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LIFE OF PORUNAR IN PORUNAATRUPPADAI

Dr. K. Sakaya Gracy
Assistant Professor of Tamil
Jayaraj Annapackiam College for Women (Autonomous)
Periyakulam.

ஆய்வுச்சாரம்:

சங்க இலக்கியங்களை எட்டுத்தொகை, பத்துப்பாட்டு என இரண்டு வகையாகப் பிரிப்பர். பத்துப் பாட்டில் ஒன்றான பொருநராற்றுப்படையில் பொருநர்களின் வாழ்வியலை எடுத்தியம்பும் விதமாக இவ்ஆய்வு அமைந்துள்ளது. சங்ககால மக்கள் வாழ்ந்த சமுதாயமானது, நேர்மையான இயற்கைச் சூழல் கலந்த ஒன்றாக இருந்தது. மக்கள் ஒருவருக்கொருவர் உதவியும் இயற்கையைப் பாதுகாத்தும் விலங்கினங்களைப் பராமரித்தும் வந்தனர். தெய்வங்களை வணங்குவது, கற்றகையினைப் பிறருக்குக் கற்றுத்தருவது, வறுமையை ஒழிப்பது, போன்ற அறச்செயல்களோடு வாழ்ந்த சமுதாயத்தினைக் காண முடிகின்றது. இம்மதிப்பீடுகளை இக்காலச் சமுதாய மக்கள் தங்கள் வாழ்வியலாக்கத் தூண்டுவதே இவ்ஆய்வின் நோக்கமாகும்.

கருச்சொற்கள்: திணை இலக்கியம் - ஒழுக்கம் - வாழ்க்கை - நடைமுறைகள்.

ABSTRACT

The Sangam literature is divided into two types, as Ettuthogai and Patthupaattu. porunaatruppadai one among the Pattupaatu, explores the lives of the Porunar. A study of the life style of people, their society that lived, the environment that was inhospitable, mixed. People helped each other, protect nature and maintain their homes. The purpose of this study is to encourage the people of the contemporary society to make a living by worshiping Gods and eradicating poverty through the art of singing for others. .

Keywords: Sangam Literature, Life style .

முன்னுரை

பொருநர்கள், ஊர்களில் நிகழும் விழாக்களில் இசைப்புலமை காட்டுதலும், ஊர் ஊராய்ச் சுற்றித் தம் கலையைப் பரப்புதலும் வழக்கம். யாழின் சிறப்பியல்புகளும், பொருநரின் வறுமைநிலையும், பொருநர்களின் சுயநலமற்றவாழ்வும், கரிகாற் பெருவளத்தான், கலைஞர்களைப் போற்றிப் பரிசில் அளிக்கும் தன்மையும் பொருநர் ஆற்றுப்படையில் இடம்பெற்றுள்ளன. சங்ககால மக்கள் வாழ்ந்த சமுதாயமானது, நேர்மையான இயற்கைச் சூழல் கலந்த ஒன்றாக இருந்தது. மக்கள் ஒருவருக்கொருவர் உதவியும் இயற்கையைப் பாதுகாத்தும் விலங்கினங்களைப் பராமரித்தும் வாழ்ந்த வாழ்க்கையைப் பொருநர் ஆற்றுப்படை பதிவு செய்துள்ளது. பொருநர்ஆற்றுப்படை காட்டுகின்ற பொருநரின் வாழ்வியல் குறித்துக் காண்பதாக இவ்ஆய்வு அமைகிறது.

வாழ்வியல் விளக்கம்

வாழ்வு+இயல்=வாழ்வியல். மனிதவாழ்வுக்கு அடிப்படையான உணவு, உடை, உறைவிடம் ஆகியவற்றை மையமாகக் கொண்டுவாழ்வதை வாழ்வியல் எனலாம். இம்மூன்றையும் முதன்மையாய்க் கொண்டு ஒவ்வொன்றையும் உருவாக்க அவற்றை நிலைநாட்டக் கையாளும் செயல்திட்டங்களான பகுப்புக்களை உள்ளடக்கியதே வாழ்வியல். "வாழ்வு என்ற சொல்லுக்கு அகராதிதரும் விளக்கமும் இதனைமையமாகக் கொண்டே அமைந்துள்ளது. வாழ்வு - உறைவிடம், செல்வம், வாழ்க்கை"என நர்மதாவின் தமிழ் அகராதி விளக்கம் தந்துள்ளது.[1]

சங்ககாலத்தைச் சேர்ந்த சோழமன்னன் கரிகாலன் ஆவார். இவர் இளஞ்சேட்சென்னியின் மைந்தன் ஆவார். கரிகாலன் ஆட்சி புரிந்த பகுதிகளான நாகப்பட்டினம், காஞ்சிபுரம், உறையூர், காவிரி, மதுரை, கொற்கை முதலியவை மேன்மையான இடங்களாகும். இவர் நாங்கூர் வேளின் மகளை மணந்து ஆதிமந்தி என்ற பெண்மகளைப் பெற்றவர். சோழர்களில் மிக முக்கியமான மன்னர் ஆவார். சோழர் குலத்தை ஒரு குறுநில அரசிலிருந்து காஞ்சி முதல் காவிரி வரை பரவ வழிவகுத்தவர். இவரது ஆட்சியின் கீழ் வாழ்ந்த பொருநர்களின் தன்மை குறித்துக் காண்போம்.

காக்கைக்குச் சோறுபடைத்தல்

ஒற்றுமைக்கும், கூடிவாழ்தலுக்கும், பகிர்ந்துண்ணுதலுக்கும் எடுத்துக்காட்டாக விளங்குவது பறவையினம். காக்கை ஊர் வீதிகளில் உள்ள அசுத்தங்களை உண்டு சுத்தம் செய்வதால் முக்கியத்துவம் வாய்ந்ததாகக் கருதப்படுகிறது. காக்கைக்குத் குருதி

கலந்த சோற்றினைப் படைக்கும் வழக்கம் குறித்து இவ்வாற்றுப்படையில் ஆசிரியர்,

"செஞ்சோற்ற பலி மாந்திய

கருங்காக்கை கவவுமுனையின்" (பொருந. 183-184)

என்றஅடிகளால் காக்கைக்குச் சோறுபடைக்கும் வழக்கம் சங்ககாலத்தில் இருந்ததைப் புலப்படுத்துகிறார்.காக்கைக்குச் சோற்றுப் பலி இடுதல் இன்றைக்கும் காணப்படும் வழக்கம் ஆகும்.

இதனை,

".....வெண்ணெல் வெஞ்சோறு

எழுகலத் தேந்தினும்சிறிதுஎன்தோழி

பெருந்தோள் நெகிழ்த்தசெல்லற்கு

விருந்துவரக் கரைந்தகாக்கையதுபலியே"[2]* பொருந.

என்னும் குறுந்தொகைப் பாடலிலும், காணமுடிகிறது.

இளம் பெண்கள் முதியோர் செயல்

தங்கள் உடல் அமைப்பிற்கும் உள்ளநிலைக்கும் ஏற்ற விளையாட்டுகளைச் சங்ககால மகளிர் தேர்ந்தெடுத்து விளையாடினர். பொருநராற்றுப்படையில், மருதநிலத்தில் உழவு செய்யும் இளம் பெண்கள் குறித்துப் பேசப்படுகிறது. இவர்கள் நெய்தல் நிலத்தில் உள்ள மணல் குன்றில் வண்டல் இழைத்து விளையாடுவர். பொழுதுபோக்கிற்காக இது போன்ற விளையாட்டுக்களில் ஈடுபடுவர். மேலும் அங்குள்ள முதியவர்கள் கலகம் ஏற்படும் போது, அக்கலகத்தை தீர்த்துக் கொள்வதற்காக நீதி கேட்டு அறம் உரைக்கும் மன்றத்தை நாடுவர். அவ்வாறு நாடும் அளவிலே தம் உள்ளத்தில் இருந்த பகைமைநீங்கி ஒன்றுபடுவர். இதனை,

"இளையோர் வண்டலயரவும் முதியோர்

அவைபுகுபொழுதிற்றம் பகைமுரண் சொலவும்" (பொருந. 187- 188)

என்ற அடிகளால் அறியலாம்.

காடுறை தெய்வத்திற்குக் கடன் கழித்தல்

தெய்வங்களை வணங்கி, எச்செயலையும் தொடங்குவது மரபு. அவ்வகையில் பழங்கால மனிதன் தெய்வங்களையும் தெய்வங்கள் உறையும் காட்டினையும் வழிபட்டான். காடுறை தெய்வம் என்பது காளி, கூளி முதலியவற்றைக் குறிக்கும். காட்டுவழிச் செல்வோர், அக்கடவுளுக்குப் பலி கொடுத்துவிட்டு, அக்கடவுளை வாழ்த்திப்

பாடினால் தான் செல்லும் காரியம் வெற்றியடையும் என்பது மக்களின் நம்பிக்கையாகவே இருந்தது. இக்கூற்று உண்மை என்பதால்,

"காடுறைகடவுட் கடன் கழிப்பியபின்றை" (பொருந. 52)

என்றஅடிகளால் சுட்டுகிறார் ஆசிரியர். இதேபோல்,

"கடவுள் ஓங்கியகாடேசு கவலை"[3]கூத்தர் - 396

என்றுவரும் மலைபடுகடாம் (கூத்தராற்றுப்படை) அடிகளிலும் சுட்டப்படுகிறது.

பொருநர்களின் தன்மை

தான் வறுமையில் வாடினாலும் கற்ற கலை அழிவுறக் கூடாது என்ற எண்ணம். உடைய பொருநர்கள் பல காலம் வறுமையைத் தீர்க்கும் பொருட்களையும் பொன், தேர் முதலியவற்றையும் தன் சுற்றத்தார்க்குப் பகிர்ந்து கொடுக்கும் சுயநலமில்லாத உயர்ந்த எண்ணம் உடையவர்கள். தங்களிடம் உள்ள கலைத் திறமையை மன்னர்களிடம் காட்ட வேண்டும் என்று விரும்புபவர்கள். தாங்கள் வறுமை நிலையிலிருந்தாலும் பிறருக்கு உதவவேண்டும் என்று நினைப்பவர்கள். மற்றவர்களின் வறுமையைப் போக்கி வாழ்ந்தவர்கள். இதனை,

"பழுமரம் உள்ளியபறவையின்,யானுமவன்

இழுமென் சும்மை இடனுடைவரைப்பின்" (பொருந. 64-65)

என்ற அடிகளின் மூலம் அறியலாம். பழுமரத்தைநாடிச் செல்லும் பறவை போலப் பரிசிலர் புரவலரை நாடிச் செல்லுதல் இயல்பு. எனவே தங்களின் வறுமையைப் போக்கும் வள்ளலை நாடிச் செல்கின்றனர் கலைஞர்கள். பொருநர் ஆற்றுப்படையிலும் பொருநனின் வறுமை தீர கரிகால் மன்னனிடம் செல்லுமாறு மற்றொரு பொருநன் ஆற்றுப்படுத்துவதை அறியமுடிகிறது.

திருக்குறளும்,

"பயன்மரம் உள்ளூர்ப் பழுத்தற்றாற் செல்வம்

நயனுடையான்கட் படின்"[4]

என்றும்,

"பழுமரந் தீண்டியபறவையின் எழும்"[5]

என மணிமேகலையும் இதனை எடுத்துரைக்கின்றன.

ஆற்றுப்படுத்தும் பொருநனின் வறுமைநிலை

உணவு, உடை, உறைவிடம் பாதுகாப்பான சூழல், கல்வி பெறும் வாய்ப்பு,

பிறமனிதரிடம் மதிப்புப் பெறுதல், போன்ற வாய்ப்பு உடையவர்கள் மேல்வர்க்கத்தினர். வாழ்க்கைத் தரத்தைத் தீர்மானிப்பவற்றை இழந்த நிலையை உடையவர்கள் வறுமை நிலை எட்டியவர்கள் எனலாம். இத்தகைய வறுமை நிலை பொருநர்களிடையேயும் காணப்பட்டது. எனினும் அத்தகைய வறுமை நிலையிலும் செம்மையாக வாழ்ந்தனர் பொருநர்கள்.

அரசன் வறுமையைகண்டறியும் நிலை

முதன் முறையாகக் கண்டாலும் பலநாள் பழகியதன் நட்டானைக் கண்டாற் போன்றுநட்புக் கொள்ளும் பேரருளாளன் கரிகாலன் இதனை,

"... ... ... ஒன்றிய

கேளிர்போல,கேள் கொளல் வேண்டி" (பொருந. 73-74)

என்றஅடிகளில்காட்டுகின்றார் முடத்தாமக் கண்ணியார் .இக்கருத்துஇ

"புணர்ச்சிபழகுதல் வேண்டாஉணர்ச்சிதான்

நட்பாம் கிழமை தரும்"[6]

என்ற குறளுடன் ஒப்பிட்டுப் பார்க்கத்தக்கது. உணர்ச்சியால் ஒன்றுபட்ட நண்பர்களுக்குப் பழகுவதற்குக் காரணம் வேண்டியதில்லை என்பதனை அறிய முடிகின்றது.

இரவலனைக் கண்டாலும், அகத்தின்கண் எழுந்த ஆர்வம் முகத்தின்கண் தோன்ற இரவலனைத் தனக்கு நிகராக அமரவைத்து அவனிடம் இனிமையான சொற்களால் பேசி அவனுக்கு உதவிசெய்யும் இயல்பு நிறைந்தவன் கரிகாலன் என்பதனை,

"வேளாண் வாயில் வேட்பக் கூறி" (பொருந . 75)

என்ற அடிகளில் கூறுகின்றார் ஆசிரியர்.

இரவலனின் வறுமை நிலையினைப் பிறர் அறிய ஏதுவாயிருப்பதுவும், செல்வம் உடையவரிடம் இருந்து தன்னைப் பெரிதும் வேறுபடுத்திக் காட்டச் செய்வதுவும் ஆடை ஆகும். பொருநர்கள் அணிந்திருந்த கந்தலாடைகளை நீக்கி, நுட்பமாக நெய்யப்பட்டிருந்த பாம்பின் தோலை ஒத்திருந்த புதுப் பட்டாடையினை இரவலனுக்கு வழங்கினான். பட்டாடை என்று கூறும் போது அக்காலத்திலே நெசவுத் தொழிலின் மேன்மையினை உணர முடிகிறது. இரவலனின் வறுமை நிலையினை போக்க இரக்கப் பண்பு நிறைந்த வள்ளல்கள் இச்செயல்களைச் செய்தனர் என்பதனைப் பல இலக்கியங்களும் கூறுகின்றன. இதனை,

"……..மாசில்

காம்பு சொலித்தன்ன அறுவை உடீஇ"[7] (சிறுபாண். 235-236)

என்று சிறுபாணாற்றுப்படை அடிகளும், கூறுகின்றன.

உணவு கொடுத்து ஓம்பிய முறை

தமிழ்க் காப்பியமாகிய மணிமேகலை உயிர்களின் வாழ்க்கைக்கு உணவு எவ்வளவு முக்கியமானது என்பதனை இந்த உலகத்தில் வாழும் உயிர்களுக்கு எல்லாம் உண்பதற்குஉரியஉணவுகொடுத்தோர், உயிர் கொடுத்தோராகக் கருதப்படுவார்கள் என்கிறதுபுறநானூற்றில் புலவர் குடபுலவியனார்,

"உண்டிகொடுத்தோர் உயிர் கொடுத்தோரே"[8]

என்கிறார். இவ்வாறு மணிமேகலை மற்றும் புறநானூற்றுப் பாடல் அடிகள் உணவளித்தலின் உயர்வுகுறித்துக் கூறுகின்றன.

கரிகாற் பெருவளத்தான் தன்னை நாடிவந்த பொருநருக்கு அருகம்புல்லைத் தின்று வளர்ந்த கொழுத்த செம்மறி ஆட்டின் இறைச்சியைச் சுவைப்படச் சமைத்துக் கொடுத்து உண்ணச் செய்தான். திண்பண்டங்களைக் கொடுத்து அவற்றையும் உண்ணும்படி உரிமையோடு இடித்துரைத்தான். விரல் போன்று நீண்டு காணப்படும் சோற்றினையும் அதற்குத் தொட்டுக் கொள்ள நன்றாகப் பொரிக்கப்பபட்ட பொரிக்கறிகளையும் பிறவற்றையும் எங்களின் அருகே அமர்ந்து உண்ணும்படிச் செய்தான் பல் மழுங்கிப் போகும் அளவிற்கு இறைச்சி உணவு படைத்தான் என்று முடத்தாமக் கண்ணியார் கூறுகின்றார். இதனை,

"கொல்லை உழுகொழு ஏய்ப்பபல்லே

எல்லையும் இரவும் ஊன்தின்று மழுங்கி" (பொருந -117-118)

என்ற அடிகள் தெரிவிக்கின்றன. இவ்வாறு அரசன் உணவு கொடுத்து ஓம்பியமுறை குறித்துப் பொருநன் எதிர்வந்த மற்றொரு பொருநனிடம் எடுத்துரைப்பதாகப் பெண்பாற் புலவரான முடத்தாமக் கண்ணியார் இவ்வாற்றுப் படையின்கண் புலப்படுத்துகிறார்.

பரிசுபெற்றோன் பெறாதோனைவிளித்தல்

ஏழ்மையின் காரணமாகவோ அல்லது திறமையின் காரணமாகவோ பரிசில் பெற்று வாழும் பாணன் மற்றபாணனை ஆற்றுப்படுத்துதல், பரிசில் பெற்றபொருநன் எதிர் வந்த பொருநனிடம் நீயும் சென்று பயனடைவாயாக என்று கூறும்போது பொருநர்களின் தன்னலமற்ற உள்ளம் இங்குப் புலனாகிறது.

"முரசுமுழங்குதானை, மூவரும் கூடி....." (பொருந - 54)

என்று இடம்பெற்றுள்ள அடிகளால் அறிந்து கொள்ள முடிகின்றது. இதன் மூலம் ஒவ்வொரு மனிதனும் தன்னலமற்ற வாழ்வு வாழும்போது உலகமானது, மனிதநேயத்துடன் இருக்கும் என்பது உறுதி. அறவோர் வாழ்வெல்லாம் பிறருக்காகவே அமைந்திருந்தது என்பதனை நினைவில் கொண்டு, நடந்தால் உதவும் மனப்பான்மையும், தன்னலமற்ற மனிதமும் செழிக்கும்.

கொல்வது போன்ற பசியாலே உன் சுற்றத்தார் பெரிதும் வாடியிருக்கின்றனர். நீயும் நெடுநாட்களாகப் பெரும் பசியால் வாடியிருக்கின்றாய், நீயும் உன் சுற்றத்தினரும் தொன்று தொட்டு வந்த பெரும் பசியிலிருந்து விடுபட்டு நல்வாழ்வு வாழ வேண்டுமெனில் காலம் தாழ்த்தாமல் உடனே சென்று பயனடைவாயாக! என்று பரிசில் பெற்ற ஒரு பொருநன், வேறொரு பொருநனை ஆற்றுப்படுத்துவதாக அமைந்து உள்ளது. இப்பாடல்,

"ஆடுபசிஉழந்தநின் இரும்பேர் ஒக்கலொடு
நீடுபசிஒராஅல் வேண்டின் நீடுஇன்று
எழுமதிவாழி,ஏழின் கிழவ!" (பொருந. 61-63)

என்பதாகும் பொருநர் நல் மாண்புகளைக் கடைப்பிடித்ததன்மை இங்கு புலப்படுகின்றது. இப்பாடலின் வழி பிறர் துன்பங்களை அறிந்த மனத்தோடும், உதவும் மனப்பான்மையோடும் வாழ்ந்தபொருநர்களின் வாழ்வியலை அறிய முடிகிறது.

முடிவுரை

முடத்தாமக் கண்ணியாரால் இயற்றப்பட்ட இந்நூல் பொருநர் என்ற சமூகத்தின், வாழ்வியலை நுட்பமாகக் கூறுகின்றது. பொருநர் என்ற சமூகத்தின் வழியாகக் கரிகாலனின் சிறப்புக்களை அறியமுடிகின்றது. பொருநர்கள் அறங்களைகற்று, அறத்தின் வழியேதான் வாழ்ந்து பிறரையும் வாழ வைத்தார்கள். பொருநர்களின் வாழ்க்கை நாடோடி வாழ்க்கையாக அமைந்த போதிலும் அவர்களின் உதவும் மனப்பான்மையானது மேன்மை உடையதாகக் கருதப்பட்டது என்பது திண்ணமே! பலனை எதிர்பாராமல் பிறருக்கு வாரிவழங்கும் வள்ளலான கரிகாலனின் வள்ளன்மை வழி அவனுடைய நல்ல மாண்புகளை அறியமுடிகிறது. பொருநர்களிள் வாழ்வியல் வழியாக அக்காலச் சமுதாயத்தை அறிந்து கொள்ள முடிகிறது.

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FOSTERING CULTURAL UNDERSTANDING AND EMPATHY THROUGH ANCIENT INDIAN KNOWLEDGE

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ABSTRACT

Ancient Indian wisdom is a deep well of knowledge that transcends time, promoting mutualcultural understanding and empathy. It was "holistic" in nature according to the Vedas and Upanishads and valued such things as meekness, honesty with one self, and regard for all that has been created. When students are given background informationon fables, folklore and myths they gain insight into human behavior as well as universal themes. Meanwhile, this type of educationprovides opportunities for experiential learning in terms of yoga lessons or traditional works ofart by Indians which helps them appreciate their ancient culture. Nonetheless, no matter howdifficult it may be to include limited resources; collaborative efforts can blend this evergreenwisdom into contemporary schooling where such endeavours will enable learners to recognizediverse cultures besides having compassion towards others.

Keywords: Cultural understanding, Empathy**,** Folklore**,** Mythology**,** Experiential learning**,** Challenges, Misconceptions, Bestpractices**,** Integration**,** Innovation.

One effective way of incorporating ancient Indian traditions into the curriculum is through stories, folklore and mythology. By distributing these engaging narratives to students, a more profound respect for India's cultural heritage and knowledge of

the values and beliefs that's hapeditssocietycan be developed. Additionally, these stories help in understanding human nature, moralities as well as complexities of life thus enabling learners to delve into global themes that go beyond times and places.

The Introduction of ancient Indian knowledge into the classroom can be achieved through experiential learning. Students can experience and do hands-on learning about some of the old ways in which Indian people did things before such as performing rituals and dressing. For example, through yoga or meditation lessons, students can understand what mind fullness meant in ancient Indian philosophical thought. They can also try out traditional art forms like rangoli ormehndi by designing them. Such activities immerse learners in the ancient Indian knowledgesystemmakingthemfeelitmoredeeplyhenceappreciatingitsrelevancetothem odernworld.

One of the challenges educators may face when trying to incorporate ancient Indian knowledge into their classrooms is the lack of readily available resources and materials. However, this hurdle can be overcome through collaboration and resource sharing. Educators can collaborate with other institutions or organisations to share expertise in ancient Indian knowledge. They can also leverage online platforms and digital tools to access various materials, including interactive videos, virtualtours, and online libraries. Educators can find creative solutions to address the lack of physical resources by fostering a supportive network and tapping into resources.

Another challenge is addressing potential misconceptions and biases that students may have about ancient Indian knowledge. Educators must provide accurate and balanced information, dispelstereotypes, and promote critical thinking. Exposing students to diverse perspectives and challenging preconceived notions can be achieved through open discussions, guest speakers, and field trips to places of

historical and cultural significance. Educators can promote a more nuanced understanding and genuine appreciation for ancient Indian knowledge by creating a safe and inclusive learning environment for their students.

Several educational institutions andteachers have effectively incorporated traditional Indian wisdom into their educational frameworks. For instance, some schools have introduced Sanskrit as a language option, allowing students to engage with ancient texts and philosophical concepts. Other educators have developed interdisciplinary projects that combine ancient Indian history, mathematics and science encouraging students to explore the interconnectedness of these subjects. These casestudies highlight the effectiveness of incorporating ancient Indian knowledge in promoting holistic learning and nurturing well-rounded individuals.

In addition to traditional instructional techniques, novel strategies and initiatives have surfaced toamalgamate age-old Indian wisdom into the realm of education. One illustration is the utilizationof gamification, wherein learners engage in interactive gaming activities or simulations that encompass themes from ancient Indian lore. This not only enhances the appeal and enjoyment of learning but also enriches students' comprehension of the cultural backdrop. Another strategy involves the infusion of ancient Indian knowledge into STEAM (Science, Technology, Engineering, Arts, and Mathematics) education. By incorporating elements of ancient Indianarchitecture, metallurgy, or herbal medicine, students can explore the intersection of ancient wisdom and modern scientific knowledge.

In conclusion, educators are encouraged to adopt the traditional Indian knowledge system and take proactive steps to implement it within educational settings.

Integrating ancient Indian knowledge into the classroom offers a unique

opportunity to foster cultural understanding, empathy, and multidimensional learning. By incorporating stories, folklore, and mythology, students can gain insights into different values and beliefs. Engaging in experiential learning allows students to actively experience ancient Indian traditions. The implementation of ancient Indian knowledge, however, encounters obstacles like constrained resources and possible biases. By engaging in cooperation, sharing resources, and establishingsecure learning atmospheres, educators can surmount these obstacles. The effective assimilation of ancient Indian knowledge is exemplified through case studies and pioneering initiatives. It is recommended that educators incorporate the ancient Indian knowledge system across different disciplines, furnishing students with a comprehensive education that esteems varied cultures andtraditions. So, let's embark on this ancient adventure together and cultivate a love for knowledge thattranscends time and place.

In conclusion, the integration of the ancient Indian knowledge system within educational settings presents a significant opportunity to enhance the quality of learning and develop individuals witha holistic approach. Through the incorporation of this traditional knowledge, educators have thepotential to improve analytical thinking abilities, promote cross-cultural awareness, and offerstudents a wider outlook on global matters. Educators must accept this prospect and seek out innovative methods to incorporate ancient Indian wisdom in to their pedagogical approaches. This endeavour can lead to the establishment of a more inclusive and thorough educational frameworkthat equips students for the challenges of an increasingly interconnected world, all the while respecting the insights preserved from antiquity.

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AYYANKALI: A DALIT SOCIAL REFORMER IN KERALA

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ABSTRACT

Ayyankali was born on August 28, 1863 in the princely state of Travancore (modern-dayKerala), emerged as a pioneering Dalit Social Reformer whose efforts significantly transformed the oppressive caste-based social structure of his time. Hailing from the Pulayar community, which faced severe discrimination and exclusion, Ayyankali's relentless pursuit of social justice brought about substantial changes in the socio-political landscape of Kerala. He began his activism withsymbolic acts of defiance, such as riding a bullock cart on public roads, which were traditionally reserved for the upper castes.

These acts sparked widespread resistance and mobilized the Dalit community. Ayyankali's contributions were not limited to social protests; he also champion ededucational reforms by establishing schools for Dalit children and advocating for their admission into government schools. His efforts extended to women's empowerment, challenging oppressivecustoms and advocating for the rights of Dalit women. Despite facing severe opposition andnumerous challenges, Ayyankali's legacy endures as a testament to his extraordinary dedicationto social justice and equality. His life and work continue to inspire contemporary movements forsocial reform and the fight against caste-based discrimination in India. This article delves into Ayyankali's life, his pivotal role in social reform, and hislasting impacton Kerala's history.

Keywords : Reformer, Pulayar community, Discrimination, Equality, Legacy

1. INTRODUCTION

"IF YOU DON'T ALLOW YOUR CHILDREN TO STUDY,

WEEDS WILL GROW IN YOUR FIELDS"- Ayyankali

Ayyankali, born on August 28, 1863, in Perunkattuvila, Venganoor, Travancore, emerged as a pivotal figure in the fight against caste-based oppression in Kerala. Hailing from the Pulayarcommunity, which was considered untouchable, Ayyankali's life and work were dedicated to theupliftment of the lower castes. His relentless pursuit of social justice earned him recognition asone ofthe foremostDalitleaders ofmodernKerala.

1.1.EARLY LIFE

Ayyankali was born into a relatively well-off Pulayar family, which was an exception among his community. His family, having been granted five acres of land by a grateful landlord, encouraged their children to engage in agriculture. Despite this relative prosperity, Ayyankali was acutely aware of the pervasive social injustices faced by his community. The Pulayars, subjected to severe discrimination and denied basic civil rights, were treated as rural slaves and were forbidden from using public roads, entering temples, and accessing educational institutions. Growing up in such an oppressive environment, Ayyankali developed a strong sense of injustice and a desire to challenge the status. His initial acts of defiance were symbolic yet powerful, designed to provoke the upper castes and draw attention to the plight of the lower castes. Ayyankali's actions marked the beginning of a broader social movement aimed at securing basic rights and dignity for the Dalit community.

2. STRUGGLE FOR EQUALITY

Ayyankali's fight for social justice began with acts of defiance against the oppressive caste system. In a bold move, he dressed in clothing traditionally associated with the upper-caste Nairs and rode a bullock cart on public roads, an act reserved for the higher castes. This provocation led to the Chaliyar riots in 1893, a

series of violent clashes between the Dalits and the upper-caste Nairs. Despite the violence, Ayyankali's actions galvanized the oppressed communities and laid the ground work for the Dalit movement in Kerala. The Chaliyar riots marked a significant turning point in the Dalit struggle for equality. Ayyankali's leadership and defiance inspired others to standup against caste-based oppression. He continued to lead by example, organizing protests and mobilizing support for the Dalit cause. The riots lasted for a year and resulted in the death of many Nairs and Pulayars. The Travancore government tried to suppress the riots by deploying police and military forces, but they were in effective. The British government also intervened and mediated between the conflicting parties. The riots finally ended in 1894, after a compromise between the Nairs and the Dalits. The Chaliyar riots were a turning point in the history of Kerala, as they marked the beginning of the Dalit movement for social justice and equality. Ayyankali’s courage and resistance inspired many Dalits to join his cause and demand their rights. In1900, the Pulayars had gained the right to use most roads in the state, although they were still barred from those that led to Hindu temples.

2.1. EDUCATIONAL REFORMS

Ayyankali believed that education was the key to eradicating caste-based oppression. Unable to acquire formal education himself, he established a private primary school for the untouchables in Venganoor. Although the school faced fierce opposition from the upper castes and was eventually closed, Ayyankali continued to advocate for educational access. In 1907, he founded the Sadhu Jana Paripalana Sangham (SJPS), an organization dedicated to the protection and education of the lower castes. Through SJPS, Ayyankali campaigned for the admission of untouchable children into government schools and worked towards setting up Pulayar-operated schools.

Ayyankali's educational initiatives faced numerous challenges, including resistance fromthe upper castes and lack of funding. However, his persistence paid

off. He managed to securesupport from sympathetic allies, including missionaries and progressive members of the uppercastes. These alliances helped him establish more schools and provide scholarships for Dalit students. Ayyankali's educational reforms were not limited to formal schooling. He also emphasized the importance of vocational training and skill development. By equipping Dalits with practical skills, he aimed to improve their economic prospects and break the cycle of poverty. His efforts laid the foundation for a more inclusive and equitable education system in Kerala.

2.2.WOMEN'S EMPOWERMENT

Ayyankali was also a champion of women's rights, particularly focusing on the rights of Dalit women. One of his significant achievements was challenging the oppressive custom that forced Dalit women to leave their upper bodies bare as a sign of low status. He led protests against this practice, culminating in the 1916 proclamation by the Maharaja of Travancore that allowed all women, regardless of caste, to wear upper clothes. Ayyankali also supported the education of Dalit women, establishing schools for Dalit girls and encouraging their participation in social and political activities. Ayyankali recognized that empowering women was essential for the overall progress of the Dalit community. He worked tirelessly to change societal attitudes towards Dalitwomen, advocating for their rights to education, employment, and social participation. His efforts helped to elevate the status of Dalit women and provided them with opportunities for personal and professional growth.

3. CHALLENGES AND RESISTANCE

Ayyankali's journey was fought with challenges and resistance from various quarters. Theupper castes viewed his actions as a direct threat to their privileged status and often responded with violence and intimidation. Ayyankali faced physical assaults, social boycotts, and legal challenges aimed at suppressing his movement.

Despite these obstacles, he remained undeterred and continued to fight for justice. One of the significant challenges Ayyankali faced was theresistance from within his own community. Some members of the Pulayar community were hesitant to embrace his radical ideas and feared reprisal from the upper castes. Ayyankali had towork hard to win their trust and convince them of the importance of collective action. His ability to communicate effectively and build consensus was crucial in over coming internal divisions.

3.1. POLITICAL ENGAGEMENT

The first target of his group was to gain the right to walk along the highway and roads, which was denied to the Pulayars. Collecting more supporters, he began to walk along highwaysby groups. Earlier not just to walk, but they were also forced to maintain a distance of at least 64steps from the Nair community and 128 steps from Namboodiris. Ayyankali rode a bullock cart on the roads that they were not allowed to travel. This act of rebellion spread as movement acrossTravancore as it was not allowed for the Pulayars to travel in a bullock cart back then. He was inspired by the works of Sri Narayan Guru. He led a rally to assert the rights of the oppressed at Balaramapuram. The rally became famous as the ‘Walk for Freedom’. Eradication of untouchability was one of the important agendas of the Congress and was pioneered by Mahatma Gandhi himself.

In addition to his social and educational reforms, Ayyankali recognized the importance of political engagement in achieving lasting change. He actively participated in the political process, advocating for the rights of the Dalit community at various forums. In 1910, he was elected to the Travancore Legislative Assembly, becoming one of the first Dalits to hold such a position. His presence in the assembly provided a platform to voice the concerns of the Dalit community and influence policy decisions. Ayyankali used his political influence to push for legislation that would improve the lives of Dalits. Head vocated for land reforms, better working

conditions for agricultural laborers, and the abolition of discriminatory practices. His efforts contributed to the gradual dismantling of the caste system and the establishment of a more just and equitable society.

3.2. LEGACY

Ayyankali's contributions to the social reform movement in Kerala were profound. His efforts not only improved the socio-political status of the Pulayar community but also set the stage for broader social changes in the region. Ayyankali passed away on June 18, 1941, but his legacy endures. His birthday is celebrated as Ayyankali Jayanti, and he is remembered as a revolutionary leader who paved the way for social justice and equality in Kerala. Mahatma Gandhi referred to him as 'Pulaya Raja,' and Indira Gandhi described him as 'India's greatest son.' Ayyankali's legacy extends beyond Kerala and the Dalit community. His life and work serve as an inspiration forsocial reformers and activists across India. His emphasis on education, women's empowerment, and political engagement continues to resonate with contemporary movements for social justice. Ayyankali's vision of an inclusive and egalitarian society remains a guiding light for those striving to create a more just world.

4. CONCLUSION

Ayyankali's life was a testament to the power of resilience and the pursuit of justice. Hisrelentless efforts to challenge and dismantle the caste system transformed the lives of many in Kerala, creating a more inclusive and equitable society. Ayyankali remains a symbol of the struggle for Dalit rights and social reform, inspiring future generations to continue the fight against oppression and discrimination.

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A COMPREHENSIVE REVIEW ON TRIANGLE AND TRAPEZOIDAL FUZZY NUMBERS IN DECISION-MAKING PROCESSES

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ABSTRACT:

This study we have compared and analysed two forms of fuzzy numbers: triangular fuzzy numbers (TFNs) and trapezoidal fuzzy numbers (TrFNs), with the motive of establishing their ability in modelling uncertainty and imprecision. We have experimented the applicability of TFNs and TrFNs across a wide range of problem areas by conducting a comprehensive assessment of current literature that includes mathematical formulations, characteristics, and different applications. By review we demonstrated the practical applicability of TFNs and TrFNs in decision-making processes in real-world situationsand explored the contexts in which TFNs and TrFNs are best applied.

After a deep evaluation, we conclude that trapezoidal fuzzy numbers have significant advantages over triangular fuzzy numbers.These benefits originate from the greater representation flexibility and computational efficiency given by TrFNs, particularly in capturing asymmetric uncertainty and simplifying arithmeticoperations. Our conclusion emphasizes the importance of selecting thebest fuzzy number type based on the specific criteria, requirement, and characteristics of the issue area at hand. This work enhances better knowledge and benefits of TFNs and TrFNs, allowing

practitioners and researchers to make educated decisions about their use in fuzzy modelling and analysis.

Keywords: *Fuzzy Cognitive Maps (FCMs), Trapezoidal FuzzyNumber,Triangular Fuzzy Numbers,Neural network.*

1. PRELIMINARY :

Decision-making often involves uncertainty and imprecision, a factor that can introduce complexity into the decision-making process. Conventional models may encounter challenges in effectively addressing these elements. Fuzzy numbers, an extension of fuzzy sets, offer a structured approach to managing uncertainty and facilitating more well-informed decision-making. This initial exposition delves into the fundamental principles of fuzzy numbers, their utilization in decision-making contexts, and the essential components integral to the decision-making process.

Fuzzy Numbers Basics encompass the categorization of fuzzy numbers as a variant of fuzzy sets designed to represent quantities characterized by inherent uncertainty. In contrast to crisp numbers, which possess exact values, fuzzy numbers encompass a spectrum of potential values, each linked to a specific degree of membership.The utilization of fuzzy numbers in the process of decision-making presents a sturdy method to handle uncertainty and imprecision. Through the utilization of fuzzy sets and membership functions, it establishes a versatile structure that amplifies decision-making abilities across different fields.

With the escalation of complexity in decision-making settings, the importance and utilization of fuzzy numbers persistently expand, providing notable advantages in accuracy, resilience, and flexibility. This study enhances better knowledge and benefits of TFNs and TrFNs, allowing practitioners and researchers to make educated decisions about their use in fuzzy modelling and analysis.

2. LITERATURE SURVEY:

Triangular fuzzy numbers and Trapezoidal fuzzy numbers are distinct in their

shapes and applications. While Triangular fuzzy numbers are more focused on a narrower range of values with a single peak, Trapezoidal fuzzy numbers offer a wider range with the flexibility of incorporating two levels of significance, making them suitable for different types of decision-making scenarios. In 1965, Lotfi A. Zadeh introduced Fuzzy Cognitive Maps (FCMs) as a mathematical model [1].Kosko further enhanced cognitive maps by incorporating fuzzy values for concepts and fuzzy degrees of interrelationships between them in 1986 [2]. In 1976, political scientist R. Axelrod popularized FCMs for representing social scientific knowledge and described their use in decision-making within social and political systems [3].

W.B. VasanthaKandasamy and Smarandache Florentin applied Fuzzy Theory and Neutrosophic Cognitive Maps in 2000 to analyse social aspects of migrant labourers living with HIV/AIDS [4], [5]. In 2013, M. Clement Joe Anand and A. Victor Devadoss introduced Triangular Fuzzy Cognitive Maps (TrFCM) to analyse the causes of divorce within families [6]. A. Saraswathi and A. Praveen Prakash (2014) investigated problems faced by transgender individuals in India using New Triangular Fuzzy Cognitive Maps (TrFCM) [7]. A. Praveen Prakash and J. Esther (2014) applied Trapezoidal Fuzzy Cognitive Maps to rank problems experienced by deprived rural individuals with disabilities [8]. Kanimozhi Raman (2014) applied Induced Trapezoidal Fuzzy Cognitive Maps to address issues faced by the elderly [9].

In 2007, Shi-Jay Chen and Shyi-Ming Chen proposed a fuzzy risk analysis method based on the ranking of generalized trapezoidal fuzzy numbers [10]. In [11], *Michael, Hoerger* proposed two methods to investigate solution of the multiple attribute decision making problems given with trapezoidal fuzzy multi numbers (TFM-numbers). Irfan Deli, DavutKesen [12] solve multi-attribute decision-making problems using trapezoidal fuzzy multi numbers. To illustrate its practicality, they provide an example in daily life and offered an analysis table that facilitates a comparative evaluation of our proposed approach against existing methods.

Definition 2.1 A Triangle Fuzzy Number (TFN) :

A Triangle Fuzzy Number (TFN) is typically defined by a triplet (a,b,c), where a,b, and c are real numbers and$a \leq b \leq c$. The membership function of the TFN A is given by:

$$\mu_A(x) = \begin{cases} 0 & if \quad x < a \\ \dfrac{x-a}{b-a} & if \quad a \leq x \leq b \\ \dfrac{c-x}{c-b} & if \quad b \leq x \leq c \\ 0 & if \quad x > c \end{cases}$$

Definition 2.2. Trapezoidal Fuzzy Number

A Trapezoidal Fuzzy Number (TrFN) is typically defined by a quadruplet (a,b,c,d) where a, b, c, and d are real numbers and a≤b≤c≤d. The membership function of the TrFN B is given by:

$$\mu_B(x) = \begin{cases} 0 & if \quad x < a \\ \dfrac{x-a}{b-a} & if \quad a \leq x \leq b \\ 1 & if \quad b \leq x \leq c \\ \dfrac{d-x}{d-c} & if \quad c \leq x \leq d \\ 0 & if \quad x > d \end{cases}$$

3. TRAPEZOIDAL FUZZY COGNITIVE MAPS (TpFCM):

TpFCMs is a novel methodology for modelling complex systems characterized by uncertainty and ambiguity. It explains the theoretical underpinnings of TpFCMs, emphasizing their ability to represent fuzzy relationships and capture the nuances inherent in real-world phenomena.

3.1. Methodology:

The study describes the approach for creating TpFCMs to analyse the

challenges. It describes the data gathering procedure, which included interviews, questionnaires, and literature studies, with the goal of comprehending the numerous issues that were experienced in relation to the concerns. Fuzzy Number Selection: The authors most likely used generalized trapezoidal fuzzy numbers to represent unclear risk factors. A generalized trapezoidal fuzzy number is defined by four parameters: (a, b, c, d), where a and d represent the upper and lower limits, respectively. FCMs offer a graphical depiction of causal relationships among variables, facilitating the intuitive analysis of complex systems. The methodology encompasses the following steps:

3.2. Variable Identification:

The authors identify crucial variablesrepresenting socio-economic factors like income, education, employment, and healthcare. Selection criteria are based on the variables' relevance within the socio-economic context under scrutiny.

3.3. Construction of Fuzzy Cognitive Maps:

Fuzzy cognitive mapstake shape through the description of causal connections between identified variables. Each variable assumes the form of a node in the FCM, with directed edges representing causal links between them. The strength and direction of these links hinge on expert knowledge or empirical evidence.

3.4. Utilization of Fuzzy Logic Formalism:

Causal relationships among variables find expression through fuzzy logic format, wherethe degree of influence between variables manifests as fuzzy rules. These rules articulate fuzzy associations between input and output variables, incorporating linguistic descriptors such as "high," "medium," and "low" to encapsulate uncertainty and imprecision.

3.5. Parameterization and Validation:

Parameters such as the strength of causal connections and the extent of fuzziness undergo determination and validation employing real-world data or expert insights. Sensitivity analysis may be conducted to test the strength of the FCM model against variations in parameter values.

3.6. Simulation and Analysis:

Following the construction and validation of the FCM model, simulation techniques come into play to examine the behaviour of the socio-economic system over time. Dynamic simulations facilitate the exploration of diverse scenarios and the evaluation of policy interventions or decision-making strategies.In essence, the methodology employed in this study harnesses fuzzy cognitive mapping techniques to delineate the intricate interactions and feedback loops intrinsic to socio-economic systems. By using fuzzy logic and simulations, the authors provide insights into how socio-economic processes work and what effects

4. ANALYSIS AND FINDINGS:

Across those papers, researchers have carried out fuzzy cognitive maps (FCMs) and associated methodologies to analyse various complex societal issues. The whole context in their analyses involves expertise uncertainty, imprecision, and the interconnectedness of variables inside these structures. Here is the overall contexts and findings:

4.1. Modelling complicated structures:

We have explored the usage of FCMs as a tool for modelling complex structures, acknowledging the intrinsic uncertainty and imprecision in such structures. Our findings highlight the strength of FCMs in representing relationships between variables and their applicability in domains where specific information may be missing.

4.2. Societal issues evaluation:

Researchers implemented FCMs to analyse specific societal issues, including divorce fees, problems faced by marginalized communities like transgender people, and challenges experienced by underprivileged rural individuals with disabilities. Findings highlighted the multifaceted nature of those problems and the interconnectedness of different factors contributing to them.

4.3. Selection-Making tactics:

The cognitive maps of political elites were tested, providing insights into how people in positions of power understand and navigate political landscapes. Their Findings could potentially enlighten the choice-making strategies of political elites and the factors influencing their picks.

5. DEFUZZIFICATION:

From the review, defuzzification plays a essential position in translating fuzzy outputs received from fuzzy cognitive maps (FCMs) into actionable decisions or crisp values. Here's how defuzzification is applied and its importance

5.1. Usefulness of Defuzzification:

Defuzzification is crucial due to the fact FCMs regularly produce fuzzy outputs that constitute uncertain or vague information. by using changing fuzzy outputs into crisp values, defuzzification enables selection-making and movement based at the results obtained from FCMs. This manner permits to derive practical insights and tips from the fuzzy models applied in diverse domain names.

5.2. Fundamental strategies of Defuzzification:

In the context of the evaluate papers, authors possibly employed numerous simple methods of defuzzification to clarify the fuzzy outputs generated through FCMs. The se methods may include the centroid method, weighted average technique, most membership method, imply of most approach, bisector approach, and smallest of maximum method, amongst others. Each method has its own professionals and cons, relying on the precise traits of the fuzzy output and the necessities of the application.

6. EXPLORING THE EFFECTIVENESS OF TRIANGULAR ANDTRAPEZOIDAL FUZZY COGNITIVE MAPS INCOMPLEX SYSTEM MODELLING

- Representation of Uncertainty:
    - Triangular Fuzzy Numbers (TFNs): Represented by lower bound, modal value, and upper bound, suitable for symmetric uncertainty.

  - Trapezoidal Fuzzy Numbers (TRFNs): Incorporate left and right slopes for asymmetric uncertainty, providing a more detailed representation.
- Flexibility:
  - TFNs: Limited flexibility due to their fixed triangular design.
  - TRFNs: Versatile, allowing for various shapes, including symmetric and asymmetric trapezoids.
- Precision:
  - TFNs: Accurate for modal values aligning with the most probable outcome.
  - TRFNs: Offer precision, particularly for non-symmetric distributions.
- Computational Complexity:
  - TFNs: Simpler computations with fewer parameters.
  - TRFNs: May require more complex computations due to additional parameters.
- Application Suitability:
  - TFNs: Ideal for straightforward, symmetric uncertainty scenarios.
  - TRFNs: Suited for complex, asymmetric uncertainty situations, commonly used in risk analysis and financial modelling.
- Interpretation:
  - TFNs: Easy to interpret with a clear triangular design.
  - TRFNs: Interpretation can be challenging due to the trapezoidal shape and potential asymmetry.
- Trade-offs:
  - TFNs: Simplicity may compromise precision in asymmetric settings.
  - TRFNs: Offer greater flexibility and precision but may entail higher computational complexity.

The choice between TFNs and TRFNs depends on the specific requirements of the

application, considering factors such as simplicity, precision, and computational complexity.

7. CONCLUSION:

In our assessment, we comprehensively compared triangular fuzzy numbers (TFNs) and trapezoidal fuzzy numbers (TrFNs) in terms of their effectiveness in dealing with uncertainty and imprecision. Through an extensive analysis of existing literature andpractical application, we have established the versatility of TFNs and TrFNs across numerous problem domains. Althoughboth types of fuzzy numbers have their merits, our evaluation reveals thattrapezoidal fuzzy numbers offer significant advantages over triangular fuzzy numbers. This is primarilydue greater flexibility in representation and computational performance of TrFNs, in accommodating uneven uncertainty and simplifying mathematics operations. Consequently, our findings underscore the importance of choosing the ideal fuzzy range type primarily based at the unique characteristics and necessities of the problem at hand. By enhancing understanding of the relative strengths of TFNs and TrFNs, Our work empowers practitioners and researchers to make informed decisions regarding their usage in fuzzy modelling and analysis.

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TAILORING THE SURFACE MORPHOLOGY OF CuO NANOPARTICLES SYNTHESISZED BY SOLUTION COMBUSTION METHOD

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ABSTRACT

Copper oxide nanoparticles have attracted due to their unique properties and potential future applications.Copper oxide (CuO) nanoparticles (NPs) were synthesized by solution combustion technique using copper nitrate as an oxidizer and malic acid as a fuel for low (L), stoichiometric (S), and high (H) ratios. The prepared NPs were characterized by XRD, SEM, FTIR, UV-Vis and PL techniques. The XRD spectrum shows that the CuO NPs exhibit the monoclinic structure with the average particle size of 17, 20 and 18 nm for CuO-L, CuO-S and CuO-H respectively.

The SEM images revealed that the prepared CuO NPs exhibit bush like morphology which is composed of nanowheats for CuO-L ratio, nanorods for CuO-S ratio, and nanosheets for CuO-H ratio.The FTIR spectrum shows that the band in the range of 450-500 cm^{-1} which confirms the formation of CuO NPs for all the ratios. The UV-Vis spectrum shows the calculated band gap was around 3.26 eV for all the ratios. The PL spectrum shows that the band-edge emission peak around 485 nm and green emission peak around 580 nm and red emission peak around 615 nm for all the ratios.

Keywords: CuO nanoparticles, Solution combustion method, XRD, SEM, FTIR.

1. Introduction

Nanotechnology is considered as development of the next generation of technology with applications in many fields by which existing materials, virtually all man-made materials and systems, can acquire different properties rendering them suitable for novel applications. The metal oxide nanoparticles are an important class of semiconductors, which have applications in storage media, electronics, solar energy and catalysis. Due to its unique physical and chemical properties, CuO NPs has attracted considerable attention for its large number of applications as materials for catalysts, solar cells, optoelectronics devices, antibacterial materials, lithium batteries, and so on. CuO NPs are used in the development of gas sensors because of its high specific surface area and good electrochemical activity [1].

CuO nanoparticles have been prepared by many methods such as the sol–gel technique, combustion method, sonochemical method, electrochemical method, thermal decomposition method and so on. In the present work, we have synthesized CuO NPs by using solution combustion method and studied its structural, vibrational and optical properties [2].

Solution combustion synthesis is an exothermic redox reaction between metal nitrates (oxidizer agents) and an appropriate fuel (a reducing agent) and had been successfully used to synthesize nano-crystalline metal oxides. Solution combustion synthesis (SCS) is a versatile, simple and rapid process, which allows effective synthesis of a variety of nanosize materials [3].

2. Experimental

2.1 Materials

Copper nitrate ($Cu(NO_3)_2$), Malic acid ($C_4H_6O_5$) were purchased from Modern Scientific Company, Madurai. All the reagents were of analytical grade and were used without further purification.

2.2 Synthesis

The copper oxide nanoparticles were prepared by using solution combustion method. Copper Nitrate ($Cu(NO_3)_2$) was used as a metal precursor and malic acid ($C_4H_6O_5$) used as a fuel. Copper Nitrate is dissolved in deionized water and then stoichiometric amount of malic acid is added into it. The solution was mixed vigorously until the homogenous solution was obtained. Then the solution was kept in the hot plate. The solution boils and undergoes dehydration due to high temperature. At maximum temperature 300°C, the solution reaches the point of combustion, it began to burn, released a lot of heat as fumes and vaporizing all the solution. The combustion reaction was completed in 15 min. The fine black colour powder was obtained. The above procedure is repeated for two other ratios of malic acid such as fuel low and fuel high. The combustion reaction to form CuO NPs for stoichiometric ratio,

$$\mathbf{Cu\,(NO_3)_{2(c)} + 0.0091\,C_4H_6O_{5(c)} \Rightarrow CuO_{(c)} + N_{2\,(g)} + 0.0364\,CO_{2\,(g)} + 0.0273\,H_2O_{\,(g)} + 5\,O_{2\,(g)}}$$

2.3 Characterization

The X-ray diffraction patterns were recorded using X-ray diffractometer (XPERT-PRO) using Cu-Kα radiation (λ=0.1542 nm) operated at 40 kV and 30 mA. Scanning Electron Microscopy images were obtained by an instrument VEGA3 LMU. The Shimadzu IR affinity-1 Fourier Transform Infrared spectrometer was used to carry out vibrational studies. Shimadzu 1700 UV–Visible spectrophotometer was used to carry out the optical measurements. Photoluminescence (PL) measurements were performed by Perkin Elmer LS-55 luminescence spectrometer.

3.Results and Discussions

3.1 Optical studies

Ultraviolet-Visible spectroscopy

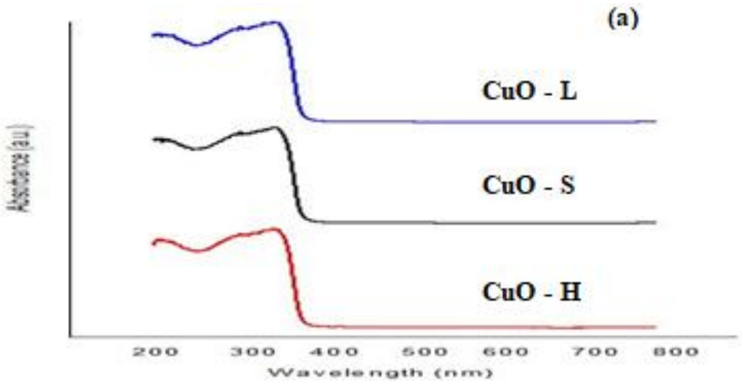


Fig. 1 (a). Absorption spectrum of CuO-L, S, H.

The optical properties of CuO NPs were determined by using UV-Vis spectroscopy. Fig. 1 shows the UV-Visible absorption spectrum of synthesized NPs for CuO-L, S and H. It shows the characteristic surface plasmon resonance (SPR) spectra with a peak maximum at 343 nm, 345 nm and 346 nm which may be attributed to the formation of CuO NPs for CuO-L, S and H.

The optical direct band gap of the produced NPs is calculated using the Tauc's relation,

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

where α=2.303A/t is called the absorption coefficient, A is the absorbance, E_g is the band gap, hν is the photon energy ('h' is the Planck's constant and 'ν' is the frequency of the incident photon) and n is the exponent that determines the type of electronic transition causing the absorption having values n =1/2 and 2 for direct and indirect band gap semiconductors respectively [4]. The calculated optical energy band gap for CuO-L, S and H are 3.28 eV, 3.26 eV, and 3.26 eV respectively. The red shift of the direct band gaps of all the 3 samples displayed the effect of the morphologies of crystals and it may be due to the quantum size effect.

Emission spectroscopy studies

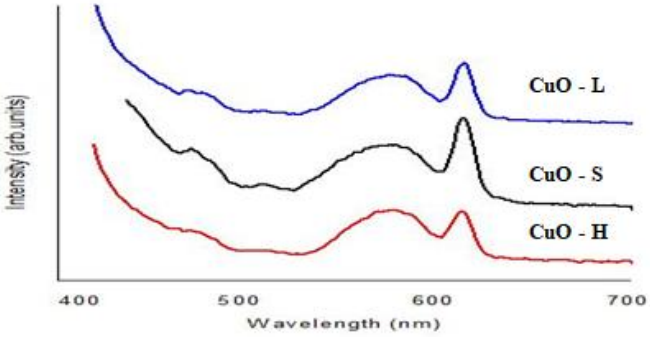


Fig. 2 Emission spectrum of CuO-L, S, H.

Fig. 2 shows the PL emission spectra of CuO NPs for CuO-L, CuO-S and CuO-H taken at 400 nm excitation wave length. The PL spectra of CuO-L NPs, which revealed the weak emission peak around 485 nm and strong emission peak around 580 and 620 nm. The band-edge emission peak is found around 485 nm in the blue region. Green emission peak is found around 580 nm. Green emission peak arises from the singly ionized oxygen vacancy of CuO materials because of recombination of a photo generated hole with a singly ionized electron in valence band. The red emission peak found around 620 nm. The different PL emission peaks of CuO may be attributed to the various sizes and shapes of CuO, which indicates that luminescence properties of CuO are strongly dependent on the morphology of the NPs [5].

3.2 Vibrational studies

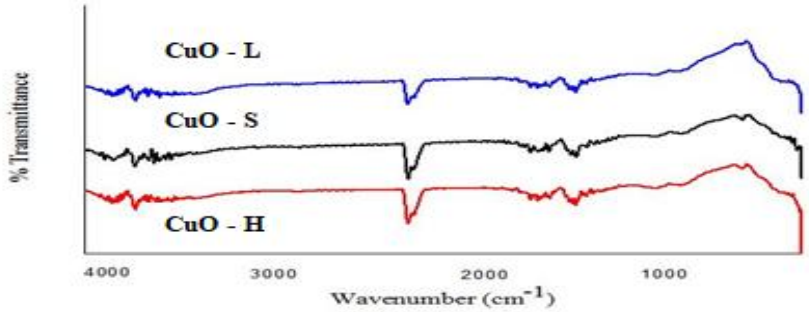


Fig. 3 FTIR spectrum of CuO-L, S, H.

Fig. 3 shows the FTIR spectrum of CuO-L, S and H NPs. FTIR Spectra were recorded in the range of 4000-400 cm^{-1}. The bands which are in the range of 3200-3800 cm^{-1} are attributed to O-H stretching vibration of water absorbed by the sample. The bands observed in the range of 2350-2360 cm^{-1} may be due to NH^{3+} stretching vibration. The bands observed in the range of 1700-1710 cm^{-1} may be due to C=O stretching vibration. The band observed around 1500 cm^{-1} may be due to N-O asymmetric stretching. The bands observed in the range of 450-550 cm^{-1} which confirms the presence of CuO NPs for all the three ratios [6]. It is clearly evident from Fig. 3 that the transmittance intensities for CuO-L have reduced and CuO-H has increased than that of CuO-S. Deviations from the stoichiometric ratio (either low or high fuel content) can lead to changes lead to changes in particle size and defect concentration, which in turn affect the optical transmittance [7].

3.3 Structural and Morphological Studies

X-ray Diffraction (XRD)

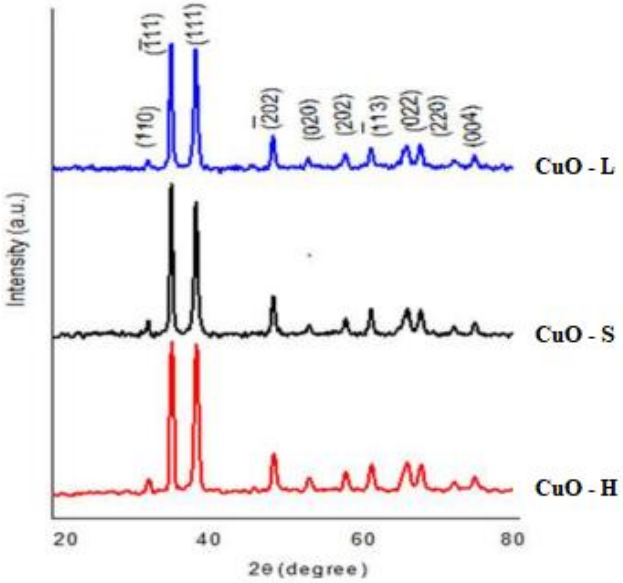


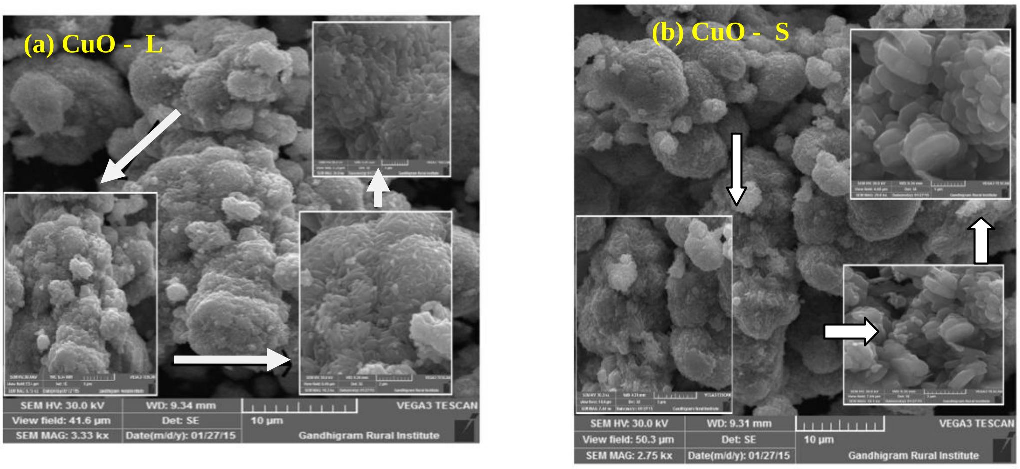
Fig. 4. XRD pattern of CuO-L, S, H.

Fig. 4 shows the XRD pattern of CuO-L, S, and H NPs. The XRD peak positions were consistent with copper oxide and sharp peaks with high intensity of XRD indicate the crystalline nature. The peaks observed at 32.45°, 35.46°, 38.67°, 48.77°, 53.43°, 58.17°, 61.49°, 66.14°, 67.98°, 72.31°, and 75.03° corresponding to (110), $(\bar{1}11)$, (111), $(\bar{2}02)$, (020), (202), $(\bar{1}13)$, $(\bar{3}11)$, (220), (311), and (004) diffraction planes respectively (JCPDS: 80-0076) [8]. All diffraction peaks of CuO corresponds to the monoclinic structure and the lattice parameters of the unit cells are a=4.679 Å, b=3.431 Å, c=5.136 Å, having β=99.262 Å. The volume of the cell for monoclinic structure was 81.40 $(Å)^3$.The average particle size of CuO NPs were calculated using Debye-Scherrer equation [9],

$$D = K\lambda / \beta\cos\theta \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Where D is the crystallite size (nm), k is a constant (0.94), λ is the wavelength of X-ray radiation (1.5406 Å), β is the full-width at half-maximum (FWHM) of the peak (in radians) and 2θ is the Bragg angle (degree) and the obtained average particle size was 17 nm for CuO-L, 20 nm for CuO-S and 18 nm for CuO-H.

Scanning Electron Microscopy (SEM)



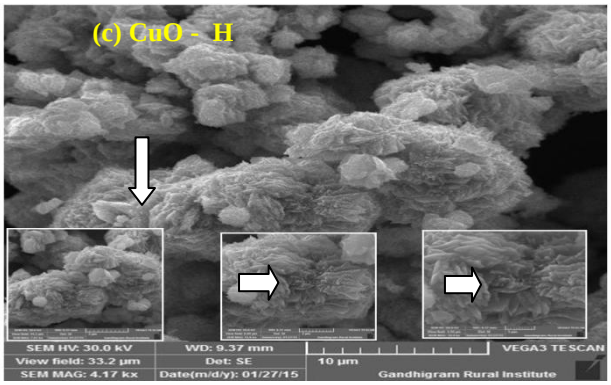


Fig. 5. a) SEM image for CuO-L. **b)** SEM image for CuO-S. **c)** SEM image for CuO-H.

Fig. 5 (a) shows the SEM image of CuO-L. The NPs exhibit the bush like morphology which is composed of wheat like structure. Fig. 5 (b) shows the SEM image of CuO-S and it exhibits the bush like morphology which is composed of rod like structure. Fig. 5 (c) shows the SEM image of CuO-H and it exhibits the bush like morphology which is composed of sheet like structure. It is clearly understood from the SEM images that, the ratio of the malic acid fuel plays a vital role in tailoring the surface morphology. In the case of fuel low ratio, the SEM images exhibits wheat like structure and when the stochiometric ratio is employed, it is transformed to rod like structure by growing in x- direction. When the fuel is increased again, the rod like morphology started to compress and started exhibiting sheet like structure [10].

4. Conclusion

The CuO NPs were synthesized by using solution combustion method. The XRD analysis showed that the CuO NPs are having monoclinic crystal structure for all three ratios. The SEM analysis exhibits different shapes of CuO NPs using different fuel ratios. The UV-Vis shows the SPR peak maximum and the obtained band gap was 3.28, 3.26, and 3.26 eV for CuO-L, CuO-S, and CuO-H respectively. The PL spectra showed that the band-edge emission peak in the blue region and the green emission peak and the red emission peak for all three ratios.

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A REVIEW ON THE METAL ELECTRODES USED IN ELECTROCOAGULATION AND NEED FOR THE ALTERNATIVE ELECTRODE

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Abstract

Electrocoagulation (EC) treatment can be used as a viable alternative to the present treatment strategy for wastewater treatment. Water treatment using the electrocoagulation technology has lately proven to be effective in avoiding the majority of difficulties while also being cost-effective. It's noted for its ease of use, efficiency, cost-effectiveness, environmental friendliness, safety, and versatility. The efficiency of the electrocoagulation method is determined by a number of factors, including the type of electrode, the amount of electrolyte, the dye concentration, the electrode's exposed area, current density, operating time, and pH. The purpose of this article is to review significant literature on subjects connected to EC within the textile wastewater that was published between 2015 and 2021.The review examines, compares, and discusses the parameters that influence the EC process in the treatment of textile wastewater and the need for its improvement for real time wastewater.

Keywords: *Electrocoagulation, Operation Costs, Parameters, Removal Efficiency, Textile wastewater.*

Introduction

Providing clean water for the human population is one of the most important challenges in today's world. Water is an essential requirement for everyone. Water scarcity, on the other hand, is a severe issue in modern India that is constantly deteriorating. The material sector, as a significant buyer of water, has a high need for water during manufacturing and handling activities.

Around 10,000 different colours are used in this business, and more than 0.7 million tonnes of these colours are produced each year. (GilPavas and Correa-Sanchez, 2020) The environment receives ten to fifteen % of these colours, which is one of the most pressing natural challenges of the twenty-first century. Because of the high concentration of colouring matters and issues of the fragments of those dye components in wastewater, produce significant environmental harmful impact (Guadie et al., 2017; Koroglu et al., 2019).

Textile effluents from a global perspective

Textile industry wastewater comprising produced colours and other auxiliary chemicals is one of the primary sources with severe contamination issues. According to market research, the textile dyeing and finishing industry is the largest consumer of the $14.5 billion commercial dyes and pigments industry, which is anticipated to grow to $42 billion by 2021. Population increase and private consumer expenditure drive the textile sector for more usage of dyestuffs.

As a result, the material sector is highly dependent on population growth and private consumer spending. In the United States, the Ready-Made Garment (RMG) industry is worth $445 billion dollars. RMG fares are highest in Asia, with China and Bangladesh as the main exporters. More than 10,000 material colours have been developed since the creation of designed colours in 1856, with an annual production prediction of more than 700,000 tonnes(Carmen and Daniel, 2012).On a yearly basis, almost a third of these coloursare used in quantities of 1,000 tonnes. Around 280,000

tonnes are released annually, either to waste water treatment facilities or directly to the environment, because only 50–95 % of the colours used are for texture(Mohamed et al., 2014; Saratale et al., 2011).Many of these colours and auxiliary synthetic compounds, including synthetics from one of the most often used colour classes, azodyes, are not biodegradable and cannot be integrated into biomass. Azodyes account for 70% of all colours used globally in terms of weight.

Dyes in textile industry

Dyeing is the most challenging step in the wet processing methods, and it is what gives the product its lovely colour. Dyeing can be done on individual fibres, yarns, or fabrics. Hundreds of different dyes and auxiliary chemicals are utilised in the manufacturing process. Water consumption per kilogramme ranges from 36 to 400 litres, with an average of 100 litres per kilogramme(Seneviratne, 2006).Textile colourants include soluble dyes and insoluble pigments and are made up of around 10,000 distinct compounds.The presence of soluble and insoluble dyes and pigments in textile effluent gives it colour. Chromophore groups (for example, N=N double bonds known as Azo) are present in these compounds. They absorb a small amount of visible light, resulting in colour. Colour can be seen at concentrations as low as 0.005 mg/L. The number of chromophore groups present determines the colour intensity.

Acid, basic, direct, dispersion, mordant, pigment, reactive, solvent, sulphur, and vat dyes are examples of different types of dyes. Basic dyes are cationic and disperse, while solvent and pigment dyes are non-ionic and just slightly water soluble. Basic dyes are cationic and disperse, while solvent and pigment dyes are non-ionic and water soluble only in small amounts. Basic dyes are cationic and disperse; solvent and pigment dyes are non-ionic and sparingly soluble in water. Acid, direct, and reactive dyes are water soluble anionic dyes; basic dyes are cationic and disperse, solvent and pigment dyes are non-ionic and sparingly soluble in water. Cotton dyes, such as reactive

and sulphur dyes have extremely poor exhaustion and fixation rates, resulting in considerable amounts ending up in the effluent.

Disperse dyes are widely used in the textile industry, mostly for synthetic fibres like polyester and cellulose acetates like Di-acetate, Tri-acetate, and nylon. At a high temperature of 120°C to 140°C, they're sprayed on the dye bath. Water does not dissolve dispersed colours. Fastness to light is generally good, however washing fastness varies greatly depending on the fibre. They are usually utilized for pastel colours in polyamides and acrylics since dark shades have limited build-up qualities and poor wash fastness. Reducing agents are needed to improve the dyeing effect of chemicals and auxiliaries like dispersion agents and thickeners (Bilińska et al., 2019)

Electrocoagulation

EC is quite possibly the most applied electrochemical techniques in wastewater treatment(Khaled et al., 2019).A. E. Dietrich invented and patented the EC measure in 1906 for the purification of bilge water from ships. J.T. Harries restricted wastewater treatment by electrocoagulation using aluminium and iron terminals in the United States in 1909.In 1984 in the US interestingly; a huge scope drinking water treatment by electrocoagulation strategy was executed.Electrocoagulation is defined by an oxidation and reduction reaction in which impurities (suspended, emulsified, or broken up) are destabilised by applying electric current to the electrolytic arrangement.

An electrolytic cell and metal anodes are connected to an exterior force supply in an EC unit. Conciliatory terminals are metal plates that are conductive and composed of the same or different materials as the anode and cathode.At the cathode, anodic disintegration produces in situ coagulants, as well as hydroxyl particles and hydrogen gas. These in situ coagulants trigger the formation of flocs within metal hydroxides and maybe poly hydroxides. By making the water lighter, the hydrogen gas created at the cathode aids in the production of flocs at the water's surface (Verma, 2017a).

For the most part, three fundamental cycles happen sequentially during electrocoagulation:

(a) Electrolytic responses at cathode surfaces

(b) Arrangement of coagulants in fluid stage

(c) Solvent or colloidal contamination adsorption on coagulants, followed by sedimentation or flotation.

Mechanism of EC

In An Electrocoagulation system, metal plates are submerged in aqueous solution. Electrodes consisting of aluminium, iron, or stainless steel are commonly used because they are inexpensive, easily available, non-toxic, and effective (GilPavas et al., 2020). One or more anode–cathode pairs are coupled in either a monopolar or bipolar mode to form an electrochemical unit(Ali et al., 2011; Chopra et al., 2011).During the electrocoagulation process, the following reactions occur at the individual electrodes (Aouni et al., 2017a).

At the anode: $M_{(S)} \rightarrow M^{n+}\ (aq) + ne^-$

$2H_2O_{(l)} \rightarrow 4H^+_{(aq)} + O_{2\,(g)} + 4e^-$

At the cathode: $M^{n+}_{(aq)} + ne^- \rightarrow M_{(S)}$

$2H_2O_{(l)} + 2e^- \rightarrow H_{2\,(g)} + 2OH^-_{(aq)}$

M stands for metal ions. During the electrocoagulation process, other side reactions occur, such as an increase in pH caused by the creation of hydroxyl ions or the consumption of hydronium ions/protons, and metal ion reduction on the cathodes. Metal cations spontaneously react to generate a range of monomeric and polymeric species, which eventually oxidise to metal hydroxide (Demirci et al., 2015).The pH of the aqueous solution has a significant impact on the formation of these complicated reactions. Pollutants in the solution are destabilised, allowing coagulation to occur; pollutants are subsequently removed from the solution via settling or flotation(Hakizimana et al., 2017).

To destabilise the contaminants, two different methods are used. Charge neutralisation of ionic species in wastewater and sweep flocculation, which captures and eliminates contaminants(Sarkar et al., 2010).

Chemical flocs are similar in size to electrochemical flocs, however electrochemical flocs are larger, have less bound water, are acid resistant, and last longer. As a result, filtration is a straightforward method for separating flocs. Gas bubbles are generated throughout the process, which bring the pollutants to the solution's surface, where they can be easily collected and removed (Tavangar et al., 2019).

Process of Electrocoagulation shown in figure 1

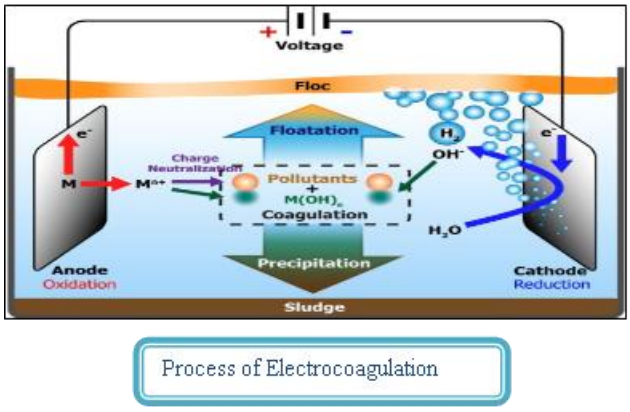

Fig. 1 Electrocoagulation process

Source:https://doi.org/10.1016/j.scitotenv.2016.11.062

Discussion of findings and relevant literature Electrodes

By delivering an electrical current into the aqueous medium via parallel metal electrodes coupled in monopolar or dipolar mode, EC can destabilise suspended, emulsified, or dissolved pollutants. The term "sacrificial electrodes" refers to conductive metal electrodes. The materials used for the sacrificial anodes and cathodes could be the same or different. The amount of electrical current needed varies depending on the volume of wastewater to be treated; nonetheless, the dyestuff must be removed with

enough, but not too much, electrical current.Excess current necessitates more electrical power and hastens electrode depletion,

Table 1 shows the different electrodes in EC under ideal conditions for wastewater other than textiles.

Table 1: Different electrodes used in EC other than textile waste water

S. No	Types of waste water	Current density	Time (mint)	pH	Anode – Cathode	COD removal %	Reference
1.	Paper industry	10 v	60	5	Fe –Al	85	(Azadi Aghdam et al., 2015)
2.	Paper industry	0.40 A/dm2	120	7	Fe –Fe	85	(Asaithambi, 2015)
3.	Olive mill	45 mA/cm2	70	6	Fe -Al	47.5	(Salameh et al., 2015)
4.	Dairy industry	5 v	120	7	Al –Fe	97	(Akansha et al., 2020)
5.	Paper making tobacco sheet waste water	40mA/cm2	6	Original	Al -SS		(Ma et al., 2015)
6.	Real printing waste water	28mA/cm2 21mA/cm2	90	original	Cu –Cu Al -Al	67 55	(Safwat et al., 2018)
7.	Rubber industry	18 v	150	7	Al/ SS	56.14	(Bow et al., n.d.)

8.	Industrial oil and Soap waste water	20 v	30	2-3	Al & Fe	96.92	(Mohammed et al., 2021)
9.	Vinegar industry	20 mA/cm2	75	4	Al	90.91	(Yılmaz et al., 2018)
10.	Vinegar industry	22.50 mA/cm2	60	9	Fe	93.58	(Yılmaz et al., 2018)
11.	Carwash waste water	30 mA/cm2	-	4-8	Ti	84	(Gönder et al., 2019)
12.	Saline water Treatment	2 mA/cm2	80	8	Al	90	(Al-Raad et al., 2019)
13.	Leather industry	20 mA/cm2	20	7	Al	82	(Gerek et al., 2019)
14.	Sugar industry	178A/m2	30	7	Al	81	(Sahu, 2019)
15.	Mining industry	4.45 mA/cm^{-2}	30	4	Al	99	(Merma et al., 2020)
16.	Hotel waste water	12 A	80	7	Al	93	(Nugroho et al., 2021)
17.	Textile waste water	5 A	15	2	SS	67	(Paul et al., 2019)

Electrode passivation

Electrode passivation is one of the most serious operating concerns with EC. Passivation of electrodes is a key risk for the process's long-term viability.

The process of depositing an obstructive layer (typically an oxide) on the electrode's surface is known as electrode passivation. For anode dissolution and electrocoagulation, passivation is undesired. The galvanostatic mode of action is the primary regulation of passivation. Both the current and potential are influenced by the system's overall resistance. A passivating layer's resistance raises the cell potential but has no effect on the coagulant or bubble formation rates.

Contaminants like carbonates, which can easily passivate the electrodes, are reduced when deionized water is used. To eliminate any passivating substance, the electrodes should be mechanically cleaned on a regular basis. This keeps the electrodes in good shape and guarantees a steady rate of anodic dissolution. Effective current flow between the anode and the cathode is likewise obstructed by these impermeable layers. When electrocoagulation is performed using AC instead of DC, corrosion on the electrodes can be prevented. The proposed EC technique with spinning electrodes by Ahmed Samir Naje et al.(Naje et al. 2017)could reduce the passivation film, increase electrolyte homogeneity, and speed up the production of flocs. This is significant since the prior EC process reactor design was incapable of removing fouling layers from the electrode's surface without the use of chemicals.

Treatment of passivation

Dye molecules and polymeric chemical species in the waste water adsorb on the electrode surfaces, causing passivation or deactivation of the electrode. Adsorption/deposition of a passivating substance on the working electrode surface is the primary cause of electrode passivation. The most noticeable implications are a reduction in electrode reaction rate, which results in the sifting of half-wave or peak potentials to more negative (in the case of cathode reaction) or more positive (in the case of anodic reaction) potentials, as well as a reduction in peak current.

Nitric acid - Nitric acid is the most frequent chemical technique for passivating a stainless steel surface. Because nitric acid is a powerful mineral acid, it dissolves all

iron complexes and other trace metals on the surface quickly. A.S. Naje et al.(Naje et al. 2017)proposed EC technique with spinning electrodes might reduce the passivation film, improve electrolyte uniformity, and speed up the generation of flocs. This is important since the previous architecture of the EC process reactor was unable to remove fouling layers from the electrode surface without the use of chemicals.

Effect of various operating parameters

The conductivity of the arrangement, anode plan, terminal shape, force supply type, pH, current density, and distance between electrodes, agitation speed, electrolysis time, initial pollutant concentration, maintenance time, and cathode passivation are all functional parameters that influence the electro coagulation interaction's effectiveness.

Arrangement of electrodes

In the cost analysis of the electro coagulation process, the electrode material and connection mode of the electrodes play a significant role.JaturunAnukulprasert et al;A. Aouni et al.(Anukulprasert et al., 2019; Aouni et al., 2017b)observed two monopolar terminals, anode and cathode, with a cathode distance of 3 cm. With dimensions of 50 x 250 x 2 mm, the aluminium plate (1100, 79.70 %) was used as terminals. The entire compelling area was 55 cm^2, and it was submerged in synthetic wastewater. According to the results of an EDAX analysis of the components in the flocs from EC, the amount of Al in the flocs was high, implying that the designed textile wastewater may be successfully treated.

The trial was led by Jayanthi et al.(Jayanthi K et al., 2018)who used iron terminals as anode and cathode, placed upright and corresponding to one another. The terminal's element measured 4 by 8cm. The spacing between the two terminals was maintained at 5cm. Iron terminals possessed the ability to transfer large amounts of Fe^+ particles into arrangement while also producing a greater amount of slop. EC with iron anode sets, the expulsion efficacy of Reactive Blue 19 was great.The test was carried out by Pushpa Lumina et al.(Pushpa Lumina, 2020)who used mild steel (MS) terminals

as anode and cathode on treating the textile wastewater. Monopolar operation was used by the terminals. Within sight of MS anodes, the underlying COD of 5600 was reduced to 449 mg/L. The best evacuation efficacy was achieved when terminals were positioned with a competent distance of 1.5 cm.

Rakshith K R et al.(R et al., 2019)concentrated their efforts on a bipolar cluster reactor with an equal number of aluminium anodes. In this treatment interaction, aluminium is employed as anodes. The anode is an aluminium helix with varied widths (6, 8, 10, and 12) mm, and the cathode is a square aluminium terminal. The usage of a novel 3D EC reactor in material wastewater treatment resulted in higher evacuation productivity when compared to comparable models.The impact of between terminal separation on expulsion proficiency was investigated by Adnan Akhtar et al. (Akhtar et al., 2020) Scrap iron sheets with an element of 7, 6cm and a viable surface space of 42 cm^2 were used as anode and cathode materials.In their research, Rezaei et al.(Rezaei et al., 2018) found that employing iron terminals to eliminate humic corrosive from watery media using the EC cycle was effective. In Zailani and Zin et al.(Zailani and Zin, 2018)announcement of the application of the EC technique for the treatment of material colours, aluminium and tempered steel cathodes were employed instead of iron terminals.

Effect of current density

One of the most fundamental activity boundaries in EC is the current density, which has a critical impact on measuring proficiency, which has an impact on the metal hydroxide fixation framed during the interaction. The cathode material deteriorates more quickly when the current density is high.The greater number of particles created on the cathodes, which encourage pollutant molecules disintegration and, finally, the total of the starting flocs, while enhancing hydrogen formation, resulted in increased dye substance evacuation productivity with increased current density.

In any case, the increased current density allows for more efficient utilization of

the anode material.Nunez et al.(Núñez et al., 2019)investigated the dye evacuation productivity remains high when the current thickness for 200 A m^2 is lowered, with 65.12 % 0.34 and 44.67 % 1.62 for Turquoise Blue (TB) colour and 46.12 % 0.26 for Scarlet Red (SR) colour, respectively. Following that, the dye evacuation ability can be assessed using a broader range of current thickness and treatment duration values. This is advantageous from both an ecological and a financial standpoint, as a reduced current density means less energy usage.

Effect of pH

In EC, the pH is a critical functional boundary. At a suitable pH for a certain effluent, the most extreme contamination expulsion productivity is obtained. An effluent's precipitation begins at a specified pH. The effluent evacuation effectiveness falls as the pH of the dye solution is increased or decreased from its ideal pH.(Kim et al., 2016)According to Khemila et al.(Khemila et al., 2018)the EC process is strongly dependent on the initial pH of the wastewater. Due to the availability of OH ions that can create metal hydroxides, T. Kim et al.(Kim et al., 2020)Using Fe and Al electrodes, researchers evaluated the removal of heavy metals (Cu, Ni, Zn, and Cr) in the presence of cyanide during EC and discovered that pH 9 was the best initial pH for heavy metal removal.According to S.P. Criado et al.(Criado et al., 2020)two types of dyes (disperse and reactive) were used in this experiment, with varying starting pH values, reaction durations, and current intensities. The influence of the starting pH was most noticeable in the reactive dye baths. pH 8 produced the greatest results. Under optimal working conditions, maximum colour removal %ages of 92.48 % and 91.34 %, as well as minimum operational expenses of $ 0.47 and $ 2.99, were reached for dispersion and reactive dyes, respectively.

Effect of EC Time

Another important element that affects the electrocoagulation process is the EC time. Because metal hydroxide production and concentrations are essential factors in

pollutant removal, operating time is important. Because electrode degradation releases more coagulant ions into the solution as response time grows, reaction time is one of the most important operational elements in all electrochemical treatment techniques. The efficiency of wastewater removal is improved by increasing reaction time. (El-Hosiny et al., 2018) undertook tests on the treatment of real wastewater from a material colouring facility at optimum states of 30 Voltage for 10 min, and found that the evacuation productivity was between15m Ampere, pH 7, and 92-99 % for all constituents, practically 100 %.EC time has the smallest value, according to Atousa Ghaffarian Khorrama et al. (Khorram and Fallah, 2018) The amount of decolorization reduced as the EC time rose from 20 to 40 minutes; however, after 40 minutes, the decolorization efficiency reversed.

This is due to variations in the volume and kind of coagulant species produced at different periods during the EC. However, at longer time intervals of 40 to 60 minutes, maximum decolorization of 97 % is recorded. This study's findings are consistent with those of earlier research, demonstrating that the optimal amount of decolorization happened about 20 minutes. As the contact time increases, better efficiencies were found, but cost of the treatment with increased contact time will not be a viable process.

Effect of Electrolyte

Examine the effect of electrolyte fixing, since most wastewater contains some salts. The evacuation capability grew as the electrolyte concentration increased due to an increase in electrical conductivity, which reached its maximum value. To boost the conductivity of the water or wastewater being treated, sodium chloride is typically employed. Using Fe and Al anodes in the presence of various supporting electrolytes such as NaCl, KCl, $CaCl_2$, NaF, Na_2CO_3, and Na_3PO_4, the influence of electrolyte type on evacuation proficiency was examined.

According to R. Keyikoglu et al. (Keyikoglu et al., 2019)the commonly used electrolyte is NaCl, because it is inexpensive and the dye wastewater contains the same,

also it has high conductivity, it requires little voltage for EC, making it economical on a modern scale. Using Fe and Al terminals in the presence of various supporting electrolytes such as NaCl, KCl, $CaCl_2$, NaF, Na_2CO_3, and Na_3PO_4, the effect of electrolyte type on expulsion efficiency was examined.Color evacuation efficiencies to Al anodes were approximately 100% with NH_4Cl, KNO_3, or KCl at a current density of 8.33 A/m^2. The removal efficiency of Fe terminals with both NaCl and KCl increased significantly when the current density was increased from 1.04 to 2.08 A/m^2. The use of KNO_3 as a supporting electrolyte appears to have decreased the colour loss effect of increased current density.

Operating Cost Analysis

In the EC process, it is vital to have the highest removal efficiency at the lowest operating cost. The electrode, the cost of electrical energy, the cost of sludge disposal, and the chemicals used to fix the pH and electrolyte are all factors in the EC's operating costs. The working expense could be calculated using the accompanying condition.

The total operational cost of the EC operation, according to Ahmed Samir Najeet al.(Naje et al., 2015a)was 1.76 US$/$m^3$. The use of electrodes and energy, as well as chemicals and sludge disposal, all contributed to this figure.Ahmed Samir Naje et al.(Naje et al., 2015b)explored how to improve an EC process for the treatment of textile effluent utilising titanium plates and integrated electrical connections, and found that under ideal conditions, 97.5 %decolorization could be achieved. According to the authors, energy usage might reach $1.69 per cubic metre.

Using Al and Fe electrodes, PhutthamonChantes et al. (Chantes et al., 2015) developed and tested a method for extracting colours from Batik dyeing effluent. The energy consumption was calculated to be 7.9010-3 kWh/kg dyes, whereas the electrode consumption was 2.2810-4kg electrodes/kg dyes. The best operational settings of an unique rotational bed EC reactor for the treatment of textile wastewater were explored by A.S. Naje et al. (Naje et al., 2016)0.038 kg/m3, 4.66 kWh/m3, and 0.44 US$/m3

were the electrode usage, energy consumption, and operational costs, respectively.

With Al and Fe electrodes, continuous flow electrocoagulation (CEC) was used to treat actual dye house effluent.Working expenses for Fe and Al electrodes at optimum operating conditions were computed as 1.562 $/m^3 or 7.282 $/kg COD for Fe electrode and 1.851 $/m^3 or 14.257 $/kg COD for Al electrode, according to M. Kobya et al. (Kobya et al., 2016)Using aluminium electrodes, Billal Khemila et al. (Khemila et al., 2018) evaluated the operation of a continuous photovoltaic electrocoagulation process (PVEC) for the removal of a textile dye containing an EC section: When utilising direct current, the specific electrical energy consumption for EC was determined to be 16 kWh/kg of removed dye, and it was shown to be equal when using solar cells. With electrode usage of 0.45 and 0.6 kg Al/kg of dye removed, the two energy sources are comparable.According to S. Bener et al. (Bener et al., 2019)real textile waste water was electrocoagulated and reused in agricultural irrigation. Monopolar electrodes composed of Al and Fe were used in this study. With various current densities, a cost analysis was considered.

It was discovered that the operating costs are directly proportional to the current. The operational cost grew when the current density was raised. At ideal conditions, the overall cost was calculated to be 1.5 $/m^3.S.P. Criado et al.(Criado et al., 2020)used EC with aluminium electrodes to treat wastewater comprising two textile colours (DanixMarinho S-2G 200 % disperse; Remazol Brilliant Blue R - reactive). Response surface methodology (RSM) was used to plan the trials, which included a Box-Behnken design (BBD) and a complete factorial design (CFD). Under optimal working conditions, maximum colour removal %ages of 92.48 and 91.34 %, as well as minimum operational costs of $ 0.47 and $ 2.99, were reached for dispersion and reactive dyes, respectively.Table 1 shows the different electrodes in EC under ideal conditions for wastewater other than textiles. Table 2 shows the EC for removing textile dyeing wastewater.

S. No	Dye	Anode/ Cathode material	Reactor type	current density	Time (min)	pH	(%) of COD removal efficiency	Reference
1.	Real time textile waste water	Pt/Ti-iron	Batch	3v	60	3	93.5	(Chanikya et al., 2021)
2.	textile waste water	Al-Al	Batch	14v	60	8	82	(Kothai et al., 2021)
3.	Real indigo dye	Fe-Fe	Continuous	35v	2Lmin^{-1}	7.5	93.972	(Hendaoui et al., 2018)
4.	Congo Red dye	Fe-Fe	Batch	80v	75	3	97	(Akhtar et al., 2020)
5.	Yellow 10 gw dye	Al-Al	Batch	40 A m^{-2}	10	7	99.84	(Kalivel et al., 2020)
6.	Yellow 10 gw dye	Cu -Cu	Batch	60 A m^{-2}	15	5	89.71	(Kalivel et al., 2020)
7.	Real time textile waste water	Fe-Fe	Batch	8mA cm^{-2}	10	7	59	(Núñez et al., 2019)
8.	Real time textile waste water	Fe-Fe	Batch	10mA cm^{-2}	60	8.7	97	(Zazou et al., 2019)
9.	Real time textile waste water	Al-Al	Batch	15 mA/ Cm2	23	5.5	40	(Khorram and Fallah, 2018)

10.	textile waste water	Mild steel –mild steel	Batch	30v	80	8.2	92	(Pushpa Lumina, 2020)
11.	textile waste water	Al-Al	Batch	20v	30	8.3	96.4	(Gzar et al., 2020)
12.	textile waste water	Al-Al	Batch	18v	60	7.2	70	(R et al., 2019)
13.	textile waste water	Al-Al	Batch	53 A m^{-2}	60	6	82.5	(M Sen et al., 2019)
14.	Real time textile waste water	Al-Al	Batch	25 mA/cm2	120	5	83.5	(Bener et al., 2019)
15.	Real time waste water	Mp Al-Bp Al	Batch	30 v	90	6	96.5	(Naje et al., 2015a)
16.	Removal of Cr(VI) ions from waste water	Fe -Fe	Batch	0.55 A	14	4.6	-	(El-Taweel et al., 2015)
17.	Reactive blue 21	Fe –Fe	Batch	30 A/m^2	7	8.4	95	(Ardhan et al., 2015)
18.	Real time waste water	Mp-Ti Bp- Al	Batch	0.6 A	90	6	97.5	(Naje et al., 2015b)
19.	Real time waste water	Fe –Fe	Taguchi	150 A/m^2	30	8	99.1	(Ozyonar, 2015)
20.	Batik dyeing wastewater	Fe-Al	Batch	12 v	60	12	70	(Chantes et al., 2015)
21.	Red nylosan N-2RBL dye	Al-Al	Continuous	100 A/m^2	35	8.8	97	(Amour et al., 2015)
22.	Crystal violet dye	Al-SS	Batch	250 A/m^2	60	5.4	70	(Mbacké et al., 2016)
23.	Real time	Al-Al	Continuo	65	80	5.5	95	(Kobya et

	waste water	Fe-Fe	us	A/m^2				al., 2016)
24.	Real time textile waste water	Fe-Al	Batch	20 A/m^2	80	8	99	(Verma, 2017b)
25.	Removal of Malachite Green	Al-Fe	Batch	76.5 A/m^2	30	8	96	(Getaye et al., n.d.)
26.	Eriochrome black textile dye	Al-Al	Batch	7 v	55	7	98.5	(Cestarolli et al., 2019)
27.	Celestine Blue Dyes	Fe,nylon 66 nanofiber	Batch	2v	24	7	79.4	(Saad et al., 2020)
28.	textile waste water	Fe –Al-SS	Batch	2.1v	65	7	96.22	(Esther Baby et al., 2021)

Conclusion

Despite the fact that many studies have been published on the removal of various colours from textile waste water using EC, it was discovered during the thorough review that only a few studies have been done to develop a strategy for boosting dye removal efficiency with reduced electrolysis time and applied current, according to the author's knowledge.A few authors have combined EC with other processes such as oxidation, ion exchange, chemical coagulation, ultra filtration RSM technique, and Nano filtration to improve the effectiveness of colour removal.Only a few authors have looked at the treatment of continuous flow textile dyeing effluent. Traditional electrode materials (Al and Fe) coagulate well, but they produce a lot of O_2, are anodically soluble, and have a short lifespan. There are limited reports on novel electrode materials in the literature. When employing aluminium electrodes, the main

concerns with the EC are energy consumption and electrode passivation, as well as the fact that iron electrodes are easily dissoluted and corroded. As a result, a new electrode will be required.

To improve the performance of EC process:

Selection of Electrode Material: Choose electrodes with high conductivity, low overpotential, and minimal passivation. Common materials include aluminium, iron, and, more recently, composite or coated electrodes that enhance performance.

Electrode Configuration: Use different electrode configurations (e.g., parallel, series) to optimise current distribution and reduce energy consumption.

Coating and Treatment: Apply coatings to electrodes to reduce corrosion and enhance conductivity. Regular treatments to remove passivation layers can also improve efficiency.

Current Density: Optimise the current density to balance efficient pollutant removal and energy consumption. Too high a current density can lead to excessive anode dissolution and increased energy costs.

Voltage Control: Implement real-time monitoring and control systems to adjust voltage based on the quality of wastewater and the extent of contamination.

Dye Breakdown Pathways: Investigate the specific breakdown pathways for various dyes to tailor the EC process for more effective decolorization. Advanced analytical techniques (e.g., mass spectrometry, NMR) can be used to identify intermediates and final products.

By focusing on these areas, the performance of the EC process can be significantly improved, making it a more viable and efficient method for real-time wastewater treatment.

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74. **DATA AVAILABILITY**

All relevant data are included in the paper

COMPETING INTERESTS

The authors declare no competing interests.

EVALUATION OF PHYTOCHEMICAL AND ANTIBACTERIAL ACTIVITY OF *CISSUS QUADRANGULARIS*

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Abstract

Nature has been a source of medicinal agents for thousands of years. In the recent years, the rise in emergence of resistant bacteria against the synthetic drugs has led to the screening of several medicinal plants for their potent antimicrobial activity. Medicinal plants produce different types of secondary metabolites showed strong compound effects against many pathogens. The aim of the present study is to analyse the phytochemical and pharmacological activity of chloroform and ethanol extract of Cissus quadrangularis. In the present study chloroform and ethanol extract of C. quadrangularis was subjected for phytochemical analysis to confirm the presence of different phytochemicals.

After the confirmation these chloroform and ethanol extract were assessed for its anti-microbial activity in terms of zone of inhibition against the selected pathogens.

The results revealed that both chloroform and ethanol extract of C. quadrangularis showed the presence of alkaloids, tannins and coumarins. Whereas flavonoids and saponins were absent in chloroform and ethanol extract. In anti bacterial activity the highest dose (500µg/ml) of both chloroform and ethanol extract of C. quadrancularis exhibited highest anti bacterial activity in terms of zone of inhibition against all the pathogens such as Streptococcus mutans, Staphylococcus aureus and Pseudomonas aeruginosa. Compared to chloroform extract most of the doses (except 50 µg/ml) of ethanol extract showed potential antibacterial activity. The results clearly indicates that the activity is a dose dependent manner which is defined as higher the concentration higher the activity. Thus, the present study revealed that the chloroform and ethanol extract of Cissus quadrangularis showed potential antibacterial activity against pathogens.

Key words: *Phytochemical analysis, antimicrobial activity, Cissus quadrangularis, chloroform extract, ethanol extract*

1. INTRODUCTION

Nature has a very rich botanical wealth and a large number of diverse types of plants grow in different parts of the country. Among the 7000 species of medicinal plants recognized all over the world. The herbal and natural products have been used in folk medicine for centuries throughout the world, but there are relatively lower incidences of adverse reaction to plant preparations compared to modern conventional pharmaceuticals (Nair *et al.,* 2005). Plants are the richest resource of drugs in traditional system of medicine, nutraceuticals, food supplements, folk medicine, pharmaceutical and enrichment for synthetic drug. Plants are used medicinally in different countries and are the source of many potent and powerful drugs. Medicinal plants are a source of great economic value all over the world. Also, the exploration of traditional herbal remedies is a viable research initiative.

According to the World Health Organization, 80% of the world population is dependent on the traditional use of medicinal plants (Swamy and Sinniah 2015). Ayurveda, unani, sidda, traditional and folk health care management includes the use of herbal medicine. It can be used to benefit the total population. Thus, it is important to explore these plants based on their bioactivity and their bioactive compounds. India has one of the richest ethnabotanical traditions in the world with more than 7000 species of plants found in different agro-ecosystems and used by various indigenous systems of medicine and industries (Sharma *et al.*, 2012).

Medicinal plants have curative properties due to the presence of various complex chemical substances called secondary metabolites. Many secondary metabolites of plant are commercially important and find use in a number of pharmaceutical products. Different plants parts are used for medicinal purpose bulbs, gel, leaves, roots, barks and peels. The most important compound in plant is alkaloids, saponins, coumarins, tannins, flavonoid. World health organization also describe that plant can be used for synthesis of useful drug and for other therapeutic uses. These phytochemicals are considered to be effective, safe, and natural compounds, with no or lower side effects (Anne Catherine, 2007).

New plant compounds with diverse chemical structure and mechanisms of action have been extensively studied by ethno pharmacologists, botanists and microbiologists. The herb *Cissus quadrangularis* belong to the botanical family Vitaceae and, genus Cissus. *C. quadrangularis* is used to treat various ailments including burns, wounds, sores, insect bites, skin allegies, chronic coughs, asthma, bronchitis, sore throat and mycobacterium tuberculosis, microbial infections, kidney troubles, decrease vaginal discharges, treat urinary diseases and headaches. The leaves also have many traditional medicinal uses, especially for the treatment of coughs, sore throats, nasal congestion.

The antimicrobial compounds extracted from plants can be used for applications in treating infectious, systemic and inflammatory activity. In food preservation and agriculture, against phytopathogens (Sakkas and Papadoulou, 2017). The aim of the present study is to evaluate the phytochemial properties and antibacterial activity of chloroform and ethanol extracts of the medicinal plant *Cissus quareangularis*.

2. MATERIAL AND METHODS

2.1 Experimental Plant

The herb *Cissus quadrandularis* belong to the botanical family Vitaceae and genus *Cissus*. It is a perennial, large succulent herb, aromatic perennial herb, and characteristics smelling leaves. *Cissus quadrangularis* reaches a height of 1.5m and has quadrangular-sectioned branches with internodes 8-10 cm long and 1.2-1.5 cm wide. Along each angle is a leathery edge. Toothed trilobe leaves 2-5 cm wide appear at the nodes. Each has a tendril emerging from the opposite side of the node. *Cissus quadrangularis* has been used as a medicinal plant since antiquity. It has been used in various ayurvedic classical medicines to heal broken bones and injured ligaments and tendons. The assamese people and the Garo tribe of Meghalaya and Bangladesh have used *C.quadrangularis* for bone fracture. The vernacular names of *C.quadrangularis* is Pirandai (Tamil), Hadjod (Hindi), Hasjora (Bengali), Veld grape (English), Nalleru (Telungu) and Ghanasakande (Marathi).

Plate:1Experimental plant - *Cissus quadrangularis*

2.2 Preparation of *C. quadrancularis* extract

C.quadrancularis plant was collected from the garden. The plant was washed thoroughly 2-3 times in tap water followed by distilled water and shade dried. The dried plant was crushed, powdered and stored in refrigerator at 20^{o} C until used.

i. Preparation of chloroform extract (CE)

According to the method of Cooper and Gunn, (2005) and Singh *et al.,* (2007), the chloroform extract of C. *quadrangularis was* prepared. According to the method, hundred grams of plant powder were exhaustively percolated with 200ml of chloroform for five days with regular agitation. After five days of percolation, the extract was filtered through sterile muslin cloth and the filtrate was collected and the solvent was removed from the filtrate using Rotary Vacuum Evaporator and the residue obtained after evaporation was stored at -20º C until used for further experimentation.

ii. Preparation of ethanol extract (EE)

Ethanol extract of *C. quadrangularis* was prepared by following the method of Cooper and Gunn, (2005) and Singh *et al.,* (2007). According to this method, hundred grams of plant powder was percolated with 200 ml of ethanol for five days with intermittent shaking. The extract was filtered through sterile muslin cloth and the filtrate was collected and the solvent was removed from the filtrate using Rotary Vacuum Evaporator and the residue obtained after evaporation was stored at -20º C until used for further experimentation.

2.3 QUALITATIVE CHEMICAL EVALUATION

The extract obtained were subjected to qualitative test for the identification of various phytochemical constituents.

a). Detection of alkaloids

A small quantity of the extract was treated with a few drops of diluted hydrochloric acid and filtered. The filtrate was treated with different regents such as

Wagner's reagent and Mayer's reagent. On treatment with diluted hydrochloric acid basic alkaloids are made soluble in water by forming salt. The alkaloids in acid solution form insoluble precipitate when treated with different reagents containing metal ions (Mukerjee, 2002).

i. Wagner's test

To 1 ml of extract few drops of Wagner's reagent (iodine and potassium iodide) was added. Formation of reddish-brown precipitate showed the presence of alkaloids.

ii. Mayer's test

To 1ml of the extract, few drops of Mayer's reagent that has solution of potassiomercuric iodide solution were added. Formation of cream or yellow coloured precipitate indicates the presence of alkaloids.

b). Detection of saponins

The extract was diluted using 20 ml of distilled water. Then it was agitated in a graduated cylinder for 15 minutes. Steroidal glycosides (saponins) are surface active. Hence it reduces surface tension like soap solution. The formation of foam showed the presence of saponins (Kokate *et al.,* 1999).

c). Detection of coumarins

To 1ml of extract and 1ml of 10% NaOH was added. When treated with bases like ammonia or sodium hydroxide, coumarin gives yellow colour. The formation of yellow colour is due to the cleaved products of coumarin containing phenolic group, which form salt with sodium hydroxide (Dean *et al*.,1963)

d). Detection of tannins

i) Ferric chloride test

To 1- 2 ml of plant extract, few drops of 5% aqueous FeCl3 solution was added. A bluish black colour was formed and it disappears by the addition of few ml of diluted H2SO4 and followed by the formation of a yellowish-brown precipitate indicates the presence if tannins (Kokate *et al*., 1999).

e). Detection of flavonoids

To 0.5 ml of plant extract was treated with 5-10 drops diluted HCI solution. Then few drops of magnesium were added. To this soution, 5-6 drops of concentrated hydrochloric acid was added and red or orange color was observed which indicates the presence of flavonoids (Klyne, 1965).

2.4 Anti- bacterial activity of *Cissus quadrangularis*

Test organisms

Pseudomonas aeruginosa, *Staphylococcus aureus* and *Streptococcus mutans* was purchased from MTCC, Chandihar, India. Nutrient Agar medium, Nutrient broth, Gentamicin antibiotic solution was purchased from Himedia, India. Test sample, petri-plates, test tubes, beakers conical flasks, Spirit lamp and double distilled water.

A. ANTIMICROBIAL ASSAY USING AGAR – WELL DIFFUSION METHOD

a. Preparation

The medium was prepared by dissolving 2.8 g of the commercially available Nutrient Agar Media (HiMedia) in 100ml of distilled water. The dissolved medium was autoclaved at 15 lbs pressure at 121^{o}C for 15 minutes. The autoclaved medium was mixed well and poured on to 100 mm petriplates (25-30ml/plate) while still molten.

b. Preparation of Nutrient broth

Nutrient broth was prepared by dissolving 2.8 g of commercially available nutrient medium (HiMedia) in 100ml distilled water and boiled to dissolve the medium completely. The medium was dispensed as desired and sterilized by autoclaving at 15 lbs pressure (121^{o}C) for 15 minutes.

c. Anti-microbial assay

According to the method of (Murry *et al*., 1995) petri plate containing 20ml of nutrient agar medium were seeded with 24 hrs culture of bacterial strains such as *Pseudomonas aeruginosa* - 424, *Staphyloccus aureus* - 902 and *Streptococcus mutans*

were adjusted to 0.5 OD value according to McFarland standard. Wells were cut and concentration of sample chloroform and ethanol extract of *C.quardrangularis* at a concentration of 500, 250, 100 and 50 µg/ml was added. The plates were then incubated at 37^{o}C for 24 hours. The antibacterial activity was analyzed by measuring the diameter of the inhibition zone formed around the wells. Gentamicin antibiotic was used as a positive control. The values were calculated using Graph Pad Prism 6.0 software (USA).

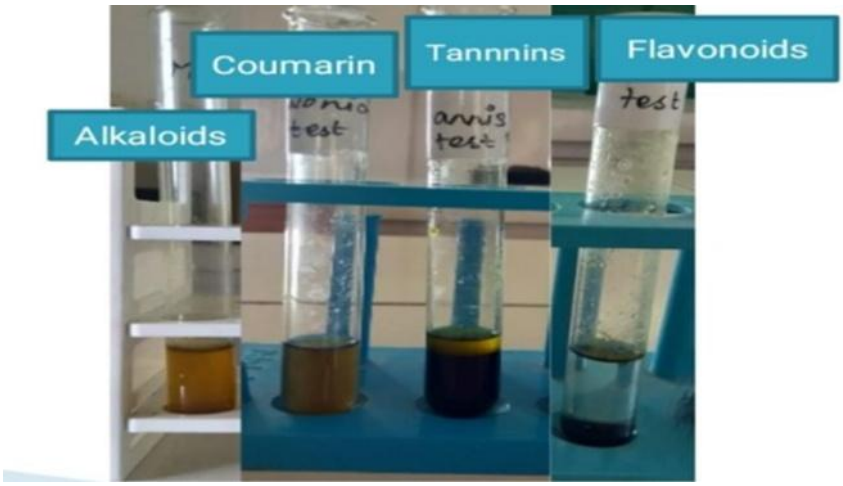
3. RESULTS

3.1 QUALITATIVE ANALYSIS OF PHYTOCHEMICAL CONSTITUENTS OF CHLOROFORM AND ETHANOL EXTRACT OF *C.QUADRANGULARIS*

The qualitative test was performed to analyze the presence of various phytochemical constituents of chloroform and ethanol extract of *C. quadrangularis.*

Table: 1 Qualitative analysis of phytochemical constituents in the chloroformand ethanol extract of *C . quadrangularis*

Phytocomponents	Chloroform extract	Ethanol extract
Alkaloids	+	+
Saponins	+	-
Coumarins	+	+
Tannin	+	+
Flavonoids	-	+



Phytochemical analysis of chloroform extract of *C.quardrengularis*

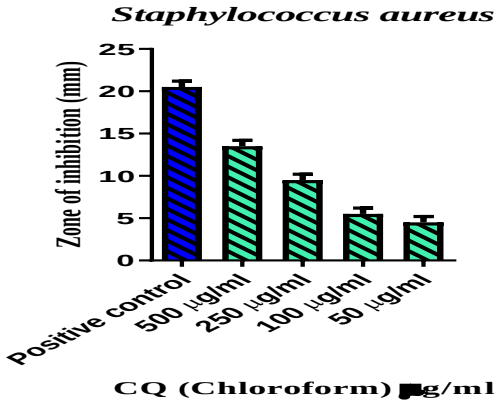
2. Phytochemical analysis of ethanol extract of *C.quardrengularis*

The result showed that the presence of alkaloids, coumarins and tannin were present in both chloroform and ethanol extract whereas saponin was present only in chloroform extract and flavonoids were present only in ethanol extract.

3.2 Effect of chloroform extract of *C. quadrangularis* on antibacterial activity

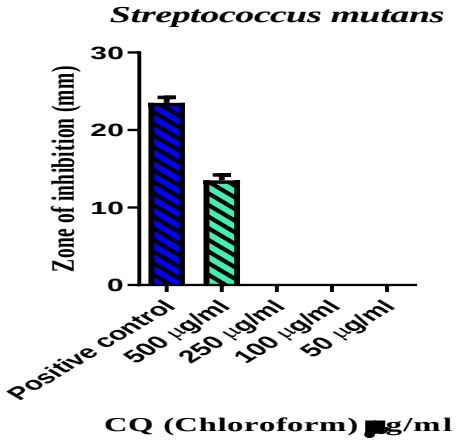
In the present study, chloroform extract obtained from *C. aureus* was studied against *Staphylococcus aureus*, *Streptococcus mutans* and *Staphylococcus aureus* at a concentration of 50, 100, 250 & 500 µg/ml.

1. Antibacterial activity of chloroform extract of *C. quadrangularis* against *S. aureus.*



2Antibacterial activity of chloroform extract of *C. quadrangularis* against *S.mutans*

S.mutans



3. Antibacterial activity of chloroform extract of *C. quadrangularis* against *P.aeruginosa*

Pseudomonas aeruginosa

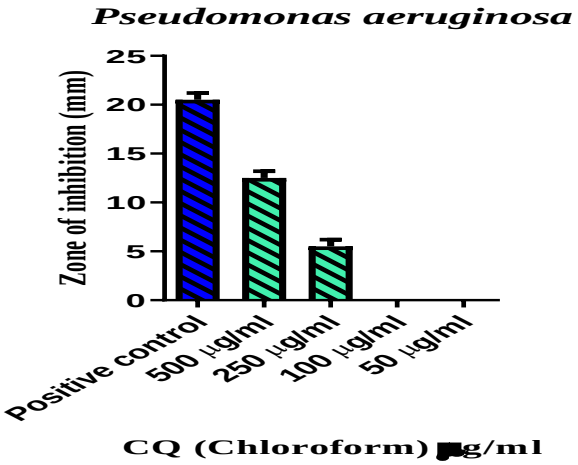


Table: 2 Zone of inhibition of chloroform extract of *C.quadrangularis* against different microorganisms

S. No	Name of the test organism	Zone of inhibition (mm) SD ± mean				
		500µg/ml	250µg/ml	100µg/ml	50µg/ml	PC
1	*Streptococcus mutans*	13.5±0.7	0	0	0	23.5±0.7
2	*Staphylococcus aureus*	14.5±0.7	9.5±0.7	5.5±0.7	4.5±0.7	20.5±0.7
3	*Pseudomonas aeruginosa*	12.5±0.7	5.5±0.7	0	0	20.5±0.7

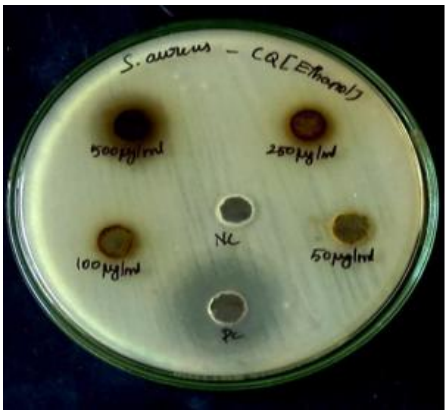
As per the result shown in table 2, the highest dose (500µg/ml) of chloroform

extract exhibited highest antibacterial activity against all the pathogens such as *Streptococcus mutans*, (Zone of inhibition 13.5±0.7), *Staphylococcus aureus (*Zone of inhibition 14.5±0.7) and *Pseudomonas aeruginosa* (Zone of inhibition 12.5±0.7).

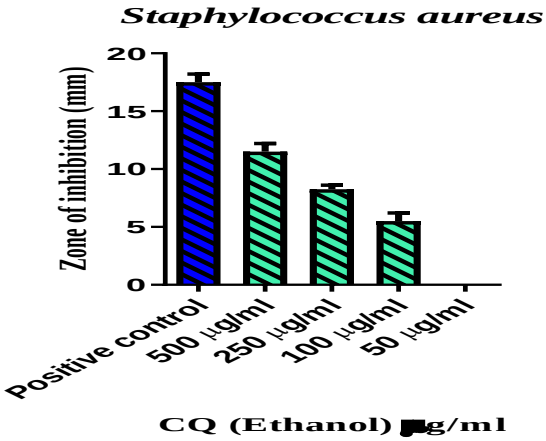
3.3 Effect of ethanol extract of *C. quadrangularis* on antibacterial activity

In the present study, ethanol extract obtained from *C. aureus* was studied against *Staphylococcus aureus*, *Streptococcus mutans* and *Staphylococcus aureus* at a concentration of 50, 100, 250 & 500 µg/ml.

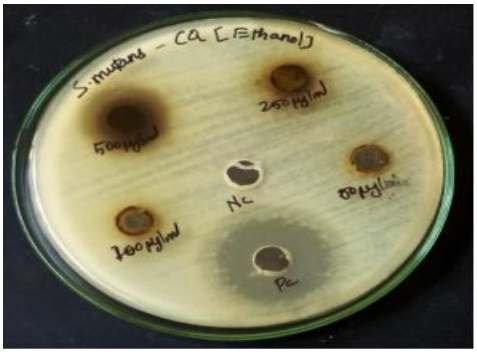
1. Antibacterial activity of ethanol extract of *C. quadrangularis* against *S. aureus*.



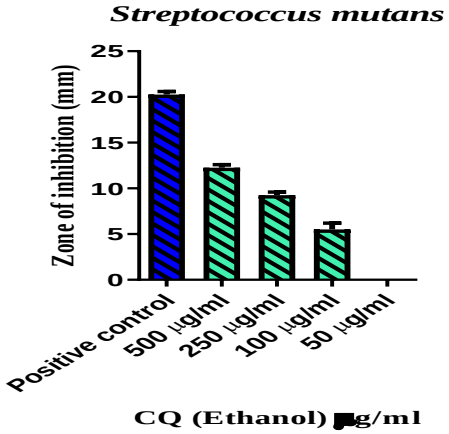
Staphylococcus aureus



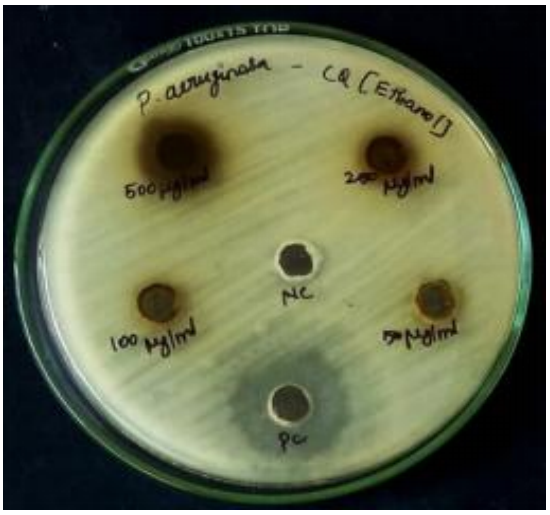
2. Antibacterial activity of ethanol extract of *C. quadrangularis* against *S. mutans*



Streptococcus mutans



Antibacterial activity of ethanol extract of *C. P.aeruginosa*.



Pseudomonas aeruginosa

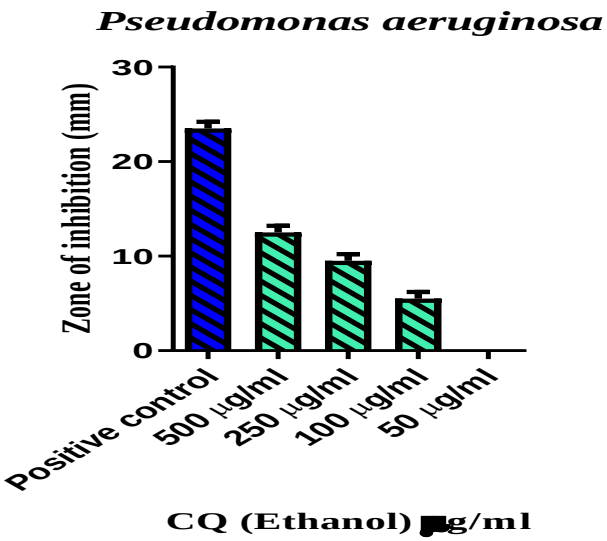


Table: 3 Zone of inhibition of ethanol extract of *C.quadrangularis* against different microorganisms

S. No	Name of the test organism	Zone of inhibition (mm) SD ± mean				
		500µg/ml	**250µg/ml**	**100µg/ml**	**50µg/ml**	**PC**
1	*Streptococcus mutans*	12.25±0.35	9.25±0.35	5.5±0.7	**0**	20.25±0.3 5
2	*Staphylococcus aureus*	11.5±0.7	8.25±0.35	5.5±0.7	**0**	17.5±0.7
3	*Pseudomonas aeruginosa*	12.5±0.7	9.5±0.7	5.5±0.7	**0**	23.5±0.7

The highest dose (500µg/ml) of ethanol extract of *C. quadrangularis* exhibited potential antibacterial activity against *Streptococcus mutans* (12.25±0.35), *Staphylococcus aureus* (11.5±0.7) and *Pseudomonas aeruginosa* (12.5±0.7). Like that the mid (250 µg/ml) and lower dose (100 µg/ml) exhibited potential antibacterial activity against all the doses tested.(Table: 3).

4. DISCUSSION

4.1 ANALYSIS OF PHYTOCHEMICAL CONSTITUENTS OF *C. QUADRANGULARIS*

The qualitative phytochemical analysis of chloroform and ethanol extract of *C. quadrangularis* exhibited the presence of alkaloids, flavonoids, tannin, saponins and coumarins. Our results are in agreement with Wadood *et al.* (2013) reported that the phytochemical constituents of aqueous extract of *Acacia nilotica, Psidium gujauva, Morus alba, Luffa cylindrical, Morus nigra, Fagonia cretica, Ficus palmate, Prunus persica and Momordica charantia* leaves. They have revealed that all the plants showed the presence of flavonoids,
alkaloids, reducing sugar, phlobatannins and terpenoids. The methanol, chloroform and ethylacetate extract of *Eurycoma longifolia* stem and root showed the presence of flavonoids, terpenoids, proteins, cardiac glycosides and phenolic compounds (Khanam *et al*., 2015).

The petroleum ether, benzene, chloroform, methanol, ethanol and acetone extracts of *Anamirta cocculus* showed the presence of different types of bioactive compounds such as alkaloids, flavonoids, lipids, phytosterols, proteins, glycosides, phenols, saponins, cardiac glycosides, terpenoids, tannins, phenolic compounds and carbohydrates (Qadir *et al.*, 2015). The methanol, chloroform and ethylacetate extract of *Eurycomalongifolia*stem and root showed the presence of flavonoids, terpenoids, proteins, cardiac glycosides and phenolic compounds (Khanam *et al*., 2015).

The methanol and ethanol extract of *Cissus quadrangularis* showed the presence of alkaloids, tannins, terpenoids, flavonoids, proteins, carbohydrates, cardiac glycosides, phenols and saponins (Prabhavathi *et al*., 2016). The methanol and ethanol extract of *Ephedra intermedia* showed the presence of phenols, flavonoids, cardiac glycosides, reducingsugars and alkaloids (Gul *et al.,* 2017). The water and water alcohol extract of *Withania somnifera* showed the presence of phenols (Dhanani *et al.,* 2017). The *Pterocarpus marsupium* exhibited the presence of saponins, alkaloids, glycosides, tannins, proteins, cardiac glycosides, terpenoids, flavonoids and carbohydrates (Pant *et al*., 2017). The phytochemical screening of Tulbaghia species such as *T.acutiloba, T.alliacea, T.cernua, T.eucantha, T.natalensis, T.ludwigiana, T.simmleri* and *T.violacea* showed the presence of steroids, flavonoids, tannins, glycosides, terpenoids and saponins (Takaidza *et al*., 2018).

In another study the methanol and ethanol extract of *C.qudrangularis* exhibited the presence of flavonoids, alkaloids, tannins triterpenoids, saponins and glycosides (Dhanasekaran, 2020).The phytochemical assessment of *C.quadrangularis* indicated the presence of flavonoids, triterpenoids, alkaloids, saponins, glycosides, iridoids, vitamins and steroids (Bafna *et al.,* 2021). Jha *et al.,* (2022) reported that the ethanolic extract of *Aloe vera* extract showed the presence of alkaloids, saponins, tannins, flavonoids, anthraquionones, terpenoids, coumarins, glycosides, xanthoproteins, steroids and phenols. Hamid and Patil, (2023) reported that the *C.quadrangularis* exhibited a variety of phytochemical constituents such as tannins, proteins, carbohydrates, phenol flavonoids, triterpenoids, phytosterols, glycosides, saponins, vitamin C and alkaloids. The methanol and ethanol extract of *C. quadrangularis* showed the presence of flavonoids, alkaloids, saponins, phenolic compounds and carbohydrares (Undal, 2023). The methanol extract of *Andrachne aspera* and *Dichrostachys cinerea* showed a potential antibacterial activity against *S.epidermidis* (Asfaw *et al*., 2023).

4.2 ANTIBACTERIAL ACTIVITY OF *C. QUADRANGULARIS*

In the present study the highest dose (500µg/ml) of chloroform anf ethanol extract of *C.quardrangularis* showed a potential anti-bacterial activity against *Streptococcus mutans, Staphylococcus aureus* and *Pseudomonas aeruginosa.* Our results are in aggreement with Mishra *et al.* (2013). They reported that 75% methanol extract of *A. paniculata* leaves was found to be active against *S.aureus*, *E. faecalis* and *M. tuberculosis*. The hexane, methanol and chloroform extract of *Polyalthia logiflia* leaf extract provoked strong antibacterial activity against the pathogenic bacteria *Sarcina lutea* with the zone of inhibition ranging from 41.80mm, 44.20mm and 43.50mm respectively (Parvin *et al*., 2013). The chloroform extract of *Cissus quadrangularis* exhibited a significant antibacterial activity against *E.coli, B.staphylococcus, Pseudomonas putida* and *Staphylococcus aureus* (Baskar *et al.*, 2013).

The chloroform stem extract of *A.paniculata* possess highest antibacterial activity against *Escherichia coli, Bacillus subtilis, Staphylococcus aureus* and *Streptococcus pyogenes* (Gurupriya and Cathrine, 2016). The acetone and isopropyl alcohol extract of *Pterocarpus marsupium* showed the antibacterial activity against *Staphylococcus aureus* and *Bacillus cereus* (Pant *et al*., 2017). The methanol and ethanol extract of *Lepidium sativum* showed maximum antimicrobial activity against *E.coli* and methanol extract exhibited antibacterial activity against *P.aeruginosa* (Besufekad, *et al*., 2018).

The methanolic extract of *A.paniculata* revealed the presence of phenols, flavonoids, tannins, alkaloids, saponing, terpenes and steroids (Akintola *et al.*, 2018). The phytochemical screening of Tulbaghia species such as *T.acutiloba, T.alliacea, T.cernua, T.eucantha, T.natalensis, T.ludwigiana, T.simmleri* and *T.violacea* showed the presence of steroids, flavonoids, tannins, glycosides, terpenoids and saponins (Takaidza *et al*., 2018).

The methanol extract of *C.quadrangularis* showed a potential antibacterial activity against Escherichia species (Chenniappan *et al.,* 2020). The ethanol extract of *C.quadrangularis* showed a effective antibacterial activity against *Entericoccus faecalis* and *Pseudomonas aeruginosa* (Rattanasuk *et al.,* 2021). The methanolic extract of *C.quadrangularis* showed highest anti-bacterial activity against *Vibrio parahaemolyticus, Shigella flexneri* and *Serratia marcescens* (Payani *et al.*, 2023). The leaf methanol extract of *C.hastata* showed the presence of alkaloids, steroids, terpenoids and saponins (Muhamad *et a* Discuss the implications of the findings for practical applications and suggest directions for future research.*l.*, 2023). The methanol extract of *Solanum sisymbriifolium* exhibited the presence of proteins, phenols, saponins, flavonoids, alkaloids, steroids, carbohydrates and terpenoids (Gebrewbet and Hndeya 2023).

5. CONCLUSION

The present study clearly reveals the chloroform and ethanol extract of *C. quadrangularis* showed the presence of various phytochemical constituents and exhibited potential antibacterial activity against various pathogens. Over the time, health benefits of the available drugs are under threat as it becoming less effective not only because many of them produce toxic reactions but also due to emergence of drug-resistant bacteria. Further phytochemical research is important to provide relevant information for the development of potential bioactive compounds that benefit the development of new therapeutic needs for microbial infection. Thus, the result of the study on *Cissus quadrangularis* conformed the multifaceted consequential ingredients for superior health and nutrition of human beings.

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INFLUENCING AI TOOLS IN TEACHING, LEARNING AND RESEARCH: A COMPREHENSIVE STUDY

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Abstract

The impact of Artificial Intelligence (AI) on learning, teaching and researchdomain in higher education is examined in this study. The researchers have conducted a thorough and systematic analysis of the research literature, highlighting the potential of AI to improve teaching strategies, raise standards of education and influence employment opportunities in the future. They also emphasize the significance of responsible design and execution as they address AI's role in personalized learning by online education, work automation and assessment enhancement. The importance of more research is also emphasized by this study in order to fully comprehend how AI affects assessments, ethics and career development in higher education. The study discusses the *rise of AI in educational technology and its effects on research, teaching, and learning in higher education.*

Keywords: *Artificial Intelligence;AI Tool; Higher Education; Teaching, Learning and Research; Online Education; Educational Technology*

1. INTRODUCTION

In educational research, there has been widespread interest in Artificial Intelligence (AI) and its applications in teaching learning, and research. This thorough analysis looks into how AI technologies are used in classrooms and how they affect instructors' teaching methods and students' learning objectives. Transforming conventional teaching methods, Artificial Intelligence (AI) applications such as

intelligent tutoring systems, personalized learning platforms, educational chatbots and automated assessment tools have a significant influence on today's higher education system. They enable personalized learning experiences, automating administrative duties, offering real-time feedback and supporting educators' data-driven decision-making. These technologies synthesize empirical information on improving teaching practices by AI.

Through research studies and case examples across multiple disciplines and grade levels, the impact of AI on student learning outcomes, including academic achievement, engagement, motivation, and retention, must also be taken into account. Data privacy and algorithmic bias are important considerations when using AI in higher education. Equity issues and ethical issues pertaining to accountability, transparency and justice are some of the challenges and constraints that come with implementing AI. It is imperative to explore future directions and emerging trends in AI research for education, with an emphasis on areas that offer room for innovation and development. This study offers important implications for educational practice, policy and research by considering and integrating the body of existing literature and empirical data. It also sheds light on the potential benefits and drawbacks, exploring consequences and implications [2].

2. REVIEW OF LITERATURE

In the investigation of the effects of Artificial Intelligence (AI) on higher education, Zouhaier Slimi [2021] looked at how technology may improve instruction, develop new teaching strategies and get students ready for the workforce [3]. This study examined how AI significantly changed educational procedures and improved graduates' readiness to face the ever-evolving needs of the labour market. Numerous studies conducted in various nations, including Saudi Arabia and Russia, have emphasised the useful uses of AI in education, such as creating systems for academic advising and assisting in decision-making.

A general education method can enhance students' comprehension, attitudes and ethical awareness of Artificial Intelligence (AI) principles [4]. Kang Shih et al. [2021] found that teaching AI fundamentals and ethics to non-engineering students through hands-on exercises. After participating in real-world AI-related tasks, first-year students from various non-engineering faculties showed notable improvements in their understanding of AI.

The use of Artificial Intelligence (AI) in Chinese educational institutions to provide individualized learning experiences and address the social needs of students was expounded upon by Fen Qin [2020] [5].The researchers highlighted elements including technology functioning, teachers' abilities and individual perceptions of AI and autonomy in order to highlight the importance of user confidence in AI-based educational systems. Researchers analyzed user attitudes about AI in education using ethnography and interviews, classifying user comments to comprehend aspects of AI-based educational systems that foster trust.

The use of Artificial Intelligence in education (AIED) to enhance instruction, learning, and decision-making in learning contexts. [2020] [6]. AIED sought to provide students with individualized guidance and support educators and policymakers in making informed decisions. In spite of the multidisciplinary difficulties, scholars provide study themes and frameworks to direct studies in this area, which will ultimately improve education by providing knowledgeable assistance to teachers and students.

HachikYazadzhiyan [2023] discussed the use of Artificial Intelligence (AI) and its present applications in the field of education using AI techniques, emphasizing the rise of AI in educational technology [7]. The study addressed educators' concerns regarding the effective use of Artificial Intelligence (AI) to enhance pedagogy on a broader scale, along with its potential impact on teaching and learning in higher education. The study claimed benefits such as automated grading systems, gesture

detection technology for student involvement and personalized curricula.

Ke Zhang et al.'s comprehensive assessment of empirical research on Artificial Intelligence in education (AIEd) [2020] concentrated on AI applications and technology in the educational field [8]. It emphasized the condition of AIEd research at the moment, the advantages of AI technology for learning and the necessity of interdisciplinary cooperation to solve privacy and ethical issues in AI education applications. The utilization of AI in education entails employing a range of search techniques and selection criteria to identify relevant papers for analysis from databases such as Web of Science and specialized publications. Studies involving undergraduate and graduate students as well as volunteers were carried out in Australia, China, Spain and other countries.

According to the study, both the United States and China have been prominent in AI research, with projections indicating a 48% increase in the AI market within the education sector in the near future. [9]. Researchers have proposed the use of AI robots to supplement certain teaching positions; Sang Joon Lee et al. (2024) conducted a systematic review of AI education. The objective of AI education in K–12 institutions is to educate students about the basics of AI, along with its diverse applications and ethical considerations. The research revealed difficulties like skewed perceptions and a lack of technological expertise, found that AI was used in fields like gaming, mathematics, and personalisation in China and Korea.

Veronica Salido (2023) discussed AI-powered educational resources for students, exploring how Artificial Intelligence is integrated into teaching [10]. The essay examined the impact of Artificial Intelligence on education, particularly focusing on chatbots and Automatic Essay Writing (AEW) software. It emphasized the importance of striking a balance between human guidance and technological assistance to deal with ethical issues, deal with infrastructure issues and guarantee equitable access to AI-augmented education.

In their review, Sang Joon Lee et al. (2018) demonstrated that K–12 AI education covered a range of AI topics and made use of practical exercises to improve students' comprehension of AI ideas, problem-solving abilities and ethical considerations [11]. The results indicated that educating students about Artificial Intelligence (AI) can improve their problem-solving skills, foster interest in technology and enhance AI literacy, potentially inspiring them to pursue careers in the field.

3. AI TOOLS IN EDUCATION

AI has significantly advanced education by providing cutting-edge resources and platforms that enhance student learning. These AI-driven teaching aids engage students and benefit both educators and learners. They address various educational needs, including content generation, evaluation and personalized learning. These tools track student progress, create immersive learning experiences through virtual reality simulations and adaptive platforms, and provide real-time feedback. They are particularly useful for managing classroom behavior, lesson planning, integrating audio-visual aids, facilitating parent-teacher communication, supporting language learning, test preparation, assessment and managing learning systems. They also automatically generate presentations, coach speakers, and convert text into audio recordings [13]. These tools fall into the following categories and some example tools too.

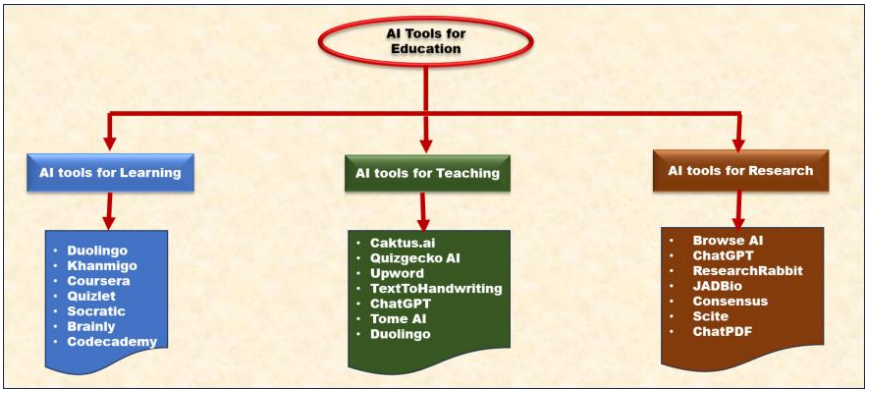

Figure 1: Categories of AI tools and Examples

3. SYSTEMATIC ANALYSIS ON AI TOOLS

A systematic analysis of AI tools is presented in Table 1 below:

S.NO	TOOL NAME	MERITS	DEMERITS
		AI TOOLS FOR LEARNING	
1.	**Duolingo**	• This platform offers a user-friendly and gamified interface, which enhances language learning by making it enjoyable and motivating for users. • Tacks users' progress, provides statistics, awards achievements, helping to maintain motivation and accountability • Accessibility, Community InteractionProgress, Tracking, Free Version Available	• Limited Depth, Lack of Speaking Practice, Repetitive Content, Limited Language Selection. • Some users may find the lessons repetitive in the early stages, which can lead to boredom and decreased engagement over time. • It may lack depth in advanced grammar and vocabulary, potentially limiting proficiency for advanced learners.
2.	**Khanmigo**	• Comprehensive Content, Free Access, Adaptive Learning, Interactive Exercises, Video Lessons, Progress Tracking • Offers a vast array of educational content across various subjects, including math, science, humanities, and test preparation • The platform uses adaptive algorithms to personalize learning	• Lack of Live Support, Limited Depth in Advanced Topics, Dependency on Technology, Potential for Passive Learning, Not Accredited, Limited Language Options. • While Khan Academy provides valuable educational resources, it does not offer accredited courses or certifications, which may be important for some students pursuing formal education or career

		experiences, providing tailored recommendations and pacing for individual students.	advancement.
3.	**Coursera**	• High-Quality Content, Diverse Course Selection, Flexibility, Interactive Learning, Certification • Coursera offers courses created by top universities and industry experts, ensuring high-quality content and up-to-date knowledge in the field of AI. • Coursera offers a diverse array of AI courses encompassing topics including machine learning, deep learning, natural language processing, computer vision, and more, catering to learners with diverse interests and skill levels.	• Cost, Variable Quality, Limited Instructor Interaction Dependency on Technology, Self-Motivation Required, No Accreditation • Especially in classes with a high student enrollment, opportunities for direct interaction with instructors may be limited, posing challenges in obtaining personalized feedback or assistance. • Stable internet connection, which may be a limitation for learners in certain regions or with limited resources.
4.	**Quizlet**	• Versatile Study Tools, User-Generated Content, Accessibility, Interactive Learning, Collaborative Learning, Progress Tracking • The platform offers a variety of study tools,	• Quality Control, Dependency on Technology, Passive Learning, Limited Depth, Potential Distractions, Subscription Costs. • While Quizlet offers a free version with basic features,

		including flashcards, quizzes, games, and practice tests, enabling learners to choose the method that best suits their learning style. • Allows users to create study groups, share study materials, and collaborate with classmates, fostering a sense of community and peer learning.	some advanced functionalities, such as offline access and advanced analytics, require a paid subscription, which may be a barrier for some users • Because it relies on user-generated content, the quality of study materials can vary, and inaccuracies or errors may be present in some flashcards or quizzes.
5.	**Socratic**	• Instant Assistance, Step-by-Step Solutions, Multiple Formats, Accessibility, Cross-Platform Integration, Free to Use • Socratic provides instant assistance to students through AI algorithms that answer questions and offer explanations on a wide range of academic topics. • Socratic can answer questions in various formats, including text, images, and videos, thus catering to different learning styles and preferences.	• Overreliance on Technology, Risk of Inaccurate Information, Lack of Depth, Ethical Concerns, Limited Subject Coverage, Dependency on Internet Connection. • While Socratic can provide instant assistance, some students may become overly reliant on the app and not develop critical thinking and problem-solving skills on their own. • Although Socratic covers a broad range of academic topics, its coverage may be limited compared to specialized textbooks or resources, particularly for advanced or niche subjects
6.	**Brainly**	• Community support for collaborative learning. • Wide range of academic subjects covered.	• Accuracy concerns with user-generated content. • Varying quality of answers. • Risk of dependency on

		• Accessibility online and through mobile apps. Free to use. • Prompt responses to questions. • Detailed explanations provided.	external help. • Ethical concerns regarding academic honesty. • Limited depth in explanations. • Language barrier for non-native speakers.
7.	**Codecademy**	• The platform provides an interactive learning experience through hands-on coding exercises. • Wide range of programming languages and courses available. • Structured curriculum with clear learning paths and progression. • Instant feedback and hints to aid learning. • The platform is accessible on various devices, including Smartphone's and computers.	• Some courses have limited depth on advanced topics. • Dependency on internet connectivity for accessing content. • A paid subscription is necessary for unrestricted access to all courses and features. • Variable quality of instruction across different courses. • Limited support for non-programming topics or skills.
		AI TOOLS FOR TEACHING	
1.	**Caktus.ai**	• Offers personalized learning experiences through adaptive content. • Automates grading tasks, saving educators valuable time. • Provides data-driven insights to tailor instruction effectively. • Facilitates increased	• Elicits privacy concerns regarding the collection and utilization of student data. • May manifest biases within algorithms, thereby potentially affecting fairness. • Technical glitches or outages have the potential to disrupt the learning process. • Excessive reliance on AI tools could reduce educator

		student engagement by offering interactive learning experiences.	autonomy and creativity.
2.	**Quizgecko AI**	• Employs AI for the generation of quizzes and assessments. • Delivers personalized recommendations tailored to individual user performance. • Furnishes users with immediate feedback.	• The quality of the questions may exhibit variability. • Subject coverage is limited in comparison to comprehensive learning platforms.
3.	**Upword**	• Helps users expand their vocabulary through AI-driven exercises. • Offers personalized learning experiences. • Supports language learners in improving their skills.	• Limited focus on other language skills such as grammar or speaking. • May not be suitable as the sole method for language acquisition.
4.	**TextToHandwriting**	• Converts digital text into handwritten format. • Supports visual learners or those who prefer handwritten notes.	• Limited educational utility beyond aesthetics. • May not enhance learning outcomes significantly
5.	**ChatGPT**	• Facilitates language learning through interactive methods. • Provides assistance and information across a wide range of topics.	• Interactions are limited to text-based formats. • May not offer the same depth of explanation or feedback as human instructors.
6.	**Tome AI**	• It Assists users in summarizing and extracting key information from texts. • Aids in research and	• May not capture all nuances or context in text summarization. • Requires critical thinking skills to evaluate

		study processes • Reduces the time required for information processing and synthesis. •	summarized content effectively.
7.	**Duolingo**	• Gamified language learning experience. • Offers a variety of languages. • Delivers bite-sized lessons for convenient learning.	• Limited depth in grammar explanations. • Not suitable as the sole method for achieving fluency.
AI TOOLS FOR RESEARCH AND WRITING			
1	**Browse AI**	• User-friendly interface for browsing and discovering relevant information online. • Advanced search functionalities to filter results based on specific criteria. • Integration with other AI tools for seamless research and analysis workflows.	• Limited ins-depth analysis capabilities compared to specialized research tools. • May prioritize popular or trending content over more scholarly or authoritative sources. • Dependence on internet connectivity may limit access in areas with poor network coverage.
2.	**ChatGPT**	• Facilitates interactive learning and assistance through natural language conversations. • Offers personalized responses tailored to individual user queries and preferences. • Available 24/7 for on-demand support and guidance.	• Lacks human empathy and intuition, leading to potential disconnect in interactions. • May struggle to understand complex or nuanced queries, resulting in inaccurate responses. • Privacy concerns arise from sharing sensitive information during interactions.
3.	**ResearchRabbit**	• Automates the process	• Limited access to certain

		of finding and organizing research articles and papers. • Offers advanced search and filtering options to quickly identify relevant literature. • Helps manage references and citations efficiently for academic writing projects.	databases or repositories depending on subscription level. • Potential biases in search results based on algorithms and indexing methods. • Reliance on machine learning algorithms may lead to occasional errors or mismatches in search results.
4.	**JADBio**	• Advanced tools for bioinformatics research and analysis. • Integration with biological databases and resources for data-driven discoveries. • Provides algorithms and models for predictive modeling and data interpretation.	• Users without a background in bioinformatics or computational biology may experience a steep learning curve. • Limited availability of documentation or support resources for troubleshooting. • Requires access to high-performance computing resources for complex analyses.
5.	**Consensus**	• Facilitates collaborative decision-making and consensus-building processes. • Offers tools for group discussion, voting, and prioritization of ideas or proposals. • Enhances transparency and accountability in decision-making within organizations or communities.	• May lead to conflicts or disagreements if consensus cannot be reached among participants. • Requires active participation and engagement from all stakeholders to be effective. • Implementation may be challenging in hierarchical or authoritarian organizational structures.
6.	**Scite**	• Offers citation context	• Reliance on machine

		for research articles, aiding researchers in evaluating the credibility and relevance of sources. • Offers insights into the impact and influence of research publications through citation analysis. • Helps identify potential errors or retractions in scientific literature through automated fact-checking.	learning algorithms may result in occasional inaccuracies or misinterpretations in citation analysis. • Limited coverage of research literature across different disciplines or languages. • Users may encounter difficulties in accessing full-text articles or verifying citation context for certain sources.
7.	**ChatPDF**	• Enables natural language interactions for querying and extracting information from PDF documents. • Offers convenience and efficiency in accessing content within PDF files without manual searching or browsing. • Supports collaboration and knowledge sharing through text-based annotations and highlights.	• Limited functionality compared to comprehensive PDF management or annotation tools. • Dependency on accurate text extraction and interpretation for effective search and retrieval. • Privacy concerns related to sharing sensitive information or documents during interactions.

4. CONCLUSION

This paper examines the role of Artificial Intelligence (AI) in facilitating multilingual communication and conducting detailed evaluations, while also emphasizing the need to critically assess its limitations, biases, and ethical implications. It discusses a study on AI's impact on higher education, focusing on educational

quality, teaching methods, assessment techniques, ethical considerations, and future career prospects [14]. The findings highlight the importance of integrating AI into education, addressing potential negative consequences and biases, and identifying research gaps for further investigation. This approach aims to enhance educational standards and develop ethical AI-based educational systems.

AI's influence on higher education, emphasizing its impact on educational quality, learning processes, assessments, and ethics in future careers. It highlights the need for further research on how AI affects assessments and ethical considerations, emphasizing the importance of integrating AI into educational systems to enhance teaching and learning methods and prepare students for the job market. Students and instructors perceive AI's impact on learner-instructor interaction in online learning, highlighting concerns regarding responsibility, agency and surveillance issues. The study emphasizes the importance of balancing the benefits of AI systems with addressing ethical considerations to effectively enhance learner-instructor interactions in online education.

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E-BANKING IN INDIA: CHALLENGES AND OPPORTUITES

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ABSTARCT

Financial sector plays an important role in the economic development of a country. Banking is the life line of an economy requirement for economic growth.The implementation Indian banking industry today is observing an IT The implementation of internet in banking organizations has modernized the banks. Implementing the internet banking approach has benefited the both introduce the core concept of IT based Enabled Services (ITES). The E-Banking services areexecuted only upon the customer, andthesee-banking services would fully integrate with the corebanking solution that is already in usage. The objective of the present paper is to examine and analyze the progress madeby Internet Banking in India.

Keywords: E-Banking, Information Technology, Internet Banking, India.

INTRODUCTION

Information Technology has become a necessary tool in today's organizations. Banks today operate in a highly globalized, liberalized, privatized and a competitive environment. Internet Banking refers to a system allowing individual customers to perform banking activitiesat off-bank sites such as home, office and other locations via internet based secured networks.Internetoronlinebankingthrough traditional banks enable customers to perform all routine transactions, such as account transfers, balance inquiries, bill payments and stop-paymentrequests,andsomeeven offer online loan and

credit card applications. banking is a web-basedservice that enables the banks authorized customers to access their account information. It permits thecustomers to log on to the banks website with the help of bank"sissued identification and personal identification number (PIN). The banking system verifies the user and provides access to the requestedservices, the range of products and service offered by each bank on the internet differs widely in theircontentThe banking industry can kill two birds with one stone that is with help of technology.

REVIEW OF LITERATURE

Trivedi & Patel (2012) the problems faced by customers while using e-banking facilities in India. It observed that most of the customers know about the e-banking services offered by their bank. The study foundthat there is a significant difference amongst different problems identified while using e-banking services. It also found that some problems affect more and some problems affect less in use of banking services. It concludedthat all the reasons are not equally responsible for not using e-banking services.

Gupta & Mishra (2013) examined the new emerging trends of E-banking in Indian banking industry. The studyfound that there are many challenges faced by banks in E-banking and there are many opportunities availablewith the banks. It concluded that banking sector will need to master a new business model by buildingmanagement and customer services. It also suggested that banks should contribute intensive efforts to renderbetter services to their customers.

Chavan (2013) described the benefits and challenges of Internet banking in an emerging economy. It observed that online banking is now replacing the traditional banking practice. It showed that online banking has a lot of benefits which add value to customers" satisfaction in terms of better quality of service offerings and at the same time enable the banks gain advantage over the competitors. It also discussed some challenges in an emerging economy

OBJECTIVESOFTHESTUDY

- To study the current status of financial innovations in Indian banking sector
- To identify various e-banking services / products adopted by India.
- To study the challenges faced in E-banking.
- E-banking is a generic term making use of electronic channels through telephone mobile phone, internet etc. for delivery of banking services and products

Indian banks offer to the or customers following e-banking products and services

- Internet Banking
- Automatic Teller Machine (ATM)
- Mobile Banking
- Phone Banking
- Tele banking
- Electronic Clearing Services
- Electronic Clearing Cards
- Smart Cards
- Door Step Banking
- Electronic Fund Transfer
- G Pay
- Phone pay

Challenges and Issues in E-Banking

- **Security Risk**

  It is very big challenge for E-banking,very big challenge to make consumers and marketers to opt it because of security issues. We have heard of various internet frauds, fishing acts, password hacks etc. According to the IAMAI report (2006), 43% of internet users are not using internet banking in India because of security concerns. So, it's a big challenge for increase in online banking use.

- **Privacy Risk**

  Peoples fear very much from the fact that there is fear of identity theft and disclosing private information in online or E-banking (wiki leaks, Panama paper leaks etc.). They feel bank may invade their privacy by utilizing their information for marketing and other secondary purposes without consent of consumers. People feel very much irritated when they receive calls for credit cards or insurance etc.

- **Trust Factor**

  Trust is the biggest thing when you have to do anything, especially when you do a financial transaction you have to have full faith on the medium you are using, the site you are using the connection etc. There arise several questions in mind of users: Did transaction go through? Did I push the transfer button once or twice? Is my Password and ID is secured? Trust is very important factor which influence the customers.

- **Customer Awareness**

  Villages are backbone of India and when we talk about villages, peoples are still not aware of banks, so in India there is a long way for E-banking. So we first have to educate peoples first about the banks system and then slowly have to educate them.increase in online banking use

OPRTUITIES OF E-BANKING

- **Increasing Internet Users & Computer Literacy**

To use internet banking it is very important orinitial requirement that people should have knowledge about internet technology so that they can easily adopt the internet banking services. Thefast-increasing internet users in India can be a very big opportunity and services

Initiatives Taken By Government Agencies For Financial Literacy

Financial literacy and education play a crucial role in financial inclusion, and inclusive growth. A study reported that there is significant impact of financial literacy

on use of internet banking, If customers are not financially educated they will simply avoid using new online services and not change their traditional way of banking, thus banks will not be able to convert users into their new online banking strategies. Various government institutions like RBI, SEBI, IRDA and various other market players have taken a number of initiatives on financial education. They have prepared a school curriculum along with various topics including internet banking, banking product and services, net banking to educate the school students, college students, working executives, middle income group, home makers, retired personnel, self-help groups etc.

- **Competitive Advantage The benefit of adopting e-bank**

provides a competitive advantage to the banks over other players. The Implementation of e-banking is beneficial for bank in many ways as it reduces cost to banks, improves customer relation increases the geographical reach of the bank, etc. The benefits of e-banking have become opportunities for the banks to manage their banking business in a better way.

CONCLUSION

The concept of internet banking has got attention in the Indian context.Most of the banks have already implemented the e-banking facilities are beneficial to both.Banks as well consumers the banks are facing many challenges and many opportunities are available with the banks. Many financial innovations like ATMs,Credit Cards, RTGS,Debit cards,Mobile banking etc.finally it affected at the bankers and mass banking to class banking. This shift has also increased the degree of accessibility of a common to banks for his variety of needs and requirement.e-banking will not only acceptable mode of banking but will be preferred mode of banking.

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WOMEN EXECUTIVES' PROBLEMS IN THE MADURAI DISTRICT'S BANKS

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ABSTRACT

India is a nation with many different traditions and practices. Women have a revered place in all religions. Unfortunately, women's roles have been restricted to home matters and household responsibilities for millennia. Women in the patriarchal Indian society were subjected to extreme forms of exploitation. Women were compelled to seek work in the informal sector (as field laborers on family farms, small traders, or artisans) due to a number of circumstances, such as the loss of the breadwinner, an abrupt decline in family income, or insufficient family income, but this did not lead to women's empowerment.

Women's educational attainment and labor involvement were very low. Indian women differ from their counterparts in the West in that they continue to fulfill their traditional roles as housewives and mothers in addition to their professional obligations. They know ways to effectively blend a traditional love of home with superior professional skills. The study, which is entirely exploratory in nature, aims to pinpoint the barriers that keep female employees from pursuing more senior positions as well as the issues that female bank executives confront in terms of their productivity. Additionally, this seeks to ascertain whether the firm supports female employees in advancing to higher positions.

KEYWORDS: *Promotion in Careers, women in the banking, Empowerment, practices, Responsibility.*

INTRODUCTION

The Indian banking system has not only quickly expanded its network, but it has also completely changed its stated goals, methods, and scope of business. This is a transition that was never anticipated. Undoubtedly, technology has been a significant element in this revolution. Banks had to meander down a newly discovered and largely unexplored trail. Rather than continuing to function only as deposit collectors and lenders, they started to play a more active role in accelerating the socioeconomic change of our nation—an objective that was previously seen to be outside the purview of banks. Enter your desired changes in this section. Then, use the button below to paraphrase. It really is that simple!

Women were permitted to continue education as a result of the enormous shift in Indian society's perspective, which led to a rise in the number of graduates—not just postgraduates but also technical graduates. As a result, women started looking for professions to help support their families and afford more luxuries. To put it briefly, women are being pushed to pursue profitable careers by rising levels of literacy among them, mounting financial pressure, and a strong desire to achieve both social and economic independence. The extraordinary expansion of banks has given our country's educated youth unemployment rate a huge boost in employment prospects. Women looking for work find that positions in banks are more appealing and better suited to their personalities. Because women have more power than men, banks not only refused to accept them, but even welcomed their arrival.

ISSUES FACING WOMEN IN THE BANKING SECTOR

To ascertain danger levels based on employees' self-evaluations, a group of Bulgarian professionals led by Professor Ivanovich, department head at the National Centre of Public Health Protection, conducted a survey regarding banking industry working conditions. A case study was carried out in 2004 at a significant national bank in Bulgaria that has branches all over the country.

The study's conclusions showed that female employees were more likely than male employees to report physical pain and discomfort. Compared to their male colleagues, women experience weariness earlier and more intensely (especially after the fourth hour of work).

Pregnant women are adversely affected by prolonged exposure to computer terminal radiation. Due to their precarious health, women workers are more susceptible to negative effects such as fast work speeds, intense psychological strain, dry air, noise, poor lighting, and sitting positions. The sedentary aspect of bank work increases the risk of severe headaches, paintings on fingers, wrists, backaches, waist difficulties, neck and shoulder pain, and eye strain for female employees.

The majority of female executives in banks choose not to pursue promotions due to concerns about upsetting their families, even when they have passed the CAIIB and other bank-conducted officer cadre tests and are completely competent. The idea of taking care of a newborn, toddlers, kids coming home from school, etc. diverts the focus of thirtysomething women CEOs. Female CEOs' productivity is negatively impacted by this.

The inability of executives such as cashiers, tellers, accountants, loan officers, portfolio managers, assistant branch managers, etc. to leave the bank without tallying the account causes more hardship for the families of these executives than for their male counterparts, and the mental stress these executives endure worsens their psychological well-being. In addition, furious and irate clients verbally insult female executives. The psychological health of female executives is affected by this. When a male chauvinist holds a position of authority and is responsible for evaluating performance, he may exhibit bias during the assessment process.

REVIEW OF LITERATURE

Sophia J. Ali (2011) looked to the obstacles that Kenya's Kapsabet Municipality's female workforce faces while they pursue their careers. She discovered

that women faced discrimination in professional development chances and that most female employees were unsatisfied with career development programs. According to the survey, companies should try to make sure that career development programs are designed to support the professional growth of female employees. To handle women's career development urgently, firms should implement affirmative action policies and show top management's commitment to the same.

Skinner and Pocock (2008) examined the association between full-time employees' (N=887) work-life conflict, work-overload, control over their schedules, and hours worked in relation to their preferences. Work overload was found to have the largest correlation with work-life conflict, followed by work schedule control, work hours, and work-hour fit. It was determined that while time-based work-life rules, processes, and interventions were important, they were insufficient to address work-life conflict. They demanded that in order to promote a positive work-life balance, work overload be well managed.

Ahmad, Aminah (2007) Study looked at the work-family conflict that 239 married women in production had in their dual-career households, as well as the social support that they received and the coping mechanisms they employed. The women reported greater disruptions from work to their families than from families to their jobs. In the early life cycle period compared to the later stage, there was a considerable increase in the intensity of work interference with family. Due mostly to the growing expense of childcare services, nearly two thirds of the women stated that they planned to quit their jobs after having another child. When it came to dispute resolution, they tended to use reactive role behavior and personal role redefinition techniques, and they received the least social support from their supervisors relative to other sources.

Gupta & Mehta, (2020) The glass ceiling remains a significant barrier, with invisible obstacles preventing women from ascending to top leadership positions.

Despite having the necessary qualifications and experience, women in Madurai's banks struggle to break through this barrier.

Agarwal & Kumar, (2019) Networking Opportunities Limited access to professional networks and forums is another challenge. Networking is critical for career advancement, yet women executives often find themselves excluded from informal networks that are predominantly male dominated.

Kaur & Sinha, (2018) An inclusive organizational culture is crucial for the growth of women executives. However, many banks exhibit a culture that is not fully supportive of gender diversity, leading to isolation and reduced morale among women executives.

NATURE AND SCOPE OF THE STUDY

The study, which is entirely exploratory in nature, looks at how family responsibilities affect the career choices made by female employees in the banking industry and aims to determine the barriers that keep these workers from pursuing higher post-issues related to work performance. Additionally, this seeks to ascertain whether the firm supports female employees in their pursuit of promotions. The goal of the current study is to interview exclusively female Assistant Managers who deal with difficult circumstances that require advanced skills to handle.

OBJECTIVES OF THE STUDY

- To find out socio economic Profile of Women Executives Working in Banks-Madurai district.
- To study the Issues Impeding the Effectiveness of Female Bank Executives.
- To study the reasons why female employees aren't trying to get higher level positions in the banking hierarchy ranking system.

METHODOLOGY

This type of research being exploratory in nature, questionnaire method of data collection was followed primary method of data collection from different category of employees are collected various aspects. Around 50 samples are selected in a systematic manner.

RESEARCH DESIGN

This study is applicable to the women executives working in banks Madurai district banks located at semi urban areas. The researcher proposes directly visit the banks and collected the necessary data with the help of pre-tested interview schedule. As the numbers of employees are large, the researcher decided to adopt convenient sampling for collecting information from 50 employees as sample respondents of bank. The required data are collected from the respondents by the studying in the bank during the banking hours.

TOOLS FOR DATA ANALYSIS

The study used following Statistical tools for analysis

- Percentage analysis
- Correlation
- Chi square analysis
- Garret ranking method.

FINDINGS

Table -1 Demographic Factor of the Respondents

S.No	Variable	Majority Category	Percentage
1	Age	26(25-50)	52
2	Educational Qualification	28(UG)	56
3	Marital Status	31(Married)	62
4	Salary	20(30000-40000)	40
5	Designation	24(Asst.manager)	48
6	Experience	20(10 – 15 yrs)	40

Source: Primary Data

The above table shows that the majority of the employees are in the age group of 25-50,(52%) mostly (62%) married. They are with a monthly salary of 30000-40000/. (40%), and most of their designations are Asst.manager (48%). Most of the employees are experience in the group of 10- 15 yrs (40%).

Table -2 Issues Impeding the Effectiveness of Female Bank Executives

S.No	Variable	Majority Category	Percentage
1	At the end of the day, my hard workload leaves me exhausted.	25/50 (S.A)*	50
2	The physical and mental strain that comes with asking subordinates to perform tasks, interacting with customers, and responding to higher-ups is intolerable.	35/50 (S.A)*	70
3	I realise it difficult to focus on work after work because of my kids, who would have returned from school.	22/50 (A)**	44
4	It takes a lot of effort to get work out of our male subordinates.	25/50 (A)**	50
5	Women are naturally subservient, which leads to exploitation. I'm expected to perform tasks that go above and beyond my declared work duties.	30/50 (S.A)*	60
6	I get agitated because of inconsiderate customers who bug me and occasionally argue with me. Unlike our male peers, I am powerless to control them.	33/50(D)*****	66

7	I must put up with verbal abuse at work and harassment.	20/50 (A)**	40
8	I feel overburdened at my work because of the pressing tasks at hand, managing the performance of my subordinates, and interacting with many customer kinds all at once. Being a woman, it goes beyond my capacity for physical endurance, and I frequently lose my anger.	26/50 (A) **	52
9	I sometimes feel that I must do more and more work due of gender prejudice.	20/50 (D)*****	40
10	Controlling subordinates who fight with clients frequently is difficult.	30/50 (D)*****	60

Source: Primary Data

The above table shows that 50% of the respondents are strongly agree to the fact that women executive have heavy workload and 70% of the respondents strongly agree to the fact that women executive affect physical strain, it create mental stress also, followed by 44% respondents agree that women executive cannot concentrate children work after office. 50% of the respondents agree that extracting work from our male subordinates is very tedious because 60% of the respondents strongly agree that submissiveness natural to womenfolk. 66% of the respondents involved in dealing with ignorant customer among women executive.52% of the respondents agree to the fact that women executive supervising the work performance of our subordinates and dealing with different types of customers all at the same time, it feels that lose my temper.

Table - 3

The Relationship between Experience and Women's executives working in banks.

Experience of the Respondents	Problems faced by women's executives in banks Madurai district.					Total	Correlation
	A	S.A	N.O	D	S.D		
Less than 10 years	1	1	1	1	1	5	.713
10 - 15	6	10	1	2	1	20	
15- 20	1	1	1	1	1	5	
20- 25	4	2	1	3	2	12	
Above 25	2	3	1	1	1	8	
Total	14	17	5	8	6	50	

Source: Primary Data

There exists positive correlation between Experience and Problems faced by women's Executives in banks r = +0.713. As co-efficient of correlation is only 0.713, they conclude that there exists only less correlation between Experience and Problems faced by women Executives in banks.

Table- 4 Chi-Square test

Variables	P Value	Significance
Age of the Respondents with at the end of the day, my hard workload leaves me exhausted.	58.462	.002
Age of the Respondents with the physical and mental strain that comes with asking subordinates to perform tasks, interacting with customers, and responding to higher-ups is intolerable.	46.154	.001

Age of the Respondents with I realise it difficult to focus on work after work because of my kids, who would have returned from school.	90.581	.003
Age of the Respondents with It takes a lot of effort to get work out of our male subordinates.	86.014	.002
Age of the Respondents with Women are naturally subservient, which leads to exploitation. I'm expected to perform tasks that go above and beyond my declared work duties.	47.253	.001
Age of the Respondents with I get agitated because of inconsiderate customers who bug me and occasionally argue with me. Unlike our male peers, I am powerless to control them.	47.403	.004
Age of the Respondents with I must put up with verbal abuse at work and harassment.	1.000E2	.003
Age of the Respondents with I feel overburdened at my work because of the pressing tasks at hand, managing the performance of my subordinates, and interacting with many customer kinds all at once. Being a woman, it goes beyond my capacity for physical endurance, and I frequently lose my anger.	1.000E2	.002
Age of the Respondents with I sometimes feel that I must do more and more work due of gender prejudice.	66.538	.001
Age of the Respondents with Controlling subordinates who fight with clients frequently is difficult.	50.667	.004
Experience of the Respondents with at the end of the day, my hard workload leaves me exhausted.	84.635	.004
Experience of the Respondents with the physical and mental strain that comes with asking subordinates to perform tasks, interacting with customers, and responding to higher-ups is intolerable.	58.190	.002
Experience of the Respondents with I realise it difficult to focus on work after work because of my kids, who would have returned from school.	73.603	.004

Experience of the Respondents with It takes a lot of effort to get work out of our male subordinates.	89.343	.001
Experience of the Respondents with Women are naturally subservient, which leads to exploitation. I'm expected to perform tasks that go above and beyond my declared work duties.	69.079	.003
Experience of the Respondents with I get agitated because of inconsiderate customers who bug me and occasionally argue with me. Unlike our male peers, I am powerless to control them.	38.636	.002
Experience of the Respondents with I must put up with verbal abuse at work and harassment.	83.833	.004
Experience of the Respondents with I feel overburdened at my work because of the pressing tasks at hand, managing the performance of my subordinates, and interacting with many customer kinds all at once. Being a woman, it goes beyond my capacity for physical endurance, and I frequently lose my anger.	75.641	.001
Experience of the Respondents with I sometimes feel that I must do more and more work due of gender prejudice.	67.429	.002
Experience of the Respondents with Controlling subordinates who fight with clients frequently is difficult.	50.000	.001
Designation of the Respondents with At the end of the day, my hard workload leaves me exhausted.	49.333	.002
Designation of the Respondents with The physical and mental strain that comes with asking subordinates to perform tasks, interacting with customers, and responding to higher-ups is intolerable.	23.214	.003
Designation of the Respondents with I realise it difficult to focus on work after work because of my kids, who would have returned from school.	60.909	.002
Designation of the Respondents with It takes a lot of effort to get work out of our male subordinates.	78.750	.002
Designation of the Respondents with Women are naturally subservient, which leads to exploitation. I'm expected to	36.111	.004

perform tasks that go above and beyond my declared work duties.		
Designation of the Respondents with I get agitated because of inconsiderate customers who bug me and occasionally argue with me. Unlike our male peers, I am powerless to control them.	79.246	.005
Designation of the Respondents with I must put up with verbal abuse at work and harassment.	66.458	.002
Designation of the Respondents with I feel overburdened at my work because of the pressing tasks at hand, managing the performance of my subordinates, and interacting with many customer kinds all at once. Being a woman, it goes beyond my capacity for physical endurance, and I frequently lose my anger.	52.372	.001
Designation of the Respondents with I sometimes feel that I must do more and more work due of gender prejudice.	1.187E2	.004
Designation of the Respondents with Controlling subordinates who fight with clients frequently is difficult.	95.243	.002

Source: Primary Data

From the above table it is found that Age, Designation, and experience are found to be significant with respect to problem faced by women executives working in banks.

Table - 5 Reasons Why Female Employees Aren't Trying to Get Higher Level Positions in the Banking Hierarchy Ranking System

S.No	Factors	Total score	Total Mean Score	Rank
1	traditional home responsibilities as a homemaker are inevitable and leave little time for professional advancement.	4970	47.79	IV
2	Working from home and the office at the same time leaves little time to prepare us for	6212	59.73	II

	promotions.			
3	Physical strain making extended office hours necessary.	5510	52.98	III
4	Higher positions necessitate quicker decision-making and harder decision-making.	3875	37.26	VI
5	The burden of regular field trips and/or tours.	4402	42.33	V
6	Fear of transfer disrupts home harmony and family life.	6752	64.92	I

Source: Primary Data

The table 4 explains how female executives view the obstacles standing in their way of pursuing more senior positions within the banking industry. According to the ranking of the different variables, the component that fears being transferred or promoted is the most important, with a total mean score of 64.92. The factor that prioritizes combining work and life comes in second, with a total mean score of 52.98. However, elements like the strain of frequent tours, which ranked at fifth place with a total mean score of 42.33, and the challenge of using superior judgment, which ranks sixth with a total mean score of 37.26.

The remaining elements are contributing in a moderate way. Given this context, it can be assumed that female CEOs place greater importance on family life without sacrificing their commitment to their careers. As a result, female leaders would rather overcome any obstacle without compromising their family responsibilities. The respondents' first two rankings reflect how important family life is to women. The final two rankings show that female executives are assured of making wiser decisions and exercising solid judgment. It shows how confident they are in their ability to handle any difficulty in their career. They aren't troubled, however, by having to travel for work-related purposes. Sort of speaking, female executives at PSBs want to do everything without having an impact on their family lives.

CONCLUSION

It is evident from the study that there are certain issues. The initial stressor,

which arises from physical strain, has been recognized as a major contributor to issues faced by female bank executives. The second, which is the exploitation of female CEOs because of their submissive disposition, has been marginalized as less significant. The third involves naive clients facing female CEOs. The issues facing female executives in banks are primarily the fault of all three of them. Staff management stresses is the term used to describe all three of the main contributing factors. Regarding average scores, factor the factor that ranks second is fear of transfer, which disrupts family life and household harmony. When we combine work from home and the office, we don't have enough time to prepare for positions at higher levels.

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A CUSTOMER PERCEPTION TOWARDS ONLINE SHOPPING AND OFFLINE SHOPPING

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ABSTRACT

This research's primary goal is to examine consumers' perceptions of offline and online shopping, as well as their degree of satisfaction with the purchasing criteria. The study in question is being conducted in Theni District. But when it comes to direct and internet buying, the retail marketing industry is growing quickly. In this instance, the available research suggests the following scenarios: first, to investigate customer satisfaction, which entails determining whether the customer is interested in shopping offline or online; second, to investigate customer attraction, which entails determining what mode (online or offline) attracts the customer; and third, to observe the customer feedback regarding the methods of shopping. The technique used includes gathering primary data from 25 male and 25 female consumers, then utilizing chi-square and descriptive analysis to analyze it.

Keywords – *Onlin eshopping, Offline shopping, Customer Insights, Customer satisfaction*

1. INTRODUCTION

The purpose of the study is to investigate how customers in the Theni region perceive both direct and online shopping. But in terms of buying preferences, internet shopping contributes significantly to the current digital evolution's rapid expansion when compared to physical shopping techniques. Thus, exposure to internet buying techniques is the research's main objective. From an online standpoint, the consumer's

trust is impacted by price and quality. Nonetheless, the perception of internet shopping as a whole is enticing and invigorating for buyers. Online shopping attracts more customers because of its ability to provide clients one roof access, which is another benefit of the nature of digital evolution. Its enormous selection of consumer goods, which anybody may access and purchase from anywhere in the world, is said to be its main draw.

2. EVOLUTION OF ONLINE AND OFFLINE SHOPPING

2.1 Offline Shopping

The history of offline shopping sometimes referred to as conventional or brick-and-mortar shopping, dates back to the ancient marketplaces. From the founding of the first marketplaces and bazaars to the growth of department shops, supermarkets, and shopping centers, this section charts the history of offline shopping. Important turning points including the emergence of chain stores, the introduction of self-service shopping, and the emergence of experiential retail are covered.

2.2 Online Shopping

With the development of digital technology and the internet in the late 20th century, online shopping, or e-commerce, began to take off. The development of online purchasing is examined in this part, starting with the introduction of the first e-commerce sites, like Amazon and eBay. Examined are significant advancements including the advent of safe payment methods, enhancements to website usability, and the growth of mobile shopping**.**

3. OBJECTIVES OF THE RESEARCH

- The goal of the study is to determine what drives consumers to make purchases both online and offline.
- The goal of the study is to find out how satisfied consumers are with both online and offline purchasing.

- Examining consumer feedback on both online and offline purchasing is the goal.
- The objectives are to Research consumer perceptions of online and offline buying; and Create a positive image of both online and offline shopping.

4. RESEARCH METHODOLOGY

The procedure of meeting and gathering all the data from the complete population is thought to be difficult. Consequently, some researchers employ a technique known as convenient sampling methods. In this procedure, the sampling units are classified based on the researchers' convenience. With the use of carefully constructed questionnaires, a thorough analysis of the primary data is gathered with a sample size of fifty individuals, 25 of whom are males and 25 of whom are women. Through magazines, websites, and books, secondary data was gathered.

4.1Toolsof Study

The data were collected from the respondents were analyzed using various statistical tools such as descriptive analysis, and chi-squaretest.

4.2 StatisticalAnalysis

Based on a well structured questionnaire the following data are obtained and analyzed which are given in table1.

Table1: Customer perception towards online shopping and offline shopping

S. No	Description	N	Mean	SD	Chi-Square	df	Asymp. Sig.	Result
1	Age	50	2	0.93	11.280[a]	3	0.01	Significant
2	Gender	50	0.5	0.51	.000[b]	1	1.00	Not Significant
3	MaritalStatus	50	1.36	0.48	3.920[b]	1	0.05	Significant
4	Occupation	50	2.88	1.06	5.840[a]	3	0.12	Not Significant

5	MonthlyIncome	50	2.24	1.06	3.280[a]	3	0.35	Not Significant
6	Which do you prefer: buying offline or online?	50	1.48	0.50	.080[b]	1	0.78	Not Significant
7	What do you often buy when you shop online?	50	2.04	1.01	9.840[a]	3	0.02	Significant
8	What do you often buy when you shop offline?	50	1.9	0.89	16.720[a]	3	0.00	Significant
9	How satisfied are you with your online purchasing experience?	50	2.1	0.97	11.280[a]	3	0.01	Significant
10	How satisfied are you with your offline shopping experiences?	50	2.34	0.89	13.840[a]	3	0.00	Significant
11	Why would you prefer to shop online as opposed to in person?	50	2.64	1.10	.880[a]	3	0.83	Not Significant
12	Do you feel secure making purchases online?	50	0.8	0.40	18.000[b]	1	0.00	Significant
13	How frequently do you purchase in person?	50	2.42	1.13	.400[a]	3	0.94	Not Significant
14	Which of the following factors will influence your online purchase?	50	2.62	1.16	1.680[a]	3	0.64	Not Significant
15	Indicate with a check why you went for an offline product.	50	2.46	1.15	.400[a]	3	0.94	Not Significant

16	Does physical retail offer a variety of products?	50	2.54	1.09	1.680[a]	3	0.64	Not Significant
17	Have you ever purchased anything online?	50	0.8	0.40	18.000[b]	1	0.00	Significant
18	Does online buying provide you access to the newest products on the market?	50	0.74	0.44	11.520[b]	1	0.00	Significant
19	How frequently do you shop online using the internet?	50	2.32	1.13	6.000[a]	3	0.11	Not Significant
20	Which payment method is most handy when shopping?	50	2.82	0.94	9.040[a]	3	0.03	Significant
a. 0 cells(0.0%) have expected frequenciesless than5. The minimum expected cell frequency is12.5.								
b. 0 cells (0.0%) have expected frequencies lessthan 5. The minimum expected cell frequency is 25.0								

Source: Primary data and developed by the researcher

The following conclusions are drawn from table 1. The following outcomes are attained by testing the hypothesis with descriptive analysis and the Chi-square test.

- Regarding age group there are twelve in the 46–60 range, three in the 61–75 range, andeighteen in the 31–45 range. The age groupings differ significantly from one another.
- Of the participants in the study, 25 were found to be male and 25 to be female. Gender does not differ in this way; both are seen as being the same.

- As for marital status, 32 people are married and 18 are single. The distinction in marital status is substantial.
- Concerning Profession Ten work in business, fifteen are professionals, seven are government employees, and eighteen are self-employed. The differences between different jobs are negligible.
- In terms of monthly income in rupees, 15 people earn less than 15000, 16 between 15001 and 30000, 11 between 30001 and 50000, 8 between 50001 and 75000, and 0 above 75000. The monthly incomes of the consumers are not significantly different from one another.
- When consumers were questioned about whether they preferred to purchase online or offline of them, 24 replied no and 26 said yes. Therefore, there is no discernible difference between the preferences of clients for online and offline shopping.
- Of those questioned about their typical internet shopping purchases, 18 said groceries, 18 said clothing, 8 said electronics, and 6 said other products. Therefore, there is a notable distinction in the typical purchases made when buying online.
- Of those questioned about their typical offline shopping purchases, 21 indicated groceries, 14 said clothes, 14 said electronics, and 1 mentioned other items. As a result, customary offline purchasing purchases differ significantly.
- Out of the people surveyed, 15 expressed average satisfaction, 21 satisfied, 8 highly satisfied, and 6 unsatisfied with their online purchasing experience. The degree of happiness experienced when shopping online varies significantly.
- When asked how satisfied they were with their offline shopping experience, 8 people responded with "average," 23 with "satisfied," 13 with "very satisfied," and 6 with "dissatisfied." When buying offline, there is a noticeable difference in the degree of satisfaction.

- When asked which would they prefer—online or offline—to shop, 10 stated they were not social people, 12 said time efficiency, 14 said it's easier, and 14 said there were more things available online. The decision between online and offline buying is not very different.
- When clients are questioned about how confident they feel about their purchases
- Of those asked how often they buy in person, 14 said they do so monthly, 12 said they do so regularly, 13 said they do so infrequently, and 11 said once a week. The number of times consumers purchase offline does not significantly differ.
- Out of the 16 respondents, 11 identified advertising, 13 social media, 10 the internet, and 16 all of the above when asked what influences their decision to make an online purchase. The overall set of factors influencing their online purchases does not exhibit any notable variances.
- When asked to check the reasons for their selection of offline products, 14 stated they would rather handle the item, 11 said they would prefer the return policy, 13 said there were in-store discounts, and 12 indicated all of the above. Likewise
- When questioned about their experience with online purchasing Ten said no, and forty said yes. Online shopping is very different from traditional retail.
- Of those asked if online shopping gives you access to the newest products available, 37 responded in the affirmative and 13 in the negative. Online shopping offers the newest products, which makes a big difference.
- When asked how frequently they shop online, 14 said they do it very often, 18 said they do so often, 6 said they do so occasionally, and 12 said they do not. When it comes to using the internet for online shopping, there are no notable differences.
- Of the clients surveyed, five indicated spot cash as the most convenient method of payment when asked, while twelve mentioned other options.

SUGGESTIONS AND CONCLUSIONS

A study is conducted in Theni, Tamil Nadu, involving 25 male and 25 female customers to examine their perceptions of online and offline purchasing. The age groups are different. Gender is the same and does not differ from the other. The two are not the same in terms of marital status. There are no distinctions between different professions. The consumers' respective monthly incomes are the same. Customers' preferences for online and offline are the same. Purchasing. Online shoppers' typical purchases differ from one another. When shopping offline, there are differences in the typical purchases made. While purchasing online, there are differences in the degree of satisfaction.

When buying offline, there is a variation in the degree of satisfaction. Nothing is different. here is no variation in the quantity of factors influencing their online purchases. Selecting an offline product makes no difference. The variety of products available when buying offline is the same. Online shopping is different from traditional retail. Online shopping offers the newest products, which makes a difference. When it comes to using the internet for online shopping, there are no notable differences. The practical method of payment when purchasing differs significantly. In conclusion, there has been a noticeable growth in consumer behavior toward online purchasing, according to a study on how customers perceive online and offline shopping.

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A STUDY ON EMPLOYEE INVOLVEMENT AMONG THE EMPLOYEES OF THE PROFESSIONAL COURIER IN TIRUNELVELI, JUNCTION

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ABSTRACT:

This study investigates the connection between perceived organisational success and employee participation in decision-making and problem-solving. Concurrently, the term of employee involvement was examined by situating it within the framework of national culture. Data were gathered from 150 professional courier personnel at Tirunelveli Junction who participated in a survey. A quantitative approach and statistical data analysis were used to evaluate a hypothesis. Perceived organisational performance is positively correlated with the efficient use of employee involvement. More specifically, there is a direct and statistically significant relationship between the managerial assessment of the performance of the organisation and employee engagement and empowerment programmes as well as the employment of self-managing teams. Based on the findings, businesses are urged to implement employee engagement initiatives to improve productivity, expansion, and competitiveness.

Key words: *employee participation and empowerment, self-managing teams, perceived organizational performance.*

INTRODUCTION:

Employee involvement is a process for empowering employees to participate in

managerial decision-making and improvement activities appropriate to their levels in the organization. All enterprises Top Management would very much like to have their personnel “involved” in the work they do, and “committed” to generate a better enterprises Performance. Many other enterprises have understood the vital importance of having their employee “involved and committed” over the years, have set up a “Human Resource Management” strategy for this objective.

Employee Involvement concerns work design and its impact on intrinsic motivation and job satisfaction.The work on individual job enrichment, as well as the work on self-managing workteams and socio-tech work systems, forms a criticalpart ofthe historicalthinking that has been combined to develop management approaches that stress employee involvement. So, HR must initiate employee involvement and, he must facilitatethe cultureofteamwork either in the form of Team Task, Suggestion Schemes or any such others innovated employee involvement schemes.

Employee involvement should be supported where it can be combined withthe development of employee ownership plans.This is because research has indicated the board-based employee share ownership combined with employee participation and involvement in the workplace is conducive to increase productivity, loyalty, and employee satisfaction.

Employee involvement has attracted a lot of attention in modern organizational studies as a means of improving workplace dynamics and organizational effectiveness. Employee involvement, which is defined as the active participation of employees in problem-solving, goal-setting, and decision-making processes, is becoming more widely acknowledged as a crucial factor in determining an organization's success in the current competitive environment.

Excellent employee involvement is essential to developing a dedicated and driven team. It fosters an atmosphere that is favourable to creativity and productivity in addition to raising job satisfaction and staff morale. Organizations may fully utilize their

human capital to drive sustainable growth and competitive advantage by allowing people to share their knowledge and thoughts.

This research is important because it has the potential to advance the fields of organizational behaviour and human resource management with empirical data and practical insights. Through the examination of employee participation best practices, obstacles, and results, this study seeks to offer useful advice to companies looking to maximize workforce engagement initiatives.

REVIEW OF LITERATURE:

Prannahth (2017) His study explains that Inviting employees into the change process may be messy, but it's the best way to ensure a smooth transition. Give teams the opportunity to invest them into the organization's future, and they'll be thankful for it.

Smith, John & Williams, Emma (2018) examined the impact of employee involvement on organizational innovation. Their study found that organizations with higher levels of employee involvement showed significant improvements in innovation processes. Employees who participated in decision-making and problem-solving were more likely to contribute creative ideas and solutions. The study emphasized the need for creating an inclusive culture that encourages participation at all levels.

Johnson, Peter & Brown, Michael (2019) explored the relationship between employee involvement and job satisfaction in the tech industry. Their findings indicated that employee involvement led to higher job satisfaction and lower turnover rates. The researchers attributed this to employees feeling valued and empowered when they had a say in organizational decisions. They recommended implementing structured involvement programs to sustain employee engagement.

Garcia, Maria & Lopez, Carlos (2020) investigated the role of employee involvement in crisis management. During the COVID-19 pandemic, organizations that

actively involved employees in decision-making were better able to adapt to rapid changes and maintain operational stability. The study highlighted the importance of transparent communication and collaborative problem-solving during crises.

Kumar, Raj & Singh, Anjali (2021) focused on the effects of employee involvement on organizational commitment in the banking sector. They found that employees who were involved in decision-making processes exhibited higher levels of organizational commitment and loyalty. The study suggested that involvement initiatives such as participative management and team-based decision-making could enhance commitment levels.

Chen, Li & Wong, Samuel (2022) studied the influence of employee involvement on performance metrics in manufacturing companies. Their research demonstrated a positive correlation between employee involvement and key performance indicators (KPIs) such as productivity, quality, and efficiency. The authors recommended that manufacturing firms adopt continuous improvement practices that include employee input to sustain high performance.

Ahmed, Sara & Rahman, Faisal (2023) examined the impact of digital tools on employee involvement in remote work settings. Their study found that digital platforms facilitating communication and collaboration significantly boosted employee involvement. Employees reported feeling more connected and engaged when using tools like video conferencing, project management software, and collaborative documents. The study stressed the importance of leveraging technology to enhance involvement in remote and hybrid work environments.

Martinez, Lucia, and Torres, Javier (2023) explored on the relationship between organizational resilience and employee involvement. They concluded that companies with significant employee involvement were more resistant to shocks and disturbances from the outside world. Workers at these companies handled difficulties with greater initiative and adaptability. Building an engaged culture is one way to

strengthen organizational resilience, according to the study.

OBJECTIVE OF THE STUDY:

- To find out socio-economic profile of the Employees in courier sectors.
- To find out the opinion about the Employee Involvemen tamong employees in Professional Couriers.
- To study the level of employee involvement among employees in professional couriers.
- To suggest ways to improve employee involvement in courier sectors.

METHODOLOGY

This type of research being descriptive in nature, questionnaire method of data collection was followed primary method of data collection from different category of Employees are collected various aspects. Around 150 samples are selected in a systematic manner.

RESEARCH DESIGN

This study is applicable to the Employees ofThe Professional Courier in Tirunelveli, Junction located at semi urban areas. The researcher proposes directly visit the Courier Office and collected the necessary data with the help of pre-tested interview schedule. As the numbers of Employees are large, the researcher decided to adopt convenient sampling for collecting information from 150 Employees as sample respondents of Courier office. The required data are collected from the respondents by the studying in the Courier office during the Working hours.

TOOLS FOR DATA ANALYSIS

The study used following Statistical tools for analysis.

- ✓ Percentage analysis
- ✓ Chi square analysis

FINDINGS

Table -1 Demographic Factor of the Respondents

S. No	Variable	Majority Category	Percentage
1	Age	89 (31-40)	59.3
2	Gender	76 (Male)	50.7
3	Marital status	90 (Married)	60
4	Experience	77 (Above 5 years)	51.3
5	Designation	117 (Staff)	78
6	Income	80 (10,000-20,000)	53.3

The table indicates that most employees at The Professional Courier in Tirunelveli Junction are aged 31-40 (59.3%), male (50.7%), married (60%), have over 5 years of experience (51.3%), are staff members (78%), and earn between 10,000-20,000 (53.3%).

Table- 2 Opinion about employees' satisfaction in Professional Couriers

S. No	Variable	Majority Category	Percentage
1	Are you satisfiedwiththe administration of compensation benefits.	50/150 SA*	33.3
2	With in your organization, the employees are the empowered to act in the organizations best interest	60/150 SA*	40
3	Do you feel the work environment and climate helps to maintain an appropriate and healthy balance between your work and your personal commitments	60/150 SA*	40

4	Does the senior management make sure that the employee Balance their interests with that of the needs of the organizations.	70/150 SA*	46.6
5	Does the mission and purpose of the organization make you feel the importance of your job	60/150 SA*	40
6	Are you satisfied with the development on your work	60/ A**	40

The above table shows that 33.3% of the respondents are strongly agree that satisfied with the administration of compensation benefits, 40% agree that their organization, empowered to act in the organizations best interest, 40% of respondents strongly agree that work environment and climate helps to maintain an appropriate and healthy balance between your work and your personal commitments followed by 46.6% strongly agree to the senior management make sure that the employee Balance their interests with that of the needs of the organizations, 40% of the employees are agreed that their mission and purpose of the organization make feel the importance of their job, 40% of the respondents strongly agree that their satisfied with the development on their work

*S. A- Strongly Agree, **A- Agree***, N- Neutral****, S.D- Strongly Disagree, *****D- Disagree

Table-3 Level of Employees Involvement in Professional Couriers

S. No	**Variable**	**Majority Category**	**Percentage**
1	How far are you involved in your work environment	60/150SA*	40
2	Incertain situations, has the organization given you the right to take the decision to complete the work	60/150A**	40
3	To achieve company goals and fulfill its objectives my contributionis	70/150 SA*	46.6

4	Do you feel that you can approach your superior at anytime to clarify your queries	60/150A**	40
5	Do you think is the main momentum behind employee involvement?	70/150SA*	46.6
6	While working on the assigned tasks I can see effective teamwork among	60/150SA*	40
7	When your organization decides upon the process of making the compensation decisions, how far do they consult the employees?	70/150SA*	46.6
8	Do you feel your organizations act immediately regarding the feedback given by the employees?	80/150SA*	53.3
9	To what extent you feel that employee's participation in the decision makings of the organization	60/150A**	40
10	Do you think that the appraisal provided in your organization follows the effect of the employee	60/150SA*	40
11	Are you satisfied with the current reward system in your organization	60/150A**	40
12	Does your company inspire you at work?	60/150SA*	40
13	What kinds of things are done, if anything in terms of involving employees in the health and safety of the organization?	60/150A**	40

The above table shows that 40% of the respondents are strongly agree that involved in their work environment, 40% agree that Incertain situations, has the organization given the right to take the decision to complete the work, 46.6% of respondents strongly agree that their contributionhelps to achieve company goal sand fulfill its objectives, followed by 40% of respondents agree that can approach the superior at anytime to clarify their queries.

46.6% of respondents strongly agree that the main momentum behind their involvement, 40% of respondents agree that while working on the assigned tasks they

can see effective team work among themselves, 46.6% of respondents strongly agree that organization decides upon the process of making the compensation decisions, have to consult with them, 53.3% strongly agree to the organizations act immediately regarding the feedback given by them, 40% of the respondents agree that they are participation in the decision makings of the organization, 40% of the respondents strongly agree that the appraisal provided the organization follows the effect of them, 40% of respondents agree that satisfied with the current reward system in their organization, 40% of respondents strongly agree that company inspire their work, 40% of respondents agree that the organization involving their health and safety.

*S. A- Strongly Agree, **A- Agree***, N- Neutral****, S.D- Strongly Disagree, *****D- Disagree

Table-4 Chi Square Test

Variables	P Value	Significance
Age with Satisfaction of Employees	59.871	.000
Age with Empowerment Act of Interest	17.280	.068
Age with Healthy Balance	17.028	.317
Age with Senior Management	28.812	.001
Age with Importance of job	14.389	.496
Age with Satisfaction on Development of work	17.992	.003
Worker's Experience with satisfaction of employees	39.980	.000
Worker's Experience with empowerment of act	17.862	.001
Worker's Experience with Healthy Balance	42.620	.000
Worker's Experience with Senior Management	45.537	.000
Worker's Experience with Importance of job	35.135	.000

Worker's Experience with satisfaction on development of work	22.343	.000

From the above table it is found that, significant associations between age, experience, and various job satisfaction aspects. The impact of age on work growth, senior management perceptions, and employee satisfaction is significant. The experiences of employees also have a big impact on job importance, feelings of empowerment, a good work-life balance, happiness with work development, and opinions about senior management. Interestingly, age has little bearing on views of the value of a job or a healthy work-life balance, but it does have a small correlation with interest in acts of empowerment. These results emphasize how important age and experience are in determining how satisfied employees are with their jobs and how the organization views them.

CONCLUSION

In this study clearly shows that there is an employee's involvement among the employees of the Professional Courier in Tirunelveli, Junction. There are so many factors that are observed which influences the employee's involvement in the organizations are good relationship between the senior management and the employees, best interest and satisfaction is found among the employee towards their work to achieve the personal and organization goal, employees feel great because of the compensation and benefits provided by the organization.

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