internet banking services. Out of the 151 respondents who have a professional qualification, 24 (15.9%) are highly aware of internet banking services, 109 (72.2%) are aware of internet banking services and 18 (11.9%) are unaware of them. Out of the 108 respondents who are postgraduates, 28 (25.9%) are highly aware of internet banking services, while 52 (48.2%) are aware of them and 28 (25.9%) are unaware of internet banking services. Out of the 21 respondents who have other educational qualifications, one (4.7%) is highly aware of

internet banking services, 17 (81%) are aware of internet banking services and 3 (14.3%) are unaware of such services. It is found from the analysis that the respondents with college-level education have the maximum level of awareness over internet banking services.

Satisfaction level on internet banking services among customers of different average monthly income

'ANOVA' test is applied with the following null hypothesis,

Null Hypothesis: There is no significant difference between the mean scores regarding satisfaction level on internet banking services concerning the average monthly income of customers in Kanyakumari district.

To test the significant difference between the mean score among the sample customers concerning average monthly income and satisfaction level on internet banking services, the ANOVA test is used and the result is also shown in Table 4.

Table 4: Satisfaction level on internet banking services among customers having different average monthly income

Particulars	Average monthly income (Mean Score)				F Statistics
	Less than Rs.20,000	Rs.20,001-40,000	Rs.40,001-60,000	Above Rs.60,000	
Account statement is easily viewed by the user when it needed in the bank website	3.8718	3.6557	3.8246	3.5258	1.701
The bank updates the technology regularly on their website	3.9872	4.1038	3.8947	4.0722	0.481
The high speed in access of internet banking services	3.7137	3.8019	3.5614	3.6495	0.478
Internet banking provides secure banking transactions	3.1752	3.1887	3.5088	3.4433	1.087
The internet banking service is easily started by a simple procedure in bank	3.4145	3.3113	3.7368	3.4021	0.971
Extra service charges have not been taken unnecessarily	3.9316	4.0094	4.0351	4.0515	0.795
More payment options are provided by the bank	3.6581	3.5943	3.4211	3.5876	1.694
Internet banking grievance cell provides more support to the customers	3.6923	3.6745	3.5088	3.6598	1.092
Internet banking transactions can be done faster than in-branch banking	3.6325	3.5755	3.6491	3.5464	0.592
Transaction fee amount of internet banking is considerable	3.5598	3.6445	3.6964	3.6289	0.698
Internet banking provides	3.7051	3.7689	3.6667	3.7835	0.550

proficient service to customers					
The bank provides financial security and confidentiality in internet banking.	3.8718	4.0849	3.9825	3.9088	2.743*
The bank authority care listen to queries	3.8803	4.0330	4.1228	3.9259	2.853*
The web page provides details of its product and services	4.1230	4.0425	4.0877	3.9381	0.560
Easy to understand the internet banking access in bank	3.8248	3.9717	3.9649	3.7010	2.851*

Source: Primary data

*-Significant at five percent level

Table 4 demonstrates that the web page providing details of its products and services and the bank updating the technology regularly in their website are the important satisfaction level on internet banking services among the customers who have an average monthly income below Rs. 20,000 as their mean scores are 4.1230 and 3.9872 respectively. The table further indicates that the bank updates the technology regularly on their website and the bank provides financial security and confidentiality in internet banking are the important satisfaction level on internet banking services among the customers who belong to the group of customers who have a monthly income between Rs.20,001-40,000 as their mean scores are 4.1038 and 4.0849 respectively. The table further shows that the bank authorities care and listen to queries and the web page providing details of its products and services are the important satisfaction level on internet banking services among the customers who belong to the monthly income group between Rs.40,001-60,000 as their mean scores are 4.1228 and 4.0877 respectively. The table further reveals that the bank updates the technology regularly on their website and extra service charges have not been taken unnecessarily are the important satisfaction level on internet banking services among the customers who belong to the monthly income group of above Rs.60,000 as their mean scores are 4.0722 and 4.0515 respectively.

Since the calculated 'F' value of satisfaction level on internet banking services namely the bank provides financial security and confidentiality in internet banking, the bank authorities care and listen to queries and the ease to understand the internet banking access in the bank are significant at 5 percent.

Problems faced while using the internet banking services by different Gender groups of the customers

To study the outcome of the variable that the gender groups of customers on problems faced while using the internet banking services, 't' test is applied with the following null hypothesis:

Null Hypothesis: There is no significant difference between the mean scores regarding problems faced while using the internet banking services concerning the gender groups of the customers in Kanyakumari district.

To test the significant difference between the mean score among the sample customers concerning gender groups and problems faced while using the internet banking services, the 't' test is used and the result is also depicted in Table 5.

Table 5 : Problems faced while using the internet banking services among different Gender groups of customers

Problems	Gender group [Mean Score]		t Statistics
	Male	Female	
Internet banking channels are creating more confusion for customers	4.2668	4.2489	0.212
Internet banking services charge more hidden cost	4.3989	4.3188	0.929
Smart card sometimes creates technical hurdles to making payments	4.2911	4.2620	0.367
Lack of ATM services, Crowd in peak hours, and restriction in withdrawal	4.2884	4.2445	0.457
Lack of infrastructure and unsuitable location of ATMs	4.3369	4.2969	0.431
Unauthorized access within the network and loss or damage of data by hackers	4.2561	4.1834	0.757
Inability to manage information properly and to deliver products or services	4.2615	4.0786	2.431*
Inadequate information to customers about product use and problem resolution procedures	3.8221	3.7773	0.757
Inaccurate processing of transactions and transactions have not been uploaded	4.1482	4.1266	0.172
Significant problem with networks connection	4.3558	4.1572	2.772*
E-channels are creating relationships among the bank employees	4.0081	3.9432	0.192
Data privacy and confidentially	4.0270	4.0917	0.577
Lack of knowledge regarding use of e-channels	3.9892	4.0437	0.791

Source: Primary data

*-Significant at five percent level

Table 5 indicates that internet banking services have more hidden charges and significant problems with networks connection are the important problems faced while using

the internet banking services among the customers who are males as their mean scores are 4.3989 and 4.3558 respectively. This table further indicates that internet banking services have more hidden charges and lack of infrastructure and unsuitable location of ATMs are the important problems faced while using the internet banking services among the customers who are females as their mean scores are 4.3188 and 4.2969 respectively.

Since the 't' value of problems faced while using the internet banking services among different gender groups of the customers namely inability to manage information properly and to deliver products or services and significant problem with networks connections are significant at 5 percent. It can be concluded that gender-wise there is a significant difference in problems faced while using the internet banking services namely the inability to manage information properly and to deliver products or services and significant problem with networks connection.

Problems faced while using the internet banking services among the different age groups of customers

To study the effect of the variable age group of customers on problems faced while using the internet banking services, 'ANOVA' test is applied with the following null hypothesis,

Null Hypothesis: There is no significant difference between the mean scores regarding problems faced while using the internet banking services concerning the age group of customers in Kanyakumari district.

To test the significant difference between the mean score among the sample customers concerning age groups and problems faced while using the internet banking services, the ANOVA test is used and the result is shown in Table 6.

Table 6: Problems faced while using the internet banking services among different age groups of the customers

Problems	Age Group (Mean Score)				F Statistics
	Below 25 years	25-35 years	35-45 years	Above 45 years	
Internet banking channels are creating more confusion for customers	4.3107	4.2801	4.3111	3.8824	2.796*
Internet banking services have more hidden charges	4.4068	4.4220	4.3333	4.0000	2.882*
Smart card sometimes creates technical hurdles to making payments	4.4011	4.2482	4.3139	3.9412	3.410
Lack of ATM services, Crowd in peak hours, and restriction in withdrawal	4.3277	4.2376	4.3556	4.1176	0.696

Lack of infrastructure and unsuitable location of ATMs	4.3051	4.3475	4.3000	4.2745	0.107
Unauthorized access within the network and loss or damage of data by hackers	4.1864	4.2447	4.2444	4.2549	0.113
Inability to manage information properly and to deliver products or services	4.1299	4.2411	4.2333	4.0588	0.550
Inadequate information to customers about product use and problem resolution procedures	3.8249	3.8794	3.8000	3.3333	2.126
Inaccurate processing of transactions and transactions have not been uploaded	4.2486	4.0922	4.1111	4.0784	0.585
Significant problems with networks connection	4.3842	4.3191	4.2667	3.7255	4.390*
E-channels are creating relationships among the bank employees	4.0056	3.9681	3.9889	3.9804	0.029
Data privacy and confidentiality	4.0226	4.0248	4.0333	4.3333	2.152
Lack of knowledge regarding the use of e-channels	4.0452	3.9645	4.0111	4.1373	0.808

Source: Primary data

*-Significant at five percent level

Table 6 demonstrates that internet banking services have more hidden charges and smart cards sometimes create technical hurdles to make payments are the important problems faced while using the internet banking services by the customers who are below 25 years as their mean scores are 4.4068 and 4.4011 respectively. The table further indicates that internet banking services have more hidden charges and lack of infrastructure and unsuitable location of ATMs are the important problems faced while using the internet banking services among the customers who belong to the age group between 25-35 years as their mean scores are 4.4220 and 4.3475 respectively. The table further shows that lack of ATM services, the crowd in peak hours and restrictions in withdrawal and internet banking services have more hidden charges are the important problems faced while using the internet banking services among the customers who belong to the age group between 35-45 years as their mean scores are 4.3556 and 4.3333 respectively. The table further reveals that lack of infrastructure and unsuitable location of ATMs and data privacy and confidentiality are the important problems faced while using the internet banking services among the customers who are above 45 years as their mean scores are 4.3333 and 4.2745 respectively. Since the calculated 'F' value of problems faced

while using the internet banking services namely internet banking channels are creating more confusion for customers and internet banking services have more hidden charges and significant problems with networks connection are significant at 5 percent.

SUGGESTIONS

- Customers need to be given more sustained public education and awareness concerning the use of internet banking services such as proper maintenance of ATM cards, how to make various online transactions without giving room for Internet fraudsters, and ensuring more security for their online transactions
- The banks should introduce Mobile ATM services, for which a vehicle-carrying ATM with sufficient manpower should be kept and moved to prominent places such as bazaars, shopping complexes, and crowded important public places.
- The banks should build customer awareness and inform the customers on the uses of technology-based banking services. The Reserve Bank of India and banks should plan a coordinated campaign in partnership with the trainers and professionals to educate customers about operating internet banking services.
- Banks should implement awareness programs to customers on how to use modern and advanced banking technologies.

CONCLUSION

It is concluded that most of the customers have awareness about internet banking services. Finally, the researchers have concluded that the bank customers and the bankers have adapted to internet banking services in one way or other in tune with current requirements and also with current trends at the domestic and global level. This has made Indian banking carry out its operations financially and socially as well. In this respect, the Reserve Bank of India plays a very important role in giving confirmative directions to the banks to be digital technology conscious. Therefore, this will enable us to understand the role of internet banking services in commercial banks in the new electronic era.

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INTERNET BANKING PRODUCTS IN INDIA – AN OVERVIEW

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ABSTRACT

Internet banking is also known as online banking, e-banking or virtual banking, is an electronic payment system that enables customers of a bank or other financial institution to conduct a range of financial transactions through the financial institution's website. The government of India has enacted the IT Act 2000 with effect from October 17, 2000 which provided legal recognition to electronic transaction and other means of E-commerce the Reserve Bank of India is monitoring and reviewing the legal and other requirements of Internet Banking on a continuous bases to ensure that Internet banking would develop on sound lines and Internet Banking related challenges would not pose a threat to financial stability. The present research is descriptive in nature and study the Internet banking products in India

Keywords: - E-banking, Government of India, Reserve Bank of India, Information Technology, Banking Sector.

INTRODUCTION

Banking is the lifeline of an economy. The present and future of any economy depends upon the success and development of banking. Indian banking is the helping hand of the nation and its people. Indian banking industry, today, is in the midst of an IT (Information Technology) revolution. The competition among the banks has led to the increasing total banking automation in the Indian banking industry. E-banking is a generic term for delivery of banking services and products through electronic channels, such as the telephone, the internet, the cell phone, etc. The concept and scope of E-banking is still evolving. It facilitates an effective payment and accounting system thereby, enhancing the speed of delivery of banking services considerably. Several initiatives taken by the government of India, as well as the Reserve Bank of India (RBI), have facilitated the development of E-banking in India. The government of India enacted the IT Act 2000.

OBJECTIVES OF THE STUDY

- To study the Benefits of Internet banking
- To Study the Internet Banking products used in India

RESEARCH METHODOLOGY

The present studies based on secondary data and is descriptive in nature. The secondary data has been collected through various resources such as books, research journals, articles, reports of Reserve Bank of India and planning commission of India

INTERNET BANKING ERA IN INDIA

The Internet came to India in the year 1985 with the introduction of ERNET (Educational and



Research Network) which was a project of the Department of Electronics. Initially, it linked only IITs, but slowly some research organizations and educational institutions were also included in the list. Later on, VSNL (Videsh Sanchar Nigam Ltd.) started providing Internet services to individuals. Realizing the Indian traffic, the Government of India permitted ISP (Internet Service Provider) business to private companies as well in the year 1998. While the world over, the Internet has already become a mass media and crossed the limit of 50 million users, the growth of the Internet in India, even though impressive has not reached the expected level. In September 2000, there were 20, 45,500 Internet connections in India. The Internet is cyberspace allotted to various fields like e-business, internet banking, e-learning, e-taxation, etc. Internet banking is changing the banking industry and is having major effects on banking relationships. Internet banking involves the use of electronic devices for the delivery of banking products and services. Internet banking uses electronic media for providing services to their customers. It falls into four main categories, from level-1 minimum functionality sites that offer access only to deposit account data to level-4 sites, that offer highly sophisticated services enabling the integrated sale of additional products and access to other financial services such as investment and insurance. In other words, a successful internet banking solution offers the following internet banking products and services:

1. ATM (Automated Teller Machine)
2. Cards- Credit card/Debit cards/Smart card
3. Mobile banking
4. Phone banking
5. Internet/online banking
6. Electronic fund system (EFT)
7. Electronic clearing services (ECS)
8. Electronic data interchange (EDI)
9. D-mat account
10. Digital signature
11. Society for worldwide interbank financial telecommunication (SWIFT)
12. Corporate Banking Terminals
13. Core banking solutions (CBS)

The banking industry in India is facing unprecedented competition from nontraditional banking institutions, which now offer banking and financial services over the Internet. Indian banks are going for retail banking in a big way throughout the country. Internet Banking is in the nascent stage of development and only 50 banks are offering varied kinds of Internet banking services. In general, these Internet sites offer only the most basic services. 55% are the so-called 'entry level' sites offering a little more than company information and basic marketing materials. Only 8% offer 'advanced transactions' such as online funds transfer, and other cash management services. Foreign and Private Banks are much more advanced in terms of the number of sites and their level of development.

Internet banking as a medium of delivery of banking services and as a strategic tool for business development has gained acceptance worldwide and is fast catching up in India with more and more banks entering the fray. India can be said to be on the threshold of a major banking revolution with net banking having already been unveiled. In 2001, a Reserve Bank of India survey revealed that "out of 46 major banks operating in India, 11 banks are providing Internet banking services at different levels, 22 banks proposed to offer Internet banking shortly while the remaining 13 banks have no immediate plans to offer such facility."



According to a Reserve Bank of India research report, "the total Internet users in the country were estimated at 9 lakhs. However, this is expected to grow exponentially to 90 lakhs by 2003. Only about 1% of Internet users did banking online in 1998. This increased to 16.7 % in March 2000."

INTERNET BANKING PRODUCTS IN INDIA

In the recent past, a large number of banking services shifted from Traditional banking to Internet banking. The present study focuses on the important forms of Internet banking such as ATM, Debit cards, Credit cards, RTGS, and Mobile Banking.

1. Automated Teller Machine

An ATM is a computerized machine that provides the customer to make a financial transaction without the help of a bank employee. For using an ATM, the customer has to obtain an ATM card or debit card from his bank. Using an ATM a customer can avail of various services like withdrawal of cash, depositing money, making balance inquiries, etc. The system is recognized as "Any Time Money" or "Anywhere Money" as it permits the customers to withdraw money from the bank from any of its ATMs without any constraint of time, ATMs are also beneficial for the customer who regularly visits foreign countries. They can withdraw money in foreign nations. The currency will be converted at the financial institution's exchange rate. Nowadays ATMs are considered one of the easiest modes of withdrawing money.

Table 1: ATMs deployed by the banks in India

Sl. No.	Year	Number of ATMs	Growth Rate
1.	2014	116378	-
2.	2015	162543	39.67
3.	2016	182480	12.27
4.	2017	199954	9.58
5.	2018	207813	3.93
6.	2019	207920	0.05
	Total	1077088	
	Average	179514.67	
	CAGR	12.31%	

Source: Author's calculation, basic data collected from the Reserve Bank of India.

Table 1 shows the increase in ATM deployment by the banks in India from the period from 2014 to 2019. It is clear from the table that the number of ATMs deployed by the banks increased from 1.16 lakhs to 2.07 lakhs from the year 2014 to 2019 and it is showing a slow growth rate in the year 2019 compare to the previous years 2018 and overall compound annual growth rate is 12.31 percent.

2. Debit Cards

A debit card is a plastic card, which delivers an alternative payment system to cash when we make purchases. The customers need not carry paper cash. Instead of using paper cash, they can use their cards for cash withdrawal and to make purchases. In India, the majority of the banks provide debit cards whenever a customer opens a savings bank account. As and when cash is required a customer can withdraw money with the help of a debit card from ATMs. The customer can withdraw money if he has a sufficient balance in his account with the bank. Although many debit cards are of the Rupay card, Visa, or Master card type, there are many other forms of debit cards, each being recognized only within a particular country. The customers need to be most careful when they are making transactions using



such cards.

Table 2 :The total number of debit cards issued outstanding

Sl. No.	Year	Debit Cards	Growth Rate
1.	2014	336866879	-
2.	2015	399652017	18.64
3.	2016	564707913	41.30
4.	2017	671187187	18.86
5.	2018	780795417	16.33
6.	2019	906356781	16.08
	Total	3659566194	
	Average	609927699	
	CAGR	22%	

Source: Author's calculation, basic data collected from the Reserve Bank of India.

The above table shows the number of debit cards issued outstanding (after adjusting the number of cards withdrawn/canceled) from April 2014 to April 2019. As is clear there has been an increase from 33.68 Cr. to 90.63 Cr. in the issue of debit cards by the banks and the increase in issuing of debit cards in the period 2014 to 2019 has been more than double. The average number of debit cards issued between the period 2014 and 2019 is 60.99 Cr. The growth rate of issuing debit cards was at the maximum in the year 2016 and it is showing a constant growth rate in the last three years the overall compound annual growth rate stands at 22 percent.

3. Credit Cards

A credit card is also known as plastic money which permits its customers to buy goods and services on a credit basis. The credit cards are provided by the banks, and when the customers swipe the card for their purchases a line of credit is granted to them, and the amount is repaid within a stipulated period to the bank. A credit card transaction is often more secure than other forms of payment such as cash payments or cheque payments. Customers have an apprehension to use credit cards because it leads to more spending than required. It also involves a high risk of fraud in case the card gets stolen or if the card's information is shared unknowingly.

Table 3: Total number of credit cards issued outstanding

Sl. No	Year	Credit Cards	Growth Rate
1.	2014	19553677	-
2.	2015	19226475	-1.67
3.	2016	21288891	10.73
4.	2017	24860730	16.78
5.	2018	30374102	22.18
6.	2019	37782876	24.39
	Total	153086751	
	Average	25514458.5	
	CAGR	14%	

Source: Author's calculation, basic data collected from the Reserve Bank of India.

Table 3 shows the number of credit cards issued outstanding (after adjusting the number of cards withdrawn/canceled) from April 2014 to April 2019. It is observed from the table that the number of credit cards issued has registered an increase from 1.95 Cr. to 3.77 Cr. between the period 2014 and



2019. We can find a decline in the growth rate in the year 2015, and thereafter continuously increasing in subsequent years. The data shows that the overall Compounded annual growth rate stands at 14 percent.

4. National Electronic Fund Transfer

National electronic fund transfer is a nation-wide payment system enabling one to transfer funds. Under this system individuals and corporates can electronically transfer funds from any bank branch to any individual or corporate having an account with any other bank branch in the country participating in the scheme. For being a part of the NEFT funds transfer network, a bank branch has to be National Electronic fund transfer enabled. Individuals and firms who hold saving bank accounts with a bank branch can receive or send funds through the NEFT scheme hence the customers must have an account with NEFT-enabled bank branch. There is no limit on the number of funds transfers that could be made using NEFT. From July 10, 2017, onwards the settlement of fund transfer requests in the NEFT system is done on a half-hourly basis.

Table 4 : NEFT transactions in the form of volume and value

Year	NEFT Volume (Million)	Growth Rate	NEFT Value (Billion)	Growth rate
2014	394.13	-	29022.42	-
2015	661.01	67.71	43785.52	50.87
2016	927.55	40.32	59803.83	36.58
2017	1252.88	35.07	83273.11	39.24
2018	1622.1	29.47	120039.68	44.15
2019	1946.36	19.99	172228.52	43.48
Total	6804.03		508153.08	
Average	1134		84692	
CAGR	38%		43%	

Source: Author's calculation, basic data collected from the Reserve Bank of India.

Table 4 shows the NEFT transactions in Volume (Million) and Value (Billion) made by banks from the period from 2014 to 2019. From the above table, one can observe that NEFT transactions increased in volume and value of transactions from 394.13 million to 1946.36 million during the period between 2014 and 2019. And it shows a positive growth rate in NEFT transactions in volume and value. The overall Compounded annual growth rate in volume and value shows 38 percent and 43 percent respectively.

5. Real Time Gross Settlement

Real-Time Gross Settlement is defined as the continuous settlement of funds transfer separately on an order by order basis. Real-time means processing orders at the time they are received rather than at a later time. Gross settlement means, the settlement of funds transfer instructions take place individually on an instruction by instruction basis. Considering that the fund's payment takes place in the books of the RBI, the payments are ultimate and irrevocable. RTGS is mainly meant for large value transactions. The lowest amount to be settled through RTGS is Rs. Two lakhs and there is no upper limit for RTGS transactions. The banks have to transfer the funds from one account to another on a real-time basis and the customer can receive the amount within thirty minutes from receiving the fund's transfer message. The RTGS service for customer's transactions is available to the bank from 9:00 AM to 4:30 PM on working days. Charges are levied by banks for offering fund transfer through the RTGS system



and there are no charges for inward transactions made through RTGS. For outward transactions Rs.30 is charged for the transactions of Rs 2 lakh to 5 lakh, and Rs.55 is charged for the transactions above 5 lakhs.

Table 5 : RTGS Transactions in form of volume and value

Year	RTGS Volume (Million)	Growth Rate	RTGS Value (Billion)	Growth rate
2014	68.52	-	1026350.05	
2015	81.11	18.37	904968.04	-11.83
2016	92.78	14.39	929332.89	2.69
2017	98.34	5.99	1035551.64	11.43
2018	107.86	9.68	1253652.08	21.06
2019	124.46	15.39	1467431.99	17.05
Total	573.07		6617286.69	
Average	95.51		1102881.12	
CAGR	13%		7%	

Source: Author's calculation, basic data collected from the Reserve Bank of India.

The above table shows the RTGS transactions in Volume (Million) and Value (Billion) made by the banks from the period of 2012-13 to 2017-18. From the above table, one can observe that RTGS transactions increased over a period of time in volume and value. And it shows the variability in growth rate concerning the volume and value of RTGS transactions. The overall Compounded annual growth rate of volume and value of RTGS transactions shows 13 percent and 7 percent respectively.

6 Mobile Banking

Mobile Banking is the act of performing banking transactions on a mobile device like cell phones, tablets, etc. Mobile phones as a medium for covering banking services have reached greater significance because of their pervasive nature. Banks are allowed to offer mobile banking services through SMS, USSD, or mobile banking application after obtaining necessary permission from the department of payment and settlement systems. Mobile banking services are to be made available to bank customers irrespective of the mobile network. Banks that are licensed and have a physical presence in India and only banks who have implemented core banking solutions are permitted to offer mobile banking services to the customers. To enable mobile banking services, the customers should fulfill know your customer norms.

Table 6 : Mobile banking transactions in volume and value

Year	Mobile Banking Volume (Million)	Growth Rate	Mobile Banking Value (Billion)	Growth rate
2014	53.3	-	59.9	-
2015	94.71	77.69	224.18	274.26
2016	171.92	81.52	1035.3	361.82
2017	389.49	126.55	4040.91	290.31
2018	976.85	150.80	13104.76	224.30



2019	1872.26	91.66	14738.54	12.47
Total	3558.53		33203.59	
Average	593.09		5533.93	
CAGR	104%		201%	

Source: Author's calculation, basic data collected from the Reserve Bank of India.

Table 6 shows the Mobile banking transactions in Volume (Million) and Value (Billion) made by banks from the period from 2014 to 2019. From the above table, we can observe that Mobile banking transactions increased significantly over a period of time. And it shows a high growth rate in the years 2017 and 2018 in volume and the years 2015 and 2016 in value of mobile banking transactions. The overall Compounded annual growth rate of volume and value of mobile banking transactions shows more than 100 percent i.e., 104 percent and 201 percent respectively.

BENEFITS OF INTERNET BANKING

Internet banking helps one in overcoming the drawbacks of the manual system, as computers are capable of storing, analyzing, consolidating, searching, and presenting the data as per the user requirements with high speed and accuracy. Several benefits accrue to various parties of the transactions with the development of internet banking.

1. To the Banks

- Internet banking services help in increasing profits.
- Internet banking provides a competitive advantage with a boundaryless network to the banks.
- Due to internet banking banks carry on business with less paper money and more with plastic money; have an online transfer of funds, thus economizing the cost of storage of huge stocks of currency notes and coins.
- By connecting with ATMs and PO terminals, the risk of cash overdraw can be eliminated in the case of ATM credit and debit cards.
- Internet banking websites can act as revenue earners through promotional activities.
- Customers can avail of internet banking facilities from anywhere, therefore saving investments on building infrastructures.
- Websites that offer financial convergence for the customer will create a more involved banking customer who will more frequently utilize the banking websites.

2. To the Customers

- Internet banking provides 24 hours service to the customers for cash withdrawal from any branch.
- Quick and steady access to information.
- Online purchases of goods and services and payments can be made for various purposes.
- The customer can view his/her account balance, can get a statement of his account, can apply for loans, check the progress of his investments, review interest rates and collect other important information.

3. To the Merchants, Traders, etc.

- It ensures assured quick payment and settlement to the various transactions made by the traders.
- It provides a variety of services to businessmen on par with the international standards with low transaction costs.
- Cost and risk problems involved in handling cash which is very high in business transactions are avoided.
- It leads to the growth of global and local clientele base with the development of internet banking.



➤ Other benefits include an improved image, improved customer service, eliminating paperwork, reduced waiting costs, and enhanced flexibility.

CONCLUSIONS

The internet banking revolution has fundamentally changed the business of banking by scaling borders and bringing about new opportunities. In India also, it has strongly impacted the strategic business considerations for banks by significantly cutting down costs of delivery and transactions. Compared to developed countries, developing countries face many impediments that affect the successful implementation of internet banking initiatives. In this study, the author has identified some such impediments in the Indian context. Thus, all the channels of banking will co-exist with Internet banking facilities. Right now with low and lack of adequate security, infrastructure, and internet penetration, it is significant to take necessary actions to enhance Internet banking.

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Study On Satisfaction, Awareness, And Problems Experienced By The Customers While Availing Internet Banking Services In Kanyakumari District

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ABSTRACT

The present study attempts to examine the level of satisfaction of customers towards internet banking services and also the problems faced by the customers while availing of internet banking services. It aims to understand the awareness of the customers regarding internet banking services. The present study is exploratory, where a survey method was used to collect primary data from 600 customers of public sector banks and private sector banks in Kanyakumari district. Primary data has been collected to elicit the views and perceptions of customers' towards internet banking through a specially designed interview schedule. By Simple Random Method, five branches are selected from each bank in Kanyakumari district and by the Stratified Random Sampling Method, 12 customers are selected from each bank. Totally 60 customers from each bank and 300 customers from public sector banks and 300 customers from private sector banks are selected. It is found from the analysis that the respondents who are married have the maximum level of awareness towards internet banking services. It is found from the analysis that the respondents with college-level education have the maximum level of awareness towards internet banking services. It is concluded that most of the customers are aware of internet banking services. Finally, the researchers have concluded that the bank customers and the bankers have adapted to internet banking services in one way or other in tune with current requirements and also with current trends at the domestic and global level. This has made Indian banking carry out its operations financially and socially as well.

Keywords: Awareness, Satisfaction, Problems, and Internet Banking Services.

INTRODUCTION

Internet banking services can not only provide enormous benefits to customers in terms of ease and cost of transactions, but it also poses new challenges for banks in

supervising their financial systems and in designing and implementing necessary security measures and controls. In doing so, understanding security communication in e-banking issues is important for senior management because it would help them improve their approach to internet banking security.

STATEMENT OF THE PROBLEM

The customers have been facing difficulties due to lack of knowledge in the usage of e-channels, lack of proper training, outdated technology, security and transaction difficulties, more confusion for customers, more hidden costs, lack of ATM services, restriction in withdrawals, network problems, inadequate information to customers about product use and problem resolution procedures. The study deals with the awareness of the customers regarding internet banking services. Moreover, the study examines the level of satisfaction of customers towards internet banking services and it concludes with the problems faced by the customers while availing internet banking services.

SCOPE OF THE STUDY

The present study attempts to examine the level of satisfaction of customers towards internet banking services and also the problems faced by the customers while availing of internet banking services. It aims to understand the awareness of the customers regarding internet banking services.

OBJECTIVES OF THE STUDY

1. To know the level of satisfaction of customers towards internet banking services
2. To analyze the problems faced by the customers while availing internet banking services.
3. To analyze the awareness of the customers regarding internet banking services.

HYPOTHESES

The following hypotheses were framed for the present study:

H₀₁ - There is no significant association between the demographic profile of customers and level of satisfaction towards internet banking services

H₀₂ - There is no significant association between the demographic profile of customers and level of awareness towards internet banking services

H₀₃ - There is no significant difference in problems faced while using the internet banking services among different demographic profiles of customers

METHODOLOGY

The present study is exploratory, where a survey method was used to collect primary data from 600 customers of public sector banks and private sector banks in Kanyakumari district. Primary data has been collected to elicit the views and perceptions of customers towards internet banking through a specially designed interview schedule. There are 12 public sector banks and 10 private sector banks in Kanyakumari district. Among them randomly five banks that have more branches are selected as a sample of this study. By Simple Random Method five branches are selected from each bank in Kanyakumari district and by the Stratified Random Sampling Method, 12 customers are selected from each branch.

Totally 60 customers from each bank and 300 customers are selected from public sector banks and 300 customers are selected from private sector banks.

ANALYSIS AND INTERPRETATION

Table 1: Marital Status of the Respondents and their Awareness on Internet Banking Services

Marital Status	Awareness about Internet Banking Services			Total
	Highly Aware	Aware	Unaware	
Married	130 (27.6)	259 (55.0)	82 (17.4)	471 (100)
Unmarried	38 (29.5)	66 (51.1)	25 (19.4)	129 (100)
Total	168 (28)	325 (54.2)	107 (17.8)	600 (100)

Source: Primary data

It is found from Table 1 that out of the total 600 respondents, 168 (28%) are highly aware of internet banking services, while 325 (54.2%) are aware of internet banking services and 107 (17.8%) are unaware of internet banking services. Out of the total 471 sample respondents who are males, 130 (27.6%) are highly aware of internet banking services, 259 (55%) are aware of internet banking services and 82 (17.4%) are unaware of internet banking services. Out of the 129 unmarried respondents, 38 (29.5%) are highly aware of internet banking services, 66 (51.1%) are aware of internet banking services and 25 (19.4%) are unaware of internet banking services. It is found from the analysis that the respondents who are married have the maximum level of awareness towards internet banking services.

An attempt has been made to find out the relationship between the marital status of the sample customers and their awareness about internet banking services, the chi-square test was applied and the results of the test are presented in Table 2.

H_0 : There is no significant relationship between the marital status of the sample customers and their awareness about internet banking services.

H_1 : There is a significant relationship between the marital status of the sample customers and their awareness about internet banking services.

Table 2: Marital Status of the Sample Customers and their Awareness about Internet Banking Services – Chi-Square Test

Particulars	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.619 ^a	2	.734
Likelihood Ratio	.617	2	.735
Linear-by-Linear Association	.000	1	.986
N of Valid Cases	600	-	-

Table 2 highlights that the computed Chi-square value for awareness on internet banking services among different marital statuses of the respondents is 0.619 which is not significant at the 'p' value of 0.734, the null hypothesis is accepted at 5 percent level of significance. It is inferred that there is no significant relationship between the marital status

of the respondents and their awareness of internet banking services.

Table 3: Educational Qualification of the Respondents and their Awareness on Internet Banking Services

Educational Qualification	Awareness about Internet Banking Services			Total
	Highly Aware	Aware	Unaware	
Up to Higher Secondary	14 (19.7)	42 (59.2)	15 (21.1)	71 (100)
Undergraduate	101 (40.6)	105 (42.2)	43 (17.3)	249 (100)
Professional	24 (15.9)	109 (72.2)	18 (11.9)	151 (100)
Postgraduate	28 (25.9)	52 (48.2)	28 (25.9)	108 (100)
Others	1 (4.7)	17 (81)	3 (14.3)	21 (100)
Total	168 (28)	325 (54.2)	107 (17.3)	600 (100)

Source: Primary data

It is observed from Table 3 that out of the 71 respondents who have studied up to higher secondary school level education, 14 (19.7%) are highly aware of internet banking services, while 42 (59.2%) are aware of them and 15 (21.1%) are unaware of internet banking services. Out of the 249 respondents who are undergraduates, 101 (40.6%) are highly aware of internet banking services, 105 (42.2%) are aware of internet banking services and 43 (17.3%) are unaware of internet banking services. Out of the 151 respondents who have a professional qualification, 24 (15.9%) are highly aware of internet banking services, 109 (72.2%) are aware of internet banking services and 18 (11.9%) are unaware of them. Out of the 108 respondents who are postgraduates, 28 (25.9%) are highly aware of internet banking services, while 52 (48.2%) are aware of them and 28 (25.9%) are unaware of internet banking services. Out of the 21 respondents who have other educational qualifications, one (4.7%) is highly aware of internet banking services, 17 (81%) are aware of internet banking services and 3 (14.3%) are unaware of such services. It is found from the analysis that the respondents with college-level education have the maximum level of awareness over internet banking services.

Satisfaction level on internet banking services among customers of different average monthly income

'ANOVA' test is applied with the following null hypothesis,

Null Hypothesis: There is no significant difference between the mean scores regarding satisfaction level on internet banking services concerning the average monthly income of customers in Kanyakumari district.

To test the significant difference between the mean score among the sample customers concerning average monthly income and satisfaction level on internet banking services, the ANOVA test is used and the result is also shown in Table 4.

Table 4: Satisfaction level on internet banking services among customers having different average monthly income

Particulars	Average monthly income (Mean Score)				F Statistics
	Less than Rs.20,000	Rs.20,001-40,000	Rs.40,001-60,000	Above Rs.60,000	
Account statement is easily viewed by the user when it needed in the bank website	3.8718	3.6557	3.8246	3.5258	1.701
The bank updates the technology regularly on their website	3.9872	4.1038	3.8947	4.0722	0.481
The high speed in access of internet banking services	3.7137	3.8019	3.5614	3.6495	0.478
Internet banking provides secure banking transactions	3.1752	3.1887	3.5088	3.4433	1.087
The internet banking service is easily started by a simple procedure in bank	3.4145	3.3113	3.7368	3.4021	0.971
Extra service charges have not been taken unnecessarily	3.9316	4.0094	4.0351	4.0515	0.795
More payment options are provided by the bank	3.6581	3.5943	3.4211	3.5876	1.694
Internet banking grievance cell provides more support to the customers	3.6923	3.6745	3.5088	3.6598	1.092
Internet banking transactions can be done faster than in-branch banking	3.6325	3.5755	3.6491	3.5464	0.592
Transaction fee amount of internet banking is considerable	3.5598	3.6445	3.6964	3.6289	0.698
Internet banking provides proficient service to customers	3.7051	3.7689	3.6667	3.7835	0.550
The bank provides financial security and confidentiality in internet banking.	3.8718	4.0849	3.9825	3.9088	2.743*
The bank authority care listen to queries	3.8803	4.0330	4.1228	3.9259	2.853*
The web page provides	4.1230	4.0425	4.0877	3.9381	0.560

details of its product and services					
Easy to understand the internet banking access in bank	3.8248	3.9717	3.9649	3.7010	2.851*

Source: Primary data

*-Significant at five percent level

Table 4 demonstrates that the web page providing details of its products and services and the bank updating the technology regularly in their website are the important satisfaction level on internet banking services among the customers who have an average monthly income below Rs. 20,000 as their mean scores are 4.1230 and 3.9872 respectively. The table further indicates that the bank updates the technology regularly on their website and the bank provides financial security and confidentiality in internet banking are the important satisfaction level on internet banking services among the customers who belong to the group of customers who have a monthly income between Rs.20,001-40,000 as their mean scores are 4.1038 and 4.0849 respectively. The table further shows that the bank authorities care and listen to queries and the web page providing details of its products and services are the important satisfaction level on internet banking services among the customers who belong to the monthly income group between Rs.40,001-60,000 as their mean scores are 4.1228 and 4.0877 respectively. The table further reveals that the bank updates the technology regularly on their website and extra service charges have not been taken unnecessarily are the important satisfaction level on internet banking services among the customers who belong to the monthly income group of above Rs.60,000 as their mean scores are 4.0722 and 4.0515 respectively.

Since the calculated 'F' value of satisfaction level on internet banking services namely the bank provides financial security and confidentiality in internet banking, the bank authorities care and listen to queries and the ease to understand the internet banking access in the bank are significant at 5 percent.

Problems faced while using the internet banking services by different Gender groups of the customers

To study the outcome of the variable that the gender groups of customers on problems faced while using the internet banking services, 't' test is applied with the following null hypothesis:

Null Hypothesis: There is no significant difference between the mean scores regarding problems faced while using the internet banking services concerning the gender groups of the customers in Kanyakumari district.

To test the significant difference between the mean score among the sample customers concerning gender groups and problems faced while using the internet banking services, the 't' test is used and the result is also depicted in Table 5.

Table 5 : Problems faced while using the internet banking services among different Gender groups of customers

Problems	Gender group [Mean Score]		t Statistics
	Male	Female	
Internet banking channels are creating more confusion for customers	4.2668	4.2489	0.212
Internet banking services charge more hidden cost	4.3989	4.3188	0.929
Smart card sometimes creates technical hurdles to making payments	4.2911	4.2620	0.367
Lack of ATM services, Crowd in peak hours, and restriction in withdrawal	4.2884	4.2445	0.457
Lack of infrastructure and unsuitable location of ATMs	4.3369	4.2969	0.431
Unauthorized access within the network and loss or damage of data by hackers	4.2561	4.1834	0.757
Inability to manage information properly and to deliver products or services	4.2615	4.0786	2.431*
Inadequate information to customers about product use and problem resolution procedures	3.8221	3.7773	0.757
Inaccurate processing of transactions and transactions have not been uploaded	4.1482	4.1266	0.172
Significant problem with networks connection	4.3558	4.1572	2.772*
E-channels are creating relationships among the bank employees	4.0081	3.9432	0.192
Data privacy and confidentiality	4.0270	4.0917	0.577
Lack of knowledge regarding use of e-channels	3.9892	4.0437	0.791

Source: Primary data

*-Significant at five percent level

Table 5 indicates that internet banking services have more hidden charges and significant problems with networks connection are the important problems faced while using the internet banking services among the customers who are males as their mean scores are 4.3989 and 4.3558 respectively. This table further indicates that internet banking services have more hidden charges and lack of infrastructure and unsuitable location of ATMs are the important problems faced while using the internet banking services among the customers who are females as their mean scores are 4.3188 and 4.2969 respectively.

Since the 't' value of problems faced while using the internet banking services among different gender groups of the customers namely inability to manage information properly and to deliver products or services and significant problem with networks connections are significant at 5 percent. It can be concluded that gender-wise there is a significant difference

in problems faced while using the internet banking services namely the inability to manage information properly and to deliver products or services and significant problem with networks connection.

Problems faced while using the internet banking services among the different age groups of customers

To study the effect of the variable age group of customers on problems faced while using the internet banking services, 'ANOVA' test is applied with the following null hypothesis,

Null Hypothesis: There is no significant difference between the mean scores regarding problems faced while using the internet banking services concerning the age group of customers in Kanyakumari district.

To test the significant difference between the mean score among the sample customers concerning age groups and problems faced while using the internet banking services, the ANOVA test is used and the result is shown in Table 6.

Table 6: Problems faced while using the internet banking services among different age groups of the customers

Problems	Age Group (Mean Score)				F Statistics
	Below 25 years	25-35 years	35-45 years	Above 45 years	
Internet banking channels are creating more confusion for customers	4.3107	4.2801	4.3111	3.8824	2.796*
Internet banking services have more hidden charges	4.4068	4.4220	4.3333	4.0000	2.882*
Smart card sometimes creates technical hurdles to making payments	4.4011	4.2482	4.3139	3.9412	3.410
Lack of ATM services, Crowd in peak hours, and restriction in withdrawal	4.3277	4.2376	4.3556	4.1176	0.696
Lack of infrastructure and unsuitable location of ATMs	4.3051	4.3475	4.3000	4.2745	0.107
Unauthorized access within the network and loss or damage of data by hackers	4.1864	4.2447	4.2444	4.2549	0.113
Inability to manage information properly and to deliver products or services	4.1299	4.2411	4.2333	4.0588	0.550
Inadequate information to customers about product use and problem resolution procedures	3.8249	3.8794	3.8000	3.3333	2.126
Inaccurate processing of transactions	4.2486	4.0922	4.1111	4.0784	0.585

and transactions have not been uploaded					
Significant problems with networks connection	4.3842	4.3191	4.2667	3.7255	4.390*
E-channels are creating relationships among the bank employees	4.0056	3.9681	3.9889	3.9804	0.029
Data privacy and confidentially	4.0226	4.0248	4.0333	4.3333	2.152
Lack of knowledge regarding the use of e-channels	4.0452	3.9645	4.0111	4.1373	0.808

Source: Primary data

*-Significant at five percent level

Table 6 demonstrates that internet banking services have more hidden charges and smart cards sometimes create technical hurdles to make payments are the important problems faced while using the internet banking services by the customers who are below 25 years as their mean scores are 4.4068 and 4.4011 respectively. The table further indicates that internet banking services have more hidden charges and lack of infrastructure and unsuitable location of ATMs are the important problems faced while using the internet banking services among the customers who belong to the age group between 25-35 years as their mean scores are 4.4220 and 4.3475 respectively. The table further shows that lack of ATM services, the crowd in peak hours and restrictions in withdrawal and internet banking services have more hidden charges are the important problems faced while using the internet banking services among the customers who belong to the age group between 35-45 years as their mean scores are 4.3556 and 4.3333 respectively. The table further reveals that lack of infrastructure and unsuitable location of ATMs and data privacy and confidentially are the important problems faced while using the internet banking services among the customers who are above 45 years as their mean scores are 4.3333 and 4.2745 respectively. Since the calculated 'F' value of problems faced while using the internet banking services namely internet banking channels are creating more confusion for customers and internet banking services have more hidden charges and significant problems with networks connection are significant at 5 percent.

SUGGESTIONS

- Customers need to be given more sustained public education and awareness concerning the use of internet banking services such as proper maintenance of ATM cards, how to make various online transactions without giving room for Internet fraudsters, and ensuring more security for their online transactions
- The banks should introduce Mobile ATM services, for which a vehicle-carrying ATM with sufficient manpower should be kept and moved to prominent places such as bazaars, shopping complexes, and crowded important public places.
- The banks should build customer awareness and inform the customers on the uses of technology-based banking services. The Reserve Bank of India and banks should plan a coordinated campaign in partnership with the trainers and professionals to educate customers about operating internet banking services.

- Banks should implement awareness programs to customers on how to use modern and advanced banking technologies.

CONCLUSION

It is concluded that most of the customers have awareness about internet banking services. Finally, the researchers have concluded that the bank customers and the bankers have adapted to internet banking services in one way or other in tune with current requirements and also with current trends at the domestic and global level. This has made Indian banking carry out its operations financially and socially as well. In this respect, the Reserve Bank of India plays a very important role in giving confirmative directions to the banks to be digital technology conscious. Therefore, this will enable us to understand the role of internet banking services in commercial banks in the new electronic era.

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Role of HR strategies in increasing efficiency of employees in pharmaceutical industry in Trivandrum district

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Abstract

Management of human resource is a complex function which focus on better employees' productivity and Performance. HR management act as a backbone of employees by providing them all the support they need in their working environment. HR can make employees happier and more productive by providing positive training and enjoyable work environments that help retain their talent and self-confidence. The main objective of this paper is to find out the new and innovative technologies adopted by HR in pharmaceutical industry.

Keywords: Pharmaceutical industry, Pharmaceutical Representatives, Employee competencies, Quality of work

Introduction

In pharmaceutical company business quality of the product is essential and perfect product makes the leader. So, it is very essential to be a faster learner and solution maker. The pharmaceutical industry in India was valued at an estimated US\$42 billion in 2021. India is the world's largest provider of generic medicines by volume, with a 20% share of total global pharmaceutical exports. It is also the largest vaccine supplier in the world by volume, that means more than 50% of all vaccines manufactured in the world. With industry standards compliant mega production capabilities and large number of skilled domestic workforce, Indian exports meet the standards and requirements of highly regulated markets of foreign countries. The main promotional thrust of the pharmaceutical industry is through its pharmaceutical representatives. So it is the responsibility of HR to ensure quality of work life for their employees. For this purpose HRM have implemented different strategies like Employee Retention, Hybrid work strategies, employee involvement, Employee Motivation.

Objectives of the study

- To understand the role of HR in building employee satisfaction.
- To find out the role of HR in building employee efficiency
- To analyse the HR initiatives for employees.

Research methodology

For the purpose of the study the primary data collected from the employees of pharmaceuticals industry. The primary data collected through a structured interview schedule developed for this purpose. In addition to this, secondary data were obtained from publication of Pharmaceutical Companies, websites, journals etc...

Selection of Sample Units and analysis

Employees who work for minimum 5 years of experience were considered for the study. For the selection of sample units from the district, random sampling method has been adopted. required sample size of 100 employees have been selected from 5 major companies like Cipla, Abbott India, Sun pharma, Ajanta pharma and Mankind pharma. The collected data were analysed with the help of percentage and Ranking method.

Analysis and Interpretation

It has been observed (Table 1) that most (47%) of the employees are recruited through Advertisement and It is also observed that majority (64%) of them are selected through a Direct interview method, and the study reveals that the HR management consider Target achievement more for the performance Appraisal (34%) followed by sales enhancer (27%) and best performing employee (22%).

Source of Recruitment (Table 1)

Recruitment source	No. of Respondents
Job portals	16
Employee referral	15
Advertisement	47
Agencies	22
Technical support	100
Online Test	No. of Respondents
Mail	13
Direct interview	12
Video conference	64
Telephone	7
	4
	100
Basis	No. of Respondents
Target achiever	34
Sales enhancer	27
Performer	22
Hard worker	17
	100

Level of employee satisfaction

Factors	HIS	S	M	D	WA	Rank
Easy work schedule		10	20	40	2.30	8
Monetary benefits		32	15	10	3.08	2
Job security		23	28	14	2.79	5
Self confidence		20	10	14	3.18	1
Leave facility		33	25	25	2.42	6
Promotion policy		28	13	37	2.35	7
Welfare measures		20	11	20	2.98	3
Training and development		20	18	20	2.84	4

The above table shows the weighted average analysis of the level of satisfaction of employee. The first rank was given to self-confidence second to monetary benefits third to the welfare measures fourth for training and development fifth for the job security sixth for leave facility seventh for promotion policy and eighth for easy work schedule.

The above table shows the weighted average analysis of the HR strategies for the employees. The first rank was

	HIS	S	M	D	WA	Rank
HR strategies	55	17	20	8	3.19	3
Employee well-being	61	15	19	5	3.32	1
Employee involvement	57	14	9	20	3.08	4
High performance team	43	12	31	14	2.84	5
Hybrid work strategies	30	17	24	29	2.48	6
Redesigning the work	63	9	17	11	3.24	2
Training and development						

given to employee involvement second to training and development third to the employee wellbeing fourth for high performance team fifth for hybrid work strategies sixth for redesigning the work.

Conclusion :

The study provides an overall picture of the HR role in creating operational efficiency in employees. The role of HR is an inevitable factor in every organization as it focuses on the employee wellbeing and maintaining a perfect working environment for all the employees so that they can work effectively for the organization. HR plays a crucial role in employee retention and management thereby they can enjoy their work without any distress.

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The Banking Best Practices for the Growth of Women Entrepreneurs with Reference to Commercial Bank in Kerala

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Abstract

A women entrepreneur is a women conceives a business idea, initiatives a business enterprise, organizes and combines factors of production, operates the enterprise and undertakes risk economic uncertainties involved in running a business enterprise. India is a country which maintains this percentage of women population. Therefore, women are often regarded as the better half of the society. Tradition warrant women to confine themselves in the four walls of houses, performing house hold activities. But, in modern societies they have emerged out of the four walls to participate in almost all the activities which perform. Now the global evidence substantiate that women have been performing admirably well in different shepherd of activities like academics, politics, administration, social work, business and so on.

Key Words: Women entrepreneur, Banking schemes, Commercial bank.

Introduction

Women entrepreneurs may be defined as the women or a group of women who take initiative to set up a business enterprise and to run it smoothly. The women entrepreneur are those women who generate business ideas or select the best opportunity, mobilize resources, combine the factors of production, undertake risks and operate the enterprise in the most effective manner with a view to earning profit. Entrepreneurs usually require financial assistance of some kind to launch their ventures - be it a formal bank loan or money from a savings account. In financial markets, the following three main structures of constraint can be identified: gender inequality in property rights; gender segmentation of financial markets and discriminatory norms in financial markets. Women have limited possession of property and their constrained property rights limit their access to financial markets. When men regard all resources in the household as their possession, women may lose control over loans that they have taken in their own names or savings that they have accumulated from their own earnings. Men may use women's loans without repayment or use women's savings without paying interest or even paying back the amount. As a result credit and saving may not improve women's financial situation and in some cases even worsen it. Such results can depress demand for credit by women and also discourage savings by women. Financial markets exhibit gender segmentations.

Objectives

1. To study the role of commercial banks in the development of women entrepreneurs in Kerala.
2. To create awareness among women entrepreneurs about the availability of various financial schemes exclusively for women

Methodology

This study descriptive in nature secondary data is used for this study. Secondary data are those data which are already been collected by some other person, but using for our own purpose. For this study secondary data are being collected from books, journals, magazines, websites etc.

Scope Of Study

The present study has been undertaken to assess the involvement of financial institutions in the development of women entrepreneurship in Kerala. The assessment has been made by considering the perception of sample of collection of various schemes provide by the commercial banks for the development of women entrepreneurship in Kerala.

Significants of the Study

1. In what extend commercial banks are assisting women entrepreneurs for their development.
2. To get women into the mainstream they need to be motivated-special schemes /assurances are necessary.
3. To ascertain whether existing policies implemented by the government agencies and through financial institutions/commercial banks are functioning in reality.

Schemes for Women Entrepreneurs

1. **SBI Stree shakti packages:** The SBI introduced stree shakti package in the year 1989 to develop women entrepreneurs. Highlights of the packages are as follows:
 - a) Under this scheme, Entrepreneurship Development Programmes), exclusively designed for women entrepreneurs, are conducted. The programmes are organized with the help of SBI training and college and the local branches.
 - b) The branch managers and the field officers of the banks would provide necessary support and assistance to women who want to set up enterprise.
2. **Mudra Yojana Scheme:**
It is a Government of India initiative that aims to improve the status of women in the country by providing business loans and supporting them so that they can be financially independent and self-reliant. This scheme has several different types of plans as per business type, level of expansion, and loan aim. The loan limit under this women's loan scheme by the government is Rs. 10 Lakhs.
3. **Cent Kalyani Scheme:**
This government scheme for women is targeted at both new businesses and those that aim to grow and expand; the only specific emphasis is on the scheme being for Women Entrepreneurs. Retail trade, education and training, and self-help groups are not eligible for the scheme. The eligible categories are given in detail with the rules on their website. Under this scheme, the loan limit is Rs. 100 Lakh.
4. **IDBI's Mahila Udayam Nidhi (MUN) schemes :**
The IDBI has set up a special fund mahila udayam nidhi with a corpus of Rs 5 crores to provide seed capital assistance to women entrepreneur intending to set up the project in SSI sector. Women entrepreneurs who can start and manage an enterprise within a minimum financial status of percent of the equity are eligible for assistance, provided the project cost excluding working capital is less than Rs 10 lakh.
5. **SIDBI's assistance for women entrepreneurs:**
The small industries Development Bank of India (SIDBI) has special schemes for financial assistance to women entrepreneurs. These schemes aim at the following objectives:
 - i. Training and extension services according to their socio-economic status
 - ii. Financial assistance at concessional terms to help them in setting up tiny and small units.

Conclusion

Financial institutions in Kerala for supporting women entrepreneurs have an important role in development of Kerala. Without these institution women entrepreneurs can't exist. They provide various schemes of assistance to them. Commercial banks are these in the rural areas also for development of women entrepreneurs. Now the global evidence substantiate that women have been performing admirably well in different shepherd of activities like academics, politics, administration, social work, business and so on. It is also proved that those women who have started plunging into industry are running their enterprises. So, while discussing entrepreneurial development, it seems appropriate and essential to study about the development of women entrepreneur.

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A STUDY ON CUSTOMER SATISFACTION TOWARDS ONLINE SHOPPING WITH SPECIAL REFERENCE TO VILAVANCODU TALUK

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ABSTRACT

Online shopping is the process of buying is the process of buying goods and services from merchants over the internet. Since the emergence of the World Wide Web, merchants have sought to sell their products to people who spend time online. Shoppers can visit web stores from their homes and shop as they sit in front of computer. Customer can buy a huge variety of items from online stores can purchased from companies that provide their products through online stores. Many people choose to shop online because of the convenience. Many researcher have highlighted the importance of customers in today's market. The level of satisfaction of customer with a company has profound effects. Thus, through customer satisfaction does not guarantee the repurchase from a company but it does play a very important role in achieving customer loyalty. Present study provides the company with the necessary insight in order to retain and increase customer base, improve customer relationships and forces an overview about online shopping and satisfaction level of the customers.

Key word: Shopping, Online shopping, Customer satisfaction

INTRODUCTION

Online shopping is the process whereby customers directly buy goods or services from a seller in real-time, without an intermediary services, over the internet. It is a form of electronic commerce. An online shop, e-store, web shop, web store, online store or virtual store evokes the physical analogy of buying product or services at a bricks-and-mortar retailer or a shopping centre. The process is called Business-to Consumer (B2C) online shopping. When a business buys from another business, it is called Business-to Business (B2B) online shopping.

A large percentage of electronic commerce is conducted entirely in electronic form for virtual items such as access to premium content on website, but mostly on electronic. Commerce involves the transportation of physical item in some way. Online retailers are now electronically present on the World Wide Web. Customer can shop online using a range of different computers and devices, including desk computers and devices, including desktop computers, laptops, tablet computers and smart phones. Online computers must have access to the internet and a available 24 hours a days, and many consumers in western countries access internet both at work and at home.

The online shopping system presents an online display of an order cut-off time and an associated delivery window for items selected by the customer. The online shopping system does not settle with credit supplier of the customer until the item selected by the customer is picked from inventory but before it is delivered.

With rapid global growth in electronic commerce, business is attempting to gain a competitive advantage by e-commerce to interact with customer. Now days, online shopping are a fast growing phenomenon. Growing number of consumer shop to online to purchase goods and services, gather product information or even browse for enjoyment. Online shopping environment are therefore playing an increase role in the overall relationship between marketers and their consumers. That is, consumer-purchase are mainly based on cyber space appearance such as picture, images, quality information and video clips of the product not on the actual experience.

These growing and diverse internet populations mean that people having diverse tastes and purpose are now going to the web for information and to buy products and services. Thus the impact

of these online shopping environments on consumer response necessitates a critical marketing planning. Online shopping is becoming increasingly popular for variety of reasons There are certainly outside factors such as difficulty in getting to traditional store to contribution to the increased interest in online shopping. Consumer can get full information about the price with its reviews being passed by the existing users. If one wants to buy a product he is longer limit to asking the friends and a family because there are many products reviews on the web which gives options of the existing users of the product.

STATEMENT OF THE PROBLEM

In a less competitive market retention of customer is an easy task. But this is not true in online shopping, as customers have wide opportunity to choose the web portals where it is difficult for the online seller to identify the consumer's wants and needs, since potential customers are large in number. It is important to identify the factors that influence customers to prefer online shopping. Therefore customer retention is a challenging task for all e-commerce operators. Thus computer retention solely depends on the same customer's satisfaction customers who purchase good through online may be satisfied due to quality of information offered in web portals, quality of goods delivered, products matching with the product displayed on website, price charged for the product, time taken for delivery etc.. Once the customers' expectations are not fulfilled by the e-commerce operators, they may switch their choice to new e-commerce operations. Hence, it is the duty of the e-commerce operators to make them repetitive purchase. Hence, in this study an attempt has been made to ascertain the features that enhance customer satisfaction toward online purchase and factors influencing customer, satisfaction on online purchase.

SCOPE OF THE STUDY

Online shopping has a great potential to become big in India. Internet activities around is developing. So shopping is made easier and convenient for the customers through internet. Online shopping helps the customer choose the variety of models and also helps to compare the price. In online shopping the up to date information on the products available is known to the customers. The present study has been under taken to analyze the favourable factors of online shopping Vilavancode Taluk. The approach of the study was designed to encourage the customer's to purchase the product through online. This study also covers the problem faced by the online shoppers and their payment system. Besides is gives more information about the purchasing and payment system of online shop.

OBJECTIVES OF THE STUDY

- To find out satisfaction level of the customer towards online shopping.
- To know the specific reason for the customer purchase online.
- To know the product prefer most in online shopping.
- To identify the different payment system preferred by the customers.

HYPOTHESIS

H₀₁: There is no significant difference between age and purpose of using online shopping

H₀₂: There is no significant difference between education and mode of shopping

RESEARCH METHODOLOGY

Research Design	Descriptive in nature
Sampling Frame	A study on customer satisfaction towards online shopping
Sampling unit	A Study on customer satisfaction towards online shopping with special reference to vilavancode taluk
Sampling size	60
Method of sampling	Simple random sampling
Nature of data	Primary data, secondary data

Type of the Questionnaire	Structural questionnaire
Statistical tools used	Chi-square, weighted average method

REVIEW OF LITERATURE

Mack(2018)¹ businesses spend a huge amount of money both to understand and also to influence the perception of the consumers with meticulous planning and execution, businesses can influence consumer's perception and eventually generate desired consumer behaviour to boost profitability.

EI Khatib and Khan (2017)² claimed that younger generation prefers online browsing mainly because of information reliability. The pleasure features of online purchasing are more important than the privacy and security features when consumers internet purchase.

Zatalini and Pamungkar (2017)³ pointed out that factors leading to customer loyalty and the successful implementation of retailing are the privacy and security and the speed of service.

Muthumani and et al.(2017)⁷ this study shows that online shopping is one of the most popular way for consumers to make purchase of goods and availing services, but this study identifies that it is not a comfortable and safest one for consumers to make purchase and available services online shopping is gaining popularity among young people to make purchase requirements.

ANALYSIS AND INTERPERTATION OF DATA

1. Gender- Wise Classification Of The Respondents

TABLE NO :1 : Gender- Wise Classification Of The Respondents

SL NO	GENDER	NO OF RESPONDENT	PERCENTAGE
1	Male	37	62
2	Female	23	38
	Total	60	100

The above table 1 shows that out of 60 respondents, 62 percent of the respondents were group of males, 38 percent of the respondents were females.

2. Age- Wise Classifications of the Respondents

TABLE NO :2 : Age- Wise Classifications of the Respondents

SL NO	Age	No of respondents	Percentage
1	Below 15	15	25
2	15-30	20	33
3	30-45	18	30
4	45-60	7	12
	Total	60	100

The above table 4.2 shows that out of 60 respondents, 25 percent of the respondents are in the age group of below 15 years, 33 percent of the respondents are in the age group of 15-30 years, 30 percent of the respondents are in the age group of 30-45 years, 12 percent of the respondents are in the age group of 45-60 years.

3. Education Wise Classification of Respondents**TABLE NO :2 : Education Wise Classification of Respondents**

SL NO	Education	No of respondents	Percentage
1	SSLC	26	43
2	Higher Secondary	21	35
3	Under Graduate	3	5
4	Post Graduate	5	8
5	Professional	5	9
	Total	60	100

The above table 3 shows that out of 60 respondents, 43 percent of the respondents are in the category of SSLC, 35 percent of the respondents are in the category of Higher Secondary, 5 percent of the respondents are in the category of Under Graduate, 8 percent of the respondents are in the category of post graduated, 9 percent of the respondents in the category of professional.

5. Occupational Status of the Respondents**TABLE NO : 5 : Occupational Status of the Respondents**

SL NO	Occupation	No of Respondents	Percentage
1	Student	31	52
2	House wife	6	10
3	Govt employee	2	3
4	Business	6	10
5	Other	15	25
	Total	60	100

The above table 4 shows that out of 60 respondents, 52 percent of the respondents are in the category of student, 10 percent of the respondents are in the category of house wife, 3 percent of the respondents are in the category of government employee, 10 percent of the respondents are in the category of business, 25 percent of the respondents re in the category of others.

6. Usage of Internet of the respondents**TABLE NO: 6 : Usage of Internet of the respondents**

SL NO	Usage	No of Respondents	Percentage
1	Yes	60	100
2	No	0	0
	Total	100	100

The above table 6 shows that out of 60 respondents, 100 percent of the respondents are using internet.

7.Duration Of Internet Usage Of The Respondents**TABLE NO: 6 : Duration Of Internet Usage Of The Respondents**

SL NO	Duration	No of Respondents	Percentage
1	Less than one years	21	35
2	1-3 Years	25	42
3	3-5 Years	9	15
4	More than 5 years	5	8
	Total		100

The above table 6 shows that out of 60 respondents, 35 percent of the respondents are in the group of less than 1 year, 42 percent of the respondents are in the group of 1-3 years, 15 percent of the respondents are in the group of 3-5, 8 percent of the respondents are in the group of more than 5 years.

8. Purpose of Using Internet of the respondents**TABLE NO: 7 : Purpose of Using Internet of the respondents**

SL NO	Purpose of using internet	No of Respondents	Percentage
1	Social networking	10	17
2	Information gathering	23	38
3	Entertainment	14	23
4	finance	4	7
5	Shopping	9	15
	Total	60	100

The above table 7 shows that out of 60 respondents, 17 percent of the respondents are in the group of social networking, 38 percent of the respondents are in the group of information gathering, 23 percent of the respondents are in the group of entertainment, 7 percent of the respondents are in the group of finance, 15 percent of the respondents are in the group of shopping.

9. Satisfaction Of Online Shopping Of The Respondents**TABLE NO:8**

SL.NO	Satisfaction level of shopping	No of respondents	Percentage
1	Very satisfied	15	25
2	Satisfied	25	41
3	Neither satisfied	10	17
4	Not very satisfied	7	12
5	Dissatisfied	3	5
	Total	60	100

Sources: primary data

The above table. Shows that out of 60 respondents, 25 percent of the respondents are in the category of very satisfied, 41 percent of the respondents are in the category of neither satisfied, 12 of the respondents are in the category of not very satisfied, 5 percent of the respondents are in the category of dissatisfied.

CHI SQUARE TABLE

HO₁: There is no significant difference between age and purpose of using internet.

AGE AND PURPOSE OF USING INTERNET

Significance	Calculated value	Table value
5%	29.034	21.026

The calculated value is (29.034) is more than table value (21.026) the 5% level of significance. Hence the null hypothesis is rejected.

HO₂: There is no significant difference between education and mode of shopping.

EDUCATION AND MODE OF SHOPPING

Significance	Calculated value	Table value
5%	2.436	9.488

Source: Primary data

Since the calculated value is (2.436) is less than the table value (9.488) at 5% level of significance. Hence the hypothesis is accepted.

MAJOR FINDINGS

- The study found that 62% of the respondents are males.
- The study shown that 33% of the respondents are in the age group of 15-30 years.
- The study reveals that 43% of the respondent's education background is SSLC.
- The study disclosed that 52% of the respondents are in the category of student.

- The present study founded that 38% of the respondents use internet for the purpose of information gathering.
- The study pointed out that 47% of the respondents purchase from online at only once.
- The study shown that 45% of the respondents prefer to get the online shopping from Amazon .com and Flip art.
- The study reveals that 100% of the respondents are used internet facility.
- The study discloses that 57% of the respondents are preferred online shopping.
- The study reveals that 100% of the respondents are aware about online shopping.

SUGGESTIONS

As there are no proper laws for online purchase, the laws will help to maintain security and private information properly concerting their respondents. So the website developers and service providers should take necessary steps to overcome this problem.

- ✓ The online sellers must provide clear and sufficient information about online shopping to the online shoppers.
- ✓ Use secure e-commerce transaction system with fair, timely and affordable methods to resolve transaction problems.
- ✓ To take reasonable steps to ensure to consumer choice is informed and intentional.
- ✓ Reduce the costs like traditional shopping.
- ✓ To increase the credit facility to purchase from online shopping.
- ✓ Due to our time consumer traditional shopping is neglected.
- ✓ Most of people feel that products available through online shopping are costly because of the shipping charges. So the companies should provide the facility of free devilry in order to create excitement among non users.

CONCLUSION

Due to fast moving life style, online shopping has been growing in India. Increasing adoption of devices like Smartphone, tablets, and laptops, and access to the internet and the shift in buying behaviour among the consumers has contributed to the repaired growth of online consumer base. The increase of online shopping has become a trendy way for consumer to shop over internet. The research indicates that shift in buying behaviour towards online is positive due to reasons like cash on delivery, easy of purchase of purchase through online etc...Having access to online shopping has truly influenced our society as whole. This use of technology has opened new doors and opportunities that enable for a more convent life style today. From the study conclude that that people of Vilavancode Taluk locate information on internet. Most of the people purchase product from online. Some peoples are preferred manual shopping. This means that people still are lacking in confidents to purchase products online. This trend can be conjured by providing secure sites for transactions, and adequate customer service.

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A STUDY ON CUSTOMERS PERCEPTION AND SATISFACTION TOWARDS STATE BANK OF INDIA IN NAGERCOIL TOWN

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Abstract

The banking industry is facing a rapidly changing market, new technologies, economic uncertainties, heavy competition and more demanding customers and the changing climate has presented an unheard-of set of challenges. Banking is a customer oriented services industry, therefore, the customer is the focus and customer service is the differentiating factors. In the backdrop of all these developments the investigator makes an attempt to explain the Customer Service satisfaction in Indian banking Sector. For this study, descriptive research design is used where the data is collected through the questionnaire. The information is gathered from the different customers of the State Bank of India in Nagercoil Town.

Key words: Perception, Customer satisfaction Online banking, Core banking, Quality of service

Introduction

The Financial Services is the backbone of all sector. This is important not only for the banking sector but for the Indian economy as a whole. This is so because banking is a catalyst and life of modern trade and commerce. It is an integral part of not only all the businesses but also necessary for the social activities. This rapid transformation of services in the banking system has led to the evolution of a highly competitive and complex market where there is a continuous refinement of services. Hence the increased role of banking in India's economic development on the one hand and the changes in the business climate on the other has put increased pressure on them. These changes are compelling the banks to reorganize themselves in order to cope with the present conditions.

Customer satisfaction refers to how satisfied customers are with the products or services they receive from a particular agency. The level of satisfaction is determined not only by the quality and type of customer experience but also by the customer's expectations. A customer may be defined as someone who has a direct relationship with, or is directly affected by your agency and also who has receives or relies on one or more of your agency's services or products.

Customers in human services are commonly referred to as service users, consumers or clients. They can be individuals or groups. An organization with a strong customer service culture places the customer at the centre of service design, planning and service delivery. Customer centric organizations will:

- Determine the customer's expectations when they plan listen to the customer as they design.
- Focus on the delivery of customer service activities value customer feedback when they measure performance

Why is it important?

There are a number of reasons why customer perception and satisfaction is important in Banking Sector:

- Meeting the needs of the customer is the underlying rationale for the existence of community service organizations. Customers have a right to quality services that deliver outcomes.
- Organizations that strive beyond minimum standards and exceed the expectation of their customer are likely to be leaders in their sector.
- Customers are recognized as key partners in shaping service development and assessing quality of service delivery

In this paper, the main contention of the researcher is to highlight the customer satisfaction through service quality provided by the banks State Bank of India in Nagercoil Town from kanyakumari district.

Scope of the study

The study has been conducted on behalf of customer perception and satisfaction of state bank of India . The study is focus to the Nagercoil Town from Kanyakumari district. The study covers the service providers and users of state bank of India. It has put forward the Customers as well as acceptability behavior for the services. The scope of the study is to find out the Customer perception and Satisfaction level of the customer in state bank of India in Nagercoil Town.

Need of the study

Customer perception and Satisfaction is very essential for every Service to survive in the market. Its could help the business by placing future demand to the company. Customer Satisfaction gives passing the words of mouth to other potential customers. This is very Important for the company to take care of the customers and make them to satisfy. So this study made by the researcher.

Objectives of the Study

- To ascertain the perception of customers regarding the service quality in SBI.
- To study the Satisfaction of customers towards the SBI.
- To know the customer awareness regarding the SBI Bank's products
- To know the preference of customer regarding the extra services of SBI.
- To know the problems faced by customer regarding SBI.
- To give the appropriate suggestions for the improvement of SBI.

Nature of Data:

Both primary and secondary sources of data were utilized for the study.

Sources of data :

- Primary Data
- Secondary Data

Primary Data:

Primary data is that data is collected a fresh for the first time and that is original in nature. The primary data was collected by means of administering a questionnaire to the customers. The study primary data was collected 150 customers from SBI in Nagercoil town branches.

Secondary Data:

Secondary data is that data which has been collected by some one else and which has already been passed through the statistical process. Secondary data here has been collected from various publications periodicals, journals etc.

Sampling unit :

The sampling unit rate for selecting the sampling for the study is from SBI branches in Nagercoil Town.

Sampling Size:

Sampling size for the study is selected from the following branches of SBI from Nagercoil Town. Nagercoil Town 5 SBI branches. Each branch consists of 30 respondents were randomly selected for the study according to the convenience of the researcher. The following branches are taken into consideration.

1. SBI Nagercoil branch
2. SBI Nagercoil Town branch
3. SBI Parvathipuram branch
4. SBI Vadacery branch
5. SBI Vadiveeshwaram branch

Method of sampling:**Convenience sampling :**

The sample units are selected according to the convenience of the investigator or researcher. Here, the researcher used convenience sampling design collection of primary data through structured questionnaires.

Methods of data collection :**Question method:**

A questionnaire consists of a number of question printed or typed in a definite order on a form or set of forms. The respondents have to answer the questions on their own. Quite often, the questionnaire is considered as the heart of a survey operation. Hence , it should be very carefully constructed.

Analysis and Interpretation**General profile of the respondents**

Factors	Classification	No.of respondents	Percentage
Sex	Male	102	68%
	Female	48	32%
Age	Below 20 yrs	45	30%
	21 – 30 yrs	54	36%
	31 – 40 yrs	33	22%
	Above 40 yrs	18	12%
Marital status	Married	78	52%
	Unmarried	72	48%
Educational qualification	Below HSC	18	12%
	Graduate	42	28%
	Above graduate	66	44%
	Other	24	16%
Occupation	Professional	39	26%
	Business	39	26%
	Employee	51	34%

	House wife	21	14%
Family income	Below 50000	51	34%
	50000 to 100000	60	40%
	100000 to 200000	21	14%
	Above 200000	18	12%
Family size	Up to 3	18	12%
	3 to 5	66	28%
	5 to 7	42	44%
	Above 7	24	16%

Source : primary data

Inference

The above table shows that 68% of the respondents are male, 36% of the respondents having the age group of above 21 – 30 years, next regarding marital status ; 52% of the respondents are married and about 44% of the respondents are above graduate, and maximum respondents are employee (34%) and incase of the annual income of the family, 40% of them under income group of Rs 50000 to 100000 and the last one regarding family size , 44% of the respondents are coming under 3 to 5 members.

Reasons preferring this bank

Preference is based on some reasons, it easy to use, wide online banking network, immediate action taken against complaints, friendly attitude, sufficient knowledge of the staff, low time consumption and reduction of risk. The classification of reasons for preferring this bank is shown in the below Table

Classification of reasons for preferring this bank

Reasons	Strongly agree	Agree	No opinion	Disagree	Strongly disagree	Total
Availability of more products/	72	36	25	10	7	150
Convenient location of a bank	81	48	12	6	3	150
High rate of interest on deposits	57	60	15	12	6	150
More and appropriate e-channels	60	45	24	15	6	150
Only SBI Branch is available	45	48	27	21	9	150
Low time consumption	75	54	12	6	3	150
Reduction of the risk	39	75	27	3	6	150

Source : Primary data

The above Table clearly shows that the reasons for preferring this bank. Maximum number of respondents strongly agree the factors given.

Age and Satisfaction

Satisfaction is very important factor for all activities. The satisfaction of the core banking users is compared with the age of the users, which is shown in the table below.

Comparison between age and satisfaction

Age	Highly Satisfied	Satisfied	Moderate	Dissatisfied	Highly Dissatisfied	Total
Below 20	9	30	0	0	0	39
21-30	9	12	3	0	0	24
31-40	9	27	3	3	0	42
Above 40	3	30	12	0	0	45
Total	30	99	18	3	0	150

Source : Primary Data

HO There is “no relationship between age and satisfaction towards SBI banking facilities.

Inference

Calculated Value	Table value	Degree of freedom	Significance
31.02	21.03	12	Significant

Source : Primary Data**Inference**

Since the calculated value 31.02 is more than the table value 21.03 at 0.05 level of significance so the null hypothesis is rejected. It may concluded there is a relationship between age and satisfaction towards SBI.

Table Shows Rank Correlation between Core Banking services and Online Banking services:

Respondents	Core Banking Services(x)	Online Banking Services(y)	Rank x	Rank y	(d)	d ²
Professional	24	15	2	3	-1	1
Business	19	30	3	1	2	2
Employee	28	23	1	2	1	1
Other	7	14	4	4	0	0
						Σd ² =4

Source: primary data

Spearman's rank correlation equation:

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

$$1 - \frac{6 \times 4}{4(16-1)}$$

$$1 - \frac{24}{60}$$

$$1 - 0.40$$

$$0.60$$

Inference:

There is a positive Correlation between core banking respondents and online banking respondents with the value of 0.60

Table shows Feedback on over all services:

Particulars	Respondents	Percentage
Excellent	15	10
Very Good	35	23.3
Good	50	33.3
Average	40	26.7
Poor	10	6.7
Total	150	100

Source: primary data**Inference:**

From the above information regarding feed back on overall service on bank , majority 33.3% respondents gave good,26.7% were gave average,23.3% were gave very good,10% were gave excellent and only 6.7% respondents gave poor on performance.

Table shows RATING SCALE on preference of services:

Preferences	Ranks	Respondents	Percentage
Core banking	1	70	46.7
Personalized	2	30	20.0
Wide branch	3	25	16.7
Customer service	4	15	10.0
Computerized	5	10	6.6
Total		150	100

Source: primary data**Inference:**

Based on the Ranking given by respondents majority for core banking at 46.7%, personalized 20%, wide branch 16.7%, customer service 10%,and computerized as 6.6%.

Table shows services used by the respondents

Response	No.of respondents	% of the respondents
Saving	45	30%
Fixed deposit	20	13.3%
Current a/c	25	16.7%
Demat a/c	10	6.7
loan	35	23.3%
Credit cards	15	10%

Source: primary data**Inference**

Based on the Ranking given by respondents majority for saving A/C at 30%, and loan 23.3%, current A/C 16.7%, fixed deposit 13.3%, credit cards 10%, and 6.7% respondents are using demat A/C.

Table Shows Standard Deviation of Respondents on Feedback

Particulars	Respondents X	$X = X - X'$	X^2
Excellent	15	-15	225
Very Good	35	5	25
Good	50	20	400

Average	40	10	100
Poor	10	-20	400
Total	$\Sigma X = 150$		$\Sigma X^2 = 1150$

Source : primary data

Standard Deviation:

$$\begin{aligned}
 X &= \Sigma X / N \\
 &= 150 / 5 \\
 &= 30 \\
 &= \sqrt{\Sigma X^2 / N} \\
 &= \sqrt{1150 / 5} \\
 &= 15.16
 \end{aligned}$$

Inference:

From the above information it is denoted that there is a standard deviation of approximately 15 Respondents about their opinion.

Major finding

- There is a relationship between age and satisfaction towards SBI facilities
- There is a positive Correlation between core banking respondents and online banking respondents of State Bank of India.
- There is relationship between age and monthly income of the respondents
- There is significant relationship between occupational status and nature of account
- By using weighted average rank for opinion about the rank to analyse the reason for preferring this bank wide core banking network got the first rank
- 65 % of the Respondents were felt satisfied on solving of the banking problem by the State Bank of India banking staff.
- Most of the Respondents were felt that the State Bank of India bank would not restrict on maintaining of minimum balance is must in high.
- It is observed that the 78 % of the Respondents were satisfied on financial transactions of the S.B.I. Bank.
- 64% of the Respondents were felt that the State Bank of India bank would provide on savings account.
- Most of the Respondents were not preferred an alternate Bank instead of the State Bank of India bank.
- It is observed that 76% of the respondents felt difficulty while opening an account in the S.B.I. Bank.
- Only 15% the Respondents will aware of the list of shares in stock exchange provided by State Bank of India bank.
- 23.7% of the Respondents were believed in State Bank of India bank provides loan Facilities to the customers in an easy manner.
- Majority of the Respondents were preferred savings account when compared with all the remaining mode of accounts
- While asking the feedback about the State Bank of India bank services 45% of the Respondents were felt very well on service.

- It is observed that the 84% of the Respondents were satisfied on financial transactions of the S.B.I. Bank.

Suggestions

- The bank should introduce new awareness program about the various other services to the account holder
- Most of the users felt the rate of interest too high so the bank considered to reduce the interest rate.
- Most of the user expected more attractive scheme so the offer any attractive scheme and benefits to the users
- From the above findings it was found that one of the State Bank of India bank provided services is Online transactions. That is not much known to the customers, therefore the Bank management should take efforts to make awareness among the general public about online facilities.
- Majority of the customers will prefer online bill payment facility provide by State Bank of India bank. so the management should give low service charges and offering prices on Online Bill Payments.
- Advertisement of State Bank of India bank is very less when compared with the competitors. It may leads to switching on other Banks. To overcome the Bank management should promote more advertisements through various advertisement channels.
- Most of the customers felt that opening of an account is very difficult in the Bank. So the management should take care on new customers as well as old customers.

CONCLUSION

Customer satisfaction is most important factor for every business become success. In Indian banking industry , SBI is one of the important sector. From this study Some light was shed on some negative factors also like creating an awareness on online transactions, interest rates on loans, A.T.M. facilities etc., That's why Some suggestion were provided to the management like concentrating on Online services, solving banking problem with a quick time and promote loan facilities like industrial ,business, agriculture, individual loans etc, with an attracting advertisements. Its lead to growth of the industry.

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A Study on Job Satisfaction towards Dairy Farmers in Neyyattinkara Taluk of Trivandrum District

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Abstract

One of the main areas of study for organisational behaviour and human resource management is job satisfaction. It displays how employees feel about their work and how committed they are to the company. Job satisfaction is the term used to describe how someone feels or is feeling about their employment. It conveys a person's level of satisfaction with their work. The term "job satisfaction" refers to a person's sense of fulfilment when working, which serves as a driving force to do so. It is not self-satisfaction, happiness, or contentment, but rather job satisfaction. The happy emotional state that arises from the perception that one's work contributes to or facilitates the attainment of one's employment values is known as job satisfaction. The study aided in illuminating the degree of employee satisfaction in light of the numerous organisational aspects. The results of this study unequivocally demonstrate that workers in organisations are generally content with their jobs. The company must take into account factors like pay, the rapport between workers and managers, how complaints are handled, and how much opportunity it provides new hires.

Introduction

Dairy farming provides an excellent opportunity for self employment of unemployment youth. It is also an important source of income generation to small farmers and agricultural labours. Since, there is a possibility of finding employment through dairy farming. The dairy industries in many tropical countries do not produce enough milk for the countries have government supported programs to increase domestic milk production. the average herd sizes of these farms is often less than 10 milking cows and the poorly resourced farmers have great difficulty providing sufficient feed for their stock. Dairy operators have changed over the Last several decades. While large milk makes up a large portion of the Indian diet with growing incomes and urbanization, it is however by no means a luxury food. Milk or its products is something consumed practically by every class. Dairy farming from being traditional family run businesses today has grown ugly to an organized dairy industry with technological specializations in every part of the process. This huge boost in the industry has created a lot of farming jobs for the people. the best approaches is to create and run a sustainable dairy farm that gives maximum profits to farm and also takes care of the effects of dairy farmers the effects of dairy farms on environments and animals for a long period. Though a profitable business venture dairy farming in India requires hard work, proper planning and an active and vey alert and supervising capacity. In toady technological world there have been many advances in modern dairy farming. Everything from feed for dairy cows to milk processing equipment has added tremendous scope to dairy sector.

Milk plays an important essential food for human life, since baby hood to end of elderly life. Milk is a complex food that contains vital nutrients for the bodies of young mammals milk is the only food of mammal during the first period of its life and substances in milk provide energy and antibodies that help protect against infection. For humans milk and dairy products make a significant contribution to meeting our bodies' needs for calcium, magnesium, selenium, vitamin B12 and therefore play a key role for health and happiness in our development.

Statement of the Problem

Dairy farming is a major livestock enterprise in India where small marginal farmers are engaged to earn their livelihood. India has emerged as the largest producer of milk in the world in 2001 with an annual production of 84 million tonners and continuous to occupy the top position in the subsequent years and in the year 2008-09, the milk production was 108.5 million tonners. The World Bank funded operational flood programme commonly known as "white resolution" was instrumental few enhancing the milk production in the country. Kerala corporative milk federation (KCMF) popularly known as

MILMA was established in 1980 for the success of implementation of operation flood project in Kerala replicating the Anand model dairy corporative system. At present the MILMA federation consists of 8.31 lakhs dairy farmers of 2678 village level primary milk cooperatives under three milk producers unions.

At the time when the state government and MILMA are struggling hard to ensure a steady supply of milk in the city, a silent but steady white revolution is taking place in the Neyyattinkara Taluk of the district. This programme, 'dairy development project through self help groups', is the collective effort of the bank of India, Uchakkada branch and Neyyattinkara integral development society (NIDS).

Objectives of the Study

1. To reveal the profile of the dairy farmers
2. To identify the factors which influence the job satisfaction of the dairy farmers
3. To ascertain the reason for job satisfaction

Methodology

Primary data

Primary data is a fresh data collected for the first time and that is original in nature. The primary data was collected through structured interview schedule from the respondents.

Secondary data

Secondary data is that data was collected by someone else and which has already been through the statistical process. Secondary data were collected from journals, magazines, websites etc.

Sampling

Method of sampling

The research was made by the survey in accordance to the convenience of the farmers. So the sampling type is convenient sampling.

Sampling area

The research was conducted at Neyyattinkara Taluk in Kerala State.

Sampling size

Sample size of the present study is 180 respondents from Neyyattinkara Taluk

Hypothesis

1. There is no significance difference between age and satisfaction level of farmers.
2. There is no relationship difference between gender and productivity.

Analysis And Interpretation

Relationship Between Level Of Age And Overall Job Satisfaction

To analyze the relationship between the age and overall satisfaction level of the respondents is farmed. The null hypothesis is farmed the hypothesis is that there is no relationship between the age and Job satisfaction. Table 1 shows that relationship between age and overall satisfaction.

Table 1 Relationship Between Level Of Age And Overall Job Satisfaction

Age/ Level of Satisfaction	Satisfaction	Good	Highly Satisfaction	Dissatisfied	Total
Below 30	3	2	2	5	12
30-65	4	1	0	3	8
65-80	3	5	2	1	11
Above 80	4	3	3	1	11
Total	14	11	7	10	42

Sources: Primary Data

Calculative	Table value	Degrees of freedom
8.89	16.92	9

The calculate chi-square value is 8.89 is less than the table value 16.92 at 5% level of significance at 9 degrees of freedom, Hence there is no relationship between age and overall Job satisfaction.

Relationship Between Level Of Gender And Income Per Month Of Dairy Farmers

To analysis the relationship between the gender and the income per month level of the respondents. The null hypothesis is farmed. The hypothesis between the gender and income per month. Table 2 shows that no relationship between the gender and income per month.

Table 2 Relationship Between Gender And Income

Income/ Gender	Below 5000	5000-7000	7000-8000	Above 10000	Total
Male	6	8	12	3	29
Female	4	4	3	2	13
Total	10	12	15	5	42

Sources: Primary Data

Calculated	Table value	Degrees of Freedom
1.48	5.99	2

The calculated chi-square value is 1.48 is less than the table value 5.99 at 5%. Level of significance at 2 degrees of freedom. So the null hypothesis is accepted, hence there is no relationship between gender and income per month of dairy workers.

Major Findings

1. The research found that majority (60 percent) of the respondents belongs to the age group of 60-80 year.
2. As per data, majority (60 percent) of the respondents have the prior knowledge about dairy farming.
3. Majority of the respondents (38 percent) are start their Job at dairy farming by self motivated.
4. The majority (36 percent) of the respondents are earn between Rs. 7000-8000
5. The majority (40 percent) of the respondents run their farming for Increase food security. The majority (33 percent) of the respondents are purchase the cows by self.
6. The research found that (60 percent) of the respondents have the prior knowledge about climate change.
7. The (55 percent) of majority respondents are feels difficulties in selling the milk.
8. The majority (36 percent) of the respondents are having difficulties in the market.
9. There is no relationship between gender and income per month of dairy workers.
10. There is no relationship between age and overall Job satisfaction.

Suggestions

1. The dairy farmers are get very low salary due to No market. So it is need to improve the value of milk in the market.
2. Cooperative banks and other national banks should come forward to extend liberal credit facility to farmers.
3. Establishing a veterinary service centre to improve the effecting of the artificial insemination scheme.
4. The changing cropping pattern should aim to produce sufficient green and dry fodder to livestock. Population in the village.
5. The organizational support for milk producers through the cooperative sector should streamlined and expanded organization for primary cooperatives for milk Procurement should be extended.

Conclusion

This study has been made to help to government and non-government organization to take appropriate policy decision and formulate suitable scheme and programmes to Job satisfaction conditions of dairy farmers. The suggestion made in the study, it is hoped, will serve as a decision support in solving many problems relating to Job satisfaction of dairy farmers.

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A STUDY ON IMPACT OF DIGITAL MARKETING AMONG THE COLLEGE STUDENTS IN KANYAKUMARI DISTRICT

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Abstract

Digital marketing is the avenue of electronic communication which is used by the marketers to endorse the goods and the services towards the marketplace. The supreme purpose of the digital marketing is concerned with customers and allows the customers to intermingle with the product by virtue of digital media. Customers are the ones that are driving digitalization in every sphere of business. This paper intends to how the College Students know the purchasing of products via Digital marketing and what impact having in digital marketing. For this, the study researcher collected randomly 80 students to get the clear picture about the present study. Therefore, there is a potential growth for digital marketing in the upcoming years. Moreover, convenience and quality of goods are the influencing factors while purchasing via online mode. The major of the study is that majority of the College Students are satisfied with the Digital marketing

Key words: Digital Marketing, Promotion, Marketing Communication.

Introduction

Digital marketing is the marketing of products or services using digital technologies ie. Social media, websites, multimedia advertising, online search engine advertisement, E-marketing, interactive marketing (polls, game adds, mobile marketing). Marketing activities conducted via digital channels enable advertisers to directly communicate with potential customers in a rapid velocity and regardless the geographical location. Digital marketing has been recently referred as one of the best means to cut through the mess and interact directly with the consumer. I toffees services according to the customer needs and requirements. By these each and every day, new technologies are providing various customer touch points. High level of satisfaction is demanded by the customer as customer expectation is very high and competition is also high with little differentiation in type of services offered. In this highly competitive market and technological advancements marketing practices have been changed from traditional practices to digital marketing. Digital marketing is a tool which can be used for expanding the business globally. With the help of digital marketing a buyer can also compare a product with another product and it also allows 24 hours of services to purchase.

Need of the study

Digital marketing is one of the latest and emerging tools in the marketing world. It includes the creative use of internet technology including the use of various multimedia, graphics, text, etc with different languages to create catchy advertisements, forms, e-shop were products can be viewed, promoted and sold. Digital marketing does not simply entail building or promoting a website, nor does it mean placing a banner ad on another website. It includes

advertisement (flash, text, graphics, audio or video), product display, product navigation, 3-D products view, basket selection, checkout and payment. Digital marketing is more convenient than traditional marketing for both the customer and the seller. It offers large variety for the particular product with lower prices and in less time. Digital marketing is still new and college student customers are less familiar and often more skeptical towards it. Therefore, this study aims to examine the Impact of Digital Marketing among the College Students in Kanyakumari District.

Review of Literature

Ms. A.Lavanya & Mrs.M.Radhikamani (2018), “A Study on Digital Marketing and Its Impacts”, this study investigated that the Individuals are investing more in online content and companies that find it hard to digest this fact in their advertising strategy need to adjust quickly. The more time individuals spend on the internet every year, the more digital platform they use play an ever-developing function in their lives. The main aim of digital India is to promote digital medium. Because people can use digital platform any time anywhere from the world companies needs to change their marketing strategy from traditional to digital.

Andriani Kusumawati (2017), “Impact of Digital Marketing on Student Decision-Making Process of Higher Education Institution: A Case of Indonesia”, This case study provided a better understanding of digital marketing impact on student decision making process in Higher Education Institutions (HEIs) in Indonesian Public University. The results emphasis that university marketing management employs digital media since its now becomes a trend in all businesses around the globe including HEIs. Moreover, in this year, digital marketing has vast progressed from previous year and educational institutions also take part of this technology advance which is always connected with their student via internet. Digital marketing is very essential and becomes a mandatory for all HEIs including public university as it follows the habit of current generation which continuously changes along with the rapid development of technology. Such digital marketing provides a low cost communication, a good return on investment, and has an ability to reach a wider community as well as ability to display whole service range due to the digital capabilities. Either public university or students also mention that they are easier to distribute and obtain information through digital marketing media compared with traditional marketing. Various interactions and responses could be obtained through social media since it has a multitasking function such as two ways communication, as well as being more effective and efficient with provided facilities such as comment columns, they also provide video and photo with little caption thus, they are easier to be understood by their audience.

Digital Marketing

Digital marketing is the marketing of products or services using digital technologies on the Internet, through mobile phone Apps, display advertising, and any other digital mediums. The way in which digital marketing has developed since the 1990s and 2000s has changed the way brands and businesses utilize technology and digital marketing for their marketing. Digital marketing campaigns are becoming more prevalent as well as efficient, as digital platforms are increasingly incorporated into marketing plans and everyday life, and as people use digital devices instead of going to physical shops.

Digital Marketing such as Search Engine Optimization (SEO), Search Engine Marketing (SEM), content marketing, influencer marketing, content automation, campaign marketing, and e-commerce marketing, social media marketing, social media optimization, e-mail direct marketing, display advertising, e-books, optical disks and games are becoming more and more

common in our advancing technology. In fact, this extends to non-Internet channels that provide digital media, such as mobile phones (SMS and MMS), callback and on-hold mobile ring tones.

Objectives of the study

- ❖ To understand the reasons for increasing popularity of digital marketing amongst colleges students.
- ❖ To know the awareness about the various tools of digital marketing
- ❖ To analyze the effectiveness and problems of digital marketing.

Research Design

The present study is of Descriptive in nature. Sample size selected for the study was 80 College Students in Kanyakumari District of Tamil Nadu State. Convenience sampling technique was adopted in the selection of the respondents.

Limitations of the Study

- ❖ The study is limited to Kanyakumari District colleges students only
- ❖ The research work is based on the primary data which are collected from the selected respondents. Therefore, the findings are not to be generalized.

RESULTS AND DISCUSSIONS

Table 1: Demographic Variables of the Respondents

VARIABLES		No of Respondents	Percentage
Age	Upto 20	18	22.50
	20-22	26	32.50
	22 & Above	36	45.00
	Total	80	100.00
Gender	Male	46	57.50
	Female	34	42.50
	Total	80	100.00
Educational Qualification	Under - Graduation	19	23.75
	Post-Graduation	28	35.00
	M.Phil	22	27.50
	Others	11	13.75
	Total	80	100.00

Sources: Primary Data

Table No.1 shows demographics wise distribution of the respondents. The age of the sample is 36 students in the age of 22 & above, 26 students in the age of 20 to 22 and rest 18 in Up to 20. Out of 80 respondents – 46 students are male and 36 are female. The education profile is 28 are Post-Graduation, 22 are M.Phil and 19 are Under-Graduation.

Table 2: Information from various sources

Sources of Information	No of Respondents	Percentage
Traditional	22	27.50
Digital	58	72.50
Total	80	100

Sources: Primary Data

As seen in table no.2, Out of 80 respondents-22 respondents seeks information from traditional sources like newspaper, TV, Pamphlets, Neighbors, etc before making a buying

decision and rest 58 respondents rely on digital source like online and mobile advertisement of information before making a buying decision

Table 3: Awareness about the various tools of digital marketing

Factors	Number of Respondents				Total
	Yes	Percentage	No	Percentage	
E-Mail Marketing	28	35.00	52	65.00	80
Social Media	76	95.00	04	5.00	80
Search Engine Optimization	29	36.25	51	63.75	80
Display Ad	54	67.50	26	32.50	80
Pop-Up	36	45.00	44	55.00	80
Web Banner Advertising	61	76.25	19	23.75	80
Affiliate marketing	27	33.75	53	66.25	80

Sources: Primary Data

As seen in the table above, it was been asked from the students that whether or not they know about the various tools of digital marketing and it was discovered that maximum students know about social marketing followed by Web Banner Advertising and Display Ad and so on.

Table 4: Reasons for effectiveness of various tools of digital marketing

Factors	NUMBER OF RESPONDENTS										Total
	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree		
	R	%	R	%	R	%	R	%	R	%	
Easy	58	72.50	15	18.75	05	6.25	02	2.50	00	0.00	80
Low Cost	33	41.25	29	36.25	10	12.50	06	7.50	02	2.50	80
Time Saving	66	82.50	12	15.00	02	2.50	00	0.00	00	0.00	80
Interactive	31	38.75	22	27.50	14	17.50	09	11.25	04	5.00	80
Up gradation	36	45.00	18	22.50	17	21.25	06	7.50	03	3.75	80
Exclusive Content	37	46.25	28	35.00	07	8.75	06	7.50	02	2.50	80
Fun & Entt	35	43.75	24	30.00	16	20.00	04	5.00	01	1.25	80

Sources: Primary Data

As seen in the table above, it was been asked from the students that Reasons for effectiveness of various tools of digital marketing and it was found that students considered digital marketing is the easiest mode of gathering information followed by time saving and Easy and so on.

Table 5: Problems of various tools of digital marketing

Problems	No of Respondents	Percentage
Suspectable	21	26.25
Fraud	18	22.50
Interrupting	15	18.75
Privacy issue	14	17.50
Lack of demonstration	12	15.00
Total	80	100.00

Sources: Primary Data

As seen in the table above, it was been asked from the students that problems of digital marketing and it was found that students considered fraud as one of the biggest problems followed by susceptible and so on.

Suggestions of the Study

- ❖ Media should organize free seminars and conferences to College Students regarding uses of digital marketing and also explain them about security and privacy.
- ❖ The academic institutions can introduce e-marketing paper to all the under graduate students to teach how to purchase the e-products and services via online.
- ❖ The e-marketing companies can create user friendly sites which could be accessible to all common people and make their website features more user friendly

Conclusion

It can be concluded that the College students of the sample selected found digital marketing as the effective mechanism of marketing due to various benefits provided by digital marketing. Most of the College students are satisfied with the products purchased through Digital Channel. A company can do lot more through Digital Marketing if they understand and delivers what consumer needs. Digital marketing is growing with a rapid pace not only in College students but throughout the world as well.

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A STUDY ON CUSTOMER SATISFACTION TOWARDS ONLINE SHOPPING WITH SPECIAL REFERENCE TO VILAVANCODU TALUK

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ABSTRACT

Online shopping is the process of buying is the process of buying goods and services from merchants over the internet. Since the emergence of the World Wide Web, merchants have sought to sell their products to people who spend time online. Shoppers can visit web stores from their homes and shop as they sit in front of computer. Customer can buy a huge variety of items from online stores can purchased from companies that provide their products through online stores. Many people choose to shop online because of the convenience. Many researcher have highlighted the importance of customers in today's market. The level of satisfaction of customer with a company has profound effects. Thus, through customer satisfaction does not guarantee the repurchase from a company but it does play a very important role in achieving customer loyalty. Present study provides the company with the necessary insight in order to retain and increase customer base, improve customer relationships and forces an overview about online shopping and satisfaction level of the customers.

Key word: Shopping, Online shopping, Customer satisfaction

INTRODUCTION

Online shopping is the process whereby customers directly buy goods or services from a seller in real-time, without an intermediary services, over the internet. It is a form of electronic commerce. An online shop, e-store, web shop, web store, online store or virtual store evokes the physical analogy of buying product or services at a bricks-and-mortar retailer or a shopping centre. The process is called Business-to Consumer (B2C) online shopping. When a business buys from another business, it is called Business-to Business (B2B) online shopping.

A large percentage of electronic commerce is conducted entirely in electronic form for virtual items such as access to premium content on website, but mostly on electronic. Commerce involves the transportation of physical item in some way. Online retailers are now electronically present on the World Wide Web. Customer can shop online using a range of different computers and devices, including desk computers and devices, including desktop computers, laptops, tablet computers and smart phones. Online computers must have access to the internet and a available 24 hours a days, and many consumers in western countries access internet both at work and at home.

The online shopping system presents an online display of an order cut-off time and an associated delivery window for items selected by the customer. The online shopping system does not settle with credit supplier of the customer until the item selected by the customer is picked from inventory but before it is delivered.

With rapid global growth in electronic commerce, business is attempting to gain a competitive advantage by e-commerce to interact with customer. Now days, online shopping are a fast growing phenomenon. Growing number of consumer shop to online to purchase goods and services, gather product information or even browse for enjoyment. Online shopping environment are therefore playing an increase role in the overall relationship between marketers and their consumers. That is, consumer-purchase are mainly based on cyber space appearance such as picture, images, quality information and video clips of the product not on the actual experience.

These growing and diverse internet populations mean that people having diverse tastes and purpose are now going to the web for information and to buy products and services. Thus the impact

of these online shopping environments on consumer response necessitates a critical marketing planning. Online shopping is becoming increasingly popular for variety of reasons There are certainly outside factors such as difficulty in getting to traditional store to contribution to the increased interest in online shopping. Consumer can get full information about the price with its reviews being passed by the existing users. If one wants to buy a product he is longer limit to asking the friends and a family because there are many products reviews on the web which gives options of the existing users of the product.

STATEMENT OF THE PROBLEM

In a less competitive market retention of customer is an easy task. But this is not true in online shopping, as customers have wide opportunity to choose the web portals where it is difficult for the online seller to identify the consumer's wants and needs, since potential customers are large in number. It is important to identify the factors that influence customers to prefer online shopping. Therefore customer retention is a challenging task for all e-commerce operators. Thus computer retention solely depends on the same customer's satisfaction customers who purchase good through online may be satisfied due to quality of information offered in web portals, quality of goods delivered, products matching with the product displayed on website, price charged for the product, time taken for delivery etc.. Once the customers' expectations are not fulfilled by the e-commerce operators, they may switch their choice to new e-commerce operations. Hence, it is the duty of the e-commerce operators to make them repetitive purchase. Hence, in this study an attempt has been made to ascertain the features that enhance customer satisfaction toward online purchase and factors influencing customer, satisfaction on online purchase.

SCOPE OF THE STUDY

Online shopping has a great potential to become big in India. Internet activities around is developing. So shopping is made easier and convenient for the customers through internet. Online shopping helps the customer choose the variety of models and also helps to compare the price. In online shopping the up to date information on the products available is known to the customers. The present study has been under taken to analyze the favourable factors of online shopping Vilavancode Taluk. The approach of the study was designed to encourage the customer's to purchase the product through online. This study also covers the problem faced by the online shoppers and their payment system. Besides is gives more information about the purchasing and payment system of online shop.

OBJECTIVES OF THE STUDY

- To find out satisfaction level of the customer towards online shopping.
- To know the specific reason for the customer purchase online.
- To know the product prefer most in online shopping.
- To identify the different payment system preferred by the customers.

HYPOTHESIS

H0₁: There is no significant difference between age and purpose of using online shopping

H0₂: There is no significant difference between education and mode of shopping

RESEARCH METHODOLOGY

Research Design	Descriptive in nature
Sampling Frame	A study on customer satisfaction towards online shopping
Sampling unit	A Study on customer satisfaction towards online shopping with special reference to vilavancode taluk
Sampling size	60
Method of sampling	Simple random sampling
Nature of data	Primary data, secondary data

Type of the Questionnaire	Structural questionnaire
Statistical tools used	Chi-square, weighted average method

REVIEW OF LITERATURE

Mack(2018)¹ businesses spend a huge amount of money both to understand and also to influence the perception of the consumers with meticulous planning and execution, businesses can influence consumer's perception and eventually generate desired consumer behaviour to boost profitability.

EI Khatib and Khan (2017)² claimed that younger generation prefers online browsing mainly because of information reliability. The pleasure features of online purchasing are more important than the privacy and security features when consumers internet purchase.

Zatalini and Pamungkar (2017)³ pointed out that factors leading to customer loyalty and the successful implementation of retailing are the privacy and security and the speed of service.

Muthumani and et al.(2017)⁷ this study shows that online shopping is one of the most popular way for consumers to make purchase of goods and availing services, but this study identifies that it is not a comfortable and safest one for consumers to make purchase and available services online shopping is gaining popularity among young people to make purchase requirements.

ANALYSIS AND INTERPERTATION OF DATA

1. Gender- Wise Classification Of The Respondents

TABLE NO :1 : Gender- Wise Classification Of The Respondents

SL NO	GENDER	NO OF RESPONDENT	PERCENTAGE
1	Male	37	62
2	Female	23	38
	Total	60	100

The above table 1 shows that out of 60 respondents, 62 percent of the respondents were group of males, 38 percent of the respondents were females.

2. Age- Wise Classifications of the Respondents

TABLE NO :2 : Age- Wise Classifications of the Respondents

SL NO	Age	No of respondents	Percentage
1	Below 15	15	25
2	15-30	20	33
3	30-45	18	30
4	45-60	7	12
	Total	60	100

The above table 4.2 shows that out of 60 respondents, 25 percent of the respondents are in the age group of below 15 years, 33 percent of the respondents are in the age group of 15-30 years, 30 percent of the respondents are in the age group of 30-45 years, 12 percent of the respondents are in the age group of 45-60 years.

3. Education Wise Classification of Respondents**TABLE NO :2 : Education Wise Classification of Respondents**

SL NO	Education	No of respondents	Percentage
1	SSLC	26	43
2	Higher Secondary	21	35
3	Under Graduate	3	5
4	Post Graduate	5	8
5	Professional	5	9
	Total	60	100

The above table 3 shows that out of 60 respondents, 43 percent of the respondents are in the category of SSLC, 35 percent of the respondents are in the category of Higher Secondary, 5 percent of the respondents are in the category of Under Graduate, 8 percent of the respondents are in the category of post graduated, 9 percent of the respondents in the category of professional.

5. Occupational Status of the Respondents**TABLE NO : 5 : Occupational Status of the Respondents**

SL NO	Occupation	No of Respondents	Percentage
1	Student	31	52
2	House wife	6	10
3	Govt employee	2	3
4	Business	6	10
5	Other	15	25
	Total	60	100

The above table 4 shows that out of 60 respondents, 52 percent of the respondents are in the category of student, 10 percent of the respondents are in the category of house wife, 3 percent of the respondents are in the category of government employee, 10 percent of the respondents are in the category of business, 25 percent of the respondents re in the category of others.

6. Usage of Internet of the respondents**TABLE NO: 6 : Usage of Internet of the respondents**

SL NO	Usage	No of Respondents	Percentage
1	Yes	60	100
2	No	0	0
	Total	100	100

The above table 6 shows that out of 60 respondents, 100 percent of the respondents are using internet.

7.Duration Of Internet Usage Of The Respondents**TABLE NO: 6 : Duration Of Internet Usage Of The Respondents**

SL NO	Duration	No of Respondents	Percentage
1	Less than one years	21	35
2	1-3 Years	25	42
3	3-5 Years	9	15
4	More than 5 years	5	8
	Total		100

The above table 6 shows that out of 60 respondents, 35 percent of the respondents are in the group of less than 1 year, 42 percent of the respondents are in the group of 1-3 years, 15 percent of the respondents are in the group of 3-5, 8 percent of the respondents are in the group of more than 5 years.

8. Purpose of Using Internet of the respondents**TABLE NO: 7 : Purpose of Using Internet of the respondents**

SL NO	Purpose of using internet	No of Respondents	Percentage
1	Social networking	10	17
2	Information gathering	23	38
3	Entertainment	14	23
4	finance	4	7
5	Shopping	9	15
	Total	60	100

The above table 7 shows that out of 60 respondents, 17 percent of the respondents are in the group of social networking, 38 percent of the respondents are in the group of information gathering, 23 percent of the respondents are in the group of entertainment, 7 percent of the respondents are in the group of finance, 15 percent of the respondents are in the group of shopping.

9. Satisfaction Of Online Shopping Of The Respondents**TABLE NO:8**

SL.NO	Satisfaction level of shopping	No of respondents	Percentage
1	Very satisfied	15	25
2	Satisfied	25	41
3	Neither satisfied	10	17
4	Not very satisfied	7	12
5	Dissatisfied	3	5
	Total	60	100

Sources: primary data

The above table. Shows that out of 60 respondents, 25 percent of the respondents are in the category of very satisfied, 41 percent of the respondents are in the category of satisfied, 12 percent of the respondents are in the category of not very satisfied, 5 percent of the respondents are in the category of dissatisfied.

CHI SQUARE TABLE

HO₁: There is no significant difference between age and purpose of using internet.

AGE AND PURPOSE OF USING INTERNET

Significance	Calculated value	Table value
5%	29.034	21.026

The calculated value is (29.034) is more than table value (21.026) the 5% level of significance. Hence the null hypothesis is rejected.

HO₂: There is no significant difference between education and mode of shopping.

EDUCATION AND MODE OF SHOPPING

Significance	Calculated value	Table value
5%	2.436	9.488

Source: Primary data

Since the calculated value is (2.436) is less than the table value (9.488) at 5% level of significance. Hence the hypothesis is accepted.

MAJOR FINDINGS

- The study found that 62% of the respondents are males.
- The study shown that 33% of the respondents are in the age group of 15-30 years.
- The study reveals that 43% of the respondent's education background is SSLC.
- The study disclosed that 52% of the respondents are in the category of student.

- The present study founded that 38% of the respondents use internet for the purpose of information gathering.
- The study pointed out that 47% of the respondents purchase from online at only once.
- The study shown that 45% of the respondents prefer to get the online shopping from Amazon .com and Flip art.
- The study reveals that 100% of the respondents are used internet facility.
- The study discloses that 57% of the respondents are preferred online shopping.
- The study reveals that 100% of the respondents are aware about online shopping.

SUGGESTIONS

As there are no proper laws for online purchase, the laws will help to maintain security and private information properly concerting their respondents. So the website developers and service providers should take necessary steps to overcome this problem.

- ✓ The online sellers must provide clear and sufficient information about online shopping to the online shoppers.
- ✓ Use secure e-commerce transaction system with fair, timely and affordable methods to resolve transaction problems.
- ✓ To take reasonable steps to ensure to consumer choice is informed and intentional.
- ✓ Reduce the costs like traditional shopping.
- ✓ To increase the credit facility to purchase from online shopping.
- ✓ Due to our time consumer traditional shopping is neglected.
- ✓ Most of people feel that products available through online shopping are costly because of the shipping charges. So the companies should provide the facility of free devilry in order to create excitement among non users.

CONCLUSION

Due to fast moving life style, online shopping has been growing in India. Increasing adoption of devices like Smartphone, tablets, and laptops, and access to the internet and the shift in buying behaviour among the consumers has contributed to the repaired growth of online consumer base. The increase of online shopping has become a trendy way for consumer to shop over internet. The research indicates that shift in buying behaviour towards online is positive due to reasons like cash on delivery, easy of purchase of purchase through online etc...Having access to online shopping has truly influenced our society as whole. This use of technology has opened new doors and opportunities that enable for a more convent life style today. From the study conclude that that people of Vilavancode Taluk locate information on internet. Most of the people purchase product from online. Some peoples are preferred manual shopping. This means that people still are lacking in confidents to purchase products online. This trend can be conjured by providing secure sites for transactions, and adequate customer service.

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A Study on Gender and Behavior Differences Influencing On Online Purchasing In Tirunelveli District

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Abstract

The development of Internet has resulted in enormous business prospects and opportunities and given new direction to traditional commercial activities. E-commerce emerged as the need of the hour. The business-to-consumer (B2C) is the most visible and prominent progeny of e-commerce. B2C is a commercial process that starts with companies and ends with end consumers. Online shopping is an emerging area in the field of E-Business and is surely going to be the future of shopping in the world. The benefits of online shopping are well known. On-line shopping in India is significantly affected by various demographic factors like age, gender, marital status, educational qualification, occupation and income. Substantial amount of research work has been carried out on all these areas. The impact of these factors on online shopping behaviour is fascinating to say the least. But the most mysterious of them all is the impact of gender on the acceptance or rejection of online shopping. Do men and women behave differently during the online shopping process or do they exhibit same kinds of behaviour during this process? This article will try to throw some light on the extremely valuable but often neglected role of gender in the online shopping behaviour of consumers. Recently, the diffusion of the Internet as a retail and distribution channel has undergone a great growth in India. This paper presents an empirical investigation on the effects of gender differences on online buying in Tirunelveli District. The study explored gender differences among twelve factors concerning the online buyer for both Male and Female in Tirunelveli District. For data collection and final testing of the model a well-structured questionnaire was designed and hosted. The researcher collected 147 respondents sent their answer out of 150 questionnaires. With regard to factors and consistent with using t-student test.

Keywords: - Online Shopping, E-Commerce, Gender Differences, Online Consumer Behaviour, Business-To-Consumer.

Introduction

As the Internet and wireless network technologies have a had lot of advancement in decades, their increasing use has resulted in more online commercial activities, in terms of consumers navigating websites and making financial or nonfinancial transactions. The growing online consumer market allows consumers to make financial transactions online anywhere in the world regardless of their locations. The Internet therefore offers enterprises a growing market with limitless opportunities that they can tap into by providing consumers with online shopping services. The most common incentives for consumers to shop online are convenience, competitive pricing, greater access to information, complementarity of traditional stores and broader selections. Most of the companies are running their online portals to sell their products/services online. Though online shopping has made enormous progress outside India, its growth in the Indian market, which is a large and diverse consumer market, is not in line with the global market. So Government of India takes some steps to develop online mode of transaction. because of this, nowadays most of the people purchasing their needs by online.

Need of the study

Nowadays, the Internet is being widely used in daily life. The existence of the Internet brought many advantages to individuals' daily lives. With the help of the media, people can communicate, learn something about goods, entertain, buy products and get services. Of course, the disadvantages of it have long been discussed; as the virus threat, the risk of personal information theft, spamming etc. Studies on online shopping investigated the factors that influence online shopping as

well as motives for, value of and antecedents of online buying behaviour. As a result, the academic researchers and the business world started to focus on the consumer side of the online purchasing behaviour and a lot of researches and articles were prepared to make guidance for the development of online shopping. The purpose of this study is to identify factors affecting consumers' online shopping gender behavior, specifically elucidating them in the context. In addition to the previously identified factors this study included gender-specific factors that may play an important role in determining Internet adoption for e-commerce. The aim of this study is to investigate the factors that affect online purchasing behaviour of two consumer groups like Male and Female. Moreover, it is also wanted to identify and analyse online buying habits of Male and Female of Tirunelveli District of Tamil Nadu.

Review of Literature

S.K. Suman and Pallavi Srivastava (2019) "Age and Gender Influences on Consumer Behavior Towards Online Discounts", They concluded that in the past few years multiple studies were carried out related to behavior of consumers towards online shopping and also the demographic (like age and gender) influences on behavior of consumers towards online shopping. But limited study has been carried out precisely related to age and gender influences on factors considered while buying online when discounted products are available. This study has a lot of significance in Indian context. Online retailers are offering massive discounts to allure the buyers to shop online and, in this process, it is essential to understand the factors which are important for different age groups and genders.

Vijay, Sai. T. & Balaji, M. S. (2009), "Status and Scope of Online Shopping: An Interactive Analysis through Literature Review", revealed that Consumers, all over the world, are increasingly shifting from the crowded stores to the one-click online shopping format. However, in spite of the convenience offered, online shopping is far from being the most preferred form of shopping in India. A survey among 150 internet users, including both users and non-users of online shopping, was carried out to understand why some purchase online while others do not. The results suggested that convenience and saving of time drive Indian consumers to shop online; while security and privacy concerns dissuade them from doing so.

Objectives of the study

To know socio-economic background of the respondents.

The aim of this study is to investigate the factors that affect online purchasing behaviour of two consumer groups like Male and Female.

Moreover, it is also wanted to identify and analyse online buying habits of Male and Female.

Research Design

The present study is of Descriptive in nature. The researcher collected primary and secondary sources. The primary data collected through convenient sampling method. Structured questionnaire was distributed through directly by researcher in Tirunelveli District of Tamil Nadu State. Secondary sources include internet, books, reports, journals and so on. Convenient sampling methods was used to collect data from 150 respondents. Of this, the filled in forms of 147 respondents were found to be complete and were taken for further analysis. The remaining forms were incomplete, therefore such data were rejected. For analyzing the data Percentages and t-test were applied.

Limitations of the Study

The study is limited to consumers residing in to Tirunelveli District only so the results of this study cannot be used to reflect the population as a whole.

This study collects convenient samples Therefore; one cannot generalize the results of the study to the population. This study can only reflect a specific and limited population's needs.

Results And Discussions

Table 1: Demographic Variables of the Respondents

VARIABLES		No of Respondents	Percentage
Gender	Male	78	53
	Female	69	47
	Total	147	100
Age	Upto 25	38	26
	26-35	44	30
	36-45	35	24

	46-55	18	12
	Above 55	12	8
	Total	147	100
Marital Status	Married	97	66
	Unmarried	50	34
	Total	147	100
Educational Qualification	Upto HSc	55	37
	Under - Graduation	48	33
	Post-Graduation	23	16
	Others	21	14
	Total	147	100
Occupation	Unemployed	6	4
	Student	26	18
	Homemaker	22	15
	Private Employee	51	35
	Government Employee	29	20
	Retired	8	5
	Other	5	3
	Total	147	100
Monthly Income	No income but pocket money	13	9
	Less than 15000	23	16
	15001-25000	32	22
	25001-35000	31	21
	35001-45000	30	20
	Above 45000	18	12
	Total	147	100
Time spend on internet daily	Less than 1 hour	51	35
	1-2 hour	53	36
	2-3 hour	29	20
	More than 3 hour	14	10
	Total	147	100

Sources: Primary Data

Table No.1 shows demographics wise distribution of the respondents. Most of the respondents were Male, Majority of respondents in the age group of 26-35 and UptoH.Sc were high as compared to other Educational groups and Private employee were high as compared to other Occupation, most of the respondents income were 15001-25000 and Most of the respondents using minimum two hours spend on daily.

Table 2: Responses for Reasons for Purchasing Online

Reasons	NUMBER OF RESPONDENTS										Total
	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree		
	R	%	R	%	R	%	R	%	R	%	
Convenience of shopping at home	64	44	40	27	39	27	3	2	1	1	147
Not limited by time	71	48	52	35	21	14	2	1	1	1	147
Easy to buy	45	31	64	44	26	18	8	5	4	3	147
Easy to search for products	31	21	72	49	37	25	5	3	2	1	147
Price cheaper than physical stores	56	38	59	40	29	20	2	1	1	1	147
Can pay online by credit card	42	29	63	43	39	27	3	2	0	0	147
Fast delivery	34	23	48	33	38	26	19	13	8	5	147
Reasonable delivery costs	74	50	53	36	14	10	5	3	1	1	147
Security of online transactions	11	7	37	25	63	43	22	15	14	10	147

Better product quality	23	16	29	20	71	48	18	12	6	4	147
Product is by well-known brand	45	31	37	25	39	27	17	12	9	6	147
Detailed product specifications and features	74	50	52	35	19	13	2	1	0	0	147

Sources: Primary Data

As seen in the table above, it was been asked from the Responses for reasons for purchasing online. For that, researcher selected twelve factors like Convenience of shopping at home, Not limited by time, Easy to buy, Easy to search for products, Price cheaper than physical stores, Can pay online by credit card, Fast delivery, Reasonable delivery costs, Security of online transactions, Better product quality, Product is by well-known brand and Detailed product specifications and features. In which most of the respondents said that agree for reason for purchasing online.

Table 3: Gender and Purchasing Online
Calculation of t-test

Factors	Variables	df	Table Value	Calculated Value	Result
Convenience of shopping at home	Male	145	1.99	1.85	Accepted
	Female				
Not limited by time	Male	145	1.99	.06	Accepted
	Female				
Easy to buy	Male	145	1.99	3.92	Rejected
	Female				
Easy to search for products	Male	145	1.99	1.24	Accepted
	Female				
Price cheaper than physical stores	Male	145	1.99	1.55	Accepted
	Female				
Can pay online by credit card	Male	145	1.99	1.63	Accepted
	Female				
Fast delivery	Male	145	1.99	2.63	Rejected
	Female				
Reasonable delivery costs	Male	145	1.99	.24	Accepted
	Female				
Security of online transactions	Male	145	1.99	2.34	Rejected
	Female				
Better product quality	Male	145	1.99	2.32	Rejected
	Female				
Product is by well-known brand	Male	145	1.99	.57	Accepted
	Female				
Detailed product specifications and features	Male	145	1.99	2.41	Rejected
	Female				

Sources: Computed Data

The above table represents the independent sample t-test. It is clear from the table that the means of the variable namely reasons for purchasing online of gender and some factors like Convenience of shopping at home, Not limited by time, Easy to search for products, Price cheaper than physical stores, Can pay online by credit card, Reasonable delivery costs and Product is by well-known brand has its Calculated value is less than the table value. There is no significance different between reasons for purchasing online of gender and the above factors. Hence the null hypothesis is accepted. But some other factors like Easy to buy, Fast delivery, Security of online transactions, Better product quality and Detailed product specifications and features has its Calculated value is more than the table value. There is significance different between reasons for purchasing online of gender and the above factors. Hence the null hypothesis is rejected.

Conclusion

On-line shopping is now a serious alternative to conventional shopping. Given that men and women have been shown to differ in their attitude, it seems surprising that there is little research that

explicitly addresses gender difference in on-line buying. Attitude and gender are important factor that online shopping behavior. Accordingly, better understanding of online shopping attitude is critical for designing and managing effective website that can help businesses attract and retain online customers. When researcher compare with gender and reasons for purchasing online, most of the respondents accepted. Therefore e-tailors must improve the hedonic benefits to create positive attitude towards online shopping.

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A Study on Retail Investors Behaviour on Equity Shares – A Special Reference to Kanyakumari District

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Abstract

An Economy of a country progresses when its savings are mobilized in the form of investments and the leakages of the consumption pattern changes in giving an injection to the Economy. As per the economic thought savings are leakages from the consumption pattern and all investments are injections in enhancing capital formation of an economy. There are avenues open to the retail investors where they can realize their savings in getting better returns. Capital market is the backbone of any country's economy. It is an engine for economic growth, providing an efficient means of resource mobilisation and allocation. The Indian Capital Market comprises of two segments, namely, the Primary and the Secondary market. The fresh issue of securities takes place in primary market and trading among investors takes place in secondary market. Generally, the Indian corporates mainly raise funds through capital market. Two types of capital are essentially raised viz., Equity and Debt. The capital raised through equity is superior to that of debt capital for both the firm and the investor. Equity enhances the borrowing power of the firm from banks and financial institutions. This study focuses on Retail Investors Behaviour on Equity Shares in Kanyakumari District. For that, the researcher circulated 50 sample and analysed socio economic background of sample respondents, source of information getting by the respondents and compare the Socio-Economic Characteristics and Category of investors. The researcher used percentage and chi-square test for this study.

KeyWords: Investors, Market, Financial Securities, Predictive Skills, Short Term Investment, Economic Growth, Equity and Debt.

Introduction

The capital market is used as a main vehicle to mobilize funds for the economic growth of the country. It performs crucial functions like the conversion of savings of the households and institutions into investment, creation of financial assets and development of asset-related products. If the capital market does their work well that country will be create sustained economic growth. It provides a bridge between investors and savers. The development of the securities market changes the quantum and composition of savings and investment of the households. The securities market facilitates the internationalization of the economy by linking it with the rest of the world.

Indian Capital market is one of the fastest growing markets in the world. It has grown impressively during the recent years in tune with the global financial markets. The Indian Capital Market comprises of two segments, namely, the Primary and the Secondary market. The fresh issue of securities takes place in primary market and trading among investors takes place in secondary market. Generally, the Indian corporates mainly raise funds through capital market. Two types of capital are essentially raised viz., Equity and Debt. The capital raised through equity is superior to that of debt capital for both the firm and the investor. Equity enhances the borrowing power of the firm from banks and financial institutions. The Indian Capital Market has witnessed unprecedented euphoria from the early nineties and it has won critical appreciation from various quarters.

Success of equity issues totally depends on the confidence of the investors. If the investors perceive high profitability prospects, they will invest in equity. There are two types of investors, namely, institutional investors and retail investors (households). Institutional investors are huge investors who operate through Portfolio Managers. Retail Investor i.e. the household sector, who is the only source of providing risk capital. The Retail Investor provides this risk capital, either directly by investing in equity market or through collective schemes popularly called as Mutual Funds. The growth of the securities

market is the result of high confidence of the investors, that too the retail equity investors, the only risk capital providers of yesterday, today and tomorrow.

Statement of the Problem

The stock market is one of the most vital and dynamic sectors in the financial system making an important contribution to the economic development of a country. Investors are the backbone of the capital market and they are not alike. Institutional investors are capable of understanding the intricacies involved in the stock market activities but the retail investors lack adequate awareness about it. As the bulk of the savings of the country generally emanate from the households, and the retail investor is still the major source of risk capital to upcoming enterprises, to undertake new industrial activities, the capital market cannot grow without their participation, directly or indirectly. So, bringing the retail investors back into the equity market would be a very healthy structural development for the nation itself. There are many studies on the stock market related areas, the information provided to the investor and industry is not sufficient. As a result, the investor and the stock market players will be searching for required information. There are some research gaps in the existing literature relating to the stock market. Hence the current study is undertaken to fill the gaps in the existing research in the field of stock market and also to provide required information to the investors as well as industry.

Review of Literature

D. Chithra & Dr. A. Seilan (2019), “Factors Influencing Investment Decision in Equity Shares – A Study in Kanyakumari District”, this research identified the various factors which the investors consider while making investment decision. This study will be beneficial for financial professionals, regulatory authorities or investment advisors so they can understand or focus on those factors that cause volatility in stock market. This study will help them to understand the relationship and impact of these factors on decision making and investor's perception toward investment in equity shares.

Byju. K & Dr P Kannan (2018), “A Study on Investment Behaviour Towards Equity Share as Investment Avenue Special Significance to Palakkad District”, this study made on investment behaviour towards equity share as investment avenue special significance to Palakkad district the necessary data were collected through questionnaire method. The descriptive analysis and statistical analysis was made to know the investors behaviour towards investment in equity shares. The investor's preference and satisfaction consist of human behaviour that induces investment decision. Investor satisfaction is the ultimate aim of all investments. It may be concluded that more awareness programs and financial market orientation programs are to be given to general public.

Equity Share

An equity share, normally known as ordinary share is a part ownership where each member is a fractional owner and initiates the maximum entrepreneurial liability related to a trading concern. These types of shareholders in any organization possess the right to vote.

Retail Investor

A retail Investor is an individual investor that invests in stock markets by purchasing shares of a company or invests in mutual funds, exchange-traded funds, etc. that is facilitated by some broker. Such investors invest relatively small amounts as compared to institutional investors like hedge funds, insurance companies, endowment funds, etc. They invest smaller amounts in comparison to institutional investors.

Objectives Of The Study

1. To know about Investors
2. To study socio economic background of Investors
3. To analyse the information search and investment option of retail Investors

Research Design

The present study is of Descriptive in nature. Sample size selected for the study was 50 respondents in Kanyakumari District of Tamil Nadu State. Convenience sampling technique was adopted in the selection of the respondents. For analyzing the data, Percentages and Chi square test were applied.

Limitations Of The Study

1. The study is confined to Kanyakumari District alone. Hence the findings may not be generalised for the other parts of the country.
2. The study is confined to the retail equity investors alone. Institutional investors remain uncovered.

Results And Discussions**Table 1: Demographic Variables of the Respondents**

VARIABLES		No of Investors	Percentage
Age	Upto 25	02	4
	26-35	16	32
	36-45	17	34
	Above 45	15	30
	Total	50	100
Gender	Male	39	78
	Female	11	22
	Total	50	100
Educational Qualification	HSC	09	18
	Graduation	21	42
	Post-Graduation	09	18
	Professional	11	22
	Total	50	100
Occupation	Government	10	20
	Private	22	44
	Business	13	26
	Farmer	05	10
	Total	50	100
Income Per Month	Less than 100000	06	12
	100001-200000	14	28
	200001-300000	12	24
	300001-400000	11	22
	Above 400000	07	14
	Total	50	100

Primary data

Table No.1 shows demographics wise distribution of the respondents. It reveals that male respondents are higher than female respondents. Majority of respondents in the age group of 36- 45 and Graduates were high as compared to other Educational groups. Majority of the respondents were Private employee and 100001-200000 respondents were high as compared to other Income level of the Investors.

Table 2: Type of Investors

Type	No of Respondents	Percentage
New generation	38	18
Hereditary	12	44
Total	50	100

Primary data Table No. 2 explained about the Type of Investors. In which majority of the Investor's Type were new generations.

Table 3: Category of Investors

Type	No of Respondents	Percentage
Daily traders	08	16
Long term	13	26
Both	29	58
Total	50	100

Primary data

Table No. 3 shows that the Category of Investors. In which, majority of the investor's Category is themselves as both long term investors and daily traders.

Table 4: Source of Investment

Type	No of Respondents	Percentage
Own funds	37	74

Borrowed funds	13	26
Total	50	100

Primary data

Table No.4 shows that the Source of Investment. There were majority of the Investor's Source is themselves only.

Table 5: Sources of Information

Type	No of Respondents	Percentage
News Papers	07	14
Television Channels	06	12
Stock Brokers	08	16
Journals & Magazines	03	6
Friends & Relatives	10	20
Investment Consultant	05	10
Web Sites	11	22
Total	50	100

Primary data

Table No.5 shows that the information getting, majority of the investors get information through web sites.

Association Between Socio-Economic Characteristics And Category Of Investors

The non-parametric chi-square test is applied to find the association between Category of investors and Socio-Economic factors such as age, sex, education, occupation and income.

Table: 6 Socio Economic Characteristics and Category of Investors

Character	Calculated Value	Degrees of Freedom	Table Value	Result
Age	7.13	6	12.59	Accepted
Sex	1.01	2	5.99	Accepted
Education	13.74	6	12.59	Rejected
Occupation	9.59	6	12.59	Accepted
Income	9.22	8	15.50	Accepted

Computed data

From the above table it is clear that there is no significant difference between level of satisfaction and socio-economic factors of Education. But there is a significance difference between Investors and the Socio- economic factors such as age, sex, Income, and occupation.

Suggestions Of The Study

1. Innovative technologies like integration of stock exchanges, demat, online trading, creation of development of web pages must be brought in capital markets for its growth and to attract the educated investors.
2. Strategies must be employed to encourage women investors. Awareness programmes has to conduct in all places.
3. Capital market should create a higher-level critical factor involved for making investment decisions.

Findings

1. Male respondents are higher than female respondents.
2. Majority of respondents in the age group of 36- 45.
3. Graduates were high as compared to other Educational groups.
4. Majority of the respondents were Private employee.
5. 100001-200000 respondents were high as compared to other Income level of the Investors.
6. Majority of the investor's Category is themselves as both long term investors and daily traders.
7. Majority of the Investor's Type is new generation.
8. Majority of the Investor's Source is themselves only.
9. Majority of the investors get information through web sites.

Conclusion

The study will help investment consultants in identifying the investment avenues. The credit rating agencies can use the information for their investment rating. Investor's preference for equity retail

investment will help policy makers in formulating strategies. The study helps for timing and type of instruments for new issues in retail investment. Stock exchanges can introduce technological advancement in trading. In short, this piece of research work has become quite friendly of players in the capital market viz. the investors.

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A STUDY ON CUSTOMERS PERCEPTION AND SATISFACTION TOWARDS STATE BANK OF INDIA IN NAGERCOIL TOWN

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Abstract

The banking industry is facing a rapidly changing market, new technologies, economic uncertainties, heavy competition and more demanding customers and the changing climate has presented an unheard-of set of challenges. Banking is a customer oriented services industry, therefore, the customer is the focus and customer service is the differentiating factors. In the backdrop of all these developments the investigator makes an attempt to explain the Customer Service satisfaction in Indian banking Sector. For this study, descriptive research design is used where the data is collected through the questionnaire. The information is gathered from the different customers of the State Bank of India in Nagercoil Town.

Key words: Perception, Customer satisfaction Online banking, Core banking, Quality of service

Introduction

The Financial Services is the backbone of all sector. This is important not only for the banking sector but for the Indian economy as a whole. This is so because banking is a catalyst and life of modern trade and commerce. It is an integral part of not only all the businesses but also necessary for the social activities. This rapid transformation of services in the banking system has led to the evolution of a highly competitive and complex market where there is a continuous refinement of services. Hence the increased role of banking in India's economic development on the one hand and the changes in the business climate on the other has put increased pressure on them. These changes are compelling the banks to reorganize themselves in order to cope with the present conditions.

Customer satisfaction refers to how satisfied customers are with the products or services they receive from a particular agency. The level of satisfaction is determined not only by the quality and type of customer experience but also by the customer's expectations. A customer may be defined as someone who has a direct relationship with, or is directly affected by your agency and also who has receives or relies on one or more of your agency's services or products.

Customers in human services are commonly referred to as service users, consumers or clients. They can be individuals or groups. An organization with a strong customer service culture places the customer at the centre of service design, planning and service delivery. Customer centric organizations will:

- Determine the customer's expectations when they plan listen to the customer as they design.
- Focus on the delivery of customer service activities value customer feedback when they measure performance

Why is it important?

There are a number of reasons why customer perception and satisfaction is important in Banking Sector:

- Meeting the needs of the customer is the underlying rationale for the existence of community service organizations. Customers have a right to quality services that deliver outcomes.
- Organizations that strive beyond minimum standards and exceed the expectation of their customer are likely to be leaders in their sector.
- Customers are recognized as key partners in shaping service development and assessing quality of service delivery

In this paper, the main contention of the researcher is to highlight the customer satisfaction through service quality provided by the banks State Bank of India in Nagercoil Town from kanyakumari district.

Scope of the study

The study has been conducted on behalf of customer perception and satisfaction of state bank of India . The study is focus to the Nagercoil Town from Kanyakumari district. The study covers the service providers and users of state bank of India. It has put forward the Customers as well as acceptability behavior for the services. The scope of the study is to find out the Customer perception and Satisfaction level of the customer in state bank of India in Nagercoil Town.

Need of the study

Customer perception and Satisfaction is very essential for every Service to survive in the market. Its could help the business by placing future demand to the company. Customer Satisfaction gives passing the words of mouth to other potential customers. This is very Important for the company to take care of the customers and make them to satisfy. So this study made by the researcher.

Objectives of the Study

- To ascertain the perception of customers regarding the service quality in SBI.
- To study the Satisfaction of customers towards the SBI.
- To know the customer awareness regarding the SBI Bank's products
- To know the preference of customer regarding the extra services of SBI.
- To know the problems faced by customer regarding SBI.
- To give the appropriate suggestions for the improvement of SBI.

Nature of Data:

Both primary and secondary sources of data were utilized for the study.

Sources of data :

- Primary Data
- Secondary Data

Primary Data:

Primary data is that data is collected a fresh for the first time and that is original in nature. The primary data was collected by means of administering a questionnaire to the customers. The study primary data was collected 150 customers from SBI in Nagercoil town branches.

Secondary Data:

Secondary data is that data which has been collected by some one else and which has already been passed through the statistical process. Secondary data here has been collected from various publications periodicals, journals etc.

Sampling unit :

The sampling unit rate for selecting the sampling for the study is from SBI branches in Nagercoil Town.

Sampling Size:

Sampling size for the study is selected from the following branches of SBI from Nagercoil Town. Nagercoil Town 5 SBI branches. Each branch consists of 30 respondents were randomly selected for the study according to the convenience of the researcher. The following branches are taken into consideration.

1. SBI Nagercoil branch
2. SBI Nagercoil Town branch
3. SBI Parvathipuram branch
4. SBI Vadacery branch
5. SBI Vadiveeshwaram branch

Method of sampling:**Convenience sampling :**

The sample units are selected according to the convenience of the investigator or researcher. Here, the researcher used convenience sampling design collection of primary data through structured questionnaires.

Methods of data collection :**Question method:**

A questionnaire consists of a number of question printed or typed in a definite order on a form or set of forms. The respondents have to answer the questions on their own. Quite often, the questionnaire is considered as the heart of a survey operation. Hence , it should be very carefully constructed.

Analysis and Interpretation**General profile of the respondents**

Factors	Classification	No.of respondents	Percentage
Sex	Male	102	68%
	Female	48	32%
Age	Below 20 yrs	45	30%
	21 – 30 yrs	54	36%
	31 – 40 yrs	33	22%
	Above 40 yrs	18	12%
Marital status	Married	78	52%
	Unmarried	72	48%
Educational qualification	Below HSC	18	12%
	Graduate	42	28%
	Above graduate	66	44%
	Other	24	16%
Occupation	Professional	39	26%
	Business	39	26%
	Employee	51	34%

	House wife	21	14%
Family income	Below 50000	51	34%
	50000 to 100000	60	40%
	100000 to 200000	21	14%
	Above 200000	18	12%
Family size	Up to 3	18	12%
	3 to 5	66	28%
	5 to 7	42	44%
	Above 7	24	16%

Source : primary data

Inference

The above table shows that 68% of the respondents are male, 36% of the respondents having the age group of above 21 – 30 years, next regarding marital status ; 52% of the respondents are married and about 44% of the respondents are above graduate, and maximum respondents are employee (34%) and incase of the annual income of the family, 40% of them under income group of Rs 50000 to 100000 and the last one regarding family size , 44% of the respondents are coming under 3 to 5 members.

Reasons preferring this bank

Preference is based on some reasons, it easy to use, wide online banking network, immediate action taken against complaints, friendly attitude, sufficient knowledge of the staff, low time consumption and reduction of risk. The classification of reasons for preferring this bank is shown in the below Table

Classification of reasons for preferring this bank

Reasons	Strongly agree	Agree	No opinion	Disagree	Strongly disagree	Total
Availability of more products/	72	36	25	10	7	150
Convenient location of a bank	81	48	12	6	3	150
High rate of interest on deposits	57	60	15	12	6	150
More and appropriate e-channels	60	45	24	15	6	150
Only SBI Branch is available	45	48	27	21	9	150
Low time consumption	75	54	12	6	3	150
Reduction of the risk	39	75	27	3	6	150

Source : Primary data

The above Table clearly shows that the reasons for preferring this bank. Maximum number of respondents strongly agree the factors given.

Age and Satisfaction

Satisfaction is very important factor for all activities. The satisfaction of the core banking users is compared with the age of the users, which is shown in the table below.

Comparison between age and satisfaction

Age	Highly Satisfied	Satisfied	Moderate	Dissatisfied	Highly Dissatisfied	Total
Below 20	9	30	0	0	0	39
21-30	9	12	3	0	0	24
31-40	9	27	3	3	0	42
Above 40	3	30	12	0	0	45
Total	30	99	18	3	0	150

Source : Primary Data

HO There is “no relationship between age and satisfaction towards SBI banking facilities.

Inference

Calculated Value	Table value	Degree of freedom	Significance
31.02	21.03	12	Significant

Source : Primary Data**Inference**

Since the calculated value 31.02 is more than the table value 21.03 at 0.05 level of significance so the null hypothesis is rejected. It may concluded there is a relationship between age and satisfaction towards SBI.

Table Shows Rank Correlation between Core Banking services and Online Banking services:

Respondents	Core Banking Services(x)	Online Banking Services(y)	Rank x	Rank y	(d)	d ²
Professional	24	15	2	3	-1	1
Business	19	30	3	1	2	2
Employee	28	23	1	2	1	1
Other	7	14	4	4	0	0
						Σd ² =4

Source: primary data

Spearman's rank correlation equation:

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

$$1 - \frac{6 \times 4}{4(16-1)}$$

$$1 - \frac{24}{60}$$

$$1 - 0.40$$

$$0.60$$

Inference:

There is a positive Correlation between core banking respondents and online banking respondents with the value of 0.60

Table shows Feedback on over all services:

Particulars	Respondents	Percentage
Excellent	15	10
Very Good	35	23.3
Good	50	33.3
Average	40	26.7
Poor	10	6.7
Total	150	100

Source: primary data**Inference:**

From the above information regarding feed back on overall service on bank , majority 33.3% respondents gave good,26.7% were gave average,23.3% were gave very good,10% were gave excellent and only 6.7% respondents gave poor on performance.

Table shows RATING SCALE on preference of services:

Preferences	Ranks	Respondents	Percentage
Core banking	1	70	46.7
Personalized	2	30	20.0
Wide branch	3	25	16.7
Customer service	4	15	10.0
Computerized	5	10	6.6
Total		150	100

Source: primary data**Inference:**

Based on the Ranking given by respondents majority for core banking at 46.7%, personalized 20%, wide branch 16.7%, customer service 10%,and computerized as 6.6%.

Table shows services used by the respondents

Response	No.of respondents	% of the respondents
Saving	45	30%
Fixed deposit	20	13.3%
Current a/c	25	16.7%
Demat a/c	10	6.7
loan	35	23.3%
Credit cards	15	10%

Source: primary data**Inference**

Based on the Ranking given by respondents majority for saving A/C at 30%, and loan 23.3%, current A/C 16.7%, fixed deposit 13.3%, credit cards 10%, and 6.7% respondents are using demat A/C.

Table Shows Standard Deviation of Respondents on Feedback

Particulars	Respondents X	$X = X - X'$	X^2
Excellent	15	-15	225
Very Good	35	5	25
Good	50	20	400

Average	40	10	100
Poor	10	-20	400
Total	$\Sigma X = 150$		$\Sigma X^2 = 1150$

Source : primary data

Standard Deviation:

$$\begin{aligned}
 X &= \Sigma X / N \\
 &= 150 / 5 \\
 &= 30 \\
 &= \sqrt{\Sigma X^2 / N} \\
 &= \sqrt{1150 / 5} \\
 &= 15.16
 \end{aligned}$$

Inference:

From the above information it is denoted that there is a standard deviation of approximately 15 Respondents about their opinion.

Major finding

- There is a relationship between age and satisfaction towards SBI facilities
- There is a positive Correlation between core banking respondents and online banking respondents of State Bank of India.
- There is relationship between age and monthly income of the respondents
- There is significant relationship between occupational status and nature of account
- By using weighted average rank for opinion about the rank to analyse the reason for preferring this bank wide core banking network got the first rank
- 65 % of the Respondents were felt satisfied on solving of the banking problem by the State Bank of India banking staff.
- Most of the Respondents were felt that the State Bank of India bank would not restrict on maintaining of minimum balance is must in high.
- It is observed that the 78 % of the Respondents were satisfied on financial transactions of the S.B.I. Bank.
- 64% of the Respondents were felt that the State Bank of India bank would provide on savings account.
- Most of the Respondents were not preferred an alternate Bank instead of the State Bank of India bank.
- It is observed that 76% of the respondents felt difficulty while opening an account in the S.B.I. Bank.
- Only 15% the Respondents will aware of the list of shares in stock exchange provided by State Bank of India bank.
- 23.7% of the Respondents were believed in State Bank of India bank provides loan Facilities to the customers in an easy manner.
- Majority of the Respondents were preferred savings account when compared with all the remaining mode of accounts
- While asking the feedback about the State Bank of India bank services 45% of the Respondents were felt very well on service.

- It is observed that the 84% of the Respondents were satisfied on financial transactions of the S.B.I. Bank.

Suggestions

- The bank should introduce new awareness program about the various other services to the account holder
- Most of the users felt the rate of interest too high so the bank considered to reduce the interest rate.
- Most of the user expected more attractive scheme so the offer any attractive scheme and benefits to the users
- From the above findings it was found that one of the State Bank of India bank provided services is Online transactions. That is not much known to the customers, therefore the Bank management should take efforts to make awareness among the general public about online facilities.
- Majority of the customers will prefer online bill payment facility provide by State Bank of India bank. so the management should give low service charges and offering prices on Online Bill Payments.
- Advertisement of State Bank of India bank is very less when compared with the competitors. It may leads to switching on other Banks. To overcome the Bank management should promote more advertisements through various advertisement channels.
- Most of the customers felt that opening of an account is very difficult in the Bank. So the management should take care on new customers as well as old customers.

CONCLUSION

Customer satisfaction is most important factor for every business become success. In Indian banking industry , SBI is one of the important sector. From this study Some light was shed on some negative factors also like creating an awareness on online transactions, interest rates on loans, A.T.M. facilities etc., That's why Some suggestion were provided to the management like concentrating on Online services, solving banking problem with a quick time and promote loan facilities like industrial ,business, agriculture, individual loans etc, with an attracting advertisements. Its lead to growth of the industry.

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EFFECTS OF ADVERTISEMENT ON CONSUMER ATTITUDE TOWARDS DURABLE PRODUCTS IN RURAL AREAS OF KANNIYAKUMARI DISTRICT

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Abstract

The advertisement shows an active role in generating demand for the products and reaching different observers' divisions. The mode of advertising transports the level of consciousness and shared understanding of the marketing environment. The marketers try to contact different types of observers through original and innovative messages strategically carried out in the process. Global advertisers create a positive impact on the advertisement, which leads to improving their brand name, targeted sales, and enhancing the firm's goodwill. After confirming the advertising objectives, the marketer chooses the most appropriate communication strategy for media advertisement. The advertising strategy is a significant factor in generating attentiveness for the products. Advertisement offers product information to secure the responsiveness, desire, concentration and actions of the consumers. The durable product advertisement on media shows a vital role in selling the products to the customer. In India, media advertisements are considered a prominent and growing industry. People come across various advertisements and how they impact them in day-to-day life. Moreover, people are aware of the range of products available in the market through multiple media sources. Therefore, the advertiser should analyse the advertisement concept and which media significantly impacts consumers' minds and reach the target group to attain maximum sales. This paper intends to understand the Effects of advertisement on Consumer attitude towards Durable Products. The study has been made by conducting a survey in rural areas of Kanniyakumari District of Tamil Nadu State. For that, the researcher collected 100 samples from the study area and Percentage, Chart, Garret ranking method and t-test used for analysed for the study.

Key words: Consumer Behavior, Advertising Strategy, Media Advertisement, Durable Products.

INTRODUCTION

In recent years, there is a large shift in consumer behaviour among Indians due to enhanced awareness and information technology. Lifestyle among urban as well as rural consumers has changed enormously with influence of socio-economic conditions, cultural environment, education level, occupation, high per capita income and wide media coverage. There is an increase in working women dramatically after 1990s, they are proving to be equally good as men, and make their own decision to buy things which they need. With the above parameters the demand for consumer durables increased significantly and also made the yesterday's luxuries into today's necessities.

Advertisements are highly informative and they are giving all the necessary information to the consumers about the particular product and brand. Some types of advertisements are comparing their product features and price with the other available brands in the market directly or indirectly. This reduces the information search of the consumers while deciding to buy a specific brand. The advertisement endorsed with a favorite celebrity will influence the consumer purchase decision. These types of celebrity advertisement attract the attention of the consumers towards the brand. Advertisement acts as a weapon to overcome the heavy competition. The main goal of advertising strategy is to maintain a positive attitude or modify negative attitudes towards products. They have taken more action for

changing the consumer attitude, which is favorable to purchase that product. Attitude is how the consumer thinks, feels and acts towards the environment like the store, radio, and reference groups.

NEED & IMPORTANCE OF THE STUDY

In the competitive world, organisations have faced many challenges in promoting their products and services in the marketing environment. The company intends to stand in the market for a more extended period, so they chose the advertising tool as a promotional strategy. The businessmen may lose their market share, goodwill and brand value due to product advertisement. Therefore, the marketer uses the advertisement as the best promotional tool for promoting their products and services. Advertising is the primary path to create awareness among the consumers and also, the marketers can promote their products and services. The advertising agencies and many marketers must understand that the market responds to the consumers' mindset towards products. The advertiser's primary objective is to focus on different advertising techniques to create awareness among potential customers about their new products and update them on the innovative product's benefits and features. The effectiveness of advertising norms depends on the understanding of how advertising works. They should analyse the force in a manner like how it works, when it works and why it is needed. The advertiser needs to examine the internal situation and external capabilities for attaining the privilege. This study analysis the suitable advertising option and how this option can bring a significant change in the consumer's mind towards durable products. This study also focuses on how advertising influences the attitude and how the customer makes decisions based on their valuable resources such as time, money, etc. The marketer should know the target customers for the durable products and understand the reasons behind their purchase. The main focus of this study is to arrive at the answers from the customer as to what factors influence their attitude towards durable product advertisements and what suggestions can be made to improve the advertisement towards the products. Moreover, this study will investigate to what extent the factors will influence the purchasing patterns of the consumer.

SCOPE OF THE STUDY

This research aims to develop a framework of advertisement and consumer attitudes for researchers and manufacturers of durable products. This study measures various dimensions of an individual perspective and this would help the manufacturer know the product's perceived value. It is an exciting topic for researching as this study is helpful to the manufacturers, marketers, advertisers and consumers. It would help them to work out the purchase intention, expectation level, understand the buying behaviour and the level of influence of advertisement on their decision-making process. This report provides many insights into the marketers for understanding the current market trend. It is advantageous to the new manufacturers to adopt creative strategies to help attract more consumers. This study will throw light on the attitude level of the advertisement on a general basis which would improve the brand value for different sections of the consumers. This study is also valuable for the consumers to understand their purchasing power and select products based on their exposure to the advertisements.

REVIEW OF LITERATURE

Khalid, M. O. (2020), "A study on the effects of social media advertisement on consumer's attitude and customer response", this study pointed out the assertiveness of the consumers concerning the needed products has been changed due to the entertainment appeals used in the receptive advertisements. Open and accessible advertisements enhanced consumers in an informative and credible way. Word of mouth communication impacts a positive attitude towards personalised products and makes frequent purchases. Personalised advertisement tactics had triggered the consumers' outlook and made them persistently recognise their needed products.

Duffett, R. G. (2015), "Facebook advertising's influence on intention-to-purchase and purchase amongst millennials", this study examined the effectiveness of digital advertisement and how the consumer influences buying behaviour of the product. Consumer behaviour towards digital

communication has been changed drastically and measured the consumer favourite, plan to purchase and perceptions of the product. Digital advertising was based on accessibility, length of usage, frequency of login, login characteristics, updated profile picture and ethnic concepts. These features enhanced positive attitudinal influence among consumers to grab the intention to view the products.

DURABLE PRODUCTS

In durable products, the consumer selects high-end products and will give importance to the value of money. This study measured the five durable products such as Home appliances, Computing and Networking, Electronics, Books and Jewellery. These durable products have played an essential role in the day to day life.

OBJECTIVES OF THE STUDY

- To study the socio-economic conditions of the sample respondents.
- To analyse the consumer opinion towards Gender of the respondents.
- To measure the effectiveness of advertisements among consumers of durable products.

RESEARCH DESIGN

The present study is of Descriptive in nature. Sample size selected for the study was 100 respondents in rural areas of Kanniyakumari District of Tamil Nadu State. Convenience sampling technique was adopted in the selection of the respondents. For analyzing the data, Percentages, Chart, Garret Ranking and t-test were applied.

LIMITATIONS OF THE STUDY

- This study measured only durable product advertisements.
- Most of the respondents refused to fill in the questionnaire as they considered it a sheer waste of time

RESULTS AND DISCUSSIONS

Table 1: Demographic Variables of the Respondents

Variables		No of Respondents	Chart
Sex	Male	58	
	Female	42	
	Total	100	
Age	Upto 25	4	
	26-35	43	
	36-45	27	
	46-55	14	
	Above 55	12	
	Total	100	
Marital Status	Married	56	
	Un-Married	44	
	Total	100	
Educational Qualification	Upto SSLC	12	
	HSC	47	
	Graduation	14	
	Post-Graduation	05	

	Others	22	
	Total	100	
Occupation	Self Employed	19	
	Govt. Job	17	
	Private Employee	34	
	Others	30	
	Total	100	
Monthly Income	Less than 10000	3	
	10001-20000	26	
	20001-30000	35	
	30001-40000	25	
	Above 40000	11	
	Total	100	
Type of Family	Joint Family	26	
	Nuclear Family	74	
	Total	100	
Size of the Family	Up to 2	06	
	3 to 5	62	
	Above 5	32	
	Total	100	

Sources: Primary Data

The above table shows that demographics wise distribution of the respondents. It reveals that male respondents are higher than female respondents. Most of respondent's age group were 26-35, when compared with marital status married were higher than un-married and HSC were high as compared to other Educational groups. Majority of the respondents were Private Employee, most of the respondents were Nuclear Family and respondents they getting 20001-30000 monthly income compared to other Income.

Table 2: Awareness of durable products through media

Medium	No of Respondents	Chart
Television	19	
Online media	43	
Newspaper	28	
Radio	10	
Total	100	

Sources: Primary Data

Consumers revealed that media helped them to know about the durable products. Based on the frequency, Online media plays a major role in the consumer's minds about the durables with 43 respondents, Television is 19 respondents, Newspaper is 28 respondents and Radio is 10 respondents.

Table 3: Reasons for purchasing the durable products

Reasons	No of Respondents	Chart
High quality	34	
Follow the trend	18	
Differentiate myself from others	11	
Brand image	23	
Show-off	14	
Total	100	

Sources: Primary Data

Consumers expect high-quality products as essential aspects which are expressed by 34 respondents. It is as expected since any purchase is made with a usage level. Therefore, it is very natural for any consumer to expect a maximum consumption period, and 23 respondents were in favour of branded durable products.

Table 4: Appropriate total amount spent on durable products

Amount Spent	No of Respondents	Chart
0 - 5000	22	
5001 – 10000	34	
10001 – 20000	24	
20001 – 30000	15	
More than 30000	05	
Total	100	

Sources: Primary Data

The above table indicated that the total amount spent on durable products by the respondents. The 34 respondents spend Rs. 5001 – Rs.10000 from the family's household income followed by 24 respondents in the range of Rs.10001 – Rs.20000 and 22 respondents spend less than Rs. 5000 for durable products.

Table 5: Frequency of Shopping

Frequency	No of Respondents	Chart
Monthly	17	
Quarterly	43	
Half-yearly	26	
Yearly	14	
Total	100	

Sources: Primary Data

The above results prove that the consumer needs a durable product depending on the short term and the long term usage. 43 respondents reviewed their purchase quarterly, whereas 14 consumers did not want to purchase the products in less than a year.

Table 6: Appropriate total amount spent on durable products

Amount Spent	No of Respondents	Chart
Home appliance	29	

Computing Networking	18	
Electronics	32	
Books	14	
Jewellery	7	
Total	100	

Sources: Primary Data

Home appliances appear to be the predominant product among 29 respondents and electronics is 32 respondents.

Table 7: Level of Opinion

Level of Opinion	Number of Respondents	Chart
Strongly agree	38	
Agree	49	
Dis Agree	13	
Strongly Dis agree	0	
Total	100	

Sources: Primary Data

From the above table it can be observed that 38 percentage of the respondents were Strongly agree, 49 percentage of the respondents were agree and 13 percentage of the respondents were Dis-agree.

Table 8: Effectiveness of Advertisement on Consumer Attitude towards Durable Products

Influence of consumers attitude	Mean Score	Rank
advertisement on remembering the products	6.35	I
advertisement on motivation	6.22	II
advertisement on product trends	6.08	III
brand recognition	5.23	IV
product interest	5.11	V
emotions	5.03	VI
changing their opinions	4.59	VII
changing the brand belief	4.21	VIII
engage with the message	4.09	IX
convincing	4.03	X

Sources: Computed Data

The above table indicates that Effectiveness of Advertisement on Consumer Attitude towards Durable Products. In which, most of the respondents they answered the advertisement on remembering the products, it is a first rank its mean value is 6.35. The following ranks were advertisement on motivation, II rank (Mean Value 6.22). advertisement on product trends, III rank (Mean Value 6.08). brand recognition, IV rank (Mean Value 5.23). product interest V rank (Mean Value 5.11). emotions, VI rank (Mean Value 5.03). changing their opinions, VII rank (Mean Value 4.59). changing the brand belief, VIII rank (Mean Value 4.21). engage with the message, VIII rank (Mean Value 4.09) and convincing, X rank (Mean Value 4.03).

ASSOCIATION BETWEEN GENDER AND LEVEL OPINION

The t- test is applied to find the association between Opinion of the respondents and Gender.

Table 9: Opinion of the respondents and Gender

Variables	Strongly agree	Agree	Dis-Agree	Strongly Dis agree	Total
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Male	24	27	7	0	58
Female	14	22	6	0	42
Total	38	49	13	0	100

Sources: Primary Data

Table 10: Calculation of t-test

Factors	Variables	df	Table Value	Calculated Value	Result
Opinion of the respondents	Male	122	1.98	0.164	Accepted
	Female				

Sources: Computed Data

The above table represents the independent sample t-test. It is clear from the table that the means of the variable namely Opinion of the respondents and Gender has its Calculated value is less than the table value. There is no significance different between namely Opinion of the beneficiaries and Gender. Hence the null hypothesis is accepted.

FINDINGS

- Male respondents are higher than female respondents.
- Most of respondent's age group were 26-35.
- when compared with marital status married were higher than un-married.
- HSC were high as compared to other Educational groups.
- Majority of the respondents were Private Employee.
- most of the respondents were Nuclear Family.
- respondents they getting 20001-30000 monthly income compared to other Income.
- Online media plays a major role in the consumer's minds about the durables with 43 respondents.
- Consumers expect high-quality products as essential aspects which are expressed by 34 respondents.
- 34 respondents spend Rs. 5001 – Rs.10000 from the family's annual household income.
- 43 respondents reviewed their purchase quarterly.
- 38 percentages of the respondents were strongly agree.

SUGGESTIONS OF THE STUDY

- The marketers need to identify the consumer behavioural changes towards durable products through research and developmental activities on the advertisements.
- Durable product companies must follow the moral and ethical values of the consumers and also, they should follow business ethics in their advertisements.
- Marketers need to consider consumers' viewpoints to develop their communication strategies effectively. Therefore, they also cautiously monitor on-going changes in the lifestyle pattern of the potential consumers towards durable products.
- Durable product companies need to upgrade their marketing strategies at all levels and improve their approaches through traditional and digital advertisements that are to be upheld from inaccuracy connections. In addition, advertising companies should try to avoid celebrities in durable products advertisements.

CONCLUSION

The advertisement plays a significant role in persuading the attitude of consumers towards durable products in Kanniyakumari District. Consumers are varied from viewpoint of education, occupation, income level and purchasing style on the durable products. Consumers are actively engaged with the message that appeared in the advertisement. They have collected more information about durable

products through peers, family members and friends. It is found that there is a significant attitudinal change among the consumers after watching the advertisement of the durable products. It is concluded that advertisements have a remarkable effect on consumer attitudes during their purchase of durable products especially in rural areas. In particular, the consumers can obtain agreeof the durable products; they can match themselves to the existing product attributes. Their purchase decision of durable products mainly depends upon the product attributes and price even though they are attracted by the advertisement and motivated to purchase the durable products.

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CONSUMER BUYING BEHAVIOR TOWARDS THE INSTANT FOOD PRODUCTS– A STUDY IN KANNIYAKUMARI DISTRICT

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ABSTRACT

A consumer is a person who not only buys the product but the one who eventually acquire, use, and dispose of the product in entirety. The cornerstone of every marketing strategy is the buying behavior of the consumer and the behavioral pattern of the consumer towards a particular product. The marketer is to identify consumer behavior towards the product and then frame the marketing strategies accordingly. A consumer's brand and product preference towards the Instant food products attitude has been considered as an essential concept for the business practices since it is clearly shown in behavioral studies that it plays an essential role in consumers' buying behavior. The present chapter discusses the consumer's preference towards the brands and products of Instant Food products in Kanniyakumari District. The Instant Food products are taken for the study, namely soups, Noodles, Tiffin Items, Gravy Items, Rice Varieties, Snacks Items, and Dessert Varieties. The present study also discusses the consumer's preference of brands, purchase place, source of information, aspect of the purchase of products, and attributes that influence the consumers to purchase of Instant Food products in Kanniyakumari District. For that, the researcher collected 90 samples from the respondents and percentage, Garret ranking method and t- test used for this study.

KEY WORDS: Marketing Strategy, Instant Food, Globalization, Consumer's Brand and Product Preference.

INTRODUCTION

Food is an essential element of everyone's lives. It provides the energy and nutrients to raise and develop, be healthy and active, to move, work, play, think, and learn. The human body needs nutrients like protein, carbohydrate, fat, vitamins, and minerals - from the food we eat to stay healthy and productive. In ancient days in India, the women are taking care of family activities, and men are dominating the family in all the aspects. Women were expected to cook the food items and eat only after the men, with whatever availability of food is left. Women in India gradually started recognizing their correct perspective. Women have started questioning the rules laid down for her by the social order. As a result, women have begun breaking barriers and earned a decent position in the world.

Now a day's Indian women have excelled in every field from social work to visit the space station. There is no arena, which remains unconquered by Indian women. Whether it is politics, sports, entertainment, literature, technology everywhere, its women power all along. In the wake of the globalization effect, there is an enormous employment opportunity creates in India. Both male and female employees are placed in the right place. The women also got an equal opportunity for employment in the entire field. The people are shifted from a natural position to an urban area for work. It leads to the cost of living is higher comparatively in their native places. In urban areas increases the damage to foods, transportations, house rent, children's education, and medical expenses. To bear the costs, it is forced to work both male and female to develop their earnings. Due to the full-fledged employment of women, they cannot concentrate on their family fully. They have the responsibility to balance both work and family. In the family, the women have to take care of their children, working husband, family, and old aged parents.

Due to these circumstances, they slowly switch over to the traditional method of foods to the modern and readily available diet.

In the globalized era, most women are working not in just ordinary jobs, but they are a significant competition to men in the corporate world, and because most of their time is spent at work, they do not have the time to cook at home, leave alone making delicacies of different kinds. So they end up buying these readymade food items almost always, and this, in turn, has increased the demand for these ready to eat, off the shelf food products.

STATEMENT OF THE PROBLEM

Indian people's food habits significantly vary from other continents in the world. Given the different groups of population and ethnicity, it is always a complicated issue to find a market in the Indian people. After the policy changes in the year 1991, LPG (Liberalization, Privatization, Globalization) economic review was adopted, and after that, significant changes have taken place. Westernization lifestyle got followed up in the major cities across India, and people started emulating western country lifestyles. Change in consumer mindset leads to many Multi-National corporations finding new space to suit their product sales in the Indian people mindset. Due to the changeover in the lifestyle and evolution of the nuclear family, people started preferring packed foods to find ease in cooking. Among the 70% of the Indian family are nuclear, and women want to spend less time in the kitchen. An increase in dual-income of the family is also one of the reasons to go for purchasing packed branded food products.

Consumer behavior towards food is worth analyzing not only because it accounts for a significant part of the consumer purchases but also due to the tremendous changes undergoing in the lifestyle and the pattern of spending. Consumers are moving from a cost-conscious position to that of health informed and value-conscious. One of the main reasons which stimulated this change is the transformation in the role of women from homemakers to that of working women. The compression of time at their disposal led to the development of a new segment of products, which are instant food products. Though the 'availability of time' is a differentiating factor between the homemaker and working women, the preference for quality, variety, and health, etc. are in the priority list for both groups while making food choices. However, differences exist in the buying behavior related to food products, mainly prepared foods, and this has received less research attention to date. The present study aims to fulfill this gap by examining the consumers' attitudes and behaviors towards the prepared foods. The various issues which need focus in this field are Product quality expected or preferred in instant food products, purchase pattern including outlet choices, timing, and frequency of purchases of instant food products, attitudes and family practices concerning shopping and purchases decisions of instant food products.

SCOPE OF THE STUDY

The proposed study's ultimate objective is to find out the consumers buying behavior towards the instant food products in Kanniyakumari District. The study's focus is to examine the consumers eating pattern of instant food products, consumer's preference of brands and products, predominant factors which influencing the consumers to prefer the usage of instant food products, influence of advertisements towards the instant food products and consumer satisfaction of availability, price, and Quality of instant food products. The results of this research will be of enormous help to the marketers in understanding the tastes and preferences of consumers, the criteria adopted by consumers in selecting particular instant food products, choosing a suitable pricing strategy, and devising a suitable marketing strategy, to get better their outcomes of instant food products in a better way.

OBJECTIVES OF THE STUDY

- To identify the consumers most preferred brands for the consumption of instant food products
- To find out the predominant factors which influence the consumers to purchase the instant food products
- To find the Comparison of Marital Status and Customers' Awareness of Instant Food Products.

RESEARCH DESIGN

A simple random convenience sampling method was used to elicit the necessary information from the consumers of instant food products. The study used both primary and secondary data. The

primary data gathered through the structured questionnaire from the consumers of instant food products. The researcher collected 90 samples from the study area. The secondary data collected from journals, magazines, books, the internet, and newspapers regarding instant food products in India. For analyzing the data, Percentages, Garret Ranking and t-test were applied.

LIMITATIONS OF THE STUDY

- The research area of the study is confined to Kanniyakumari District. Hence, the generalization of the study may not hold good for the other part of Tamil Nadu
- This study elicited the opinion on consumers' behavior of instant food products only. The consumer's idea may not be good at all times.
- The study was selected as only a specific type of instant food products only.

RESULTS AND DISCUSSIONS

Table 1: Demographic Variables of the Respondents

VARIABLES		No of Respondents	Percentage
Age	Upto 25	21	23
	26-35	27	30
	36-45	16	18
	46-55	15	17
	Above 55	11	12
	Total	90	100
Sex	Male	39	43
	Female	51	57
	Total	90	100
Marital status	Married	52	58
	Un-Married	38	42
	Total	90	100
Educational Qualification	Upto SSLC	14	16
	HSC	23	26
	Graduation	26	29
	Post-Graduation	14	16
	Others	13	14
	Total	90	100
Occupation	Farmer	11	12
	Govt. Employees	22	24
	Private Employees	29	32
	Business	16	18

	Others	12	13
	Total	90	100
Income Per Month	Up to Rs.25,000	56	62
	Rs.25,001 -50000	17	19
	Rs.50,001-75,000	11	12
	Above Rs.75,000	6	7
	Total	90	100

Sources: Primary data

Table No.1 shows demographics wise distribution of the respondents. It reveals that female respondents are higher than male respondents. Majority of respondents age group were 26-35, most of the respondents were married and Graduation were high as compared to other Educational groups. Majority of the respondents were Private Employees and Up to Rs.25,000 amount earning by respondents were high as compared to other Income Per Month for respondents.

Table 2: Nature of Family

Family	No of Respondents	Percentage
Nuclear Family	67	74
Joint Family	23	26
Total	90	100

Sources: Primary data

It is noted from the above table, 67 consumers are managing nuclear family, and 23 consumers are managing the joint family system.

Table 3: Size of the Family

Size of the Family	No of Respondents	Percentage
2 - 4 Members	47	52
4 - 6 Members	32	36
Above 6 Members	11	12
Total	90	100

Sources: Primary data

It is scrutinized from the above table, 47 respondents have 2-4 members in their family, followed by 32 respondents are having 4-6 members in their family, and 11 respondents are having above six members in their family.

Table 4: Frequency of using Instant food products

Frequency of using Instant food products	No of Respondents	Percentage
Regularly	53	59
Occasionally	21	23
Sometimes	16	18
Total	90	100

Sources: Primary data

The above table reveals the results of the Frequency of using Instant food products among the consumers in the study region. Majority (53) of the consumers are using the Instant food products

regularly, followed by 21 respondents are using the Instant food products occasionally, and 16 respondents are using the Instant food products sometimes.

Table 5: Spending on Instant food products

Spending on Instant food products	No of Respondents	Percentage
Up to Rs.5,000	17	19
Rs.5,000 - Rs.10,000	21	23
Rs.10,000 - Rs.15,000	27	30
Above Rs.15,000	25	28
Total	90	100

Sources: Primary data

The above table describes the frequency results of spending towards the Instant food products in the study region. It could be surveyed from the above table, the 27 respondents are spending towards Instant food products between Rs.10,000 - Rs.15,000. The next highest spending group is the persons who are earning Above Rs.15,000 (25). The respondents spending towards the instant food products between Rs.5,000 - Rs.10,000 is (21), and 17 respondents are spending towards the instant food products is Up to Rs.5,000.

Table 6: Respondent's frequency of using Instant food products

Usage of Instant food product	No of Respondents	Percentage
TV	22	24
Newspapers	19	21
Magazines	14	16
Bill Boards	27	30
Others	8	9
Total	90	100

Sources: Primary data

The above table describes the results of the Source of information about Instant food products among consumers. Majority (27) of the consumers have sourced the information about the instant food products through the Bill Boards/Hoardings, followed by, 22 respondents are sourced through TV, 19 respondents are source the information through Newspapers and 8 respondents are source the information through Other media.

Table 7: Respondent's frequency of using Instant food products

Usage of Instant food product	No of Respondents	Percentage
Every day	27	30
Once a week	21	23
Once a month	17	19
Very rarely during emergency	15	17
During special occasions	10	11
Total	90	100

Sources: Primary data

Respondent's frequency of using Instant food products shown in the above table, 27 respondents are using Instant food products almost every day, followed by 21 respondents are using instant food products once in a week, 17 respondents are using instant food products once in a month, 15 respondents

are using Instant food products very rarely during emergency, and 10 respondents are using Instant food products during special occasions

Table 8: Place of purchase of Instant Food products

Place of purchase	No of Respondents	Percentage
Local Grocery Shops	39	43
Super Markets	36	40
Department Stores	15	17
Total	90	100

Sources: Primary data

As shown the above table, 39 respondents are purchased the Instant Food products in Local Grocery Shops, followed by 36 respondents are purchased the Instant Food products in Super Markets and 15 respondents are purchased the Ready to Eat Food products in Department stores

Table 9: Respondent's preference for using Instant food products

Products	Mean	Rank
Gravy Items	7.21	I
Snacks	7.14	II
Rice items	7.01	III
Noodles	6.93	IV
Desserts	6.87	V
Tiffin Variety	6.81	VI
Soups	6.72	VII

Sources: Computed data

The above table shows that the respondent's preference for using Instant food products. The majority of consumers prefer the Instant food products was gravy items (7.21), followed by snack items (7.14), Rice Items (7.01), Noodles (6.93), Disserts (6.87), Tiffin items (6.81) and soups (6.72)

Table 10: Influencing attributes to purchase of Instant food products

Factors	Mean	Rank
Price	6.32	I
Quality	6.19	II
Variety	6.04	III
Taste	5.37	IV
Packaging	5.26	V
Good Brand	5.11	VI
Nutrient values	5.07	VII
Ingredients	4.97	VIII
Purchase place	4.86	IX
Manufacturing date and expiry date	4.81	X

Sources:Computed data

The above table confirms the Influencing of attributes to purchase the Instant food products. It is noted from the above table; all the attributes mean value is greater than 3, which means all the attributes are influencing the consumers to purchase the Instant Food products

Table 11: Customers' Awareness of Instant Food Products

NUMBER OF RESPONDENTS												
Statement	Strongly Aware		Aware		Neutral		Dis Aware		Strongly Dis Aware		Total R	Total %
	R	%	R	%	R	%	R	%	R	%		
Married	13	14	17	19	19	21	2	2	1	1	52	58
Un- Married	12	13	14	16	10	11	1	1	1	1	38	42
Total	25	28	31	34	29	32	3	3	2	2	90	100

Sources:Primary Data

From the above table it can be observed that 25percentages of the respondents were Strongly Aware, 31 percentages of the respondents were Aware, 29percentages of the respondents were Neutral, 3percentages of the respondents were Dis- Awareand 2percentages of the respondents were Strongly Dis Aware.

COMPARISON OF MARITAL STATUS AND AWARENESS OF INSTANT FOOD PRODUCTS

The t- test is applied to find the Comparison of Marital Status and Customers' Awareness of Instant Food Products.

Table 12: Calculation of t-test

Factors	Variables	df	Table Value	CalculatedValue	Result
Marital Status and Customers' Awareness	Male	178	1.645	-0.1741	Accepted
	Female				

Sources:Computed Data

The above table represents the independent sample t-test. It is clear from the table that the Comparison of Marital Status and Customers' Awareness of Instant Food Productshas its calculated value is less than the table value. There is no significance different between namely Comparison of Marital Status and Customers' Awareness of Instant Food Productsof the respondents. Hence the null hypothesis is accepted.

FINDINGS

- Female respondents are higher than male respondents.
- Majority of respondent's age group were 26-35.
- Most of the respondents were married.
- Graduations were high as compared to other Educational groups.
- Majority of the respondents were Private Employees.
- Up to Rs.25,000 amount earning by respondents were high as compared to other Income Per Month.
- 67 consumers are managing nuclear family.
- 47 respondents have 2-4 members in their family.
- Majority of the consumers are using the Instant food products regularly.
- 27 respondents are spending towards Instant food products between Rs.10,000 - Rs.15,000.

- 27 respondents are using Instant food products almost every day.
- 39 respondents are purchased the Instant Food products in Local Grocery Shops.
- 31 percentages of the respondents were Aware.

SUGGESTIONS OF THE STUDY

- The consumers, who form a part of smaller households, suggested increasing the quantity of food per packet, as various ready meals are not sufficient for one person also. The manufacturers should keep in mind to increase the quantity.
- The manufactures of Instant food products should use different strategies in an advertisement at the time of promotions their products.
- The manufactures of Instant food products enhance the availability of Instant products in many places; it creates the consumers can easily access the food products whenever the need arises.

CONCLUSION

The study is focused on buying behavior of Instant food products among the consumers in Kanniyakumari District. The study highlights that consumers are willing to consume Instant food products. Due to technological alterations and the transforms in the lifestyles of people are the most important reasons behind the fast growth of the instant food industry. There is a higher demand for instant food products, and the significant reasons for the same are convenient tradition, easy availability, less time consumed, and better taste. The study also points out those working peoples prefer more on consuming instant food products. The study results indicate that there is no significant association between the eating pattern of instant food products and the demographic profile of consumers. The consumers were also willing to prefer the different variety of branded instant food products in the study area. Besides, the study points out that advertisement are significantly influencing consumers to purchase instant food products. The consumers are satisfied with the prices of instant food products. The consumers also point out that the prices of instant food products are affordable. The quality and availability of instant food products are significantly influencing consumers to consume instant food products in the study area.

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A Study on Gender and Behavior Differences Influencing On Online Purchasing In Tirunelveli District

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Abstract

The development of Internet has resulted in enormous business prospects and opportunities and given new direction to traditional commercial activities. E-commerce emerged as the need of the hour. The business-to-consumer (B2C) is the most visible and prominent progeny of e-commerce. B2C is a commercial process that starts with companies and ends with end consumers. Online shopping is an emerging area in the field of E-Business and is surely going to be the future of shopping in the world. The benefits of online shopping are well known. On-line shopping in India is significantly affected by various demographic factors like age, gender, marital status, educational qualification, occupation and income. Substantial amount of research work has been carried out on all these areas. The impact of these factors on online shopping behaviour is fascinating to say the least. But the most mysterious of them all is the impact of gender on the acceptance or rejection of online shopping. Do men and women behave differently during the online shopping process or do they exhibit same kinds of behaviour during this process? This article will try to throw some light on the extremely valuable but often neglected role of gender in the online shopping behaviour of consumers. Recently, the diffusion of the Internet as a retail and distribution channel has undergone a great growth in India. This paper presents an empirical investigation on the effects of gender differences on online buying in Tirunelveli District. The study explored gender differences among twelve factors concerning the online buyer for both Male and Female in Tirunelveli District. For data collection and final testing of the model a well-structured questionnaire was designed and hosted. The researcher collected 147 respondents sent their answer out of 150 questionnaires. With regard to factors and consistent with using t-student test.

Keywords: - Online Shopping, E-Commerce, Gender Differences, Online Consumer Behaviour, Business-To-Consumer.

Introduction

As the Internet and wireless network technologies have a had lot of advancement in decades, their increasing use has resulted in more online commercial activities, in terms of consumers navigating websites and making financial or nonfinancial transactions. The growing online consumer market allows consumers to make financial transactions online anywhere in the world regardless of their locations. The Internet therefore offers enterprises a growing market with limitless opportunities that they can tap into by providing consumers with online shopping services. The most common incentives for consumers to shop online are convenience, competitive pricing, greater access to information, complementarity of traditional stores and broader selections. Most of the companies are running their online portals to sell their products/services online. Though online shopping has made enormous progress outside India, its growth in the Indian market, which is a large and diverse consumer market, is not in line with the global market. So Government of India takes some steps to develop online mode of transaction. because of this, nowadays most of the people purchasing their needs by online.

Need of the study

Nowadays, the Internet is being widely used in daily life. The existence of the Internet brought many advantages to individuals' daily lives. With the help of the media, people can communicate, learn something about goods, entertain, buy products and get services. Of course, the disadvantages of it have long been discussed; as the virus threat, the risk of personal information theft, spamming etc. Studies on online shopping investigated the factors that influence online shopping as

well as motives for, value of and antecedents of online buying behaviour. As a result, the academic researchers and the business world started to focus on the consumer side of the online purchasing behaviour and a lot of researches and articles were prepared to make guidance for the development of online shopping. The purpose of this study is to identify factors affecting consumers' online shopping gender behavior, specifically elucidating them in the context. In addition to the previously identified factors this study included gender-specific factors that may play an important role in determining Internet adoption for e-commerce. The aim of this study is to investigate the factors that affect online purchasing behaviour of two consumer groups like Male and Female. Moreover, it is also wanted to identify and analyse online buying habits of Male and Female of Tirunelveli District of Tamil Nadu.

Review of Literature

S.K. Suman and Pallavi Srivastava (2019) "Age and Gender Influences on Consumer Behavior Towards Online Discounts", They concluded that in the past few years multiple studies were carried out related to behavior of consumers towards online shopping and also the demographic (like age and gender) influences on behavior of consumers towards online shopping. But limited study has been carried out precisely related to age and gender influences on factors considered while buying online when discounted products are available. This study has a lot of significance in Indian context. Online retailers are offering massive discounts to allure the buyers to shop online and, in this process, it is essential to understand the factors which are important for different age groups and genders.

Vijay, Sai. T. & Balaji, M. S. (2009), "Status and Scope of Online Shopping: An Interactive Analysis through Literature Review", revealed that Consumers, all over the world, are increasingly shifting from the crowded stores to the one-click online shopping format. However, in spite of the convenience offered, online shopping is far from being the most preferred form of shopping in India. A survey among 150 internet users, including both users and non-users of online shopping, was carried out to understand why some purchase online while others do not. The results suggested that convenience and saving of time drive Indian consumers to shop online; while security and privacy concerns dissuade them from doing so.

Objectives of the study

To know socio-economic background of the respondents.

The aim of this study is to investigate the factors that affect online purchasing behaviour of two consumer groups like Male and Female.

Moreover, it is also wanted to identify and analyse online buying habits of Male and Female.

Research Design

The present study is of Descriptive in nature. The researcher collected primary and secondary sources. The primary data collected through convenient sampling method. Structured questionnaire was distributed through directly by researcher in Tirunelveli District of Tamil Nadu State. Secondary sources include internet, books, reports, journals and so on. Convenient sampling methods was used to collect data from 150 respondents. Of this, the filled in forms of 147 respondents were found to be complete and were taken for further analysis. The remaining forms were incomplete, therefore such data were rejected. For analyzing the data Percentages and t-test were applied.

Limitations of the Study

The study is limited to consumers residing in to Tirunelveli District only so the results of this study cannot be used to reflect the population as a whole.

This study collects convenient samples Therefore; one cannot generalize the results of the study to the population. This study can only reflect a specific and limited population's needs.

Results And Discussions

Table 1: Demographic Variables of the Respondents

VARIABLES		No of Respondents	Percentage
Gender	Male	78	53
	Female	69	47
	Total	147	100
Age	Upto 25	38	26
	26-35	44	30
	36-45	35	24

	46-55	18	12
	Above 55	12	8
	Total	147	100
Marital Status	Married	97	66
	Unmarried	50	34
	Total	147	100
Educational Qualification	Upto HSc	55	37
	Under - Graduation	48	33
	Post-Graduation	23	16
	Others	21	14
	Total	147	100
Occupation	Unemployed	6	4
	Student	26	18
	Homemaker	22	15
	Private Employee	51	35
	Government Employee	29	20
	Retired	8	5
	Other	5	3
	Total	147	100
Monthly Income	No income but pocket money	13	9
	Less than 15000	23	16
	15001-25000	32	22
	25001-35000	31	21
	35001-45000	30	20
	Above 45000	18	12
	Total	147	100
Time spend on internet daily	Less than 1 hour	51	35
	1-2 hour	53	36
	2-3 hour	29	20
	More than 3 hour	14	10
	Total	147	100

Sources: Primary Data

Table No.1 shows demographics wise distribution of the respondents. Most of the respondents were Male, Majority of respondents in the age group of 26-35 and UptoH.Sc were high as compared to other Educational groups and Private employee were high as compared to other Occupation, most of the respondents income were 15001-25000 and Most of the respondents using minimum two hours spend on daily.

Table 2: Responses for Reasons for Purchasing Online

Reasons	NUMBER OF RESPONDENTS										Total
	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree		
	R	%	R	%	R	%	R	%	R	%	
Convenience of shopping at home	64	44	40	27	39	27	3	2	1	1	147
Not limited by time	71	48	52	35	21	14	2	1	1	1	147
Easy to buy	45	31	64	44	26	18	8	5	4	3	147
Easy to search for products	31	21	72	49	37	25	5	3	2	1	147
Price cheaper than physical stores	56	38	59	40	29	20	2	1	1	1	147
Can pay online by credit card	42	29	63	43	39	27	3	2	0	0	147
Fast delivery	34	23	48	33	38	26	19	13	8	5	147
Reasonable delivery costs	74	50	53	36	14	10	5	3	1	1	147
Security of online transactions	11	7	37	25	63	43	22	15	14	10	147

Better product quality	23	16	29	20	71	48	18	12	6	4	147
Product is by well-known brand	45	31	37	25	39	27	17	12	9	6	147
Detailed product specifications and features	74	50	52	35	19	13	2	1	0	0	147

Sources: Primary Data

As seen in the table above, it was been asked from the Responses for reasons for purchasing online. For that, researcher selected twelve factors like Convenience of shopping at home, Not limited by time, Easy to buy, Easy to search for products, Price cheaper than physical stores, Can pay online by credit card, Fast delivery, Reasonable delivery costs, Security of online transactions, Better product quality, Product is by well-known brand and Detailed product specifications and features. In which most of the respondents said that agree for reason for purchasing online.

Table 3: Gender and Purchasing Online
Calculation of t-test

Factors	Variables	df	Table Value	Calculated Value	Result
Convenience of shopping at home	Male	145	1.99	1.85	Accepted
	Female				
Not limited by time	Male	145	1.99	.06	Accepted
	Female				
Easy to buy	Male	145	1.99	3.92	Rejected
	Female				
Easy to search for products	Male	145	1.99	1.24	Accepted
	Female				
Price cheaper than physical stores	Male	145	1.99	1.55	Accepted
	Female				
Can pay online by credit card	Male	145	1.99	1.63	Accepted
	Female				
Fast delivery	Male	145	1.99	2.63	Rejected
	Female				
Reasonable delivery costs	Male	145	1.99	.24	Accepted
	Female				
Security of online transactions	Male	145	1.99	2.34	Rejected
	Female				
Better product quality	Male	145	1.99	2.32	Rejected
	Female				
Product is by well-known brand	Male	145	1.99	.57	Accepted
	Female				
Detailed product specifications and features	Male	145	1.99	2.41	Rejected
	Female				

Sources: Computed Data

The above table represents the independent sample t-test. It is clear from the table that the means of the variable namely reasons for purchasing online of gender and some factors like Convenience of shopping at home, Not limited by time, Easy to search for products, Price cheaper than physical stores, Can pay online by credit card, Reasonable delivery costs and Product is by well-known brand has its Calculated value is less than the table value. There is no significance different between reasons for purchasing online of gender and the above factors. Hence the null hypothesis is accepted. But some other factors like Easy to buy, Fast delivery, Security of online transactions, Better product quality and Detailed product specifications and features has its Calculated value is more than the table value. There is significance different between reasons for purchasing online of gender and the above factors. Hence the null hypothesis is rejected.

Conclusion

On-line shopping is now a serious alternative to conventional shopping. Given that men and women have been shown to differ in their attitude, it seems surprising that there is little research that

explicitly addresses gender difference in on-line buying. Attitude and gender are important factor that online shopping behavior. Accordingly, better understanding of online shopping attitude is critical for designing and managing effective website that can help businesses attract and retain online customers. When researcher compare with gender and reasons for purchasing online, most of the respondents accepted. Therefore e-tailors must improve the hedonic benefits to create positive attitude towards online shopping.

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A STUDY ON SATISFACTION OF DEVELOPMENT OFFICERS IN LIC OF INDIA

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ABSTRACT

Life Insurance Corporation is a public sector company. The motto of the company is “Yogakshemam Vahamyaham: which means – “Your Welfare is our Responsibility”. It is governed by the LIC Act 1956. The Development Officers help the corporation for its smooth functioning. They are the employees of the corporation. The important duty of a development officer is locating markets for life insurance business. The marketing of the products of the LIC of India depends on the agents and development officers. Their work commences from the identification of prospects and ends with closure of sale. The sales potentiality of an agent and development officer is determined by some external and internal factors. He has to improvise a lot and find his own style of operation, draft his own plans, devise his own strategies for the development of insurance business. This study is focus on the satisfaction of Development Officers in LIC of India. The objective formulated are to study the contribution of Development Officers; to study the Methods suggested by the respondents to their team to attract new Customer adopted by Development Officers and to compare the demographic variables with the level of satisfaction of the selected respondents. For this, the researcher selected 50 development officers and used Percentage and Chi-square test for analysing the data. The researcher also compared the socio economic factors with the Level of satisfaction and concluded that the Null Hypotheses were accepted in all. One of the suggestions for the growth and development of insurance sector is to appoint more female Development Officers and in turn they promote more female agents in order-to motivate the female policyholders. The other one is Development Officers will help their agents to overcome the hurdles in the insurance business with their experiences and to achieve the targets.

Key words: Life Insurance Corporation of India, Development Officer, Agents, Savings.

INTRODUCTION

In today's global environment, the service sector occupies a key role in our economy. Life Insurance Corporation (LIC) is one among them. It was started in 1956 by merging 245 insurance companies and provident societies. It is fully owned by the Central Government. It is a public sector company. The motto of the company is "Yogakshemam Vahamyaham: which means – Your Welfare is our Responsibility". It is governed by the LIC Act 1956. It is the largest Life Insurance Company in India. LIC of India has its headquarter in Mumbai. Life Insurance is a contract that pledges payment of an amount to the person assured or his nominee on the happening of the event insured against or on the maturity date. It provides wide range of life insurance plans from pure term insurance plans to savings and investment products. It has a phenomenal presence in both urban and rural India. The Development Officers help the corporation for its smooth functioning. They are the employees of the corporation. Development Officer is a sales profile job in LIC of India. Development Officers are very important in the modern ever-widening insurance market by making distribution of insurance products to the public in an easy way. Development officers concentrate their effort on insurance products through agents. They have real concern and care for their agents. They improvise a lot and use their own style of operation, draft their own plans, derive their own strategies for the development of insurance business.

Statement of the Problem

The development officer is the representative of the LIC of India. The important duty of a development officer is locating markets for life insurance business. The success of marketing depends on the marketing practices adopted by the agents and development officers along with the product innovation. The marketing of the products of the LIC of India depends on the agents and development officers. Their work commences from the identification of prospects and ends with closure of sale. Further the agents and development officers should have the talent to convert the probable policy-holders into potential buyers. The sales personality of an agent and development officer is determined by some external and internal factors. The internal factors are the attitude and the personality traits. The external factors are the education, culture and socio-economic factors of the development officers and agents. They may shape them to be a better salesman and also play a definite role on their marketing. Hence, the present study has been undertaken to evaluate the contribution of development officers and compare the level of satisfaction of Life Insurance Corporation of India.

Review of Literature

Sucheta Rani and Anil Kumar Soni (2019), "Role of CRM Initiatives of Life Insurance Corporation of India to Satisfy the Customers", they concluded that CRM practices of LIC have seen a drastic change over the past few years to achieve successful CRM, a company should understand what is and why it is beneficial to customers in order to retain them for long time. Customers give priority only to satisfy their needs. The success rate of CRM depends upon the quality of CRM. From the paper it is concluded that although LIC has taken a large number of initiatives to satisfy their customers, yet there is a need to build a strong database of customers. It is possible only if the LIC will conduct regular surveys and interact with the customers. Moreover

most of CRM services are at fingertips, sometimes, some customers are not comfortable with technology. Some assistants should be provided to assist them. LIC should introduce new ways that makes the customers more delightful and help to attract new customers

Dr. Krishna Banana and R. Vijaya Naik (2018), “A Study on Customer Perception on Life Insurance Policies in India”, their conclusion was LIC dominates the Indian insurance industry. In today’s competitive world, customer satisfaction has become an important aspect to retain the customers, not only to grow but also to serve. Increased competition, wide range of product offerings and multiple distribution channels cause companies to value satisfied and highly profitable customers. Customer service is the critical success factor in a company and providing top notch customer service differentiates great customer service from indifferent customer service.

Vanitha and Rajakrishnan (2017) highlighted Life Insurance Corporation of India (LIC) is a monolithic company from last few decades. After the successful implementation of economic reforms in life insurance Sector on India, LIC of India has made several positive efforts to triumph the hearts of the people. To achieve that LIC of India have adopted a number of new trends in marketing strategies for introducing innovation technologies. The study is an attempt to know about the recent trends followed by LIC of India order to make their products available to each and every forth coming customer in the life insurance market. The present research paper is a comprehensive study to know whether the implemented strategies have truly helped LIC of India in the changing trends of the society and will also suggest how these recent trends have helped LIC of India as a whole to manage the existing leading position in the life insurance market. The present study thus reveals those important areas where more contribution on the part of LIC of India required. LIC of India must increase their agent’s base to retain its dominating market share because agents are the back bone of the corporation. The increased number will not only help the corporation to facet their visible presence in the market but also in turn help in increasing their business volume too.

Definitions

Insurance

Insurance is a co-operative method for spreading over the loss suffered by one or more, caused by a particular risk, over a number of persons who agree to share the loss.

Development Officer

In Life Insurance Corporation of India Development Officers are the full-time employees. They belong to the Class II officer category. They are in charge of their territory for the development of insurance policies. The primary job is to appoint agents and through them try to boost insurance business.

Agent

An agent is a person who represents an insurance firm and sells insurance policies on its behalf.

Contribution

Contribution in LIC refers that to give directions, instructions and guidance to a group of agents, for the purpose of achieving the goal of the insurance corporation.

Savings**Quality of a Successful Development Officer**

Quality of a successful Development Officers are the sum total of the impression made on people with whom one comes into contact. There are a number of qualities which make a Development Officer to become successful. They must possess some traits to achieve their objectives. Quality of a successful Development officer is based on the following factors such as personality of a Development Officer, knowledge of the insurance products, fixing the targets, planning the work, knowledge of the agents and their performance and the like. The following are some of the important qualities of a Development officer we discuss them in brief.

➤ Quick Action

A Development officer must be alert, quick in action. He has to face many prospects of different temperaments. He must have the mental ability to face any situation and be ready to answer any questions. He should not be an absent-minded man. He must have quick thought of answering, what throwing away the agents and policy holders.

➤ Self Confidence

A confident man never fails. He should have confidence in his work capacity and power. Confidence makes him optimistic and enthusiastic. He can meet any situation in the insurance product line. He engages or talks with agents, act on his suggestions. Confidence makes him to meet any situation with courage. Knowledge through experience is the base for confidence.

➤ Initiative

A Development Officer must have initiative. He must learn the tricks of insurance trade and the knowledge of various schemes of insurance products. Active initiator is a self-starter. His job can be successfully carried out. He must have skill and be able to face tackle situations intelligently.

➤ Observation

A Development Officer must be keen observer. He must have to update knowledge about different types of insurance products, assignment, nomination, settlement of claims, changes in rules and regulations, attitude of the competitors and government and the like. With all the latest information he can easily make suggestions to insurance agents and help them in achieving their targets.

➤ **Co-operation**

Co-operative attitude is essential for the success of a Development Officer. He must co-operate with the insurance agents. Progress of insurance company depends on the mutual co-operation of all the employees.

➤ **Sincerity**

It is an value added quality within a person. He must be sincere towards his assigned duties. By sincerity, one can win similar other favors. Dependability is increased through sincerity.

➤ **Self-Management**

Everyone works to achieve an aimed target of insurance business. A self-governed Development Officer can easily achieve his target through his agents. This is because he plans his work in advance and works according to the plan. So, the Development Officer finds enough time in feeling of self-assurance.

Contribution of Development Officer

The Main Contribution of Development officers are ensuring that all agents have proper licensing and training to sell products on the firm's behalf, distributing marketing, collateral attracting and educating potential policy holders and monitoring the performance of agency.

➤ **Recruitment of agents**

An important duty of a Development officer is to find or select suitable persons to work as agents. The Development Officers should make an arrangement for appointing suitable persons on the basis of their educational qualifications, abilities, experience, written test and interviews.

➤ **Training of agents**

Training is the process or state of being guided, drilled or prepared. Training enables a person to do the Job correctly, effectively and conscientiously to produce the high result. After the appointment of agents the main duty of Development Officer is to give proper training to the agents. By training an agent can increase knowledge in an insurance field.

➤ **Supervision of agents**

Supervision becomes necessary when a goal has to be attained which depends upon the cumulative efforts of a group of people. The Development officer has to develop individual abilities, so that he can get the best out of every one of his agents.

➤ Motivation of agents

Agents are the backbone of an insurance business. A good agent makes poor selling insurance product into a progressive one. The success or failure of an insurance company depends upon the ability and initiation of insurance agents. The will and willingness to work is a motivational factor.

Objectives of the Study

- To study the Methods suggested by the respondents to their team to attract new Customer
- To know the growth of development officers in LIC of India
- To compare the Demographic Variables of the respondents and Level of Job Satisfaction of the respondents

Growth of Development Officers in LIC of India

The following table indicates the growth of development officers in LIC of India, from the year of 2009-2010 to 2019-2020.

Table - 1
Growth of Development Officers in LIC of India
2009-2010 To 2019-2020

Year	Development Officers
2009-10	23634
2010-11	24517
2011-12	25638
2012-13	26430
2013-14	28621
2014-15	24715
2015-16	23281
2016-17	24836
2017-18	22830
2018-19	21588
2019-20	24388

Source: Respective annual report of LIC, India.

The above table expresses that the growth of development officers in LIC of India, from the year of 2009-10 to 2019-20. The number of development officers during the year 2009-2010 was recorded as 23,634 but in the year of 2019-2020 it was 24388.

Research Design

The present study is of Descriptive in nature. Sample size selected for the study was 50 respondents out of 24388 Development officers in India. Convenience sampling technique was adopted in the selection of the respondents. For analyzing the data, Percentages and Chi square test were applied.

Limitations of the Study

- The study area is a very limited one the data were collected only from 50 Development Officers.
- Most of the time respondents were not available at the time of filling the questionnaire.
- The employees may or may have not given honest answers.

Table – 2
Demographic Variables of the Respondents

VARIABLES		No of Respondents	Percentage
Sex	Male	40	8
	Female	10	20
	Total	50	100
Age	Below 35	15	30
	36-45	18	36
	46-55	8	16
	Above 56	9	18
	Total	50	100
Marital Status	Married	44	88
	Un-Married	6	12
	Total	50	100
Educational Qualification	Post-Graduation	15	30
	Professional	5	10
	Graduation	22	44
	Others	8	16
	Total	50	100
Experience	1-5	12	24
	5-10	8	16
	10-15	11	22
	15-20	10	20
	Above 20 years	9	18
	Total	50	100

Source: Primary data

Table No.2 shows demographics wise distribution of the respondents. It reveals that male respondents are higher than female respondents. Majority of respondents in the age group of 36-45 years, Married respondents were higher and Graduation were high as compared to other Educational groups. Majority of the respondents 1-5 years Experience were high as compared to other Experience level of the respondents.

Level of Satisfaction of the Respondent

The frequency distribution of respondents on the basis of level of satisfaction has been given in the table below.

Table - 3
Level of Job Satisfaction of the Respondent

Satisfaction	No of Respondents	Percentage
Highly Satisfied	19	38
Satisfied	15	30
Dissatisfied	13	26
No Opinion	03	06
Total	50	100

Source: Primary Data

It is identified from table that out of the 50 respondents, 19 of the sample respondent express that they are highly satisfied with their present job, followed by 15 of the sample respondents are satisfied, 03 of the members are not willing to response this option and 13 of the sample respondents are dissatisfied with their present job in the study area. The overall observation of the table indicates that the majority of the development officers are highly satisfied and satisfied with their present employment.

Gaining Knowledge about LIC

The sample respondents acquired knowledge about insurance in different ways. It has been given in the table below.

Table- 4
Gaining Knowledge About LIC

Opinion	No of Respondents	Percentage
Field training at the time of Appointment	16	32
Through Journal and Magazines	05	10
Through Internet	06	12
Through Orientation given by officials	11	22
Through Peer officers	04	08
Through Personal Experience	05	10
Through the study of related courses	03	06
Total	50	100

Source: Primary Data

The above table indicates about gaining knowledge related to LIC. In it, 16 respondents were getting knowledge through Field training at the time of Appointment and three respondents were getting knowledge through the study of related courses.

Methods Suggested by the respondents to their Team to attract New Customer

The development officers suggest the different methods to attract new customers. It has been given in the table below.

Table - 5
Methods Suggested to attract New Customer

Opinion	No of Respondents	Percentage
Direct Marketing	09	18
Regular Visit	19	38
Contacting through Friends and Relatives	08	16
Contact through Social Club	03	06
Personal Help	05	10
By Offering to pay initial Premium	06	12
Total	50	100

Source: Primary Data

The above table indicates the methods suggest by development officer to their team members to attract the new customers in the study area. It has the identified 50 sample. Out of this, 19 respondents identified the regular visit their new customer., it has highest level of total respondents, 03 respondents identified the Contact through Social Club their new customer., it has lowest level of total respondents.

ASSOCIATION BETWEEN SOCIO-ECONOMIC CHARACTERISTICS AND LEVEL OF SATISFACTION OF THE RESPONDENT

The non-parametric chi-square test is applied to find the association between Socio-Economic Characteristics and Level of Satisfaction of the Respondent factors such as sex, age, marital status, education and experience.

Table – 6
Sex and Level of Satisfaction of the Respondent

Sex	Highly Satisfied	Satisfied	Dissatisfied	No Opinion	Total
Male	16	12	10	2	40
Female	3	3	3	1	10
Total	19	15	13	3	50

Sources: Computed data

Results of chi-square test are as follows

Chi-Square test	Calculated value	Df	Table Value	Result
	0.62	3	7.81	Accepted

Above table indicate that the Table Value is less than Calculated value. Therefore, test is accepted.

Table – 7
Age and Level of Satisfaction of the Respondent

Age	Highly Satisfied	Satisfied	Dissatisfied	No Opinion	Total
Below 35	7	6	1	1	15
36-45	8	4	6	0	18
46-55	2	2	3	1	8

Above 56	2	3	3	1	9
Total	19	15	13	3	50

Sources: Computed data

Results of chi-square test are as follows

	Calculated value	Df	Table Value	Result
Chi-Square test	14.45	9	16.92	Accepted

Above table indicate that the Table Value is less than Calculated value. Therefore, test is accepted.

Table - 8

Marital Status and Level of Satisfaction of the Respondent

Marital Status	Highly Satisfied	Satisfied	Dissatisfied	No Opinion	Total
Male	17	13	12	2	44
Female	2	2	1	1	6
Total	19	15	13	3	50

Sources: Computed data

Results of chi-square test are as follows

	Calculated value	Df	Table Value	Result
Chi-Square test	1.59	3	7.81	Accepted

Above table indicate that the Table Value is less than Calculated value. Therefore, test is accepted.

Table –9

Education and Level of Satisfaction of the Respondent

Education	Highly Satisfied	Satisfied	Dissatisfied	No Opinion	Total
Post-Graduation	7	3	3	2	15
Professional	1	2	1	1	5
Graduation	7	9	6	0	22
Others	4	1	3	0	8
Total	19	15	13	3	50

Sources: Computed data

Results of chi-square test are as follows

	Calculated value	Df	Table Value	Result
Chi-Square test	9.08	9	16.92	Accepted

Above table indicate that the Table Value is less than Calculated value. Therefore, test is accepted.

Table – 10

Experience and Level of Satisfaction of the Respondent

Experience	Highly Satisfied	Satisfied	Dissatisfied	No Opinion	Total
1-5	5	4	2	1	12
5-10	1	2	4	1	8
10-15	6	4	1	0	11
15-20	2	5	3	0	10
Total	19	15	13	3	50

Sources: Computed data

Results of chi-square test are as follows

	Calculated value	Df	Table Value	Result
Chi-Square test	19.58	12	21.03	Accepted

Above table indicate that the Table Value is less than Calculated value. Therefore, test is accepted.

Suggestions of the Study

- The female development officer's strength is very less when compare to male development officer's strength. Therefore, the insurance authority should take initiative to recruit the more female development officers. Hence, they can easily approach the potential female customers and contribute the growth and development of insurance sector in the study area.
- The development officer to meet his agents, discuss with them their problems, attend to joint etc., and also undertake training of the agents. The tour should therefore be a productive tour, not only in respect of new business but also in respect of motivation and building up the morale of the agency organisation.

CONCLUSION

Development officer duties is to create a proper corporate image in the public mind. He carries the message of social security to all nooks and corners of his area, rural or urban, through his team of agents. He, thus, plays a very vital role in attaining one of the primary objectives of the nationalized insurance. By this, who to provide financial security to all sections of the community, in the farthest corner of the country. But, the job of the development officer not only conclude the procurement of a handsome amount business but also actively imparts adequate training to the agents.

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A Study on Gender and Behavior Differences Influencing On Online Purchasing In Tirunelveli District

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Abstract

The development of Internet has resulted in enormous business prospects and opportunities and given new direction to traditional commercial activities. E-commerce emerged as the need of the hour. The business-to-consumer (B2C) is the most visible and prominent progeny of e-commerce. B2C is a commercial process that starts with companies and ends with end consumers. Online shopping is an emerging area in the field of E-Business and is surely going to be the future of shopping in the world. The benefits of online shopping are well known. On-line shopping in India is significantly affected by various demographic factors like age, gender, marital status, educational qualification, occupation and income. Substantial amount of research work has been carried out on all these areas. The impact of these factors on online shopping behaviour is fascinating to say the least. But the most mysterious of them all is the impact of gender on the acceptance or rejection of online shopping. Do men and women behave differently during the online shopping process or do they exhibit same kinds of behaviour during this process? This article will try to throw some light on the extremely valuable but often neglected role of gender in the online shopping behaviour of consumers. Recently, the diffusion of the Internet as a retail and distribution channel has undergone a great growth in India. This paper presents an empirical investigation on the effects of gender differences on online buying in Tirunelveli District. The study explored gender differences among twelve factors concerning the online buyer for both Male and Female in Tirunelveli District. For data collection and final testing of the model a well-structured questionnaire was designed and hosted. The researcher collected 147 respondents sent their answer out of 150 questionnaires. With regard to factors and consistent with using t-student test.

Keywords: - Online Shopping, E-Commerce, Gender Differences, Online Consumer Behaviour, Business-To-Consumer.

Introduction

As the Internet and wireless network technologies have a had lot of advancement in decades, their increasing use has resulted in more online commercial activities, in terms of consumers navigating websites and making financial or nonfinancial transactions. The growing online consumer market allows consumers to make financial transactions online anywhere in the world regardless of their locations. The Internet therefore offers enterprises a growing market with limitless opportunities that they can tap into by providing consumers with online shopping services. The most common incentives for consumers to shop online are convenience, competitive pricing, greater access to information, complementarity of traditional stores and broader selections. Most of the companies are running their online portals to sell their products/services online. Though online shopping has made enormous progress outside India, its growth in the Indian market, which is a large and diverse consumer market, is not in line with the global market. So Government of India takes some steps to develop online mode of transaction. because of this, nowadays most of the people purchasing their needs by online.

Need of the study

Nowadays, the Internet is being widely used in daily life. The existence of the Internet brought many advantages to individuals' daily lives. With the help of the media, people can communicate, learn something about goods, entertain, buy products and get services. Of course, the disadvantages of it have long been discussed; as the virus threat, the risk of personal information theft, spamming etc. Studies on online shopping investigated the factors that influence online shopping as

well as motives for, value of and antecedents of online buying behaviour. As a result, the academic researchers and the business world started to focus on the consumer side of the online purchasing behaviour and a lot of researches and articles were prepared to make guidance for the development of online shopping. The purpose of this study is to identify factors affecting consumers' online shopping gender behavior, specifically elucidating them in the context. In addition to the previously identified factors this study included gender-specific factors that may play an important role in determining Internet adoption for e-commerce. The aim of this study is to investigate the factors that affect online purchasing behaviour of two consumer groups like Male and Female. Moreover, it is also wanted to identify and analyse online buying habits of Male and Female of Tirunelveli District of Tamil Nadu.

Review of Literature

S.K. Suman and Pallavi Srivastava (2019) "Age and Gender Influences on Consumer Behavior Towards Online Discounts", They concluded that in the past few years multiple studies were carried out related to behavior of consumers towards online shopping and also the demographic (like age and gender) influences on behavior of consumers towards online shopping. But limited study has been carried out precisely related to age and gender influences on factors considered while buying online when discounted products are available. This study has a lot of significance in Indian context. Online retailers are offering massive discounts to allure the buyers to shop online and, in this process, it is essential to understand the factors which are important for different age groups and genders.

Vijay, Sai. T. & Balaji, M. S. (2009), "Status and Scope of Online Shopping: An Interactive Analysis through Literature Review", revealed that Consumers, all over the world, are increasingly shifting from the crowded stores to the one-click online shopping format. However, in spite of the convenience offered, online shopping is far from being the most preferred form of shopping in India. A survey among 150 internet users, including both users and non-users of online shopping, was carried out to understand why some purchase online while others do not. The results suggested that convenience and saving of time drive Indian consumers to shop online; while security and privacy concerns dissuade them from doing so.

Objectives of the study

To know socio-economic background of the respondents.

The aim of this study is to investigate the factors that affect online purchasing behaviour of two consumer groups like Male and Female.

Moreover, it is also wanted to identify and analyse online buying habits of Male and Female.

Research Design

The present study is of Descriptive in nature. The researcher collected primary and secondary sources. The primary data collected through convenient sampling method. Structured questionnaire was distributed through directly by researcher in Tirunelveli District of Tamil Nadu State. Secondary sources include internet, books, reports, journals and so on. Convenient sampling methods was used to collect data from 150 respondents. Of this, the filled in forms of 147 respondents were found to be complete and were taken for further analysis. The remaining forms were incomplete, therefore such data were rejected. For analyzing the data Percentages and t-test were applied.

Limitations of the Study

The study is limited to consumers residing in to Tirunelveli District only so the results of this study cannot be used to reflect the population as a whole.

This study collects convenient samples Therefore; one cannot generalize the results of the study to the population. This study can only reflect a specific and limited population's needs.

Results And Discussions

Table 1: Demographic Variables of the Respondents

VARIABLES		No of Respondents	Percentage
Gender	Male	78	53
	Female	69	47
	Total	147	100
Age	Upto 25	38	26
	26-35	44	30
	36-45	35	24

	46-55	18	12
	Above 55	12	8
	Total	147	100
Marital Status	Married	97	66
	Unmarried	50	34
	Total	147	100
Educational Qualification	Upto HSc	55	37
	Under - Graduation	48	33
	Post-Graduation	23	16
	Others	21	14
	Total	147	100
Occupation	Unemployed	6	4
	Student	26	18
	Homemaker	22	15
	Private Employee	51	35
	Government Employee	29	20
	Retired	8	5
	Other	5	3
	Total	147	100
Monthly Income	No income but pocket money	13	9
	Less than 15000	23	16
	15001-25000	32	22
	25001-35000	31	21
	35001-45000	30	20
	Above 45000	18	12
	Total	147	100
Time spend on internet daily	Less than 1 hour	51	35
	1-2 hour	53	36
	2-3 hour	29	20
	More than 3 hour	14	10
	Total	147	100

Sources: Primary Data

Table No.1 shows demographics wise distribution of the respondents. Most of the respondents were Male, Majority of respondents in the age group of 26-35 and UptoH.Sc were high as compared to other Educational groups and Private employee were high as compared to other Occupation, most of the respondents income were 15001-25000 and Most of the respondents using minimum two hours spend on daily.

Table 2: Responses for Reasons for Purchasing Online

Reasons	NUMBER OF RESPONDENTS										Total
	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree		
	R	%	R	%	R	%	R	%	R	%	
Convenience of shopping at home	64	44	40	27	39	27	3	2	1	1	147
Not limited by time	71	48	52	35	21	14	2	1	1	1	147
Easy to buy	45	31	64	44	26	18	8	5	4	3	147
Easy to search for products	31	21	72	49	37	25	5	3	2	1	147
Price cheaper than physical stores	56	38	59	40	29	20	2	1	1	1	147
Can pay online by credit card	42	29	63	43	39	27	3	2	0	0	147
Fast delivery	34	23	48	33	38	26	19	13	8	5	147
Reasonable delivery costs	74	50	53	36	14	10	5	3	1	1	147
Security of online transactions	11	7	37	25	63	43	22	15	14	10	147

Better product quality	23	16	29	20	71	48	18	12	6	4	147
Product is by well-known brand	45	31	37	25	39	27	17	12	9	6	147
Detailed product specifications and features	74	50	52	35	19	13	2	1	0	0	147

Sources: Primary Data

As seen in the table above, it was been asked from the Responses for reasons for purchasing online. For that, researcher selected twelve factors like Convenience of shopping at home, Not limited by time, Easy to buy, Easy to search for products, Price cheaper than physical stores, Can pay online by credit card, Fast delivery, Reasonable delivery costs, Security of online transactions, Better product quality, Product is by well-known brand and Detailed product specifications and features. In which most of the respondents said that agree for reason for purchasing online.

Table 3: Gender and Purchasing Online
Calculation of t-test

Factors	Variables	df	Table Value	Calculated Value	Result
Convenience of shopping at home	Male	145	1.99	1.85	Accepted
	Female				
Not limited by time	Male	145	1.99	.06	Accepted
	Female				
Easy to buy	Male	145	1.99	3.92	Rejected
	Female				
Easy to search for products	Male	145	1.99	1.24	Accepted
	Female				
Price cheaper than physical stores	Male	145	1.99	1.55	Accepted
	Female				
Can pay online by credit card	Male	145	1.99	1.63	Accepted
	Female				
Fast delivery	Male	145	1.99	2.63	Rejected
	Female				
Reasonable delivery costs	Male	145	1.99	.24	Accepted
	Female				
Security of online transactions	Male	145	1.99	2.34	Rejected
	Female				
Better product quality	Male	145	1.99	2.32	Rejected
	Female				
Product is by well-known brand	Male	145	1.99	.57	Accepted
	Female				
Detailed product specifications and features	Male	145	1.99	2.41	Rejected
	Female				

Sources: Computed Data

The above table represents the independent sample t-test. It is clear from the table that the means of the variable namely reasons for purchasing online of gender and some factors like Convenience of shopping at home, Not limited by time, Easy to search for products, Price cheaper than physical stores, Can pay online by credit card, Reasonable delivery costs and Product is by well-known brand has its Calculated value is less than the table value. There is no significance different between reasons for purchasing online of gender and the above factors. Hence the null hypothesis is accepted. But some other factors like Easy to buy, Fast delivery, Security of online transactions, Better product quality and Detailed product specifications and features has its Calculated value is more than the table value. There is significance different between reasons for purchasing online of gender and the above factors. Hence the null hypothesis is rejected.

Conclusion

On-line shopping is now a serious alternative to conventional shopping. Given that men and women have been shown to differ in their attitude, it seems surprising that there is little research that

explicitly addresses gender difference in on-line buying. Attitude and gender are important factor that online shopping behavior. Accordingly, better understanding of online shopping attitude is critical for designing and managing effective website that can help businesses attract and retain online customers. When researcher compare with gender and reasons for purchasing online, most of the respondents accepted. Therefore e-tailors must improve the hedonic benefits to create positive attitude towards online shopping.

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A STUDY ON KNOWLEDGE AND ATTITUDE TOWARDS ALCOHOL ADDICTION AND SUBSTANCE ABUSE AMONG TRIBAL ADOLESCENTS

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ABSTRACT

The study gained knowledge and the attitude towards alcohol addiction and substance abuse among tribal adolescents in Ponmanai Panchayath in Kanyakumari District. The utmost objectives of the study were to determine the demographic profile of the respondents and knowledge, attitude towards alcohol addiction and substance abuse. The researcher selected 50 samples and used lottery method to collect the data. The informants were young adolescents from Ponmanai Panchayat in Kanyakumari District. The investigator used self-prepared interview schedule to collect data. The research highlighted the unawareness of the addiction, loss of economic condition for use of substance abuse and alcohol, disturbances of education and violent behavior in public. The researcher suggested implementing awareness programmes incorporated with government and nongovernmental organizations.

KEYWORDS: Alcohol, Addiction, Substance Tribal & Adolescents

INTRODUCTION

Alcoholism and substance abuse are some of the costliest diseases affecting persons worldwide. These are associated with a range of physical and mental disorders. Using alcohol and other substances at a young age has negative health effects. Some teens will experiment and stop, or continue to use occasionally without significant problems. Some will develop a dependency, moving on to more dangerous drugs and causing significant harm to themselves and possibly others. Alcoholism and substance abuse is one of the major causes of morbidity and mortality worldwide. The word addiction is derived from the Latin word “Addicere” meaning to devote. The ultimate aim of this research is to extrapolate the knowledge and attitude towards alcohol addiction and substance abuse among tribal in Ponmanai Panchayat in the Kanyakumari district. The researcher selected 50 samples from the panchayath. The researcher found that most of them were uneducated and unaware of the harmful effects of alcohol and substance abuse.

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ALCOHOL ADDICTION

Alcohol addiction is a physical or mental dependence on alcohol. Alcohol addiction can lead to health and social problems, and difficulty in maintaining responsibilities. Alcoholism is the most serious form of problem drinking, and describes a strong, often uncontrollable, desire to drink.

SUBSTANCE ABUSE

Substance abuse can simply be defined as a pattern of harmful use of any substance for mood altering purposes “substances” can include alcohol and other drugs as well as some substances that are not drugs at all.

PREVALENCE OF ALCOHOL

Alcohol is quite common in India both in rural and urban areas with prevalence rates as per various studies varying from 23% to 74% in males in general and although it's not that common in females but it has been found to be prevalent about 24% to 48 % in females in certain sections and communities

PREVALENCE OF SUBSTANCE ABUSE

Nearly 32% adolescents are addicted under substance abuse. Prevalence rate is higher in males (55.33) than compared to females (5%). Tobacco is the most common substance abuse by the adolescents.

SYMPTOMS OF ALCOHOLISM AND SUBSTANCE ABUSE

- Being unable to limit the amount of alcohol which drinks.
- Spending lot of time of using substance abuse
- Poor decision making abilities.
- Risky behavior
- While facing family problems.
- Financial problems
- Often has a strong desire to use substances
- Drinks alone often use
- Neglects other interests

COPING SKILLS

- Creating a social support.
- Becoming a member of a support group

- Enhancing International skills
- Spiritual practices
- Mindfulness practices
- Evaluating decisions
- Emotional regulation skills

STATEMENT OF THE PROBLEM

A drug is any substance that, when absorbed into the body of a living organism, alters normal biological processes. In pharmacology, a drug could be a chemical substance utilized in the treatment, cure, prevention, or diagnosis or on an everyday basis for chronic disorders. Recreational drugs are chemical substances that affect the central nervous system, such as opioids or hallucinogens. They may be used for perceived beneficial effects on perception, consciousness, personality, and behavior. Experimentation with alcohol and medicines during adolescence is common. Drug use is related to a spread of negative consequences, including increased risk of great drug use later in life, school failure, and poor judgment which can put in danger for accidents, violence, unplanned and unsafe sex, and suicide.

OBJECTIVES

GENERAL OBJECTIVE

Knowledge and attitude towards alcohol addiction and substance abuse among tribal in Ponmanai Panchayat.

SPECIFIC OBJECTIVES

- To study the demographic profile of the respondents
- To assess the knowledge of alcoholic addiction and substance abuse among the respondents.
- To identify the attitude towards alcohol addiction and substance abuse among the respondents.

METHODOLOGY

The study was focused to assess the knowledge and attitude towards alcohol addiction and substance abuse among tribal adolescents. There were 610 families in the Panchayat and 250 adolescents. The researcher adopted descriptive research design and interview schedule. The primary data was collected by direct interview schedule from tribal adolescents in Ponmanai Panchayat. The secondary data was collected from various articles, journals, text book, and internet from previous research study.

Inclusion criteria

1. Respondents were males and females
2. Respondents were well cooperated with the researcher
3. Respondents attended in awareness programmes

Exclusion criteria

1. Respondents who have memory difficulties
2. Respondents who have mental illness

A pretestis conducted by the researcher with an interview schedule in order to identify any problems such as unclear wording or the questionnaire taking too long to administer. It helped the investigator to get facts and information and also able to reframe the questions if required. Then the pre test interview schedule was finalized.

ANALYSIS OF DATA**Table 1: Distribution of personal details of the respondents**

S. No.	VARIABLE	VALUE LEVEL	RESPONSES	
			NO	%
1	Gender	Male	41	82%
		Female	9	18%
2	Age	12-20	8	16%
		20-30	26	52%
		30-45	9	18%
		45 above	7	14%
3	Education	Uneducated	13	26%
		8 th _12 th standard	34	68%
		Diploma/Degree	3	6%
4	Annual Income	50000	50	100%
		100000	0	0%
		200000	0	0%
5	Religion	Hindu	45	90%
		Christian	5	10%
		Muslim	0	0%
		Others	0	0%
6	Marital status	Married	29	58%
		Unmarried	21	42%
7	Economic condition	Poor	31	62%
		Middle class	19	38%
		Rich	0	0%
8	Staying place	Village	0	0%

		Mountain	50	100%
9	Motivating others to drink	Yes No	30(60%) 20(40%)	100%
10	Using others money to drink	Yes No	45(90%) 5(10%)	100%

Table 1 showed that majority of the respondents were males (82%.) and 52% of the respondents were in the age group of 20-30.68% of the respondents were studied upto 8 th standard to 12 th standard, The annual income of all the respondents (100%)was 50000.Due to alcoholism and substance abuse the economic condition was very poor.Majority of the respondents were Hindu(90%) and 58.5 of the respondents were married. Allrespondents 100% were living in mountain areas and 60% of the respondentswere motivating others to drink and 90 % of the respondents were using other'smoney to drink .

Table 2: Distribution of Responses Leading to Diseases and Making Problems

S. No.	DISEASES	RESPONSES		TOTAL
		YES	NO	
1	Depression	44(88%)	6(12%)	100%
2.	Mental disease	43(86%)	7(14%)	100%
3	Memory loss	44(88%)	6(12%)	100%
4	a) Social diseases b) Psychological c) Inpatients	7(14%) 41(82%) 2(4%)		100%
5	Economic problem	43(86%)	7(14%)	100%
6	Breaking home material	31(62%)	19(38)	100%
7	Beating their wife	32(64%)	18(36%)	100%
8	Disturbing children's education	23(46)%	27(54)	100%
9	Damaging public properties	46(92%)	4(8%)	100%
10	Making family problem	48(96%)	2(4%)	100%

Table 2 exhibited the variation of disease due to alcoholism and substance abuse. From the above table it was observed that 88% respondents were having depression and 86% of the respondents have mentalillness. 98% of the respondents have memory loss due to addiction

and 82% developed psychological issues. 86% of the respondents have economic problem due to spending their earning to addiction. From the study it was analysed that due to alcohol addiction, 62% of the respondents always break their home materials, 64% always beat their wives, 92% of the respondents damage public properties, and 96% of the respondents always make family problems. Therefore it was elucidated that alcoholism lead to societal problem as well as loss of peace in family.

Table 3: Distribution of responses towards knowledge about alcohol, substances and rehabilitation.

SL NO	CAUSES AND KNOWLEDGE	RESPONSES		TOTAL
		YES	NO	
1	Removing stress	15(30%)	35(70%)	100%
2	Reducing body pain	14(28%)	36(72%)	100%
3	Getting pleasure	15(30%)	35(70%)	100%
4	Knowing injections	20(40%)	30(60%)	100%
5	Knowing the type of substance	30(60%)	20(40%)	100%
6	Knowing alcohol addiction and substance abuse	49(98%)	01(02%)	100%
7	Rehabilitation awareness	12(24%)	38(76%)	100%
8	Knowing rehabilitation centre	10(20%)	40(80%)	100%
9	Attending awareness programme	37(74%)	13(26%)	100%
10	Making accident	48(96%)	02(04%)	100%

Table 3 showed the distribution of responses towards knowledge about rehabilitation and substance abuse. Half of the respondents were using alcohol and substance abuse to get pleasure and 60% of them were not aware about the injections. 60% of the respondents aware about the type of substances 76% of the respondents did not have knowledge about rehabilitation. 74% of the respondents were attending awareness programmes and 96% of the respondents were making accidents due to alcoholism and substance abuse.

SUGGESTIONS

- ❖ The awareness programmes can be conducted to tribal people about alcohol and substance abuse

- ❖ The tribal school should provide special classes related to alcohol addiction and substance abuse’.
- ❖ The government should encourage the society to participate in awareness programmes about alcohol addiction and substance abuse.
- ❖ Conduct yearly based survey under the guidance of government.
- ❖ Provide modern awareness facilities for youngster’s related to addiction and rehabilitation.
- ❖ Encourage the tribal youths to update their knowledge from newspaper cuttings, researches, articles etc....
- ❖ Encourage the tribal in participating co-curricular activities.
- ❖ The tribal village can have the counsellor with professionally trained person only.

CONCLUSION

The purpose of the study was to assess the knowledge and attitude towards addiction and substance abuse among tribal adolescents in Ponmanai Panchayat, Kanyakumari district. Many studies have attempted to identify risk factors associated with adolescent drug and alcohol usage. The results revealed that more than half of the adolescent people in Ponmanai Panchayat were not aware of the reason for alcohol and substance abuse, the effects and treatment procedures. They have myths and misconceptions regarding alcohol abuse and substance abuse. In addition to that, all the respondents did not know the rehabilitation programmes for addicted people. So, the researcher suggested that conducting awareness programmes and motivation programmes were the only way to be aware of alcohol addiction and substance abuse. The results of this study should help to increase the knowledge of alcohol addiction and substance abuse among tribal people. Also the social worker can meet the family to help them to learn more effectively about rehabilitation.

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