3.3.1: Number of research papers published per teacher in the Journals notified on UGC care list during the last five years

INDEX

S.N.	Name of Document
1.	List of paper published.
2.	The first page/full papers published by the faculties

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Principal
Dr. Laxman Dhaked

3.3.1 Number of research papers published per teacher in the Journals notified on UGC CARE list during the last five years

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Calendar Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal /Digital Object		
						Link to website of the Journal	Link to article / paper / abstract of the article	Is it listed in UGC Care list
Analysis of Water Quality Parameters of Man Sagar Lake Jaipur	Narendra Kumar Sharma	Chemistry	International Journal of Humanities , Law and Social Science by New Archeological &Genological Society Kanpur India (Kanpur Philisophers)	2023	2348-8301		IJournal (searchkanpur.com)	
Antimicrovial Studies Of Some Recently Synthesized Th(IV) And UO_2(VI) Complexes With Nitrogen Donor Ligand	Narendra Kumar Sharma	Chemistry	The Journal of Oriental Research Madras	2023	0022-3301		https://ksri.in/academic-and-research-pursuits/ksri-publications/book-catalogue/the-journal-of-oriental-research-madras	
Antimicrovial Studies Of Some Recently Synthesized Th(IV) And UO_2(VI) Complexes With Nitrogen Donor Ligand	Narendra Kumar Sharma	Chemistry	International Journal of Scientific Research & Growth	2022	2456-1363		http://www.ijsrg.com/ijsrg/wp-content/uploads/2022/09/IJSRG-June-2022-narendra-sharma-pdf-final.pdf	
Organic Farming: A Great Decision of India Farmers	Narendra Kumar Sharma	Chemistry	International Journal of Scientific Research & Growth	2022	2456-1363		http://www.ijsrg.com/ijsrg/wp-content/uploads/2022/09/IJSRG-June-2022-Savita-Chauhan-pdf.pdf	
Antimicrovial study of some thorium (iv) complexes with nitrogen donor ligand	Narendra Kumar Sharma	Chemistry	International Journal of Scientific Research & Growth	2022	2456-1363		http://www.ijsrg.com/ijsrg/wp-content/uploads/2022/06/narendra-paper-3.pdf	
4-NN-Bis-2'- Cyanoethyl Amino Benzaldehyde and -2-Methyl-4-NN Bis-2-Cyanoethyl Amino Benzaldehyde and Aniline	Narendra Kumar Sharma	Chemistry	Journal of Survey in fisheries Sciences	2023	2311-3111		www.sifisheriessciences.com/index.php/journal/article/view/2343/1599	

E. Coli, PSEUDOMONAS Species, Aspergillusniger, Candida Species, And Spectral Studies Of Th (No3) 4 Complex With 4CABPT Ligand	Dr. Narendra Kumar Sharma	Chemistry	Journal for Re Attache Therapy and Developmental Diversities	2023	2589-7799		https://jrtdd.com/index.php/journal/article/view/2681/1935	
NEP 2020: Features and Role in School and Higher Education	Dr. Narendra Kumar Sharma	Chemistry	International Journal of Scientific Research & Growth	2022	2456-1363		http://www.ijsrg.com/ijsrg/2023/02/05/nep-2020-features-and-role-in-school-and-higher-education/	
A Method of Deriving Companion Identities Associating q - Series	Keshav Prasad Yadav	Mathematics	Application and Applied Mathematics	2018	1932-9466		http://pvamu.edu/aam	
NEP 2020: Features, Importance in Education and Role of Teacher	Narendra Kumar Sharma	Chemistry	TechnoLearn	2023	2249-5223		https://www.indianjournals.com/ijor.aspx?target=ijor:tle&volume=12&issue=2&article=009	
Review of NEP in Rural Development: A Demographic Study of Karauli District	Raghunandan Singh	Geogrophy	An International Journal of Education Technology	2022	2249-5223		https://ndpublisher.in/admin/issues/TLV12I2g.pdf	
Industrial Development in Karauli District : Challenges and Opportunities	Raghunandan Singh	Geogrophy	International Journal of Innovative Research in Science, Engineering and	2023	2319-8753		https://www.ijirset.com/upload/2023/may/197_Industrial%20_NC.pdf	
Population Dynamics in Karauli District	Raghunandan Singh	Geogrophy	Shodhshree	2022	2277-5587		https://shodhshree.in/2023/?page_id=235#_	
The Condition of the Industrial Worker in present Senereo	Dr. Laxman Dhaked	Social Science	Research Reinforcement	2020	2348-3857		http://www.researchreinforcement.com/issues/May-2020-Issue-(English).pdf	
The Role of Intellectual Property Rights in promoting Company and Ecosystem level Innovation	Dr. Laxman Dhaked	Social Science	Shodhshree	2022	2277-5587		https://shodhshree.in/2023/?page_id=235#flipbook-df_671/209/	
Right to Reinstatement of the Industrial Workers A study in Legislative and Judicial Trends	Dr. Laxman Dhaked	Social Science	Shodhshree	2019	2277-5587		https://shodhshree.in/2023/?page_id=235#flipbook-df_726/133/	

Right To Reinstatement of the Industrial Workers Challenges in Hospitality Industry and Roll of Civil Services	Dr. Laxman Dhaked	Social Science	B.Aadhar	2020	2278-9308		www.aadharsocial.com	
Review of Essential Amendments in Higher Education Innovation in India with Special Reference to a focus on NEP 2020	Dr. Laxman Dhaked	Social Science	Shodhshree	2023	2277-5587		https://shodhshree.in/2023/?page_id=235#flipbook-df_661/233/	
NEP 2020: Features and Role in School and Higher Education	Dr. Laxman Dhaked	Social Science	International Journal of Scientific Research & Growth	2022	2456-1363		www.ijsrg.com	
Thermodynamic Study of Green Corrosion Inhibitor on Mild steel with Aqueous Extract of Ziziphus jujube Fruits in 1 M HCL Solution	Keshav Parashar	Chemistry	Sambodhi	2020	2249-6661		Printed journal	yes
Anti-inflammatory and Anti – arrhythmic Activities of 1 (Alkanoylphenoxy/ Thiophenoxy) -3- (N – Phenylpiperazinyl) Propane	Keshav Parashar	Chemistry	Journal of Drug Delivery and Therapeutics(ARTICLE)	2019	2250-1177		https://doi.org/10.22270/jddt.v9i3-s.2872	
Thermodynamic Study of Green Corrosion Inhibitor on Mild steel with Aqueous Extract of Ziziphus jujube Fruits in 1 M HCL Solution	Keshav Parashar	Chemistry	Acta Ciencia indica	2020	0253-7338		https://acta.co.in/acta/search_published_general.php	yes
Medication of diabetes and Impact of Cultivation and Gathering of Medicinal plants on Biodiversity	Keshav Parashar	Chemistry	Maharaja Sayajirao U NIVERSITY OF BARODA	2020	0025-0422		maharaja sayajirao university of baroda	

Effect of succinic acid on compression strength concrete material	Keshav Parashar	Chemistry	ELSEVIER	2021	2214-7853		https://doi.org/10.1016/j.matpr.2021.05.405	
Green synthesis and characterization of silver nanoparticles using Enicostemmaaxillare (Lam.) leaf extract	Suresh Chand Mali	Botany	Biochemical and Biophysical Research Communications	2018	0006-291X		https://doi.org/10.1016/j.bbrc.2018.08.045	
Biosynthesis of copper oxide nanoparticles using Enicostemmaaxillare (Lam.) leaf extract	Suresh Chand Mali	Botany	Biochemistry and Biophysics Reports	2019	2405-5808		https://doi.org/10.1016/j.bbrep.2019.100699	
Nanotechnology a novel approach to enhance crop productivity	Suresh Chand Mali	Botany	Biochemistry and Biophysics Reports	2020	2405-5808		https://doi.org/10.1016/j.bbrep.2020.100821	
Green synthesis of copper nanoparticles using CelastruspaniculatusWilld. leaf extract and their photocatalytic and antifungal properties	Suresh Chand Mali	Botany	Biotechnology reports	2020	2215-017X		https://doi.org/10.1016/j.btre.2020.e00518	
Review on biogenic synthesis of copper nanoparticles and its potential applications	Suresh Chand Mali	Botany	Inorganic Chemistry Communications	2023	1387-7003		https://doi.org/10.1016/j.inoche.2023.110448	
राजनीति में नारी की भूमिका	Munesh Kumar Meena	Political Science	IJARESM	2022	2455-6211		https://www.ijaresm.com/uploaded_files/document_file/munesh_kumar_meenaXBwi.pdf	

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ANALYSIS OF WATER QUALITY PARAMETERS OF MAN SAGAR LAKE JAIPUR, RAJASTHAN, INDIA

Authored By

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ANALYSIS OF WATER QUALITY PARAMETERS OF MAN SAGAR LAKE JAIPUR, RAJASTHAN, INDIA

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Abstract:
The natural world has been polluted. The water we use every day comes from rivers and lakes. On Earth, water is the single most important substance. The quality of available water has a direct impact on people's health and ability to make a living. Water pollution is a leading cause of death worldwide. Human activity ruins water. The pollution of Man Sagar Lake is also caused by the entry of partially treated and untreated effluent. The parameters of physico-chemical nature found during assessment were compared with the prescribed limits as per the guidelines of National Plan for Conservation of Aquatic Ecosystems (NPCA) enacted by the Ministry of Environment, Forests & Climate Change, Government of India and it was found that the parameters are beyond the standard limits, indicating that the lake is getting polluted. Pollution problems presides in the Lake due to the Inflow of Wastewater by the increasing flow of partly treated wastewater and untreated wastewater with severe contamination. All this leads to the alteration of the
various Physico Chemical Parameters of the water body as well as the accumulation of the heavy metals resulting in the various phenomenon like Eutrophication of the water body, Deposition of Silts, and the pronounced deterioration of the Water Quality.

Keywords: Man Sagar Lake, Water Quality, Physico-chemical, Parameters, Physiochemical, Wastewater.

Introduction:

Water Quality testing and Monitoring is considered as very Important and needed approach in the present scenario. There are many Water Bodies surrounding us nearby and at far distances too, but it becomes more important when the water source is itself Ecologically precious and also having a great

consideration towards Economic, Aesthetic and as well as Archaeologically important Heritage. "Jalmahal" or, "ManSagar- Lake" is that place which has all the above valuable characteristics. So, it becomes naturally very important and a curious issue for masses to know about it, preserve it and have to maintain its Ecological Balance by encompassing all the desired proceedings in conserving this monument as well as the two most valuable natural resource, "Water" and the "soil". "Mansagar Lake" is an Ecologically versatile Wetland Site, where several Important Migratory Bird Species comes every year. It is their nesting, breeding and playing site which gives a treat to the Ornithologists and many nature lovers to watch them. Its wetland area is vast and spreading all around the Monument. Sight Seeing is very famous for all the tourists who come here. Many Fish Species resides inside the Water Body. On the other hand one more crucial aspect is this water body is becoming and obviously had became a partially treated and mostly untreated Sewage water dumping site. If the Waste Water is put straight in the Surface Water, Wells, Streams, Lakes or even Sea without any treatment it will inevitably pollute that water(Asia and Akporhonor, 2007). All the waste water from the Walled City and nearby area is dumped into it. Two main Nalas, one is the Brahmpuri Nala from the city area and other is Nagtalai Nala open their chanelling waste water inside the Jalmahal or the Man sagar lake. Resultantly, all this destroyed the Water Quality of the Lake and impacts the associated living organisms inside it.

The Man Sagar Lake was enlisted in conservation sites under the National Lake Conservation Plan (Now renamed as National Plan for Conservation of Aquatic Ecosystems) in December 2002. [NPCA, 2019] and the Government of India sanctioned Rs. 25 Crore for the conservation and restoration of the lake under this plan [SML, 2019]

In past, many researchers have carried out similar studies on water quality of different lakes including Man Sagar Lake Jaipur (Kavita Sahni et al.,2011; Chetna Pradhan et al., 2016; Neera Srivastava et al., 2009; Meenakshi Singh et al., 2010]
and other major cities of India like Bhopal (Dixit S. et al., 2008), Hyderabad (Aruna Jyothi Kora et al., 2017), Una–Bilaspur, Himachal Pradesh (Vandana Sharma et al., 2015) and have reported that in almost all of these cities, the lake were polluted.

Research Methodology:

The water and soil samples were collected seasonally during the winter in the month of February, summer (May), Monsoon (August) and during post monsoon((November). A year round analysis had been done for the two natural resources. Water samples were collected in clean sterilized plastic bottles and soil samples in the clear plastic bags. Water and Soil samples taken from the Mansagar Lake were analysed for various physico-chemical parameters analysed in the lake water samples are pH, temperature, TDS (Total Dissolved Solids), EC (Electrical Conductivity), DO (Dissolved Oxygen), Total Hardness (as CaCO3), Calcium Hardness, Magnesium Hardness, Turbidity, Acidity, Alkalinity Chloride, Fluoride, Nitrate, BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen

Demand).

All the experiments were performed in the Research Laboratory of Indira Gandhi Centre for HEEPS, University of Rajasthan, Jaipur.

Result and Discussion:

Physico-Chemical analysis of the water of "ManSagar Lake"(Jalmahal) for complete one year in all the four seasons:-

Table 1: Physico-Chemical Analysis of the water in "ManSagar Lake"(Jalmahal).
(*Rest all Values are in Mg/l) (Mean± Standard Deviation)

s.no.	Parameter	February	May	August	November
1.	pH	7.73±0.11	7.70±0.015	7.49±0.015	8.25±0.032
2.	E.C.(µmho/cm)	1.96±0.041	1.99±0.015	1.97±0.01	1.80±0.020
3.	T.D.S.	1612.33±0.577	1589.67±0.577	1721.33±1.527	1715.67±0.577
4.	D.O.	4.066±0.057	4.033±0.152	4.76±0.152	4.26±0.057
5.	B.O.D.	239.33±1.154	229±1.00 *	234±1.732	199.33±1.154
6.	Total Hardness	713±1.732	644.66±0.577	729.66±1.527	722.66±1.527
7.	Calcium Hardness	402.33±0.577	414±1.00	430.33±0.577	423.66±0.577
8.	Magnesium Hardness	310±1.00	230.66±1.154	299.33±1.154	299±1.00
9.	Chloride(Salinity)	360.1±0.10	398.68±0.586	402.03±0.028	398.38±0.545
10.	Alkalinity	501.33±1.527	520±1.00	519.66±1.527	398.33±1.527
11.	Acidity	125.33±1.527	119±1.00	117.66±1.527	116.66±1.154
12.	Fluoride(ppm)	0.233±0.020	0.31±0.01	0.40±0.011	0.36±0.015
13.	Nitrate(ppm)	2.26±0.115	2.13±0.057	2.26±0.152	2.2±0.10

Table 2: Physico-Chemical Analysis of the Soil of "ManSagar Lake" (Jalmahal).
(Mean ±Standard Deviation).

S.no.	Parameter	February	May	August	November
1.	pH	7.16±0.047	7.9±0.173	8.36±0.057	7.6±0.346
2.	E.C.(µmho/cm)	1.13±0.012	1.14±0.015	1.98±0.037	1.19±0.015
3.	%Moisture	38.53±0.040	35.67±0.090	40.36±0.603	34.43±1.463
4.	%Organic Matter	3.32±0.193	3.48±0.025	1.58±0.087	3.67±0.083
5.	%Organic Carbon	1.84±0.017	2.02±0.015	0.92±0.051	2.13±0.049
6.	Chloride(Salinity)(mg/l)	35.99±0.012	35.02±0.080	32.40±0.577	34.48±0.518

The above Year round analysis of the Water and Soil samples from Jalmahal, clearly depicts about their deteriorating quality. While considering the water sample first and taking its pH value it shows its alkaline nature which is lower(7.70±0.015)
in the month of May and greater(8.25±0.032) in the month of November. Since the pH range 5-9 is suitable for the survival of aquatic life (Lloyd, 1960), therefore enormous amount of aquatic flora and fauna sustained here. Electrical Conductivity is the measuring amount of impurities in the Water sample. There is fluctuating range of the conduction which is more than the normal range, so in terms

of purity water contains impurities in many forms which are dissolved inside in it and also makes it turbid too. Here the value of Total Dissolved Soilds is more than the permissible range according to the WHO(1984) and thus makes water unsuitable for the usuage like in irrigation purposes Maximum TDS observed in the month of

August(1721.33±1.527) due to the accumulation of the particulate material from surrounding hilly areas in Monsoonic Climate . D.O and B.O.D of the water body show the present ongoing water quality destruction and deteriorating status for the survival of aquatic life. Dissolved Oxygen in terms of life survival supports the aquatic life but on the other hand the Biochemical Oxygen Demand (B.O.D) is much more coveted by the microbial polulation which demands more oxygen and show

their great status inside the water body. All this leads to the condition of the oxygen depletion , low light penetration and the process of "Eutrophication" of the water body. In terms of Hardness water of Jalmahal is hard including calcium and magnesium ion accumulation which makes the water profile hard . one reason for this condition is the ca. and mg. ion accumulation by surrounding rock felt hilly area and another is by inlet of used domestic waste water which includes detergents, soap and other similar residual material which makes it hard. Total Hardness is higher in the month of August (729.66±1.527). Large concentration of chloride is an indicator f organic pollution of water (Venkatasubramani and Meenambal, 2007). Concentration of Chloride in the water exceeds the range. Highest range has been observed in the month of August (402.03±0.028).Increasing acidity or alkalinity may make some poisons present in water more toxic (Lloyd, 1960). Many associated reasons and altered patterns of rainfall and temperatue ranges are responsible for the Acidic or Alkaline conditions of the water body. Here the values of Alkalinity are observed higher as compared to the acidity. (520±1.00) and, (125.33±1.527) (Alkalinity and Acidity) in the month of May and February respectively. Concentration of Fluoride impacts the water and living environment directly and indirectly both. Highest conc. Of Fluoride is observed in the month of

August(0.40±0.011) and lowest in the month of February(0.233±0.020). All are withing the permissible range. Slightly varying from month to month. Nitrate conc. Is also very limited and low in the water samples collected. Lowest as (2.13±0.057) to highest as much as only (2.26±0.152) (2.26±0.115) in May and August, February respectively.

Conclusion:

All of our drinking water comes from lakes and rivers. There is a severe water shortage. All other substances are dissolved in water. Water, which is odourless, tasteless, colourless, and transparent, is the most vital material on Earth. Clean drinking water is a need. A lack of access to safe water threatens people's health

and ability to make a living. Polluted water is a leading cause of illness and death worldwide. Individual human needs are met by it. When water is contaminated by human activities, it becomes unusable. Man Sagar Lake's pollution problem stems from the lake's constant and increasing exposure to wastewater, raw sewage and sewage that has only been partly cleansed can contain dangerous amounts of pollution. The introduction of wastewater is to blame for this issue. Approximately 130

square kilometres in size, the lake may be found in the Indian state of Rajasthan, not far from the city of Jaipur. In 1610 AD, Raja Man Singh constructed it by damming the Dravayavathi River. Discharges of untreated wastewater and other polluting components, including as effluents from industrial activities, household trash, and agricultural waste, are contributing to the lake's continually increasing pollution level. Each year, this pollution becomes much worse. All of these items contribute to pollution by collecting heavy metals and altering the physicochemical characteristics of the water in which they are found.

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THE JOURNAL OF ORIENTAL RESEARCH MADRAS

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Editor

ANTIMICROBIAL STUDIES OF SOME RECENTLY SYNTHESIZED Th(IV) AND UO_2 (VI) COMPLEXES WITH NITROGEN DONOR LIGAND*

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ABSTRACT

We report here series of new the Th(IV) and $U0_2$ (VI) complexes with Schiff base having general composition Th X_4.nL (X=NO_3, n=2) and UO_2X_2.nl (X=CH_3 COO, n=2), Where L = Schiff base

The complexes were characterized on the basis of analytical conductance, molecular weight and spectral studies. The Schiff base behave as neutral monodentate ligand which coordinate to the central metal atom through azomethine nitrogen.

Key words – Schiff base ligand, Th(IV) and UO_2 (VI)

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* Correspondence Author: Narendra Kumar Sharma

INTRODUCTION

A number of complexes with linear UO_2 (VI) ion in 6- or 8- coordinator number and with th(IV) in 6-, 8- or 10 coordination number known ref (1-6). In the present work, we wish to report the synthesis and characterization of series of complexes of these metal ins with Schiff base ligand which is derived from the condensation of 0-chloroaniline and 2-Methy- 4-NN-bis -2'-cyanoethylaminobenzaldehyde.

Preparation of 2-Methyl-(NN bis – 2'- Cyanoethyl) amino benzaldehyde:-

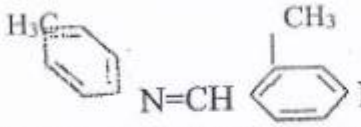
It was moduled on the procedure give in the literature ref. J.T. Brain Holtz F.g. Mann I. chem.. Soc. 1817 (1953

Ref. V.S. Jolly and P.I. Ittyrah J. Indian Chem. Soc. 46, 997 (1969)

Preparation of Schiff base ligand:-

A mixture of the aldehyde (1 mmol) and the. P-toluidine (1 m.mol) in absolute ethanol in taken in a round bottom flask and two drops of piperdine were added. The mixture was refluxed for 4-5 hrs. On cooling dark coloured solid separated which was filtered under suction and recrystalized, from ethanol as yellow solids.

M.P. -161^{0}C
Yield -83%
Colour -Yellow



2-Methyl- 4-NN-bis-2'- Cyanoethyl Amino Benzylidine-Para toludine (2MCABPT)

Synthesis of complexes:-

The respective metal salt solutions were treated with ligand solution in the required molar concentrations.In some of the casers complexes were isolated immediately in cold while in some cases in not solutions. In other cases the resulting solutions were refluxed for 2-3 hrs at Ca 65-70^{0}c. The solvents uses were ethanol, Isopropanol or acetone. The complexes were collected washed with the solvents and finally with ether and dried in vacuo over anlyd. $CaCl_2$.

$$Th(NO_3)_4 + 2L \xrightarrow[heat\ and\ reflux]{Isopropanol,\ 65-70^0 c} Th(L)_2(NO_3)_4$$

$$UO_2(CH_3COO)_2 + 2L \xrightarrow[heat\ and\ reflux]{Isopropanol\ 65-72^0 c} UO_2(L)_2(CH_3COO)_2$$

The analytical data Table – 1 indicate that the complex are non-ionic in nature the complexes are fairly stable at room temperature except. The Iodo complexes which convert in to stickly mass after some time .

Complexes	Colour	M.P.	Yield	M.W. found (calcd.)	Analysis	Found	(Calcd.) Analysis	Λ_M (Ohm^{-1} cm^2mole^{-1}
					C	H	N	
• $Th(NO_3)_4$. (2MCABPT)	Yellow	146	51	950 (1185)	43.92 (45.20)	4.10 (4.29)	12.11 (14.80)	4.1
$UO_2(CH_3COO)_2$. 2(2MCABPT)	Dark Yellow	145	74	978 (1093)	45.10 (46.20)	3.80 (4.0)	12.0 (13.10)	3.2
$ThI_{4.4}$(2MCABPT)	Orange yellow	141	71	1100 (2150)	42.29 (44.10)	4.10 (5.11)	12.35 (10.11)	55
$UO_2(NO_3)_4$.2(2MCABPT)	DarkYellow	150	84	996 (1099)	46.10 (48.50)	3.90 (4.10)	10.20 (11.30)	3.8

Table – 1

Electronic Spectral Studies:-

The electronic spectral studies of these complexes are of loss interest since metal ion does not contain any unpaired electrons in its outer most shell. All the complexes which are studies on the bases of electronic spectra exhibit $n \rightarrow \pi^*$ bands which are around 240-220 mm and bands at 330-250 nm which corresponds to $\pi - \pi^*$ transition .

Anti-microbial Studies

Anti-microbial namely antifungal, antibacterial studies of complexes as well as that of organic compounds were the field the interest of various workers [17,-19]. Antifungal/Antibacterial activities against various pathogens using Thorium (VI) and dioxouranium (IV) compounds have been reported in the past [20-22].

Antimicrobial activity was determined by disc diffusion method. Filter paper disc measuring 6.0 mm diameter were cut with a punch from Whatman filter paper No.1 sterilized at 160°C in hot air oven for one hour, antimicrobial solutions of desired concentration were dropped on discs and were dried in incubator in 37 °C and stored in freezer. Nutrient agar was poured into plates,keeping depth of the medium 4.0 mm. After the medium solidified,the plates were kept for 30 minutes in an incubator

(35 to 55 ^{0}C) to remove excess of moisture,4-5 colonies of pure culture on Nutrient agar /Sabouroud's Dextrose agar were transferred into a culture tube containing peptone water with the help of wire loop.The culture was incubated by lawn culture method. A loop full of 2 mm diameter was used to streak the plates with the test organisms and kept it for 5-10 minutes at room temperature.

The discs were removed with the help of flamed forceps from their respective vials and placed in the plate 15 mm away from the edge,at equal distance and sufficiently separated from each other to avoid overlapping of zone of inhibition, finally pressed them lightly with forceps to make complete contact with surface of medium .The plates were incubated at 35-38°C for 24-30 hours.

CULTURE MEDIA USED

Nutrient agar

Agar 2% was added to prepare nutrient agar for antimicrobial sensitivity test. The pH was maintained between 7.4-7.6.

Composition

Peptone	=	10g
Sodium Chloride	=	05g
Beef extract	=	10g
Distilled water	=	1000ml.

After addition of 2% agar , media was autoclaved at 15-25 minutes and poured in sterilized plates.

Sabouraod's Dextrose agar

Composition

Peptone	=	10.0g
Dextrose	=	40.0g
Agar	=	20.0g
Distilled water	=	1000ml

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Organic Farming: A Great Decision of India Farmers

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Abstract
Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, genetically modified organisms and livestock food additives. Organic farming is an agricultural system that uses fertilizers of organic origin such as compost manure, green manure, and bone meal and places emphasis on techniques such as crop rotation and companion planting.
Key words : Organic farming, human health and natural environment

Introduction

In ancient times, farming was done according to human health and natural environment, due to which the cycle of exchange between organic and inorganic substances (ecosystem) was going on continuously, as a result of which water, land, air and environment are not polluted. Cow rearing was done along with agriculture since ancient times in India.

The evidence of which is Lord Krishna and Balaram in our texts, whom we address as Gopal and Haldhar, that is, agriculture and livestock combined were very beneficial, which was very useful for the animal and the environment. But in the changing environment, the farming has gradually decreased and various types of chemical fertilizers and pesticides are being used in agriculture.

As a result, the balance of the cycle of biotic and inorganic substances is deteriorating and polluting the environment, affecting the health of mankind. Now instead of using chemical fertilizers, toxic pesticides, we can get more and more production by using organic fertilizers and medicines, so that the land, water and environment will be pure and humans and every living being will be healthy.

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Chemicals are not used in organic farming and quality production is done at low cost. In organic farming, instead of chemical fertilizers, pesticides or weedicides, farming is done with the help of cow dung, compost manure, green manure, bacterial culture, organic manure and organic pesticides etc.The method of organic farming gives equal or more production than the method of chemical farming, that is, organic farming is completely helpful in increasing the fertility of the soil and the productivity of the farmers. The method of organic farming is even more profitable in rain fed areas. By doing farming by organic method, the cost of production is reduced, along with this, farmers get more income and organic products meet more in the competition of international market. As a result of which farmers can get more profit than normal production. In modern times, the path of organic farming is very beneficial for the ever-increasing population, environmental pollution, conservation of soil fertility and human health. For the all-round development of human life, it is absolutely necessary that the natural resources should not be polluted, there should be a pure environment and for this we have to adopt the agricultural methods of organic farming, which will not pollute our natural resources and human environment. Will be able to provide food to us and show us the way to live happily.

*The fertility of the land increases.

*Increase in productivity of crops.

*With the increase in the demand for organic products in the market, the income of the farmers also increases.

*The ground water level rises.

*There is a reduction in pollution through water in the soil, food and land.

*The use of waste in making manure reduces diseases.

*The use of organic manure improves the quality of the land.

*Increases the water holding capacity of the land.

*There will be less evaporation of water from the land.

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In view of the increasing population from the time of Green Revolution and increasing production in terms of income, it is necessary to increase the production of chemical fertilizers and insecticides in large quantities in agriculture, due to which the ordinary and small farmers have high cost in less holding. and water, land, air and environment are also getting polluted as well as food items are also becoming poisonous.

Importance of organic farming

Good nutrition
Getting good nutrition is essential for every human being. Actually, nutrients play the most important role in a person's physical development. Due to the lack of nutrients, many times the full development of children is not possible.

Freedom from poison
Various types of toxic chemicals are used in traditional agriculture. Due to which man, animal and soil all face many problems. If there is organic farming, then we will get freedom from poison.

Great taste
Who doesn't like good taste? Every man wants that he should have good taste and if it is available for less money then it will be even better.

Good health
The crops that grow by doing traditional agriculture contain all kinds of harmful elements which when they enter the human body, man becomes afflicted with all kinds of diseases. If there is organic agriculture then there will be good health.

Organic farming methods technique

Crop diversity: Crop diversity is encouraged in organic farming, according to which many crops are produced at the same place.

Soil Management :Soil management is an important part of land management, using it we can increase the quality of the land. For doing this, we need to pay attention to the type of soil and the characteristics of the soil.

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Weed management :Weed means unnecessary vegetation that grows automatically in the middle of crops or plants and uses the nutrition provided to the crops itself, which is also disposed of in organic farming.

Making organic compost

To do organic or organic farming, you must have sufficient amount of organic manure. For this, it is very important for you to have knowledge about making organic fertilizers. Organic manure means such manure, which is made from animal excreta, ie cow dung and crop residues. You can prepare organic manure in 3 to 6 months with the help of waste disposer.

Green compost

To do organic farming, sow cowpea, mung, urad, dhacha, etc., which grow in time due to the rains in the field where you want to produce the crop. And after about 40 to 60 days, plow that field.

By doing this the field gets green manure. Nitrogen, sulfur, sulphur, potash, magnesium, calcium, copper, iron and zinc are found in abundance in green manure, which increases the fertile power of the field.

Conclusion

By doing organic farming, crop production increases, due to which the income of the farmers also increases. The problem of agriculture will be solved as well as the physical level of the farmers will also improve. Most of the places in India, agriculture is based on rain and nowadays the rainfall is not getting according to the time, due to which agriculture also suffers. If farmers adopt organic farming, then this problem can also be overcome.

Sikkim is the first such organic state not only in India but in the world, where no chemical fertilizers and pesticides are used. More than 66 thousand farmers have benefited from organic farming in Sikkim and their number is increasing continuously.

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ANTIMICROBIAL STUDIES OF SOME RECENTLY SYNTHESIZED Th(IV) AND UO_2 (VI) COMPLEXES WITH NITROGEN DONOR LIGAND.

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Abstract
We report here series of new the Th(IV) and $U0_2$ (VI) complexes with Schiff base having general composition Th X_4.nL (X=NO_3, n=2) and UO_2X_2.nl (X=CH_3 COO, n=2), Where L = Schiff base
The complexes were characterized on the basis of analytical conductance, molecular weight and spectral studies. The Schiff base behave as neutral monodentate ligand which coordinate to the central metal atom through azomethine nitrogen.
Key words – Schiff base ligand, Th(IV) and UO_2 (VI)

Introduction
A number of complexes with linear UO_2 (VI) ion in 6- or 8- coordinator number and with th(IV) in 6- , 8- or 10 coordination number known ref (1-6). In the present work, we wish to report the synthesis and characterization of series of complexes of these metal ins with Schiff base ligand which is derived from the condensation of 0-chloroaniline and 2-Methy- 4-NN-bis -2'-cyanoethylaminobenzaldehyde.

Preparation of 2-Methyl-(NN bis – 2'- Cyanoethyl) amino benzaldehyde:-
It was moduled on the procedure give in the literature ref. J.T. Brain Holtz F.g. Mann I. chem.. Soc. 1817 (1953)
Ref. V.S. Jolly and P.I. Ittyrah J. Indian Chem. Soc. 46, 997 (1969)

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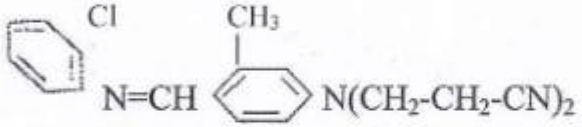
Preparation of Schiff base ligand:-

A mixture of the aldehyde (1 mmol) and the. P-toluidine (1 m.mol) in absolute ethanol in taken in a round bottom flask and two drops of piperdine were added. The mixture was refluxed for 4-5 hrs. On cooling dark coloured solid separated which was filtered under suction and recrystalized, from ethanol as yellow solids.

M.P. -165^{0}C
Yield -80%
Colour -Yellow



2-Methyl- 4-NN-bis-2'- Cyanoethyl amino benzylidine-o-chloroaniline (2MCABCA)

Synthesis of complexes:-

The respective metal salt solutions were treated with ligand solution in the required molar concentrations.In some of the casers complexes were isolated immediately in cold while in some cases in not solutions. In other cases the resulting solutions were refluxed for 2-3 hrs at Ca 65-70^{0}c. The solvents uses were ethanol, Isopropanol or acetone. The complexes were collected washed with the solvents and finally with ether and dried in vacuo over anlyd. $CaCl_2$.

$$Th(NO_3)_4 + 2L \xrightarrow[heat\ and\ reflux]{Isopropanol,\ 65-70^0c} Th(L)_2(NO_3)_4$$

$$UO_2(CH_3COO)_2 + 2L \xrightarrow[heat\ and\ reflux]{Isopropanol\ 65-72^0c} UO_2(L)_2(CH_3COO)_2$$

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The analytical data Table – 1 indicate that the complex are non-ionic in nature the complexes are fairly stable at room temperature except. The lodo complexes which convert in to stickly mass after some time (7-12)

Table – 1

Complexes	Colour	M.P.	Yield	M.W. found (calcd.)	Analysis	Found	(Calcd.) Analysis	Λ_m (Ohm^{-1} cm^2mole^{-1}
					C	H	N	
$Th(NO_3)_4 \cdot 2$(2MCABCA)	Dark yellow	146	81	950 (1185)	43.92 (45.20)	4.10 (4.29)	12.11 (14.80)	4.1
$UO_2(CH_3COO)_2 \cdot 2$(2MCABCA)	Dark Yellow	155	78	978 (1093)	45.10 (46.20)	3.80 (4.0)	12.0 (13.10)	3.2
$ThI_{4.4}$(2MCABCA)	orange yellow	148	71	1100 (2150)	42.29 (44.10)	4.10 (5.11)	12.35 (10.11)	55
$UO_2(NO_3)_4$.2(2MCABC)	Yellow	160	74	996 (1099)	46.10 (48.50)	3.90 (4.10)	10.20 (11.30)	3.8

Electronic Spectral Studies:-

The electronic spectral studies of these complexes are of loss interest since metal ion does not contain any unpaired electrons in its outer most shell. All the complexes which are studies on the bases of electronic spectra exhibit $n \rightarrow \pi^*$ bands which are around 240-220 mm and bands at 330-250 nm which corresponds to $\pi - \pi^*$ transition (13-16).

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Anti-microbial Studies

Anti-microbial namely antifungal, antibacterial studies of complexes as well as that of organic compounds were the field the interest of various workers [17,-19]. Antifungal/Antibacterial activities against various pathogens using Thorium (VI) and dioxouranium (IV) compounds have been reported in the past [20-22].

Antimicrobial activity was determined by disc diffusion method. Filter paper disc measuring 6.0 mm diameter were cut with a punch from Whatman filter paper No.1 sterilized at 160°C in hot air oven for one hour, antimicrobial solutions of desired concentration were dropped on discs and were dried in incubator in 37 °C and stored in freezer. Nutrient agar was poured into plates,keeping depth of the medium 4.0 mm. After the medium solidified,the plates were kept for 30 minutes in an incubator (35 to 55 ^{0}C) to remove excess of moisture,4-5 colonies of pure culture on Nutrient agar /Sabouroud's Dextrose agar were transferred into a culture tube containing peptone water with the help of wire loop.The culture was incubated by lawn culture method. A loop full of 2 mm diameter was used to streak the plates with the test organisms and kept it for 5-10 minutes at room temperature.

The discs were removed with the help of flamed forceps from their respective vials and placed in the plate 15 mm away from the edge,at equal distance and sufficiently separated from each other to avoid overlapping of zone of inhibition, finally pressed them lightly with forceps to make complete contact with surface of medium .The plates were incubated at 35-38°C for 24-30 hours.

CULTURE MEDIA USED

Nutrient agar

Agar 2% was added to prepare nutrient agar for antimicrobial sensitivity test. The pH was maintained between 7.4-7.6.

Composition

Peptone	=	10g
Sodium Chloride	=	05g
Beef extract	=	10g
Distilled water	=	1000ml.

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After addition of 2% agar , media was autoclaved at 15-25 minutes and poured in sterilized plates.

Sabouraod's Dextrose agar

Composition

Peptone	=	10.0g
Dextrose	=	40.0g
Agar	=	20.0g
Distilled water	=	1000ml

In the present study new synthesized I to XII were first dissolved in dimethylsulphoxide or acetone to prepare the drug impregnated disc used in anti-bacterial and anti-fungal by disc diffusion technique. Organism tested were E.coli Pseudomonas, Aspergillus niger, and Candida albicans Diameter of zone of inhibition was measurerd in millimeter and reported as (+) for intermediate zone (partially sensitive), (++) for sensitive zone, (+++) for resistant zone,(++++) for significant resistant zone and (-) for no inhibition zone.

TABLE -2

Anti-bacterial activity of some new Complexes

Solubility data - All Solutions were prepared in DMSO

Concentration data -30gm/ml

Medium - Nutrient agar

pH range - 7.4 to 7.6

Period of growth - 24 to 48 hrs.

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S.No.	*Name of Complexes*	*E. coli*	*Pseudomonas species*
I	$Th(NO_3)_4.2(2MCABCA)$	-	-
II	$ThI_4.4(2MCABCA)$	++	-
III	$UO_2(NO_3)_2.2(2MCABCA)$	-	++
IV	$UO_2(CH_3COO)_2.2(2MCABCA$	++++	-

TABLE -3

Anti-fungal activity of some new complexes

Solubility data – All solutions were prepared in DMSO
Concentration tested - 30gm/ml
Medium - Sabouraud's Dextrose agar
pH range - 7.5

S.No.	*Name of Complexes*	*Aspergillus niger*	*Candida Species*
I	$Th(NO_3)_4.2(2MCABCA)$	-	-
II	$ThI_4.4(2MCABCA)$	++	-
III	$UO_2(NO_3)_2.2(2MCABCA)$	++++	-
IV	$UO_2(CH_3COO)_2.2(2MCABCA)$	-	++

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Period of growth - 4 days

Zone of inhibition

(+) 0-4 mm (++) 4-8 mm (+++) 8-12 mm (++++) 12-16 mm (-) No inhibition

Results and Discussion

The analytical data Table – 1 temperature indicate that the complex are non-ionic in nature the complexes are fairly stable at room except. The Iodo complexes which convert in to stickly mass after some time.Four new synthesized I to IV Complexes were screened for their anti bacterial activity against several species of E. coli, and Pseudomonas species using agar plate diffusion technique. The testing were carried out in dimethylsulphoxide solution at a concentration of 30 gm/ml. Offloxacine and tetracycline were used as the standard drugs.Results are assembled in Table- 2.

Anti-fungal activity

Four new complexes (I to IV) were screened for antifungal activity against Aspergillus niger and Candida species at concentration of 30gm/ml Using Sabouraud's Dextrose agar media disc diffusion technique.The testing was carried out in dimethylsulphoxide solution.Amphotericin B discs were used as the standard drugs. Results are assembled in Table- 3.

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PRINCIPAL

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Antimicrovial studies of some thorium (iv) and dioxouranium (vi) complexes with nitrogen donor ligand.

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Abstract

We report here series of new the Th(IV) and UO_2 (VI) complexes with Schiff base having general composition Th X_4.nL (X=NO_3, n=2) and UO_2X_2.nl (X=CH_3 COO, n=2), Where L = Schiff base The complexes were characterized on the basis of analytical conductance, molecular weight and spectral studies. The Schiff base behave as neutral monodentate ligand which coordinate to the central metal atom through azomethine nitrogen.

Key words – Schiff base ligand, Th(IV) and UO_2 (VI)

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A number of complexes with linear UO_2 (VI) ion in 6- or 8- coordinator number and with th(IV) in 6- , 8- or 10 coordination number known ref (1-6). In the present work, we wish to report the synthesis and characterization of series of complexes of these metal ins with Schiff base ligand which is derived from the condensation of 0-chloroaniline and 4-NN-bis -2'-cyanoethylaminobenzaldehyde.

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Antimicrovial studies of some thorium (iv) and dioxouranium (vi) complexes with nitrogen donor ligand.

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Abstract

We report here series of new the Th(IV) and UO_2 (VI) complexes with Schiff base having general composition Th X_4.nL. (X=NO_3, n=2) and UO_2X_2.nl (X=CH_3 COO, n=2), Where L = Schiff base The complexes were characterized on the basis of analytical conductance, molecular weight and spectral studies. The Schiff base behave as neutral monodentate ligand which coordinate to the central metal atom through azomethine nitrogen.

Key words – Schiff base ligand, Th(IV) and UO_2 (VI)

Introduction

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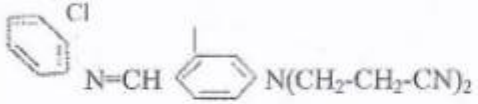
Preparation of Schiff base ligand:-

A mixture of the aldehyde (1 mmol) and the. P-toluidine (1 m.mol) in absolute ethanol in taken in a round bottom flask and two drops of piperdine were added. The mixture was refluxed for 4-5 hrs. On cooling dark coloured solid separated which was filtered under suction and recrystalized, from ethanol as yellow solids.

M.P. -160^{0}C
Yield -87%
Colour -Yellow

Stru.of Ligand



+-////

4-NN-bis-2'- Cyanoethyl amino benzylidine-p-toludine (4CABPT)

Synthesis of complexes:-

The respective metal salt solutions were treated with ligand solution in the required molar concentrations. Fn some of the casers complexes were isolated immediately in cold while in some cases in not solutions. In other cases the resulting solutions were refluxed for 2-3 hrs at Ca 65-70^{0}c. The solvents uses were ethanol, Isopropanol or acetone. The complexes were collected washed with the solvents and finally with ether and dried in vacuo over anlyd. $CaCl_2$.

$$Th(NO_3)_4 + 2L \xrightarrow[heat\ and\ reflux]{Isopropanol,\ 65-70^0c} Th(L)_2(NO_3)_4$$

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$$UO_2(CH_3COO)_2 + 2L \xrightarrow[\text{heat and reflux}]{\text{Isopropanol } 65-72^{\circ}c} UO_2(L)_2(CH_3COO)_2$$

The analytical data Table – 1 indicate that the complex are non-ionic in nature the complexes are fairly stable at room temperature except. The Iodo complexes which convert in to stickly mass after some time (7-12)

Table – 1

Complexes	Colour	M.P.	Yield	M.W. found (calcd.)	Analysis	Found	(Calcd.) Analysis	Λ_m (Ohm^{-1} cm^2 $mole^{-1}$
					C	H	N	
$Th(NO_3)_4 \cdot 2(4CABCA)$	yellow	160	75	1000 (1170)	46.20 (44.10)	3.90 (4.60)	12.20 (13.10)	3.9
$UO_2(CH_3COO)_2 \cdot 2(4CABCA)$	Yellow	150	80	900 (1078)	44.18 (47.20)	3.90 (3.20)	10.11 (12.20)	3.8
$ThI_{44}(4CABCA)$	yellow	165	70	1085 (2135)	46.10 (42.20)	4.29 (5.10)	11.20 (12.10)	50.1
$UO_2(NO_3)_4.2(4CABCA)$	Orange	155	68	981 (1084)	45.41 (47.20)	4.10 (3.92)	10.11 (11.20)	3.4

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Electronic Spectral Studies:-

The electronic spectral studies of these complexes are of loss interest since metal ion does not contain any unpaired electrons in its outer most shell. All the complexes which are studies on the bases of electronic spectra exhibit $n \rightarrow \pi^*$ bands which are around 240-220 mm and bands at 330-250 nm which corresponds to $\pi - \pi^*$ transition (13-16).

Suggested structures of the complexes:-

The preffered coordination number of Th(IV) metal atom is 6 or 10 but higher coordination numbers have also been observed (15). It has been observed by conductance and molecular weight value. The nitrato group are linked to through two oxygen atoms, each nitrate group functioning as.a bidentate ligand (16). In the nitrate complex of this ligand the thorium metal is 10 coordinated as it is surrounded by eight coordinated oxygen atoms and two azomethine nitrogen atoms.

For dioxouranium (VI) acetato complex I.R. data reveal that the anions are bidentately covalently bonded to the metal atom there by generating an 8-coordination number on the central Uranium atom.

Anti-microbial Studies

Anti-microbial namely antifungal, antibacterial studies of complexes as well as that of organic compounds were the field the interest of various workers [17,-19]. Antifungal/Antibacterial activities against various pathogens using Thorium (VI) and dioxouranium (IV) compounds have been reported in the past [20-27].

Material and methods

Antimicrobial activity was determined by dise diffusion method. Filter paper dise measuring 6.0 mm diameter were cut with a punch from Whatman filter paper No.1 sterilized at 160°C in hot air oven for one hour, antimicrobial solutions of desired concentration were dropped on discs and were dried in incubator in 37 °C and stored in freezer. Nutrient agar was poured into plates,keeping depth of the medium 4.0 mm. After the medium solidified,the plates were kept for 30 minutes in an incubator (35 to 55 °C) to remove excess of moisture,4-5 colonies of pure culture on Nutrient agar /Sabouroud's Dextrose agar were transferred into a culture tube containing peptone water with the help of wire loop.The culture was incubated by lawn culture method. A loop full of 2 mm diameter was used to streak the plates with the test organisms and kept it for 5-10 minutes at room temperature.

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The discs were removed with the help of flamed forceps from their respective vials and placed in the plate 15 mm away from the edge,at equal distance and sufficiently separated from each other to avoid overlapping of zone of inhibition, finally pressed them lightly with forceps to make complete contact with surface of medium .The plates were incubated at 35-38°C for 24-30 hours.

Culture media used

Nutrient agar

Agar 2% was added to prepare nutrient agar for antimicrobial sensitivity test. The pH was maintained between 7.4-7.6.

Composition

Peptone	=	10g
Sodium Chloride	=	05g
Beef extract	=	10g
Distilled water	=	1000ml.

After addition of 2% agar , media was autoclaved at 15-25 minutes and poured in sterilized plates.

Sabouraod's Dextrose agar

Composition

Peptone	=	10.0g
Dextrose	=	40.0g
Agar	=	20.0g

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Distilled water = 1000ml

In the present study new synthesized I to XII were first dissolved in dimethylsulphoxide or acetone to prepare the drug impregnated disc used in anti-bacterial and anti-fungal by disc diffusion technique. Organism tested were E.coli Pseudomonas, Aspergillus niger, and Candida albicans Diameter of zone of inhibition was measurerd in millimeter and reported as (+) for intermediate zone (partially sensitive), (++) for sensitive zone, (+++) for resistant zone,(++++) for significant resistant zone and (-) for no inhibition zone.

TABLE 6.1

Anti-bacterial activity of some new Complexes

Solubility data - All Solutions were prepared in DMSO
Concentration data -30gm/ml
Medium - Nutrient agar
pH range - 7.4 to 7.6
Period of growth - 24 to 48 hrs.

S.No.	*Name of Complexes*	*E. coli*	*Pseudomonas species*
I	$Th(NO_3)_4.2(4CABCA)$	-	+
II	$ThI_4.4(4CABCA)$	-	-
III	$UO_2(NO_3)_2.2(4CABCA)$	+	++
IV	) $UO_2(CH_3COO)_2.2(4CABCA$	+	-

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TABLE 6.2

Anti-fungal activity of some new complexes

Solubility data – All solutions were prepared in DMSO

Concentration tested - 30gm/ml

Medium - Sabouraud's Dextrose agar

pH range - 7.5

Period of growth - 4 days

S.No.	*Name of Complexes*	*Aspergillus niger*	*Candida Species*
I	$Th(NO_3)_4.2(4CABCA)$	-	-
II	$ThI_4.4(4CABCA)$	+	++
III	$UO_2(NO_3)_2.2(4CABCA)$	-	++
IV	$UO_2(CH_3COO)_2.2(4CABCA)$	++++	

Zone of inhibition

(+) 0-4 mm (++) 4-8 mm (+++) 8-12 mm (++++) 12-16 mm (-) No inhibition

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Results and Discussion

The analytical data Table – 1 temperature indicate that the complex are non-ionic in nature the complexes are fairly stable at room except. The lodo complexes which convert in to stickly mass after some time.Four new synthesized I to IV Complexes were screened for their anti bacterial activity against several species of E. coli, and Pseudomonas species using agar plate diffusion technique. The testing were carried out in dimethylsulphoxide solution at a concentration of 30 gm/ml. Offloxacine and tetracycline were used as the standard drugs.Results are assembled in Table 6.1.

Anti-fungal activity

Four new complexes (I to IV) were screened for antifungal activity against Aspergillus niger and Candida species at concentration of 30gm/ml Using Sabouraud's Dextrose agar media disc diffusion technique.The testing was carried out in dimethylsulphoxide solution.Amphotericin B discs were used as the standard drugs. Results are assembled in Table 6.2.

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NEP 2020: Features And Role In School And Higher Education

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Abstract

After almost five years after the first committee to draft a new National Education Policy, NEP, was cons d, on Wednesday, the Union Cabinet oved the NEP 2020

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NEP 2020: Features And Role In School And Higher Education

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Abstract

After almost five years after the first committee to draft a new National Education Policy, NEP, was constituted, on Wednesday, the Union Cabinet approved the NEP 2020.

The education policy 2020 aims to restructure both school and higher education in India. The NEP envisions a 'Light and Tight' single regulatory higher education system and a school education system that focuses more on experiential learning than rote learning. For higher education, it proposes an undergraduate programme that will last three or four years and offer multiple exits with certificate, diploma or degree qualifications. The national Education policy 2020 envisions an Indian centered Education system that contributes directly to transforming our Nation sustainably into an aquitable vibrant knowledge in education. The New Education Policy 2020 (NEP) announced by the Ministry of Human Resource Development is to bring in changes in the current, dying 34-year-old policy in schools and higher education systems in the country. The new policy is more practical in approach and is based on the ground reality of the country's education scenario that puts more emphasis on the creativity and innovation as well as personality development of the students rather than expecting them to score high and mock up the content without getting

Keywords: New Education Policy 2020, Higher Education, innovative, futuristic, implementation, multidisciplinary, regulatory, density, age structure

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Introduction

Earlier today, the government also the Union Ministry of Human Resource Development (MHRD) Ministry of Education, as proposed in the NEP, to bring focus back on education and learning. The K. Kasturirangan Committee submitted its draft of the NEP in May, 2019.

For higher education, it proposes an undergraduate programme that will last three or four years and offer multiple exits with certificate, diploma or degree qualifications. It proposes to have a single regulator that will prescribe uniform norms for every type of institution irrespective of the nature of its management and ensure compliance through a system of voluntary disclosures. There is also a proposal to fix the fees.For school education, the emphasis is on early childhood education. The policy proposes univeralisating secondary school education and early childhood care education (for ages three to six) by 2030. The NEP also announces for formulation of a new and comprehensive National Curricular Framework for School Education, NCFSE 2020-21, which will be revisited and updated once every 5-10 years.

The policy emphasizes on the use of technology at both school and higher education levels.Union minister for HRD, Ramesh Pokhriyal 'Nishank' said: "Our New Education Policy will turn India into a knowledge society. The policy proposes to increase public spending on education to 6% of the country's Gross Domestic Product, or GDP -- a promise made since the 1960's but never kept."

NEP 2020: Higher education

Under the NEP, all education institutions will be held to similar standards of audit and disclosure. And the system will be governed by a single regulator, the Higher Education Commission of India.It states that all fees set by private HEIs will be transparently and fully disclosed, and there shall be no arbitrary increases. Amit Khare, secretary, higher education, also added that there will be "fee fixation" across institutions as well.Higher education institutions will be reorganised into three types of institutions -- research, teaching and autonomous degree granting ones. New multidisciplinary institutions will be established.

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In fact, the NEP's main vision for higher education is one of multidisciplinary and flexible learning and it is to be achieved by 2040. Khare suggested it will be possible to study physics with fashion design because of a system of studying a combination of "major" and "minor" subjects. Rejoining courses will be eased by the recording and transfer of "credits" will be eased by the Digilocker and "academic credit bank".

The policy includes the establishment of a National Research Foundation.

As per the new Policy, the undergraduate degree will be of either three or four-year duration, with multiple exit options. It states that students will be awarded a certificate after completing 1 year in a discipline or field including vocational and professional areas, or a diploma after 2 years of study, or a Bachelor's degree after a 3-year programme. The four-year multidisciplinary bachelor's programme, however, shall be the preferred option.

Internationalisation of Education

The draft NEP states that high performing Indian universities will be encouraged to set up campuses in other countries. Similarly the top 100 universities in the world will be facilitated to operate in India by opening their campuses.

Government will also create a legislative framework under which foreign universities will be given special dispensation regarding regulatory, governance, and content norms on par with other autonomous institutions of India.

NEP 2020: School Education

The biggest challenges the NEP 2020 sets for school education are universalising early childhood care and education for ages three to six and universalizing secondary schooling or education in Classes 9 to 12. The NEP 2020, aims to achieve 100% Gross Enrolment Ratio (GER) from pre-school to secondary levels by 2030.

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The curriculum will be restructured into a 5+3+3+4 model covering ages three to 18. However, school education secretary, Anita Karwal, added that a reduction in course content is also in the offing. A National Curricular and Pedagogical Framework for Early Childhood Care and Education (NCPFECCE) for children up to the age of eight, will be developed.

Curriculum frameworks will be drawn up for both these groups. The policy suggests the creation of a National Assessment Centre -- Performance Assessment, Review, and Analysis of Knowledge for Holistic Development, or PARAKH -- "setting norms, standards, and guidelines for student assessment and evaluation for all recognized school boards". This will be the first instance of central influence on the business of state education boards.

National missions for foundational literacy and numeracy will be established to achieve both by 2025.

For improving professional standards of teachers a common guiding set of National Professional Standards for Teachers (NPST) will be developed by 2022. Teacher education will gradually be moved into multidisciplinary colleges and universities by 2030, with minimum degree qualification for teaching being the four-year integrated BEd programme..

NEP 2020: Schools Quality

The National Education Policy of India 2020 (NEP 2020), approved by the Union Cabinet of India on 29 July 2020, outlines the vision of the new education system of India. It replaces the previous National Policy on Education, 1986. The vision of the policy is to build an education system rooted in Indian ethos that contributes directly to transforming India by providing high-quality education to all, thereby making India a global knowledge superpower.

प्राचार्य
वीणा मैमोरियल पी.जी. कॉलेज
करौली (राज०)

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Highlights of National Education Policy (NEP 2020) for school education

The Indian Government made a landmark change in the year 2020. In this year characterized by uncertainty, one of the most positive breakthroughs to the otherwise dreadful start of the decade was introducing the NEP 2020, the not only anticipated but rather necessary change to reform the Indian education paradigm.

Replacing the 34-year-old National Policy on Education, which was framed in 1986, the new NEP certainly compliments the country's vision of the 'New India'; to build a culture of innovation, and a highly skilled workforce.

Let us take a look at the key changes that the new NEP proposes to bring in ; to change not only the style and pattern of education but also the mindset that today restricts us from adopting an inclusive, participatory and holistic approach to learning.

Schooling to begin from the age of 3 years

The revised policy expands the age group of mandatory schooling from 6-14 years to 3-18 years.

The existing 10+2 structure of school curriculum will be replaced by a 5+3+3+4 curricular structure corresponding to ages 3-8, 8-11, 11-14, and 14-18 years, respectively.

This new system will include 12 years of schooling with three years of Anganwadi/ Pre-primary.

For each of these stages, curricular and pedagogical approaches have been prescribed. For foundational stage play and theme-based approach shall be followed. For classes three to five that are currently a part of primary- will now be called the preparation stage and children will be learning largely through play and activities

For middle stage, with classes 6 to 8 , the curriculum and pedagogical approach will be experiential and interdisciplinary and for the secondary stage (classes 9 to 12) the subject offerings will now have a lot of flexibility and the approach followed shall be multi-disciplinary.

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To ensure that LEAD powered schools are in sync with the NEP , we at LEAD have introduced unique approaches for different subjects to ensure students learn subjects as a skill rather than gain just theoretical knowledge. The classroom interactions, activities and routines at LEAD also make learning holistic and experiential.

Digital Education Drive

NEP lays emphasis on integration of digital technology being envisaged at all levels of learning through a dedicated unit for creating digital infrastructure, digital content and capacity building. The main idea is to improve classroom processes through technological advancement so that no child is left behind.

Needless to add, we have seen a surge in the utility of online learning during the recent pandemic. The policy thus aims at achieving the objective of uninterrupted education to all sections of society.

At LEAD, apart from ensuring the classrooms are transformed using digital technologies and enabling audio-video learning, a significant focus is also laid in providing educators with the tools and technology to help their students every step of the way. Also for parents, apart from providing a wholesome and vibrant classroom experience at home through the LEAD parent app , the child will be a part of LEAD Summer Camp, Student Led Conferences (SLCs), LEAD MasterClasses and much more, all designed to ensure that not coming to school doesn't hinder holistic learning and development of the child in any way.

Integration of Essential Subjects, Skills, and Capacities

The revised policy aims at making students ready for today's rapidly changing world. Certain subjects, skills, and capacities should be learned by all students to become good, successful, innovative, adaptable, and productive.

It is recognized that mathematical thinking will be very important for India 's future and India's leadership role in the numerous upcoming fields and professions that will involve artificial intelligence, machine learning, and data science, etc. Thus, mathematics and computational thinking is given increased emphasis throughout the school years, starting with the foundational stage, through a variety of innovative methods.

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It also lays emphasis on competitions that may be held in schools for learning various topics and subjects through fun and indigenous games.

At LEAD, in our school curriculum, we have introduced subjects such as the Coding & Computational Skills (CCS) program. Rather than simply consuming content using technology, our students become creators by using technology to build apps, games, and websites and thus become future-ready. The LEAD Championship also enables building a competitive spirit among the students and gives them a wider exposure.

Knowledge of India and Multilingualism

The NEP, 2020 aims to steer the Indian schooling system towards a culturally enriching and nationally integrating one by making use of ancient and modern Indian literature, film, and music. If nothing, it wants Indian students to understand the fact that being educated in Indian languages will not reduce their capabilities or chances of employment. It would only widen their awareness, cultural sensitivity, and tolerance, for India is a melting pot of cultures.

Among the many fundamental principles listed in the NEP, it advocates for the promotion of multilingualism and highlights the power of language in teaching and learning. In consonance with this principle, the policy has laid out multiple recommendations and it has emphasized that the proposals are only broad directions and none of it would be mandatory owing to the cultural diversity across and within states and the linguistic diversity within each classroom.

Firstly, the NEP proposes that wherever possible the medium of instruction in public and private schools until at least Grade 5 and preferably till Grade 8 and beyond shall be the home language/mother-tongue/local language/regional language. The suggestion has been made based on various studies that have established that children tend to get a better grip on concepts when they are taught in their home language/mother tongue.

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It also proposes that teachers should be encouraged to use a bi-lingual approach with those students whose home language may be different from the medium of instruction.

At LEAD the curriculum is contextualized because of which students get a better understanding of knowledge of India. Also at LEAD teachers are encouraged to teach using a bilingual pattern. For example while teaching English, the teacher explains the meaning in the local language and then repeats it in English to reinforce the learning since the students will have to reproduce that in their exams in English itself.

A new age road map for teacher empowerment

The National Education Policy recognises and identifies teachers and faculty as the heart of the learning process. It acknowledges the reality of the teaching profession in India and proposes to completely overhaul it to create a robust merit-based structure of tenure, salary, and promotion that incentivizes and recognizes outstanding teachers.

International pedagogical approaches will be studied by NCERT, identified, and recommended for assimilation in pedagogical practices in India. Teachers along with principals will have to undergo Continuous Professional Development modules every year in order to enhance teaching quality, leadership, and school management along with implementing competency-based learning.

At LEAD, believing in the country's vision that the young minds of tomorrow will only be strengthened when we empower our educators – we do extensive Teacher Development Workshops. These sessions up skill and reinvigorate teachers to overcome challenges. Every teacher in a LEAD-powered school is also a part of the LEAD Academy network – designed for the teachers to keep upgrading themselves with modern day technology and teaching methods.

Many children dislike going to school. They repeatedly complain saying that they get bored at school. Early childhood classrooms are filled with routine moments.

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THE NEW 5+3+3+4 ACADEMIC STRUCTURE:

10+2 refers to two years of schooling post grade 10. According to India's new National Education Policy (NEP) 2020, 10+2 schooling system in India is set to be replaced by a new 5+3+3+4 system.
Here is the age-wise breakdown of the different levels of the school education system based on the new education policy 2020

5 years of Foundational Stage: For ages: 3 to 8

For classes: Anganwadi/pre-school, class 1, class 2

This stage will focus on teaching in play-based or activity-based methods and on the development of language skills.

3 years of Preparatory Stage:

For ages: 8 to 11

For classes: 3 to 5

The focus in the preparatory stage will remain on language development and numeracy skills. Here, the method of teaching and learning would be play and activity-based, and also include classroom interactions and the element of discovery.

3 years of Middle Stage:

For ages: 11 to 14

For classes: 6 to 8

As per NEP 2020, this stage of school education will focus on critical learning objectives, which is a big shift from the rote learning methods used in our education system for years. This stage will work on experiential learning in the sciences, mathematics, arts, social sciences and humanities.

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4 years of Secondary Stage:

For ages: 14 to 18

For classes: 9 to 12

This stage will cover two phases: Classes 9 and 10, and classes 11 and 12. Concepts will be covered in greater depth in this stage.

Transforming Exams:

As per the National Education Policy 2020, Exams will also be made 'easier'. They will test primarily core competencies to eliminate the "Coaching Culture".

Students will be allowed to take Board Exams twice in any given year, to eliminate the high stakes of board exams.

In accordance with the New Education Policy 2020, board exams in certain subjects could be redesigned. Board exam questions to have two types:

Objective type with multiple-choice questions

Descriptive type

The National Testing Agency (NTA) will offer a high-quality common aptitude test, as well as specialized common subject exams in various subjects, at least a twice every year as prep for entrance examinations.

THE 3 LANGUAGE POLICY:

The National Education Policy 2020 (NEP 2020) has emphasised on the use of mother tongue or local language as the medium of instruction till Class 5 while recommending its continuance till Class 8 and beyond. It recommends that all students will learn three languages in their school under the formula. The three languages learned by children will be the choices of States, regions, and of course the students themselves. However, at least two of the three languages should be native to India, one of which is most likely to

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be the local/ regional language. The rule will apply to both private and public schools. High-quality textbooks, including science, will be made available in home languages. In cases where home-language textbook material is not available, the language between the teachers and students will still remain the home language wherever possible.

The National Education Policy 2020 encourages teachers to use a bilingual approach, including bilingual teaching-learning materials, with those students whose home language may be differentfrom the medium of instruction.

Conceptual understanding:

We have introduced unique approaches for different subjects to ensure students learn subjects as a skill rather than gain just theoretical knowledge. The classroom interactions, activities and routines at LEAD also make learning holistic and experiential.

Early Childhood Care & Education (ECCE) & Foundational Literacy & Numeracy (FLN):

LEAD imparts strong language learning from early pre-primary years with our English Language and General Awareness (ELGA) and Sampoorna Hindi programs. While in class, we embrace activity-based learning to ensure students can easily grasp abstract subjects like Maths. Extensive practice and situation-based questions ensure the concepts get stronger.

Integration of Essential Subjects, Skills, and Capacities

In our school curriculum, we have introduced subjects such as Coding & Computational Skills (CCS) program. Rather than simply consuming content using technology, our students become creators by using technology to build. apps, games, and websites and thus become future-ready.

Teacher Empowerment:

The young minds of tomorrow will only be strengthened when we empower our educators. We do this through our extensive Teacher Development Workshops (TDWs). These sessions upskill and reinvigorate teachers to overcome challenges

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Regular formative assessment:

At LEAD, assessments target learning outcomes & competency. With remedial and doubt solving sessions, our teachers understand students' struggles and help them overcome their challenges.

All the states and union territories will set up an independent, state-wide, State School Standards Authority (SSSA) which will establish a minimal set of standards. "This information shall be self-disclosed and will be made available on a public website maintained by the SSSA," says the policy.

This will be instituted for all stages of education including pre-school education - private, public, and philanthropic - to ensure compliance with essential quality standards.

Public and private schools will be assessed and accredited on the same criteria, benchmarks, and processes.

Conclusion

The New Education Policy 2020 suggests creating an autonomous body, the National Educational Technology Forum (NETF), to provide a platform for the free exchange of ideas on the use of technology to enhance learning, assessment and planning for school and higher education.

However, education technology will be employed both in school and higher education and for both teaching-learning and education administration.

NEP 2020: Higher education:

Under the NEP, all education institutions will be held to similar standards of audit and disclosure. And the system will be governed by a single regulator, the Higher Education Commission of India.

It states that all fees set by private HEIs will be transparently and fully disclosed, and there shall be no arbitrary increases. Amit Khare, secretary, higher education, also added that there will be "fee fixation" across institutions as well.

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Higher education institutions will be reorganized into three types of institutions -- research, teaching and autonomous degree granting ones. New multidisciplinary institutions will be established.

In fact, the NEP's main vision for higher education is one of multidisciplinary and flexible learning and it is to be achieved by 2040. Khare suggested it will be possible to study physics with fashion design because of a system of studying a combination of "major" and "minor" subjects. Rejoining courses will be eased by the recording and transfer of "credits" will be eased by the Digilocker and "academic credit bank".

The policy includes the establishment of a National Research Foundation.

As per the new Policy, the undergraduate degree will be of either three or four-year duration, with multiple exit options. It states that students will be awarded a certificate after completing 1 year in a discipline or field including vocational and professional areas, or a diploma after 2 years of study, or a Bachelor's degree after a 3-year programme. The four-year multidisciplinary bachelor's programme, however, shall be the preferred option.

Internationalisation of Education:
The draft NEP states that high performing Indian universities will be encouraged to set up campuses in other countries. Similarly the top 100 universities in the world will be facilitated to operate in India by opening their campuses.

Government will also create a legislative framework under which foreign universities will be given special dispensation regarding regulatory, governance, and content norms on par with other autonomous institutions of India.

Conclusion:
The shortcomings in the education system vary from generation to generation. Some of the common complaints in the system are that degrees do not fetch you jobs, India's study pattern is more of rote learning and less of practical knowledge, most of the study is irrelevant in real lives, the system is exam- centric and so on.

The new policy definitely makes clear the government's vision to usher in some landmark changes to the education sector and aims at making India a global knowledge superpower. LEAD curriculum has been more progressive than NEP since inception. K-5 has been benchmarked to international standards on outcomes across all subjects, with international pedagogical practices used for deep conceptual understanding. Class 6-10 outcomes are benchmarked to the Boards, however international pedagogical approaches and best practices have been used to develop deep conceptual understanding & building thinking, communication and collaboration skills. Innovative programs like ELGA and CCS build strong foundational skills. With NEP guidelines coming in, adoption of LEAD curriculum will get a boost since all schools need to move away from traditional textbooks to NEP aligned curriculums like LEAD.

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A Method of Deriving Companion Identities Associating q-Series

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Abstract

In this paper, we have established two theorems by making use of Euler's q-derivative and q-shifted operators for a function of one variable and also for function of two variables. We derived several companion identities by applying these theorems on some known q-series identities. We deduced several special cases which are also the companion identities in the last section of the paper.

Keywords/Phrases: q-series identities; summation and transformation formulae for basic hypergeometric series; q-differential operator and Euler's q-derivative operator

MSC 2010 No: 33D15, 33D60

1. Introduction

Riese (1997) derived the dual and companion identities in the second chapter of his thesis by making use of the theory of qWZ-pairs developed by Wilf and Zeilberger (1990). Riese (1997) used qZeil of the q-Zeilberger algorithm (Paule and Riese (1997)) to generate the dual identities and companion identities systematically. Later, Zhang and Yang (2009) verified some of these identities. Somashekara et al. (2011) derived a new summation formula for ${}_2\Psi_2$ basic bilateral hypergeometric series by using method of parameter augmentation. Kumar et al. (2012)

established some interesting theorems which verify the special case of companion identity by using parameter augmentation method. In this paper, we have established a method for deriving such identities without use of q-Zeilberger algorithm. For any description about dual identities and companion identities readers may consult Paule and Riese (1997).Finally, we wish to derive results presented in the second chapter of the thesis of Riese (1997) without use of qZeil of the q-Zeilberger algorithm. To achieve the goal we have used the several definitions and known results that are given in the next section.

2. Preliminaries and q-Notations

For any integer n the q- shifted factorial is defined as

$$(a;q)_n = (1-a)(1-aq)(1-aq^2)\dots(1-aq^{n-1}), \tag{1}$$

$$(a;q)_n = \frac{(a;q)_\infty}{(aq^n;q)_\infty}, \tag{2}$$

$$(a;q)_\infty = \sum_{n=0}^{\infty} \frac{(-a)^n q^{\binom{n}{2}}}{(q;q)_n}, \tag{3}$$

$$\frac{1}{(a;q)_\infty} = \sum_{n=0}^{\infty} \frac{a^n}{(q;q)_n}, \tag{4}$$

$$\frac{(az;q)_\infty}{(z;q)_\infty} = \sum_{n=0}^{\infty} \frac{(a;q)_n z^n}{(q;q)_n}. \tag{5}$$

Throughout the paper, we have considered $0 < q < 1$ and $-1 < x < 1$.

Definition 2.1. q- Derivative

Euler's q- differential operator for a function $F(x)$ is introduced in Rogers (1893, 1894, 1896) as follows

$$D_q\{F(x)\} = \frac{\{F(x)-F(qx)\}}{x}. \tag{6}$$

Definition 2.2. α, β-Shift Operators

The q-shifted operator α, β for $F(x)$ is introduced in the Andrews (1971), Roman (1985) defined as

$$\alpha\{F(x)\} = F(qx),\ \beta\{F(x)\} = F(q^{-1}x). \tag{7}$$

Now, we define partial q-derivatives with respect to x and with respect y on the same fashion of Euler's q-derivative for a function $F(x, y)$ as follows

$$F'(x,y) = \frac{F(x,y)-F(qx,y)}{x}. \tag{8}$$

Now, we define partial q-derivatives with respect to x and with respect y on the same fashion of Euler's q-derivative for a function $F(x, y)$ as follows

$$F'(x,y) = \frac{F(x,y)-F(x,q^{-1}y)}{q^{-1}y}. \tag{9}$$

Definition 2.3.

We define a q-derivative formula for a function $F(x, y)$ with respect to x and y

$$D_{xy}F(x,y) = \frac{F(x,yq^{-1})-F(xq,y)}{x-q^{-1}y}. \tag{10}$$

The q-shifted operator 'α' for $F(x, y)$ is defined by

$$\alpha\{F(x,y)\} = F(qx,y). \tag{11}$$

The q-shifted operator 'β' for $F(x, y)$ is defined as under

$$\beta\{F(x,y)\} = F(x,q^{-1}y). \tag{12}$$

The two definitions (11) and (12) coincide to $F(x, y)$ for α^0 and β^0.

3. Main Results

In this section we shall established two theorems and their proof.

Theorem 3.1.

If $D_q F(x) = f(x)$ and $\alpha\{F(x)\}=F(qx)$,

then

$$F(x) - F(xq^m) = x\sum_{n=0}^{m-1} f(xq^n)q^n\,. \tag{13}$$

***Proof*:**

Taking $D_q F(x)=f(x)$ and replacing $F(qx)$ by $\alpha\{F(x)\}$ in equation (6) and rearranging, we get

$$F(x) = \frac{1}{1-\alpha}\{xf(x)\} \tag{14}$$

Multiplying both sides of (14) by $(1-\alpha^m)$ and then using the equation (7) on the left hand side and sum the right hand side as follows

$$F(x) - F(xq^m) = \sum_{n=0}^{m-1} \alpha^n\{xf(x)\} \tag{15}$$

Now, apply operator defined by equation (7) on equation (15), we get the required result in form of equation (13).

Theorem 3.2.

If $D_{xy} F(x, y)=f(x, y)$, $\alpha\{F(x, y)\}=F(qx, y)$ and

$$\beta\{F(x, y)\}=F(x, q^{-1} y),$$

then

$$F(x,y) - F(xq^m, yq^m) = (x-y)\sum_{n=0}^{m-1} f(xq^n, yq^{n+1})q^n. \tag{16}$$

Proof:

Taking $\alpha\{F(x, y)\}=F(qx, y)$ by equation (11) and $\beta\{F(x, y)\}=F(x, q^{-1} y)$ by equation (12) in equation (10) and rearrange as under

$$F(x,y) = \frac{1}{\beta(1-\alpha/\beta)}\{(x-q^{-1}y)D_{xy}F(x,y)\}. \tag{17}$$

Multiplying both sides of equation (17) by $[1-(\alpha/\beta)^m]$ and then using equation (11) and equation (12), we get

$$\left[1-\left(\frac{\alpha}{\beta}\right)^m\right]F(x,y) = \frac{1}{\beta}\left[\frac{1-\left(\frac{\alpha}{\beta}\right)^m}{1-\alpha/\beta}\right]\{(x-q^{-1}y)D_{xy}F(x,y)\}. \tag{18}$$

Taking $D_{xy} F(x, y)=f(x, y)$ and summing the right hand side of equation (18) by geometric series

$$F(x,y) - F(xq^m, yq^m) = \sum_{n=0}^{m-1} \alpha^n\beta^{-n-1}\{(x-q^{-1}y)f(x,y)\}. \tag{19}$$

Simplifying equation (19) by using equation (11) and equation (12), we get the required equation (16).

4. Applications

In this section, we shall establish some companion identities by making use of theorem 3.1 and theorem 3.2. Identity 4.1 and Identity 4.2 are derived by the application of theorem 3.1 and Identity 4.3 is derived by the application of theorem 3.2.

Identity 4.1.

If

$$F(x) = \frac{1}{(x;q)_\infty} \text{ and}$$

$$F(x) - F(xq^m) = x\sum_{n=0}^{m-1} f(xq^n)q^n,$$

then

$$x\sum_{n=0}^{m-1}(x;\ q)_n\, q^n = 1-(x;\ q)_m. \tag{20}$$

Proof:

We have

$$F(x) = \frac{1}{(x;\ q)_\infty}\ . \tag{21}$$

Using Euler's q-differential operator defined by equation (6) on equation (21), we get

$$D_q F(x) = \frac{1}{(x;\ q)_\infty} = f(x)\ . \tag{22}$$

Setting $x = xq^n$ in equation (22), we get

$$f(xq^n) = \frac{1}{(xq^n;\ q)_\infty} \tag{23}$$

and setting $x = xq^m$ in equation (21), we get

$$F(xq^m) = \frac{1}{(xq^m;\ q)_\infty}\ . \tag{24}$$

Substituting the values of $F(x)$, $F(xq^m)$ and $f(xq^n)$ from equation (21), (24) and (23) respectively in equation(13) and after simplifying, we get the required result (20).

Verification of identity (4.1)

It is verified by analytical method using equation (13). In this method the left hand side of equation (13) becomes dummy and only right hand side is solvable in two different ways. The procedure is as under:

Substituting the value of $f(xq^n)$ from equation (23) in equation (13), we get

$$F(x) - F(xq^m) = x\sum_{n=0}^{m-1}\frac{1}{(xq^n;\ q)_\infty}q^n\ . \tag{25}$$

On simplification, equation (25) can be written as

$$F(x) - F(xq^m) = \frac{x}{(x;\ q)_\infty}\sum_{n=0}^{m-1}(x;\ q)_n q^n\ . \tag{26}$$

Expanding the inner series of equation (25) by using equation (4) as follows

$$F(x) - F(xq^m) = x\sum_{n=0}^{m-1} q^n \sum_{r=0}^{\infty}\frac{(xq^n)^r}{(q;q)_r}\ . \tag{27}$$

Rearranging equation (27) becomes

$$F(x) - F(xq^m) = x\sum_{r=0}^{\infty}\frac{(x)^r}{(q;q)_r}\sum_{n=0}^{m-1} q^{n(r+1)}\,. \tag{28}$$

The inner right series is a geometric series of 'm' terms with first term 1 and common ratio q^{r+1} after summing this, equation (28) becomes

$$F(x) - F(xq^m) = \sum_{r=0}^{\infty}\frac{x^{r+1}}{(q;q)_{r+1}}\left(1 - q^{m(r+1)}\right). \tag{29}$$

Replacing r by $(r-1)$ in equation (29), we get

$$F(x) - F(xq^m) = \sum_{r=1}^{\infty}\frac{x^r}{(q;q)_r} - \sum_{r=1}^{\infty}\frac{(xq^m)^r}{(q;q)_r}. \tag{30}$$

Taking both series from $r=0$ in the right hand side of equation (30), we get

$$F(x) - F(xq^m) = \sum_{r=0}^{\infty}\frac{x^r}{(q;q)_r} - \sum_{r=0}^{\infty}\frac{(xq^m)^r}{(q;q)_r}. \tag{31}$$

Summing both series of right hand side of equation (31) by equation (4), we get

$$F(x) - F(xq^m) = \frac{1}{(x;\,q)_\infty} - \frac{1}{(xq^m;\,q)_\infty}. \tag{32}$$

On combining equation (26) and equation (32), we get the required result (20).

Identity 4.2.

If $$F(x) = (x;\,q)_\infty \text{ and}$$

$$F(x) - F(xq^m) = x\sum_{n=0}^{m-1} f(xq^n)q^n,$$

then

$$x\sum_{n=0}^{m-1}\frac{1}{(x;\,q)_{n+1}}q^n = \frac{1}{(x;\,q)_m} - 1. \tag{33}$$

Proof:

We have

$$F(x) = (x;\,q)_\infty\,. \tag{34}$$

Using Euler's q-differential operator defined by equation (6) on equation (34), we get

$$D_q F(x) = -(xq;\ q)_\infty = f(x). \tag{35}$$

Taking $x = xq^n$ in equation (35), we get

$$f(xq^n) = -(xq^{n+1};\ q)_\infty\ . \tag{36}$$

Setting $x = xq^m$ in equation (34), we get

$$F(xq^m) = (xq^m;\ q)_\infty\ . \tag{37}$$

Substituting these values of $F(x)$, $F(xq^m)$ and $f(xq^n)$ from equation (34), (36) and (37) respectively in (13), we get the required result (33).

Verification of identity (4.2)

Applying analytical method by using equation (13), the left hand side of equation (13) becomes dummy and only right hand side is solvable in two different ways as discussed in the verification of (4.1).

Identity 4.3.

If

$$F(x,y) = \frac{(yt;\ q)_\infty}{(xt;\ q)_\infty} \text{ and}$$

$$F(x,y) - F(xq^m, yq^m) = (x-y)\sum_{n=0}^{m-1} f(xq^n, yq^{n+1})q^n,$$

then

$$t(x-y)\sum_{n=0}^{m-1} \frac{(xt;\ q)_n}{(yt;\ q)_{n+1}} q^n = 1 - \frac{(xt;\ q)_m}{(yt;\ q)_m}. \tag{38}$$

Proof:

We have

$$F(x,y) = \frac{(yt;\ q)_\infty}{(xt;\ q)_\infty}. \tag{39}$$

Operating equation (10) on equation (39), we get

$$f(x,y) = t\frac{(yt;\ q)_\infty}{(xt;\ q)_\infty}\ . \tag{40}$$

Setting $x = xq^n$, $y = yq^{n+1}$ in equation (40), we get

$$f(xq^n, yq^{n-1}) = t\frac{(ytq^{n+1};q)_\infty}{(xtq^n;q)_\infty}. \quad (41)$$

Setting $x= xq^m$, $y=yq^m$ in (41), we get

$$F(xq^m, yq^m) = \frac{(ytq^m;q)_\infty}{(xtq^m;q)_\infty}. \quad (42)$$

Substituting these values of $F(x, y)$, $F(xq^m, yq^m)$ and $f(xq^n, yq^{n+l})$ in equation (16) , we get the required result (38).

Verification of identity (4.3)

It is verified by analytical method using equation (16). In this method the left hand side becomes dummy and only right hand side is solvable in two different ways. The procedure is illustrated as below:

We have

$$f(xt, yt) = \frac{(yt;q)_\infty}{(xt;q)_\infty}. \quad (43)$$

Setting $x= xq^n$, $y=yq^{n+l}$ in equation (43), we get

$$f(xtq^n, ytq^{n+1}) = \frac{(ytq^{n+1};q)_\infty}{(xtq^n;q)_\infty}. \quad (44)$$

Substituting the value of $f(xtq^n, ytq^{n+l})$ from equation (44) to equation (16), we get

$$F(xt, yt) - F(xtq^m, ytq^m) = t(x-y)\sum_{n=0}^{m-1}\frac{(ytq^{n+1};q)_\infty}{(xtq^n;q)_\infty}q^n. \quad (45)$$

On simplifying equation (45), we get

$$F(xt, yt) - F(xtq^m, ytq^m) = t\frac{(yt;q)_\infty}{(xt;q)_\infty}(x-y)\sum_{n=0}^{m-1}\frac{(xt;q)_n}{(yt;q)_{n+1}}q^n. \quad (46)$$

Expanding the inner series of equation (45), using equation (5), we have

$$F(xt, yt) - F(xtq^m, ytq^m) = t(x-y)\sum_{n=0}^{m-1}q^n\sum_{r=0}^{\infty}\frac{\left(\frac{yq}{x};q\right)_r}{(q;q)_r}(xtq^n)^r. \quad (47)$$

Rearranging the equation (47) as follows

$$F(xt,yt)-F(xtq^m,ytq^m)=t(x-y)\sum_{r=0}^{\infty}\frac{\left(\frac{yq}{x};q\right)_r}{(q;q)_r}(xt)^r\sum_{n=0}^{m-1}q^{n(r+1)}. \quad (48)$$

The inner right series is a geometric series of 'm' terms with first term 1 and common ratio q^{r+1} after summing and simplifying, the equation (48) becomes

$$F(xt,yt)-F(xtq^m,ytq^m)=\sum_{r=0}^{\infty}\frac{\left(\frac{y}{x};q\right)_{r+1}}{(q;q)_{r+1}}(xt)^{r+1}\left(1-q^{m(r+1)}\right). \quad (49)$$

Replacing r by $(r-1)$ in equation (49), we get

$$F(xt,yt)-F(xtq^m,ytq^m)=\sum_{r=1}^{\infty}\frac{\left(\frac{y}{x};q\right)_r}{(q;q)_r}x^r-\sum_{r=1}^{\infty}\frac{\left(\frac{y}{x};q\right)_r}{(q;q)_r}(xq^m)^r. \quad (50)$$

Rearranging series from $r=0$ in equation (50), we have

$$F(xt,yt)-F(xtq^m,ytq^m)=\sum_{r=0}^{\infty}\frac{\left(\frac{y}{x};q\right)_r}{(q;q)_r}(xt)^r-\sum_{r=0}^{\infty}\frac{\left(\frac{y}{x};q\right)_r}{(q;q)_r}(xtq^m)^r. \quad (51)$$

Summing right hand side of equation (51) by using equation (5), we get

$$F(xt,yt)-F(xtq^m,ytq^m)=\frac{(yt;q)_\infty}{(xt;q)_\infty}-\frac{(ytq^m;q)_\infty}{(xtq^m;q)_\infty}. \quad (52)$$

Simplifying equation (52), we get

$$F(xt,yt)-F(xtq^m,ytq^m)=\frac{(yt;q)_\infty}{(xt;q)_\infty}-\frac{(xt;q)_m}{(yt;q)_m}\frac{(yt;q)_\infty}{(xt;q)_\infty}. \quad (53)$$

On combining equation (46) and equation (53), we get the required result (38).

5. Special Cases

If we set $t=1$ in equation (38)

$$(x-y)\sum_{n=0}^{m-1}\frac{(x;q)_n}{(y;q)_{n+1}}q^n=1-\frac{(x;q)_m}{(y;q)_m}. \quad (54)$$

If we put $y=0$ in equation (54), we get the equation (20).

If we put $x=0$ in equation (54), we get the equation (33).

The limiting case as $m\to\infty$ the result (38) becomes

$$t(x-y)\sum_{n=0}^{\infty}\frac{(xt;q)_n}{(yt;q)_{n+1}}q^n=1-\frac{(xt;q)_\infty}{(yt;q)_\infty}. \quad (55)$$

If we put $t=1$ and $y=0$ in equation (55), we get a result as $lim\ m\to\infty$ of equation (20).

If we put $t=1$ and $x=0$ in equation (55), we get a result as $lim\ m\to\infty$ of equation (33).

6. Conclusion

In this paper, we have established two main theorems by making use of Euler's q- derivative and q-shifted operators for a function of one variable and two variables. Some companion identities have also been derived by applying these theorems on some known q-series identities. Finally, we deduced some special cases, which also have the companion identities. The main purpose of the paper is to derive results without making use of a qZeil of q-Zeilberger algorithm, which are listed in the second chapter of the thesis of Riese (1997).

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Review of NEP in Rural Development: A Demographic Study of Karauli District

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ABSTRACT

Of all the resources, man is the most valuable resource having relevance owing to his well-developed mind and capacity. In fact, man is not only resource in himself but all the other natural endowments which are treated as resources, are in a sense the creation of man- mind and his abilities. As Zimmerman and Michel have observed, Man-mind is the greatest resource itself. Man has played a crucial role as a controller, regulator, and modifier of resource according to his needs and capacity to fulfil his requirements. Thus, through his various interrelated activities in physical as well as cultural real man has emerged as "pivot" in the nature. Morgan has rightly remarked that "the land use patterns of agricultural system depend" not only on the physical environment and plants/animals' relationship, but all so social and economic conditions ascribed to type and level human activities. So, it is great relevance to appraise various aspects of human resource base. By analysing the population data of the last 100 years of Karauli district, how much and how has the change in population affected the development here. Also, what are the changes in the population distribution pattern here. An attempt has been made to analyse all these changes through this research paper and analysis is necessary to develop the district by making optimum use of the resources available here.

Keywords: Distribution of population, density, growth rate, age structure, literacy level

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In present population of Karauli district is 1458248 persons up to 2011. Which is distributed with much spatial variation associated with such factors as availability of fertile, land, transport and marketing facilities and impacts of floods etc, most of the people in the district reside in rural areas. The density of population of the district was 289 person per square km in 2011. Due to this change of population, the study of the changes taking place one the economic and social profile of Karauli district is very important and the study of how the invisible changes in land use due to the change of population can be used as development is essential.

Objectives

- ❖ To present the distribution of population in the district.
- ❖ Interpreting population pattern based on population growth over the last 100 years.
- ❖ To explain the dense and sparse areas of population density in district.

Review of literature

The first population analysis study in the history of the world was conducted in 1953 by G.T. Trewartha. Following this, many economists and geographers made significant contributions to the field. These included Thomson, Lynne Smith, Ackerman, C. Clark, Ward, J.I. Clark Garner, Jalensky, Stamp, Alfrid Peterson, G.J. Demko, Adams Landry, Brasley, P.E. James, Buchnan, P. George, W.E.Mori are prominent scholars.

Indian Scholars in Population Studies- Ashish Bose, B.L. Agarwal, S.N. Agrawala, R.C. Chandana, G.S. Gosal, B.N. Ghosh, B.N. Puri, V.C. Misra, B.C. Mehta, Mansur Ahmed, S.J. Mehta, Suryakant, R.S.P. Gosal, K.N. Dubey, Prem Sagar, Smita Sen Gupta, S.C. Julka, P.K. Sharma, Sodhiram, Dhaneshwari, Jitendra Mohan, Meher Singh Gill, F.Z Jamali, N.L Gupta, Hemlata Joshi, Sadhana Kothari, Ismail Haque, Indel Singh, Kamalkant Dubey, Mahendra Bahadur, Juzar Singh, Pushpa Pathik, Gopal Krishna, Abdul Razak, Nural Alam, A.S. Panwar, Anju Kohli, Gunjan Garg etc. have made their invaluable contribution.

In recent years, significant study is done in the population distribution by Bose, C. (2018), Chutia, L.J. and M.K. Sharma. (2016), Das, D., A. Kumar, and M. Sharma. (2020), Dash, M. (2016), Ribeiro HV, Oehlers M, Moreno-Monroy AI,Kropp JP, Yadav, S., Khan,Z. (2012), ZhangL, Lin X, Leng L, Zeng Y, (2021), Zhou Q, Xu Y, Zheng Y,Shao J, Lin Y, Wang H,(2020), Khan, Zuber & Yadav, Sandeep & Mangal, Nikita. (2021) and Yadav Sandeep and Sahu Sonu (2022).

Study area

Karauli district located in the south-eastern region of Rajasthan lies between 26°3' north to 26°49' north latitude and 76° 35' E to 77° 26' E longitude. The height for the sea level in

the district 400 to 600 meters, and total area of district is 5043.02 (census report, 2011). It is bounded on the East by Dhaulpur district, on the North-East Bharatpur district, on the North – West Dausa district and the South-West Sawai Madhopur and on South-East by Madhya Pradesh state. Chambal River separating the Karauli and Morena district (M.P. state).

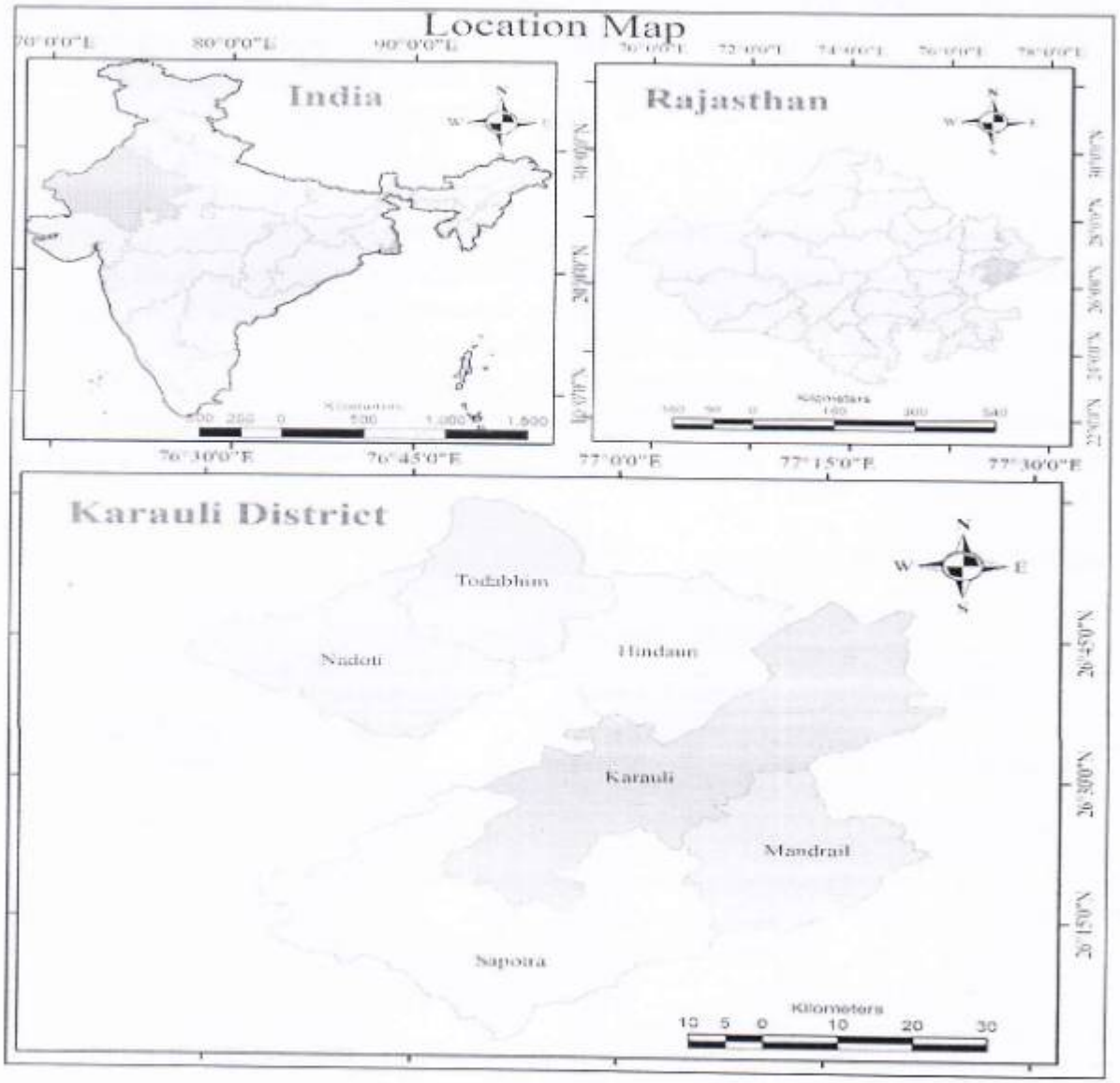

Fig. 1

Administratively, the district comprises 6 tehsils. The town of Karauli is the district headquarters. Karauli District comes under Bharatpur Divisional Commissionerate. Karauli

is famous for popular red-stone. Karauli district consists of 85.04 percent rural and 14.96 percent urban population. While almost the entire district is covered by hills and ravines, there are no lofty peaks, the highest having an elevation of less than 1400 feet above sea level. Good grade stone and some iron ore comprise the mineral resources of the area. Karauli's natural environment includes the Vindhyan and Aravalli mountains. The district has plain, high, and low and hilly parts. The plains are fertile, and clay is lightweight and sandy. There are many rivers in the district. Annual rainfall is 580.36 mm, about 35 days in a year. Maximum temperature is 49 °C in May and 2 °C in January.

Methodology

The most appropriate unit of study has been determined to be the tehsil. The study's primary data source is secondary information that was gathered from numerous reliable government sources. The tehsil level data for total, male, female population has been taken from Census of India (2011) General Population Totals, Primary Census Abstract, Rajasthan. Data was first combined into several groups and tables in accordance with the needs of the study after being obtained from various sources. The study has made use of maps and several statistical techniques to fulfil its objective requirements and conduct a factual comparative analysis of the data.

Growth & Distribution analysis

Table 1: Population Growth 1911-2011

Year	Total population		Rural population		Urban population		No. of Urban centers	Sex ratio
	Population	Decennial Variation	% Population	Decennial Variation (%)	% Population	Decennial Variation (%)		
1911	344078	–	98.78	–	1.22	–	3	825
1921	305090	-10.8	98.18	-13.53	1.82	+2.03	3	820
1931	308988	+10.05	97.78	+2.69	2.22	+1.31	3	832
1941	334736	+13.01	96.39	+6.20	3.61	+2.26	3	830
1951	371931	+12.11	92.39	+9.10	7.77	+2.38	3	840
1961	444807	+23.32	90.49	+1.45	9.51	+5.90	4	835
1971	559266	+26.49	89.10	+24.56	11.90	+3.59	4	854
1981	798926	+42.85	88.33	+42.77	11.67	+4.66	5	867
1991	927719	+16.12	87.49	+14.01	12.51	+3.62	5	840
2001	1209665	+29.13	86.39	+29.29	13.61	+4.28	6	858
2011	1458248	+20.54	84.74	+18.24	14.96	+4.79	9	861

Decennial growth of population of the district gas been rather erratic. During the second and third successive decades of the century, tide creased owing to a variety of reasons such as epidemic and unhealthy seasons, the third and fourth decades witnessed a growth of 10.05% and 13.01%. Population growth continuously increased during next successive decades. The increase in the population of the district during the 1961-71 decade was slightly less than the average increase for the whole of Rajasthan, which was 27.83%, In the present day, the growth rate of Karauli district is 20.54%. Table 1 shows medium growth of 36.57% during the period of 1921-71 while high growth during 1971-81 remained 16.36% but growth during 1981-1991 increased to 29.12% respectively. Between 1911 and 1921 this was marked decreased due to serve attack of various epidemics (e.g., cholera, plague etc.) famine and other natural calamities. But after 1921 the increase in number continued without interruption.

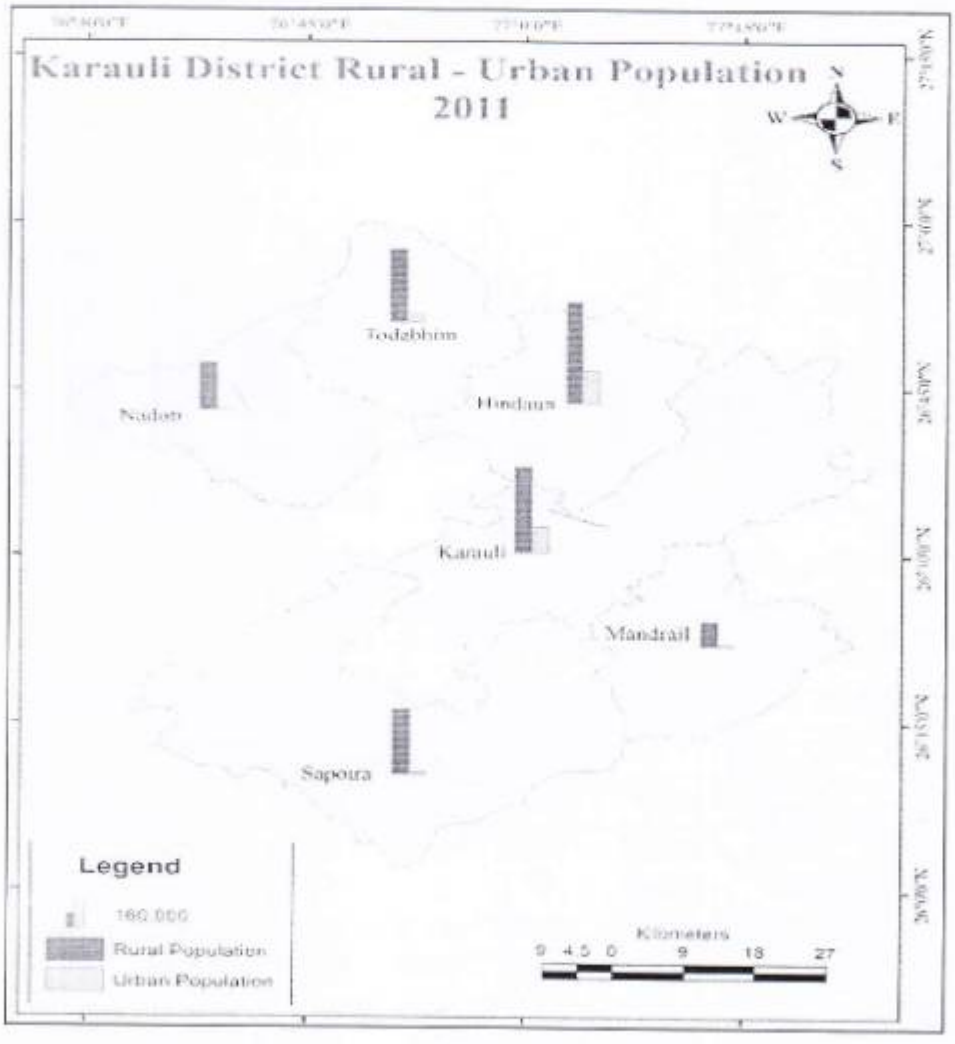

Fig. 2

At tehsil level, during 1971-81 the growth was highest (53.10%) in Hindaun tahsil and lowest (+0.47%) in Karauli tahsil. In Karauli tehsil during 1941-51 growth decreased (-1.83%) due to epidemics. Medium growth (25.83%) is observed in Todabhim tehsil. The remaining maximum number of tehsils falls under moderate low category, i.e., growth 20 to 30%.

The total population of the district is 1458248 persons up to 2011, which is distributed with much spatial variation associated with such factors as availability of fertile, land, transport and marketing facilities and impacts of floods etc. Most of the people in the district reside in rural areas. The Census of 1961 recorded that 89.81% of the population was rural and 10.19% urban respectively. The Census of 1971, however, showed some shift towards urbanization when 11.90% of population was found to be urban and 88.10% rural.

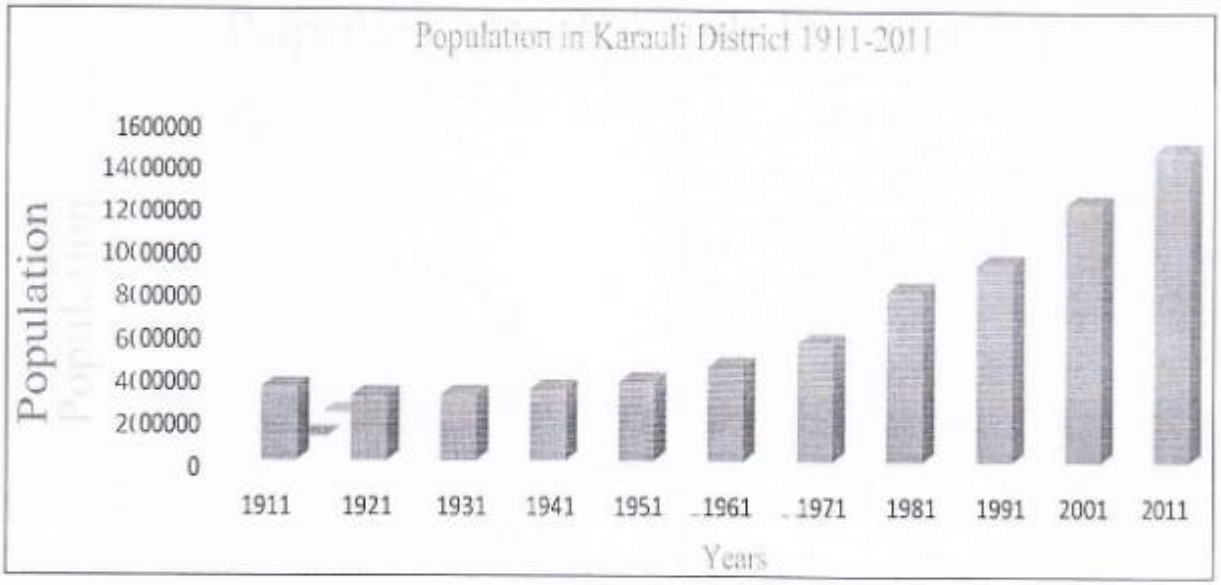

Fig. 3

Table 2: Tehsil wise population distribution in Karauli District-2011

	Rural			Urban			Total		
Tehsil	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Todabhim	122525	105676	228203	12079	10898	22977	134604	116576	251180
Nadauti	80479	70419	150898	—	—	—	80479	70419	150898
Hindaun	171569	146853	318422	55834	49618	105452	227403	196471	423874
Karauli	143984	122184	266168	43908	39052	80960	187892	161236	349128
Mandrail	40659	33941	74600	—	—	—	40659	33941	74600
Sapotara	108969	92883	201852	3633	3083	6716	112602	95966	208568

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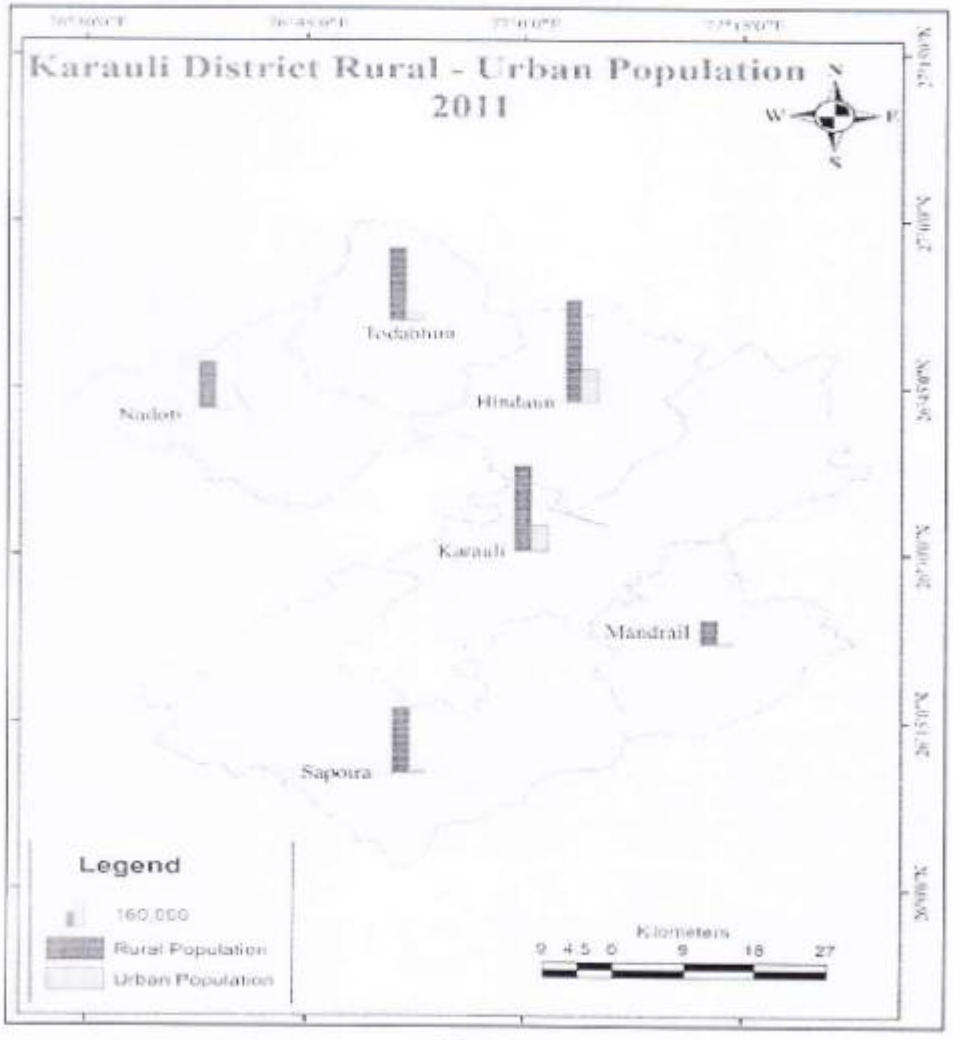

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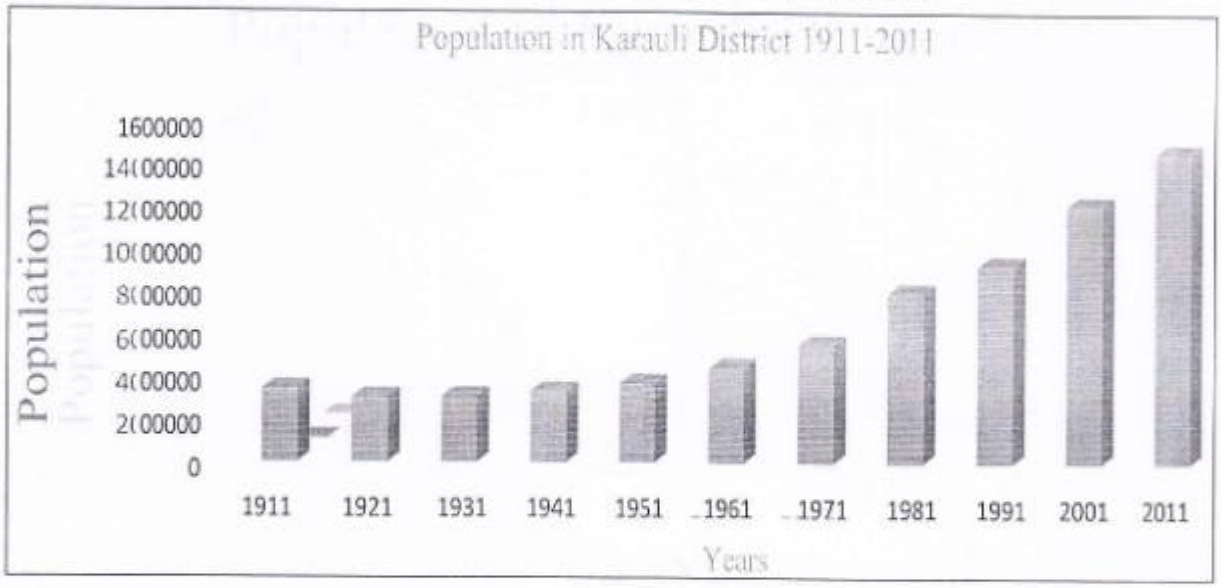

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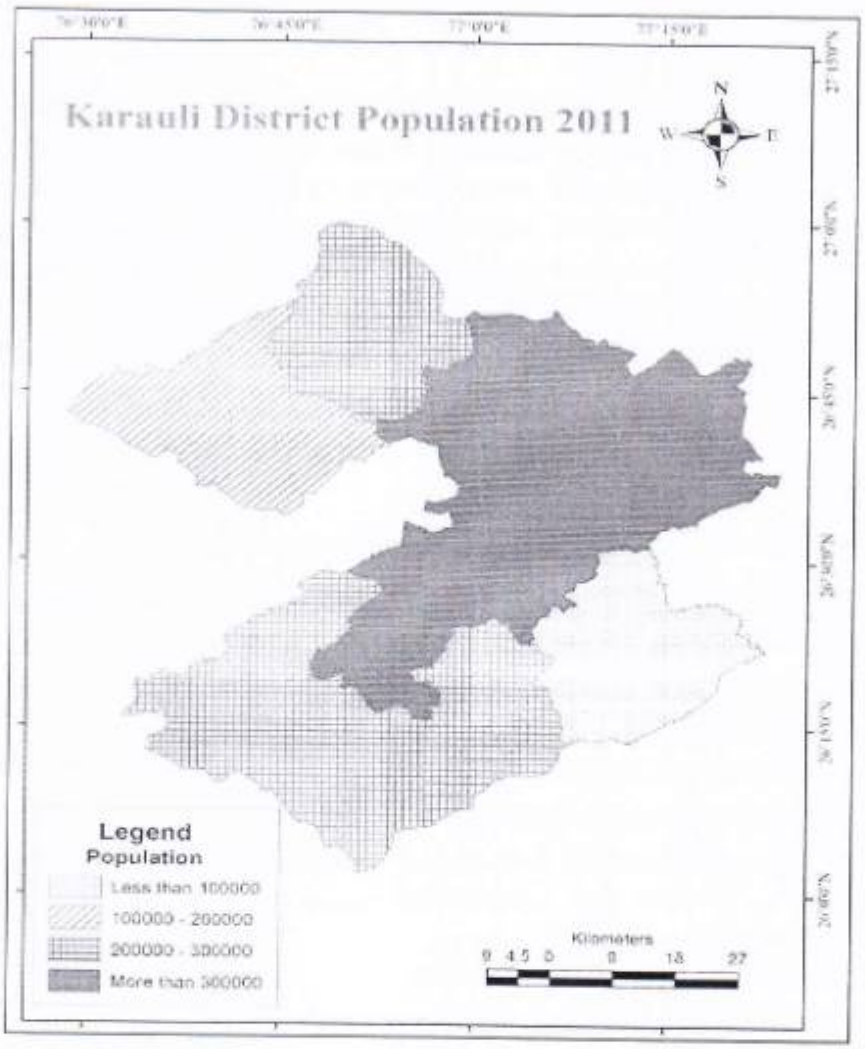

Fig. 3

Out of the three tehsils of the district, namely, Nadauti, Sapotara and Mandrail were completely rural. Highest population (423874 persons) lived in Hindaun and lowest population (74600 persons) lived in Mandrail. Along roadside, the concentration of population is observed in the form of patches. The patches of highest population are located along Hindaun-Karauli, Hindaun-Mahavirji, Karauli-Mahavirji roads where beneficial condition like fertile land and transport and marketing facilities etc. are available.

The North-West parts of Todabhim and Karauli tehsils, and southern and western parts of Sapotara tehsil have medium concentration of population, Low concentration of population in Mandrail tehsil is due to adverse and hilly area.

SUMMARY

Since the existence of Karauli district, the growth of population has been slow towards urbanization. After analyzing the population, it is seen that even today there is a lack of basic amenities which do not reach the rural areas. There is an absolute lack of pure drinking water, paved roads for accessible transport, employment, urban lifestyle, etc., which needs to be developed through government schemes and the participation of local public representatives. Even today there is a complete lack of urbanization in some tehsils of the district, due to which the development of the district is blocked. Therefore, there is an urgent need for integrated development of rural population so that the district can be included in the front line.

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Industrial Development in Karauli District: Challenges and Opportunities

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ABSTRACT: This research article explores the industrial development in Karauli district, highlighting the challenges faced by the region and identifying potential opportunities for growth. The study examines the historical background of the district's industries and assesses the spatial distribution of various industrial units. It also analyses the presence of micro, small, and medium enterprises (MSMEs) and provides an overview of their contributions to the local economy. The article concludes by discussing the constraints hindering industrial growth and offering suggestions for overcoming these challenges.

KEYWORDS: industrial development, micro/small/medium enterprises, challenges, spatial distribution

I. INTRODUCTION

The area encompassed by Karauli district has traditionally been associated with traditional artisanal crafts, such as weaving, goldsmithing, and blacksmithing, which primarily cater to local demands. However, there has been limited industrial development in the district, with minor manufacturing activities focused on niche markets in the neighbouring areas. This article aims to shed light on the growth of industries in Karauli district, focusing on the present scenario and prospects for future development.

Although public policy instruments undoubtedly influence the economic growth of different regions, the relative economic position of each region is ultimately determined by various factors, particularly local-specific factors. The prevailing view in modern economic development suggests that industry plays a significant role in both generating and reducing disparities among regions. Industry is often seen as the primary driver of economic growth and its expansion is considered more prone to "cumulative causation" compared to other sectors.

The conventional theory of regional development suggests that industrial development, and consequently overall economic development, should follow a path that leads to "convergence". Initially, industries tend to concentrate where they are already present, but as diminishing returns set in, they shift to less developed areas. Since agriculture experiences diminishing returns sooner due to land limitations and technological constraints, industry, with its history of increasing returns, acts as the equalizing force once its development begins in backward areas.

As a result, regions with different initial levels of development and capabilities are subject to "cumulative causes." They not only grow at different rates due to internal factors but also experience differences that are magnified by the interaction between regions through the "backwash effect" (Myrdal, 1957; Hirschman, 1958; Kaldor, 1970). Shortly after independence, it became evident that there were significant disparities in economic development, particularly in the industrial sector. Political mechanisms and measures were established to reduce these disparities, particularly in underdeveloped regions, through the establishment of central public institutions. However, it is worth questioning whether these state intervention policies truly promoted industrial development in poorer regions and effectively reduced regional disparities in industrialization levels. In practice, these policies often tended to favour more developed and urbanized areas within the underdeveloped regions.

II. REVIEW OF LITERATURE

Studies focusing on industrial development in Karauli District have been conducted by various researchers and organizations. Singh and Sharma (2019) examined the current state of industrial development in the district,

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highlighting the challenges and potential opportunities. Their study provided a detailed analysis of the industrial landscape in Karauli, identified constraints faced by existing industries, and proposed recommendations for promoting industrial growth.

Another relevant research conducted by Khan and Verma (2017) compared the economic development of Karauli District with neighbouring districts in Rajasthan. Their study explored the factors influencing industrial growth in the region and assessed the effectiveness of government policies in promoting economic development. By providing insights into the specific challenges faced by Karauli District, this research shed light on the efforts required to achieve industrial progress.Agarwal and Mishra (2015) focused on the socio-economic aspects of development in Karauli District, including industrial development. Their study examined the role of various stakeholders, such as the government, local communities, and industry associations, in driving economic growth. It emphasized the importance of inclusive development strategies to address regional disparities, highlighting the need for a holistic approach to industrial development.

The Rajasthan State Industrial Development and Investment Corporation Limited (RIICO) has played an instrumental role in studying industrial development in various districts of Rajasthan, including Karauli. RIICO's reports provide valuable insights into the existing industrial infrastructure, investment opportunities, and policy initiatives in the district. These studies serve as essential resources for understanding the industrial development landscape in Karauli.The Confederation of Indian Industry (CII) has also contributed to the understanding of industrial development in Rajasthan, including specific references to Karauli District. CII has published reports discussing potential sectors for industrial growth in the state, providing industry perspectives and recommendations for policymakers and investors interested in the region.

The Planning and Development Department of the Government of Rajasthan has undertaken studies on regional development, including Karauli District. Their reports analyse the existing infrastructure, investment climate, and industrial potential of the district. These studies offer valuable insights into the challenges and opportunities for industrial development in Karauli.In addition to these organizations, researchers from academic institutions, including local universities and research centres, have conducted studies on various aspects of industrial development in Rajasthan. Although not specific to Karauli District, their work provides insights into the broader context of industrial growth in the state and can be relevant for understanding the challenges faced by Karauli.

A range of studies conducted by researchers, organizations, and government bodies have provided valuable insights into the challenges and opportunities for industrial development in Karauli District. These studies offer comprehensive analyses of the industrial landscape, identify constraints, and propose strategies for promoting industrial growth. Policymakers, stakeholders, and potential investors can benefit from the findings of these studies to develop informed strategies and interventions that foster economic growth and industrial development in Karauli District.

III. OBJECTIVES

The objectives of studying industrial development in Karauli District are as follows:
1. Assess the current state of industrial growth, identifying challenges and opportunities.
2. Explore the factors influencing industrial growth, including government policies, infrastructure, resources, and local socio-economic conditions.
3. Examine the effectiveness of existing interventions and initiatives aimed at promoting industrial growth.
4. Identify opportunities for industrial diversification and expansion in the district.
5. Promote inclusive and sustainable industrial development, considering social and environmental impacts.

These objectives aim to understand the current situation, address barriers, leverage strengths, and optimize strategies for industrial development in Karauli District. By pursuing these objectives, policymakers can foster a conducive environment, attract investments, promote entrepreneurship, create employment opportunities, and ensure sustainable and inclusive growth.

IV. STUDY AREA

Karauli district, situated in the southeastern region of Rajasthan, is geographically located between 26°31' to 26°49' north latitude and 76°35' E to 77°26' E longitude. The district covers an area of 5043.02 square kilometres, with an elevation ranging from 400 to 600 meters above sea level, as per the census report of 2011. It shares borders with

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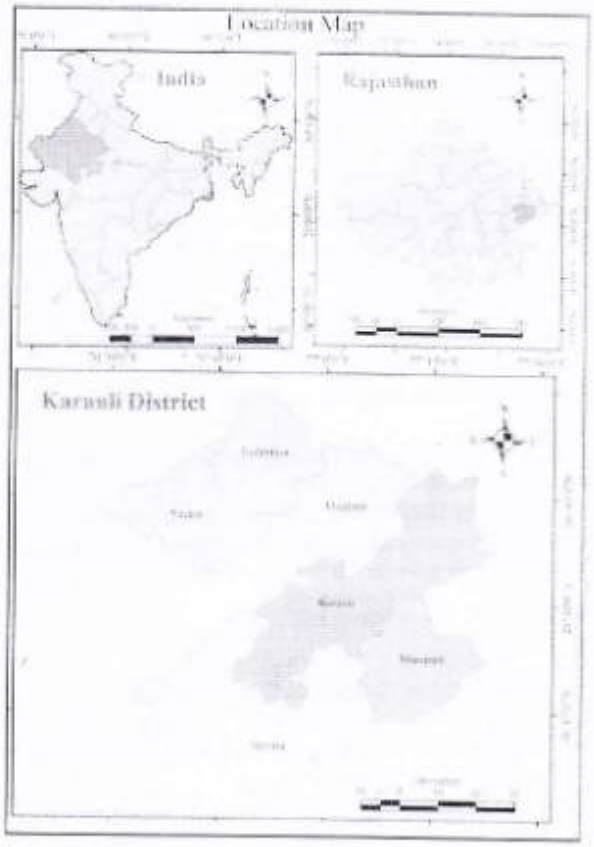
Dhaulpur district to the east, Bharatpur district to the northeast, Dausa district to the northwest, Sawai Madhopur district to the southwest, and Madhya Pradesh state to the southeast, separated by the Chambal River.

Administratively, the district is divided into 6 tehsils, with the town of Karauli serving as the district headquarters. Karauli District falls under the jurisdiction of the Bharatpur Divisional Commissionerate. The district is renowned for its abundant reserves of popular red stone. The population of Karauli district is predominantly rural, accounting for 85.04 percent, while the urban population constitutes 14.96 percent. The topography of the district is characterized by hills, ravines, and a lack of towering peaks, with the highest elevation being below 1400 feet above sea level. The region possesses mineral resources such as high-quality stone and some iron ore. The natural environment of Karauli encompasses the Vindhyan and Aravalli Mountain ranges. The district exhibits diverse terrains, including plains, highlands, lowlands, and hilly areas. The plains are fertile, featuring lightweight and sandy clay soil. Several rivers flow through the district, contributing to its water resources. The annual rainfall in Karauli averages 580.36 mm, occurring over approximately 35 days in a year. The climatic conditions vary, with the maximum temperature reaching 49 °C in May and the minimum temperature dropping to 2 °C in January.



V. RESULTS

Growth of Industries:

The historical context of industrial development in Karauli district is explored, highlighting traditional crafts, including weaving, dyeing, wooden toy manufacturing, and lacquer work. The district's past exports, such as copper vessels, lacquered wooden articles, and scents extracted from khas grass, are discussed. Additionally, the presence of state-owned cotton presses and the prominence of cotton, cloth, and carpet weaving in the district are examined. The impact of fertile tracts and the woollen cloth industry in the region is also acknowledged.

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Spatial Distribution of Industries:
The classification of industries based on raw materials, production, employment, capacity, and investment is analysed. The data obtained from the district presents a comprehensive overview of various industrial units. The absence of large-scale industries is noted, while the prevalence of micro, small, and medium enterprises (MSMEs) is emphasized. The article provides insights into the types of industries present, including stone cutting, stone slates, washing soap, readymade garments, oil expellers, paper bags, carpets, and more.

Rural Industries:
An examination of rural industries in Karauli district is undertaken, focusing on different sectors such as food and agro-based industries, forest-based industries, hand paper fibre industries, minerals-based industries, chemical-based industries, engineering non-traditional industries, and textiles and service industries. The employment generated, production, sales, and labour statistics for each sector are presented.

Table 1: Rural Industries in Karauli District (2018-19)

Group	Allot unit no.	Extra Production (In Lakh)	Extra sale (In Lakh)	Extra Employment	Labour (In Lakh)
Food and agro based industries	6	70.50	88.13	47	25.85
Forest based industries	0	0	0	0	0
Hand Paper Fiber Industries	1	6	7.5	4	2.20
Minerals based Industries	2	13.5	16.88	9	4.95
Chemical based Industries	0	0	0	0	0
Engineering nontraditional Industrial	1	9	11.25	6	3.30
Textiles and service Industries	10	0	0	59	33.18
Total	20	99	123.76	125	69.48

Industrial Estate:
The presence of an industrial estate in Karauli district is discussed, with a detailed classification of industries based on their nature and investments. The article highlights the number of industries, investment amounts, and planning figures for different industrial categories.

Challenges and Constraints:
The article identifies the major constraints faced by the district in terms of industrial development. These include a lack of working capital, inadequate supply of raw materials, uncertain power supply, traditional production techniques, high production costs, unskilled labour, and unfavourable government policies. Each constraint is discussed in detail to provide a comprehensive understanding of the challenges faced by the industrial sector in Karauli district.

Table 2:Industrial Estate in Karauli District (2018-19)

Sr. No.	Classification of Industries	No. Of Industries	Investment (In Lakh)	Planning No.
1.	Chemical Based	1	7	4
2.	Cardboard/Paper	1	40	10
3.	Data Processing	64	428	166
4.	Food ingredient	83	539	273
5.	Forest Based	4	29	12
6.	Electric & Electronic	53	375	178
7.	Iron Fabrication	7	70	35

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8.	Mineral Based	8	167	65
9.	Auto mobile	7	70	35
10.	Textile	6	35	9
11.	Engineering	2	10	5
12	Other	1089	8829	4011
	Total	1325	10598	4803

Opportunities and Suggestions:
To overcome the identified challenges, the article presents several suggestions for promoting industrial development in Karauli district. These include encouraging rural artisans to establish raw material-based industries, addressing loaning and managerial issues, providing preferential employment opportunities for local job seekers, exempting imported raw materials from taxes, ensuring reliable and affordable power supply, offering financial assistance to revitalize struggling units, and establishing training centres for skill development.

VI. CONCLUSION

The article concludes by emphasizing the need for social and administrative reforms and implementing the suggested measures to foster industrialization in Karauli district. The potential of industrial development in the district is highlighted, considering its rich traditional crafts and the availability of skilled artisans. By addressing the challenges and capitalizing on the opportunities, Karauli district has the potential to emerge as a thriving industrial hub, creating employment opportunities, boosting economic growth, and contributing to the overall development of the region.

The article explores the prospects for industrial development in Karauli district. It discusses the possibilities of leveraging the district's traditional crafts and artisans to produce high-quality, unique products for both domestic and international markets. The potential for promoting tourism through the showcasing of traditional industries and handicrafts is also examined. Furthermore, the article highlights the importance of promoting entrepreneurship and providing necessary support to budding entrepreneurs to establish and sustain their industrial ventures.

In conclusion, this research article provides a comprehensive analysis of the industrial development in Karauli district. It explores the historical background of industries, examines the spatial distribution of various industrial units, and emphasizes the presence and contributions of micro, small, and medium enterprises (MSMEs). The challenges hindering industrial growth are identified, and potential opportunities for development are highlighted.

The article concludes by emphasizing the need for concerted efforts from various stakeholders, including the government, industry associations, financial institutions, and local communities, to overcome the challenges and seize the opportunities for industrial development. By implementing the suggested measures and fostering a favourable environment for industries to thrive, Karauli district can unlock its full potential and become a vibrant industrial centre, driving economic growth, employment generation, and overall prosperity in the region.In summary, this paper serves as a valuable resource for policymakers, researchers, and individuals interested in understanding the industrial landscape of Karauli district. It provides insights into the historical context, current scenario, challenges, and opportunities in the industrial sector, offering suggestions for fostering sustainable and inclusive industrial development.

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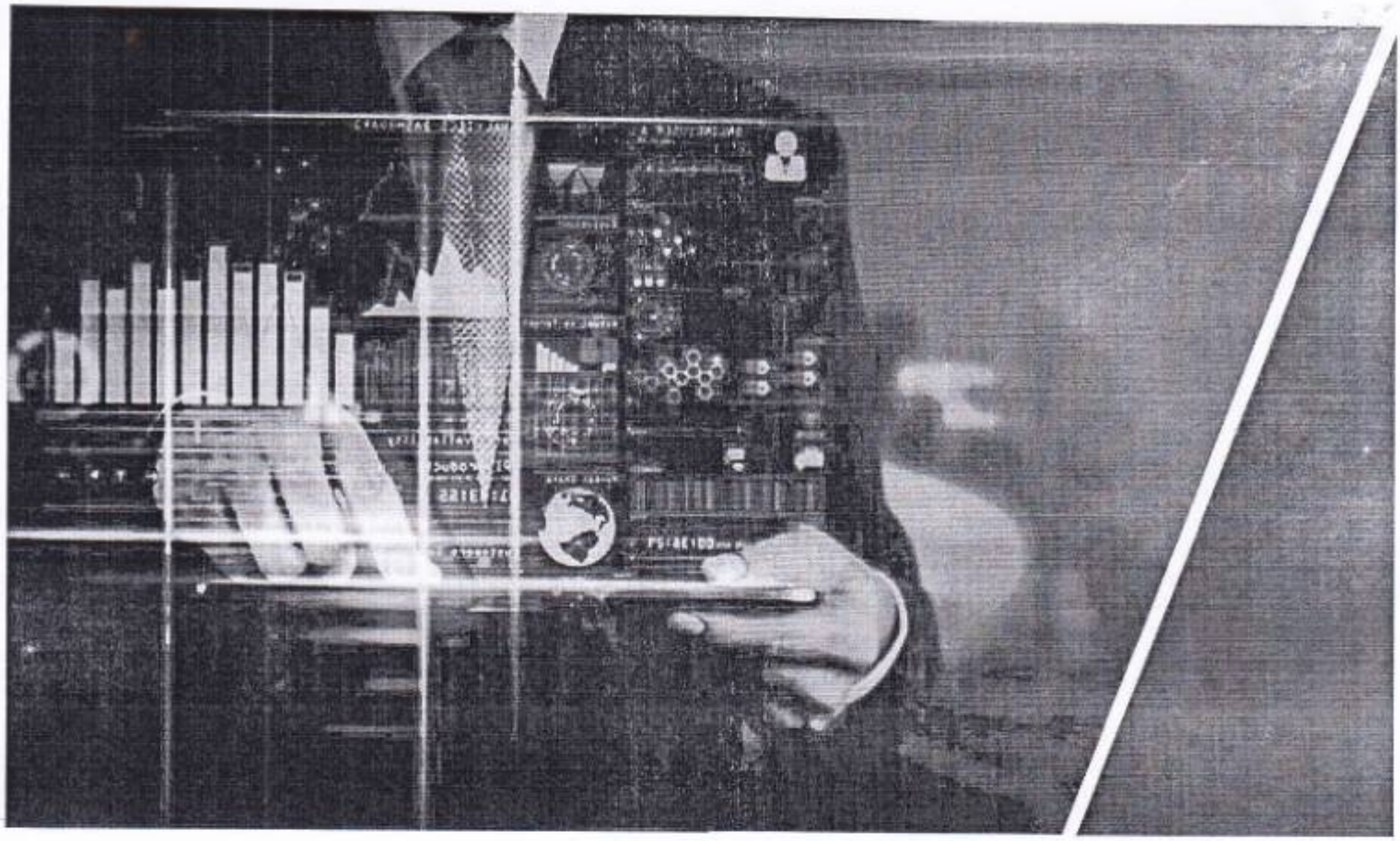

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Population Dynamics in Karauli District

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Abstract

Of all the resources, man is the most valuable resource having relevance owing to his well-developed mind and capacity. Infact, man is not only resource in himself but all the other natural endowments which are treated as resources, are in a sense the creation of man-mind and his abilities. As Zimmerman and Michel have observed, Man-mind is the greatest resource itself. Man has played a crucial role as a controller, regulator, and modifier of resource according to his needs and capacity to fulfil his requirements. Thus, through his various interrelated activities in physical as well as cultural real man has emerged as "pivot" in the nature. Morgan has rightly remarked that "the land use patterns of agricultural system depend" not only on the physical environment and plants/animals' relationship, but all so social and economic conditions ascribed to type and level human activities. So, it is great relevance to appraise various aspects of human resource base. By analysing the population data of the last 100 years of Karauli district, how much and how has the change in population affected the development here. Also, what are the changes in the population distribution pattern here. An attempt has been made to analyse all these changes through this research paper and analysis is necessary to develop the district by making optimum use of the resources available here.

Keywords : *Distribution of Population, Density, Growth Rate, Age Structure, Literacy Level.*

In present population of Karauli district is 1458248 persons up to 2011.Which is distributed with much spatial variation associated with such factors as availability of fertile, land, transport and marketing facilities and impacts of floods etc, most of the people in the district reside in rural areas. The density of population of the district was 289 person per square km in 2011.Due to this change of population, the study of the changes taking place one the economic and social profile of Karauli district is very important and the study of how the invisible changes in land use due to the change of population can be used as development is essential.

Objectives

- To present the distribution of population in the district.
- Interpreting population pattern based on population growth over the last 100 years.
- To explain the dense and sparse areas of population density in district.

Review of Literature

The first population analysis study in the history of the world was conducted in 1953 by G.T. Trewartha. Following this, many economists and geographers made significant contributions to the field. These included Thomson, Lynne Smith, Ackerman, C. Clark, Ward, J.I. Clark Garner, Jalensky, Stamp, Alfrid Peterson, G.J. Demko, Adams Landry, Brasley, P.E. James, Buchnan, P. George, W.E.Mori are prominent scholars.

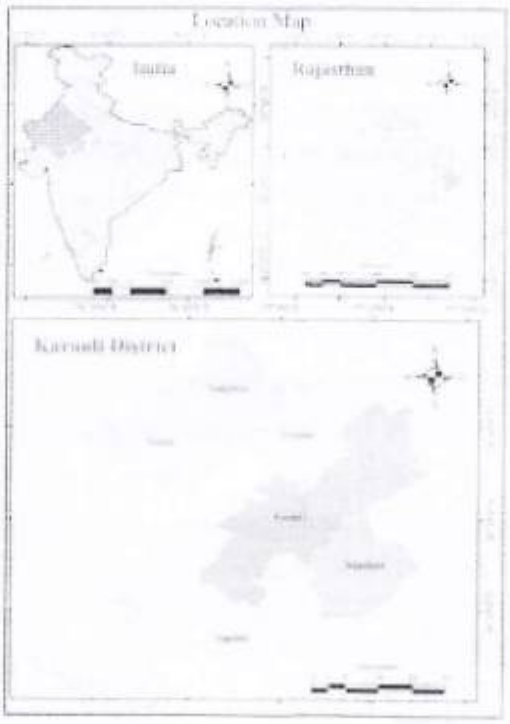
Indian Scholars in Population Studies- Ashish Bose, B.L.Agarwal, S.N.Agrawala, R.C.Chandana, G.S.Gosal, B.N.Ghosh, B.N.Puri, V.C. Misra, B.C.Mehta, Mansur Ahmed, S.J.Mehta, Suryakant, R.S.P.Gosal, K.N. Dubey, Prem Sagar, Smita Sen Gupta, S.C.Julka, P.K. .Sharma, Sodhiram, Dhaneshwari, Jitendra Mohan, Meher Singh Gill, F.Z Jamali, N.L Gupta, Hemlata Joshi, Sadhana Kothari, Ismail Haque, Indel Singh, Kamalkant Dubey, Mahendra Bahadur, Juzar Singh, Pushpa Pathik, Gopal Krishna, Abdul Razak, NuralAlam, A.S. Panwar, Anju Kohli, Gunjan Garg etc. have made their invaluable contribution.

In recent years, significant study isdone in thepopulation distributionby Bose, C.(2018), Chutia, L. J., and M.K. Sharma. (2016), Das, D., A. Kumar, and M. Sharma. (2020),Dash, M. (2016), Ribeiro HV, Oehlers M,Moreno-Monroy AI,Kropp JP, Yadav,S., Khan,Z. (2012), ZhangL, Lin X, LengL, ZengY,(2021), Zhou Q, Xu Y, Zheng Y,Shao J, Lin Y, Wang H,(2020), Khan, Zuber & Yadav, Sandeep & Mangal, Nikita. (2021) and Yadav Sandeep and Sahu Sonu (2022).

Study Area

Karauli district located in the south-eastern region of Rajasthan lies between 26o3l north to 26o49lnorth latitude and 76o 35l E to 77o 26l E longitude. The height for the sea level in the district 400 to 600 meters, and total area of district is 5043.02 (census report, 2011). It is bounded on the East by Dhaulpur district, on the North-East Bharatpur district, on the North – West Dausa district and the South-West Sawai Madhopurand on South-East by Madhya Pradeshstate.Chambal River separating the Karauli and Morena district (M.P. state).

Administratively, the district comprises 6 tehsils. The town of Karauli is the district headquarters. Karauli District comes under Bharatpur Divisional Commissionerate. Karauli is famous for popular red-stone. Karauli district consists of 85.04 percent rural and 14.96 percent urban population. While almost the entire district is covered by hills and ravines, there are no lofty peaks, the highest having an elevation of less than 1400 feet above sea level. Good grade stone and some iron ore comprise the mineral resources of the area. Karauli's natural environment includes the Vindhyanand Aravalli mountains. The district has plain, high, and low and hilly parts. The plains are fertile, and clay is lightweight and sandy. There are many rivers in the district. Annual rainfall is 580.36 mm, about 35 days in a year. Maximum temperature is 49 °C in May and 2 °C in January.



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Methodology

The most appropriate unit of study has been determined to be the tehsil. The study's primary data source is secondary information that was gathered from numerous reliable government sources. The tehsil level data for total, male, female population has been taken from Census of India (2011) General Population Totals, Primary Census Abstract, Rajasthan. Data was first combined into several groups and tables in accordance with the needs of the study after being obtained from various sources. The study has made use of maps and several statistical techniques to fulfil its objective requirements and conduct a factual comparative analysis of the data.

Growth &Distribution Analysis

Decennial growth of population of the district gas been rather erratic. During the second and third successive decades of the century, tide creased owing to a variety of reasons such as epidemic and unhealthy seasons, the third and fourth decades witnessed a growth of 10.05% and 13.01%. Population growth continuously increased during next successive decades. The increase in the population of the district during the 1961-71decade was slightly less than the average increase for the whole of Rajasthan, which was 27.83%, In the present day, the growth rate of Karauli district is 20.54%. Table 1 shows medium growth of 36.57%during the period of 1921-71 while high growth during 1971-81 remained 16.36% but growth during 1981-1991 increased to 29.12% respectively. Between 1911 and 1921 this was marked decreased due to serve attack of various epidemics (e.g., cholera, plague etc.) famine and other natural calamities. But after 1921 the increase in number continued without interruption.

Table 1:Population Growth 1911-2011

Year	Total Population		Rural Population		Urban Population		No. of Urban centers	Sex ratio
	Population	Decennial Variation	% Population	Decennial Variation (%)	% Population	Decennial Variation (%)		
1911	344078	-	98.78	-	1.22	-	3	825
1921	305090	-10.8	98.18	-13.53	1.82	+2.03	3	820
1931	308988	+10.05	97.78	+2.69	2.22	+1.31	3	832
1941	334736	+13.01	96.39	+6.20	3.61	+2.26	3	830
1951	371931	+12.11	92.39	+9.10	7.77	+2.38	3	840
1961	444807	+23.32	90.49	+1.45	9.51	+5.90	4	835
1971	559266	+26.49	89.10	+24.56	11.90	+3.59	4	854
1981	798926	+42.85	88.33	+42.77	11.67	+4.66	5	867
1991	927719	+16.12	87.49	+14.01	12.51	+3.62	5	840
2001	1209665	+29.13	86.39	+29.29	13.61	+4.28	6	858
2011	1458248	+20.54	84.74	+18.24	14.96	+4.79	9	861

At tehsil level, during 1971-81 the growth was highest (53.10%) in Hindaun tahsil and lowest (+0.47%) inKarauli tahsil. In Karaulitehsil during 1941-51 growth decreased (-1.83%) due to epidemics. Medium growth (25.83%) is observed in Todabhimtehsil. The remaining maximum number of tehsils falls under moderate low category, i.e., growth 20 to30%.

The total population of the district is 1458248 persons up to 2011, which is distributed with much spatial variation associated with such factors as availability of fertile, land, transport and marketing facilities and impacts of floods etc. Most of the people in the district reside in rural areas. The Census of 1961 recorded that 89.81% of the population was rural and 10.19% urban respectively. The Census of 1971, however, showed some shift towards urbanization when 11.90% of population was found to be urban and 88.10% rural.

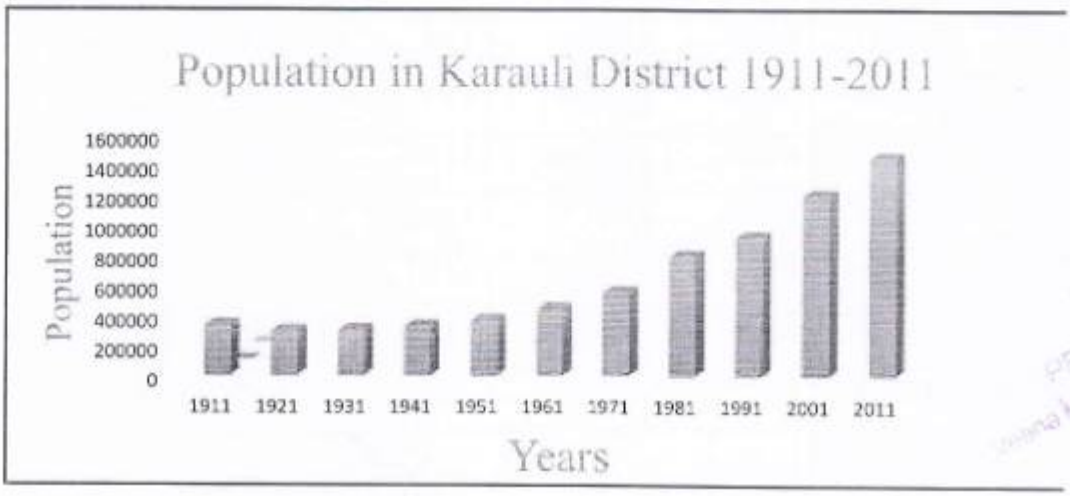
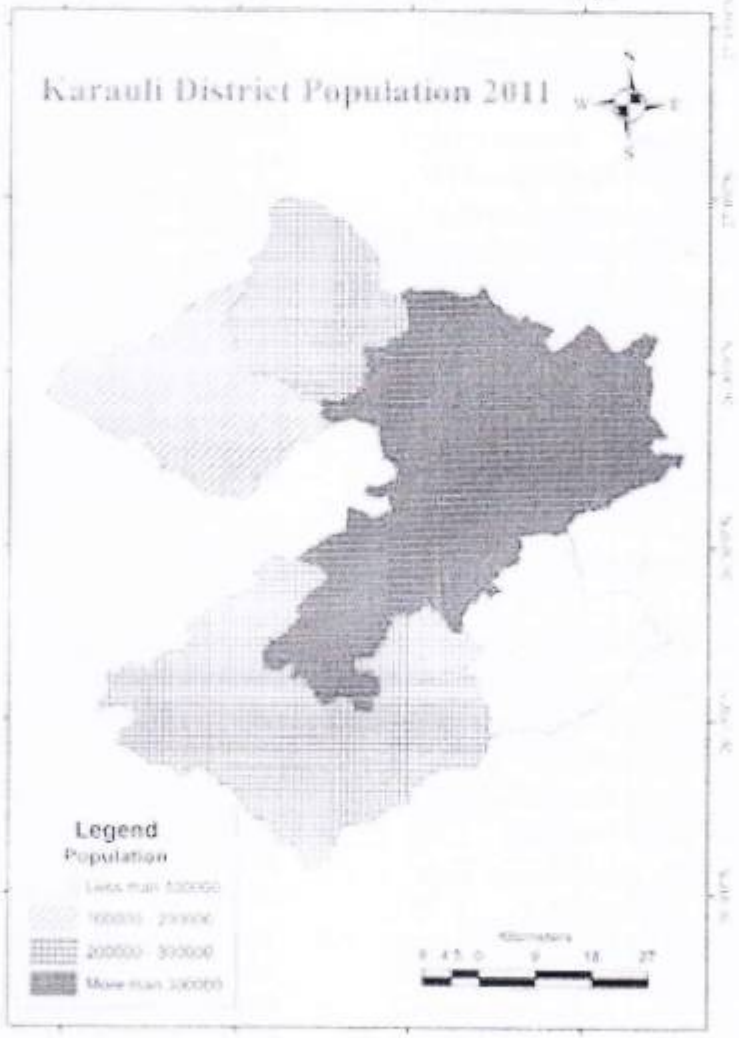


Table 2: Tehsil Wise Population Distribution in Karauli District-2011

Tehsil	Rural			Urban			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Todabhim	122525	105676	228203	12079	10898	22977	134604	116576	251180
Nadauti	80479	70419	150898	-	-	-	80479	70419	150898
Hindaun	171569	146853	318422	55834	49618	105452	227403	196471	423874
Karauli	143984	122184	266168	43908	39052	80960	187892	161236	349128
Mandrail	40659	33941	74600	-	-	-	40659	33941	74600
Sapotara	108969	92883	201852	3633	3083	6716	112602	95966	208568



Out of the three tehsils of the district, namely, Nadauti, Sapotara and Mandrail were completely rural.Highest population (423874 persons) lived in Hindaun and lowest population (74600 persons) lived in Mandrail. Along roadside, the concentration of population is observed in the

form of patches. The patches of highest population are located along Hindaun-Karauli, Hindaun-Mahavirji, Karauli-Mahavirji roads where beneficial condition like fertile land and transport and marketing facilities etc. are available.

The North-West parts of Todabhim and Karaulitehsils, and southern and western parts of Sapotaratehsil have medium concentration of population, Low concentration of population in Mandrailtehsilis due to adverse and hilly area.

Summary

Since the existence of Karauli district, the growth of population has been slow towards urbanization. After analyzing the population, it isseen that even today there is a lack of basic amenities which do not reach the rural areas. There is an absolute lack of pure drinking water, paved roads for accessible transport, employment, urban lifestyle, etc., which needs to be developed through government schemes and the participation of local public representatives. Even today there is a complete lack of urbanization in some tehsils of the district, due to which the development of the district is blocked. Therefore, there is an urgent need for integrated development of rural population so that the district can be included in the front line.

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The Condition of the Industrial Worker in Present Senerio

Dr. Laxman Dhaked

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Abstract

This paper analyses the issues related to working conditions of the Industrial Worker. What is the influence of working conditions on mobility? Using information for Indian workers, the results indicate that differences in working conditions remain after controlling for individual, job and firm characteristics: in particular, temporary workers with short job tenure seem to occupy jobs with poorer working conditions. Moreover, there is evidence that workers with worse working lives are more likely to expect to leave their current firms.We sought to portray how collective bargaining contracts promote public health, beyond their known effect on individual, family, and community well-being. In November 2014, we created an abstraction tool to identify health-related elements in 16 union contracts from industries in the Pacific Northwest. After enumerating the contract-protected benefits and working conditions, we interviewed union organizers and members to learn how these promoted health. Labor union contracts create higher wage and benefit standards, working hours limits, workplace hazards protections, and other factors. Unions also promote well-being by encouraging democratic participation and a sense of community among workers. Labour union contracts are largely underutilized, but a potentially fertile ground for public health innovation. The erosion of union density has undermined the role of organized labour as a societal power equalizer. Researchers have established a correlation between unionized work and a higher percentage of pay coming in the form of highly valued benefits. Unions have historically been involved in creating healthy and safe workplaces, advocating regulations that are monitored and enforced by public health entities such as the Occupational Safety and Health Administration. Unions help members gain control over their scheduling and job security, and union membership is associated with increased democratic participation.

Keywords: *Working and living condition, Health entities, Labour Union, disparities and job security*

Introduction

Unorganised sector covers about half of the GDP of our country. This preponderance of unorganised workers occupies almost 90% of the national labour force. This sector is characterized by seasonal employment (in agricultural sector), contractual work, no social security and welfare legislations, no rights and minimum wages. Lack of skill and education, few new openings in organized sector, unawareness of legal rights, deficient work quality and terms of service draws the labour into the available vortex of the unorganised sector. Here they face problems like poor health conditions, substandard working life, harassment at work, inadequate and unequal wage structure, long working hours, poor housing facilities, lack of safety measures, atrocities on women workers and no proper education for children of workers. Government intervention in taking necessary steps at the legal and policy level for unorganised workers is required for improving their working and living conditions.

The Role of Intellectual Property Rights in Promoting Company and Ecosystem-level Innovation

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Abstract

Over the decades, intellectual property rights (IPRs) has become one of the hottest, most significant issues of trade negotiations. Despite the continued claim that IPRs facilitate research activities and encourage technology transfer, the impact of IPRs on socio-economic development process of developing countries has evidently reflected in many areas, including health, agriculture and education. IPR will no doubt continue to have a significant impact on developing countries for many years to come. Recently, the scope of the subject of Intellectual Property Rights (IPR) has been expanded and grown to a great extent and has risen to a stature wherein it plays a major role in the development of the Global Economy. Since the early 1990s, many developed countries unilaterally strengthened their laws and regulations in this area, and many others were poised to do likewise. At the multilateral level also, the successful conclusion of the Agreement on Trade- Related Aspects of Intellectual Property Rights (TRIPS) in the World Trade Organization enhanced the protection and enforcement of IPRs to the level of a new international commitment. The new global IPR system comes with both benefits as well as some costs. The domain of Intellectual Property is vast. Its manifestation in the form of Copyright, Patent, Trademark and Design as some of the Intellectual Property Rights is very well known to have received recognition for a fairly long period of time. Newer forms of the protections are also emerging particularly stimulated by the exciting developments in scientific and technological activities.

Keywords: Intellectual Property Rights, Global Economy, Patents, Trademarks, Industrial Designs, Solemn International Committee, Copyright and Related Rights.

Intellectual property right (IPR) refers to the claim of "ownership" in creations of the mind, such as inventions; literary and artistic works; designs; symbols, and names and images used in commerce. Such "property" is protected in law by various means are patents, utility models, copyright, trademarks, and industrial designs. Without any kind of IP protection, "innovation" proves difficult to produce since there are no mechanisms (such as the granting of exclusive licenses) through which to exclude non-paying users (free-riders) of the innovation while providing full or limited accessibility to those that pay for an innovation. Consequently, there are no incentives for innovators to commercially those that pay for an innovation. Consequently, there are no incentives for innovators to commercially exploit their research results. When "free-riders" attempt to exploit or steal an innovation, there are few tools to enforce property rights in the absence of an IP system. The other side of the coin is that IP systems can be too protective and actually stymie innovation overtime. How an IP system is used depends on the creativity of the companies involved in innovation creation. The presence of effective intellectual property protections are key component of viable innovation ecosystems. Nevertheless, there is only one of several enablers or attractors that stimulate innovation. Recently, they have been joined by open source innovations wherein the inventing entity enables external parties access to its innovation in order to promote additional development. Even "open innovations" have specific rules

Right to Reinstatement of The Industrial Workers-A Study in Legislative And Judicial Trends

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Abstract

Reinstatement means "To restore to a former state, authority or station. To return to a former status," "To restore to a state from which one has been reserved" As per Black's Law Dictionary 6th Edition, "Reinstatement" means "To reinstall, to re- establish, to place again in a former state, condition or office, to restore to a state or position from which the object or person had been removed". The Constitution of India has also played a great role in the enactment of labour legislation in India. It is very clear from preamble of the Constitution of India that the Constitution emphasis on social, economic and political justice, equality of the opportunities, common brotherhood and fraternity etc. Art. 14 of the Constitution envisage fairness in the employment terms and conditions. It prohibits the discriminatory and arbitrary, unfair, unjust attitude on the part of the employer. Art. 19 confers a lot of freedom such as freedom of speech and expression, right to assemble, to form association to the labour class against the exploitive policies of the employer. Article 21 of the Constitution of India, a human rights chapter for the labour class Article 23 and 24 respectively prohibits the exploitation of the working class and particularly the child labour. Part IV of the Constitution dealing with the Directive Principles of State Policy is a moral code for the state to extend social justice and welfare to working class. The directive principles enshrined in part IV of the constitution specially Art. 38, 39, 41, 42, 43, 43A, 45, 46 and 47 are of utmost significance for the industrial workers. Article 309 to 311 of the Constitution deals with lots of protective measures for civil servants in public employment. The principles laid down by the Apex Court for the protection of civil servants from dismissal and discharge are very helpful for the protection of industrial workers from the victimization, prejudicial practices adopted by the industrial employers. In contrast to this approach of ordinary civil law, under the industrial law in India, if the services of an employee are wrongfully, improperly or unlawfully terminated, the employee is entitled to insist upon the right to continue to be employed with the same master and he can thus specifically enforce even the affirmative part of the covenant by reference of the dispute to industrial adjudication/ arbitration. Thus industrial courts/ and the Industrial Tribunals can always reinstate those workmen who have been wrongfully dismissed/ discharged. Section 2A of the Industrial Disputes (Amendment Act), 1965 provides that individual disputes relating to dismissal, discharge, termination and retrenchment are industrial disputes.

Keywords: *Reinstatement, Covenant, Prejudicial, Federal Court, Provisions, Termination, Harmonious, Enumerated, Arbitary, Punitive, Divergent, Prohibits, Precedent, Cogent.*

In order to overcome this difficulty and achieve industrial harmony and peace, the Industrial Employment (Standing Orders) Act, 1946 was enacted. This Act was therefore a social legislation, which placed restrictions on the right of the employer to lay down the conditions of service of its

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Right To Reinstatement Of The Industrial Workers :- Challenges In Hospitality Industry & Roll Of Civil Services

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Definition:-

The concept of contract is the product of the great industrial and commercialrevolution. Laissez faire with its robust ideas of equality and liberty andwith individualism as its philosophy influenced and nourished the principles of freedom of contract". The freedom of contract is the soul of EnglishCommon Law. In law, freedom of contract is considered to be part of theIndividual's right to private property and personal liberty. Every individualhas a right to enter into contract with any other individual or group ofindividuals. In England absolute freedom of contract was considered to be vital toeconomic progress in the days of the industrial revolution. However, as aresult of this revolutionary upheaval and the resulting changes in the materialconditions of human beings and the emergence of new ideas regarding therole of the state, the shortcomings of laissez-faire became manifest. Freedomof contract was often used to the determinant of the worker. Pitted against apowerful employer, the worker could not bargain with the employer on anequal footing. While collective bargaining was taking shape it could notprevent the immediate exploitation of the labourer. The state has to inquire ifhe had to be given the minimum necessities of life. The emergence of thewelfare state was in response to this demand. The welfare state with itsplethora of labour laws was obliged to restrict freedom of contract.

The course of development of principles and legal theories relating tofreedom of contract in the sphere of industrial relations may be traced in thefollowing stages:

(a) Employee had no right to bargain with the employer whetherindividually or collectively.
(b) Individual employee's right to bargain or contract with the employerwas recognized but at the same time any collective effort wasconsidered a criminal conspiracy.
(c) An attempt to collectively bargain i.e. to contract collectively with theemployer ceased to beconsidered a criminal conspiracy, but stillcontinued to be treated as a civil conspiracy.
(d) The employee's right of collective bargaining was recognized.
(e) Immunities in respect of tortuous acts committed in furtherance oftrade disputes were conferred on tradeunions.
(f) Power to create new contracts to Substitute the existing ones or modifythem was conferred on the industrial adjudication authorities, such asLabour Courts/ Industrial Tribunals/ National Tribunals and IndustrialArbitration authorities etc.

Misconduct' to attract a penalty should have a causal connection with theplace of work as well as the time at which it is committed which wouldordinarily be within the establishment and during duty hours. Even when thestanding order is couched in a language which seeks to extend its operationfar beyond the establishment, it would nonetheless be necessary to establish acausal connection between the misconduct and the employment. This causalconnection must be real and substantial, immediate and proximate, and notremote or tenuous. If the power to regulate the behaviour of the workmanoutside the duty hours and at any place wherever they may be was conferredupon the employer, the contract of service might be reduced to a contract ofslavery.

Therefore, the employer can at best have both power and jurisdictionto regulate the behaviour of the workman within the premises of theestablishment, or for peace fully carrying the industrial activity in

Review of Essential Amendments in Higher Education Innovations in India with Special Reference to a focus on NEP 2020

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Abstract

The New Educational Policy-2020 envisages transforming India from a deprived to a developed state, building a vibrant knowledge landscape, and transforming India into a global knowledge super power. India's aspirations to become a major player in the global knowledge economy are fundamentally dependent on high-quality higher education. The availability o faculty with the necessary skills is a must for the global scope of Indian ventures. The historic National Education Policy-2020 has come with an ocean of ambitions and aspirations aiming to significantly reform the Indian education system. Being radically different from all its predecessors, it seeks to take higher education to a cutting age by broadening the educational horizon and restructuring and revamping the existing education system to meet the 21st century requirements. Well defined and futuristic education policy is essential for a country at school and college levels due to the reason that education leads to economic and social progress. India with the leadership of its current prime minister and an expert team with members of varied backgrounds have developed and planned to implement a new education policy during the next decade of the 21st century called Indian National Education Policy (NEP-2020). The aim, objectives, and details are well known to practitioners and the public. NEP-2020 is an innovative and futuristic proposal with both positive and negative aspects, framed with the objective to provide a quality school education and higher education to everyone with an expectation of holistic & research-oriented progress. This paper initially depicts an overview of NEP-2020, distinguish the strengths & weakness of the policy at higher education & research part, evaluation of the implementation suggestions given in the policy, identifying and analysing possible generic strategies for implementation of NEP-2020 to fulfil its objectives based on focus group discussions. The paper also includes many predictive proposals on issues like developing quality universities & colleges, institutional restructuring & consolidation, more holistic & multidisciplinary education, optimal learning environment & student support, transforming the regulatory system of higher education, technology usage & integration, and online & digital education. Finally, some recommendations are made to implement the NEP-2020 effectively irrespective of various constraints. This article can be considered as a reference to the policy implementation teams of Govt. of India.

Keywords : *NEP, Envisages, Deprived, Vibrant, Aspirations, Fundamentally, Radically Leadership, Implement, National Educational Policy, Innovative, Aspects, Quality Education, Holistic And Research-oriented, Higher Education, Predictive, Multidisciplinary, Integration's And Digital Education.*

One of the important dimensions of Higher Education is Research. Knowledge creation and research, both fundamental and applied, are critical in growing and sustaining a large and vibrant community, upliftment of society, and progress of the nation. But India's performance in the research realm has never been up to standard. India's investment too is very low i.e. 0.69% of GDP as

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NEP 2020: Features And Role In School And Higher Education

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Abstract

After almost five years after the first committee to draft a new National Education Policy, NEP, was constituted, on Wednesday, the Union Cabinet approved the NEP 2020.

The education policy 2020 aims to restructure both school and higher education in India. The NEP envisions a 'Light and Tight' single regulatory higher education system and a school education system that focuses more on experiential learning than rote learning. For higher education, it proposes an undergraduate programme that will last three or four years and offer multiple exits with certificate, diploma or degree qualifications. The national Education policy 2020 envisions an Indian centered Education system that contributes directly to transforming our Nation sustainably into an equitable vibrant knowledge in education. The New Education Policy 2020 (NEP) announced by the Ministry of Human Resource Development is to bring in changes in the current, dying 34-year-old policy in schools and higher education systems in the country. The new policy is more practical in approach and is based on the ground reality of the country's education scenario that puts more emphasis on the creativity and innovation as well as personality development of the students rather than expecting them to score high and mock up the content without getting

Keywords: New Education Policy 2020, Higher Education, innovative, futuristic, implementation, multidisciplinary, regulatory, density, age structure

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Thermodynamic Study of Green Corrosion Inhibitor on Mild Steel with Aqueous Extract of *Ziziphus Jujuba* Fruits in 1M HCl Solution

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Abstract
The Corrosion inhibition of mild steel in 1 M HCl solution with aqueous extract of *Ziziphus Jujuba fruits* is studied by weight loss method at 303-333K temperatures. It is found that inhibition efficiency rise with increase in concentration of extract and decreased with rise in temperature. Maximum 68.60% inhibition efficiency was observed at 303 K and 8% (v/v) concentration of *Ziziphus Jujuba fruits*. Value observed for Activation energy, Gibbs free energy and variation in I.E. with temp Suggest physisorption. Adsorption of extract at mild steel surface follows Langmuir adsorption isotherm. Negative values of Gibbs energy reveals the spontaneity
of inhibition process in extracts at studied temperatures

Keywords:*Ziziphus Jujuba* stem, *Ziziphus Jujuba fruits*, Corrosion, Langmuir adsorption isotherm, Mild steel, Weight loss method

Introduction

Mild steel has widespread use in industries such as chemical processing, petroleum, constriction, pipelines, mining, marine applications and refining. Although it is one of the common metal alloys used in various industries but it suffers a major problem which is corrosion. Corrosion is the degradation of metal and their alloys by an electrochemical reaction with environment. Corrosion of metals and alloys is a well studied industrial problem hence found a fertile research field in green chemistry also. The introduction of corrosion inhibitors is the best way to prevent metallic corrosion and save the great economic loss of country [1].

Generally many chemical compounds is used as corrosion inhibitors but most of these are toxic and expensive. Green inhibitors are generally extracts of various parts of plants. Plant extracts are low cost and environmental safe. So the main advantage of using plant extracts as corrosion inhibitors are economic and environment safe. They have great corrosion inhibitor property. So they are widely used as corrosion inhibitors for metals and alloys in acidic, basic and neutral media.

Literature survey reveals various plant extracts that have been used as corrosion inhibitors for protection of different metals and their alloys. Extract of fenugreek seeds and roots[2], essential oils of *Menthaspicata, Lavandulamultifida, Pulicariamauritanica*[3,4] *Azadirachtaindica*[5,6], extract of *Ananascomosus L.*[7], *Embilicaofficinalis*[8], *Garcinacola and Cola nitida*[9], *Neriumolender leaves, Calotropisprocera* etc. have been studied. In the continuity of above corrosion inhibition studies to find out better corrosion inhibitor, the present work has been carried out which reveals the adsorption behaviour and corrosion prevention properties of aqueous extract of fruits of *Ziziphus Jujuba* for mild steel in 1 M HCl solution.

Materials and Methods

Preparation of Ziziphus jujuba fruits

The fruits of *Ziziphus Jujuba* plant were taken, washed and air dried for 6-7 days, crushed and grind mechanically. 20 g of fruits powder was heated in 200 mL distilled water for one hour using air condenser at 70°C - 80°C. This extract was left overnight and then filtered and make up to 500 mL with distilled water for the experiment.

Selection of steel specimens

Rectangular mild steel (grade 220) specimens of 5 cm length and 1cm width and 0.03cm thickness were taken and abraded with a series of emery papers, degreased with acetone, washed with distilled water, dried and constant weight was recorded by electronic balance.

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Solution Preparation

1M HCl solution was prepared by 37% HCl (Merck Ltd.) using distilled water. The employed concentration range of aqueous extract of *Ziziphus Jujuba fruits* was 1% to 8% (v/v).

Gravimetric Measurements

Gravimetric method is widely used method because of its reliability and simplicity in corrosion inhibition experiments. For each experiment 100 mL test solution was taken in250 mL beaker and Rectangular specimen was immersed in it with plastic thread for one hour.

The experiments were carried out at different temperatures from 303 K to 333K in thermostatic water bath. After one hour specimens were removed, washed with distilled water, acetone dried and abraded with series of emery papers and then weighted accurately with electronic balance. It was noted that the surfaces of specimens became rougher in test solutions without the inhibitor than the surfaces of specimens which were immersed in test solutions containing different concentrations of inhibitor.

Result and Discussion

Corrosion rates

Corrosion rates were calculated by following equation [10,11]

$$C\,R\ (g\ cm^{-2}min^{-1}) = (W_1\text{-}W_2/At) \qquad (1)$$

Where CR is corrosion rate, W_1 is weight of mild steel specimen without inhibitor andW_2 is weight of mild steel specimen with inhibitor, A is area of MS specimen and t is immersion time. **Tables 1** shows that corrosion rates of mild steel decrease with rise in concentration of *Ziziphus Jujuba fruits* inhibitor at all studied temperatures. This could be subjected to the adsorption of the phyto-constituents of inhibitor molecules with increase in concentration of inhibitor. The corrosion rate obeys Arrhenius type reaction, as it increases with rise in temperature [12].

Table 1 Mild steel corrosion rates in 1 M HCl solution in absence and presence of different concentrations of Ziziphus jujuba fruits at different temperatures

C_{inh}in (v/v) %	CR x 10^{-3} (g cm^{-2} min^{-1})			
	30° C	40° C	50° C	60° C
0	0.86	1.46	2.17	2.89
1	0.64	1.31	2.11	2.76
2	0.57	1.17	2.03	2.67
3	0.47	1.12	1.87	2.61
5	0.39	1.01	1.78	2.54
8	0.27	0.73	1.63	2.47

Inhibition efficiency

From the obtained corrosion rates, inhibition efficiencies were calculated by using following equation (2).

$$IE\% = \frac{CR_{blank} - CR_{inh}}{CR_{blank}} \times 100 \qquad (2)$$

Where CR_{blank} is the corrosion rate in absence of inhibitor and CR_{inh} is corrosion rate in presence of inhibitor. *Ziziphus jujuba fruits* data are given in Table 1 and 2show that %IE increase with in extract concentration and indication that increase in number of components of extract adsorbed on mild steel surface, which block the active sites of metal from acid attack and protect the metallic corrosion [13]. Further the decrease in % I.E. with rise in temperature suggests electrostatic interaction (physical adsorption) of the extract molecules on mild steel surface. This further indicates desorption of adsorbed inhibitor species at higher temperatures and metal dissolution takes place.[14] 68.60% inhibition efficiency is observed at 8% (v/v) concentration of inhibitor *Ziziphus jujuba* fruits.

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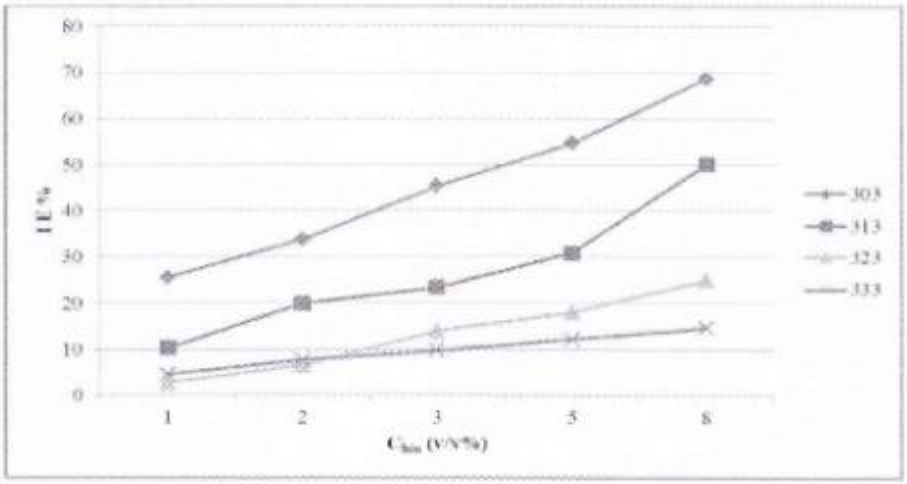

Figure 1 Variation in IE % for mild steel corrosion in 1M HCl at different concentrations of *Ziziphus jujuba* fruits at different temperatures

Table 2 Inhibition efficiencies of *Ziziphus jujuba* fruits at different concentrations and temperatures in 1 M HCl solution

C_{inh} in (v/v) %	IE (%) 30°C	40°C	50°C	60°C
1	25.58	10.27	2.764	4.49
2	33.72	19.86	6.45	7.61
3	45.34	23.28	13.82	9.68
5	54.65	30.82	17.97	12.11
8	68.60	50	24.88	14.53

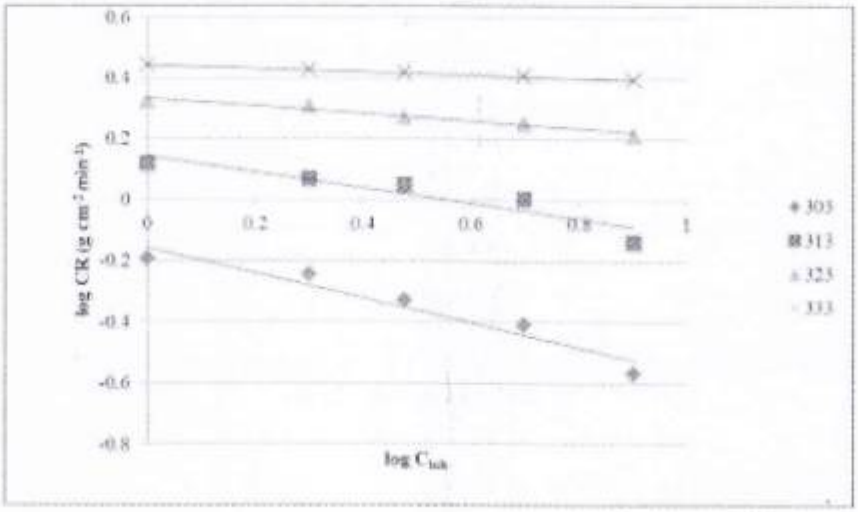

Figure2 Variation in log CR with log C_{inh} for mild steel corrosion in 1M HCl in presence of different concentration of *Ziziphus jujuba* fruits at various studied temperatures

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Kinetic Parameters

Assuming that corrosion rates of steel specimens against concentration of inhibitor obeys kinetic relationship as equation (3)

$$\log CR = \log K + B \log C_{inh} \qquad (3)$$

Where K is rate constant and equal to CR when inhibitor concentration is unity. B is reaction constant which is measure of inhibitor effectiveness and C_{inh} is the concentration v/v% (mL/100mL) of *Ziziphus jujuba* stem and *Ziziphus jujuba* fruits. **Figure 2** are plots between log CR and log C_{inh} values at various studied temperatures. B and K were calculated by slope and intercept of straight lines obtained in **Figure 1**.The obtained results are summarized in **Table 2** which can be discussed as follows [24].Negative values of B indicate that corrosion rate is inversely proportional to concentration of inhibitor. In other words the corrosion rates decrease with rise in concentration of inhibitor species. The high negative values of B reflects good inhibitive property of inhibitor High negative value of B can be observed as steep slope in graph (**Figure 2**).Value of B is high at lower temperatures, indicates that inhibitive species is more effective at comparatively lower temperatures. The rise in K values with increase in temperature, indicating the rise in corrosion rates with temperatures.

Table 3 Kinetic parameters for mild steel corrosion in 1 M HCl solution with *Ziziphus jujuba* fruits

Temperature (°C)	Kinetic Parameters	
	B	K x 10^{-3} (g cm^{-2} min^{-1})
30°C	-0.053	2.76058
40°C	-0.125	2.15278
50°C	-0.255	1.38676
60°C	-0.407	0.70146

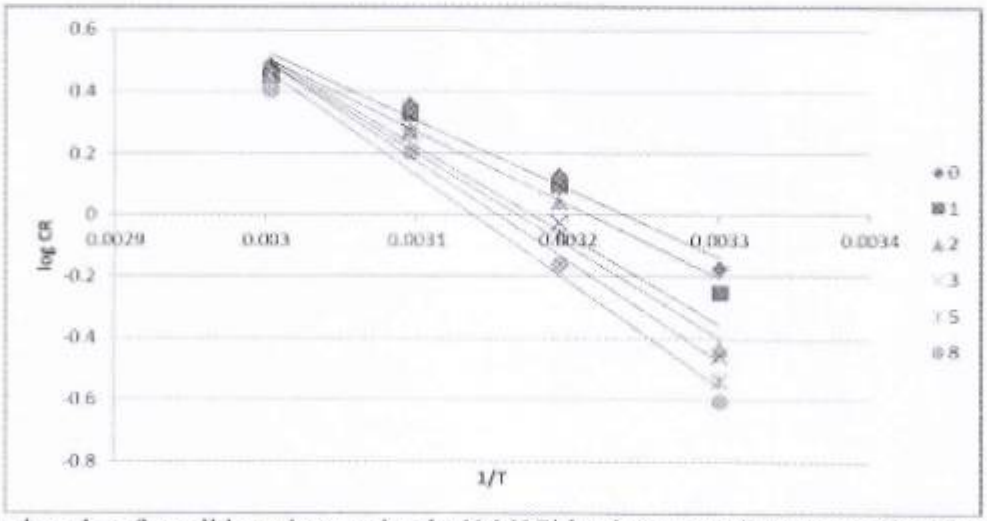

Figure 3 Arrhenius plots for mild steel corrosion in 1M HCl in absence and presence of various concentration of *Ziziphus jujuba* fruits

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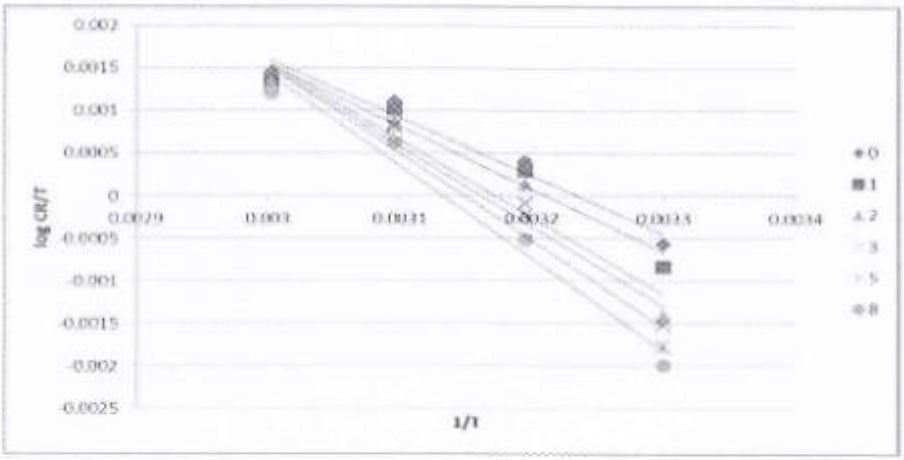

Figure 4 Transition-state plots for mild steel corrosion in 1M HCl in absence and presence of various concentrations of *Ziziphus jujuba* fruits

Thermodynamic and activation parameters

Thermodynamic and activation parameters like apparent activation energy E_{act}, enthalpy of activation Δ H*entropy of activation **ΔS*** can be calculated for steel dissolution process. Activation energies E_{act} were calculated by applying Arrhenius equation (4)

$$\log CR = \log A - \frac{Eact}{2.303RT} \qquad (4)$$

Where A is Arrhenius pre-exponential factor, E_{act} is activation energy, R is universal gas constant, T is absolute temperature. The slope of log CR vs 1/Tin **Figure 3** gives the values of activation energies at studied concentrations. **Table 4** contains the calculated data of activation energies. The values of activation energies in presence of inhibitor were found higher than in uninhibited solution. This indicates the formation of higher energy barrier in corrosion reaction by inhibitor molecules. The increase in E_{act} for corrosion process in inhibitor solution further interpreted as physical adsorption of inhibitor species on mild steel surface [15,16,17] Besides this According to Damaskin [18], the value of activation energy lesser than 80kJ/ mol and even smaller than 5kJ /mol represent physical adsorption. This assertion supports the experimental results obtained in the present study. The values of enthalpy of activation ΔH* and entropy of activation **ΔS***can be calculated by following transition state equation (5).

$$\log(CR/T) = [\log(R/Nh) + [\Delta S^*/2.303R - [\Delta H^*/2.303RT)] \qquad (5)$$

Where h is plank's constant, N is Avogadro number R is the gas constant A plot of log(CR/T) vs 1/T gave a straight line with slope of (-ΔH*/2.303R) and intercept of [(log R/Nh) +(ΔS*/2.303 R)] from which the values of ΔH* and **ΔS*** can be calculated (**Figure 4**). These values are tabulated in **Table 4**. Values of ΔH*were found positive. Positive values indicate endothermic nature of steel dissolution process.[19] Endothermic process further indicates that mild steel dissolution reduces at lower temperatures and increases with in temperatures. Negative values of ΔS* are indicative of formation of activated complex in rate determining step, which further indicate association rather than dissociation step, meaning the decrease in disorder takes place on going from reactants to activated complex.[20,21]It is also observed from data in **Table 4** that E_{act} and ΔH* vary in the same manner. Values of both E_{act} and ΔH* with in concentration of inhibitor, suggesting that energy barrier rise within inhibitor concentration .This means that corrosion reaction will further be pushed to surface sites that are characterized by progressively higher values of E_{act} as the concentration of inhibitor becomes higher [22,23]. The values of activation energy were found higher than corresponding values of enthalpy of activation, indicate the involvement of a gaseous reaction, simply hydrogen evolution in corrosion process, associated with a decrease in total reaction volume.

Table 4 Activation and thermodynamic parameters for mild steel corrosion in 1 M HCl solution with *Ziziphus jujuba* fruits

C_{inh} in (v/v)%	E_{act}(kJ/mol)	ΔH^* (kJ/mol)	ΔS^* (J/mol/K)
0	33.93	31.25	-199.27
1	40.99	38.4	-186.02
2	43.69	41.17	-185.61
3	47.7	45.26	-144.85
5	52.2	49.81	-134.45
8	62.71	60.34	-126.74

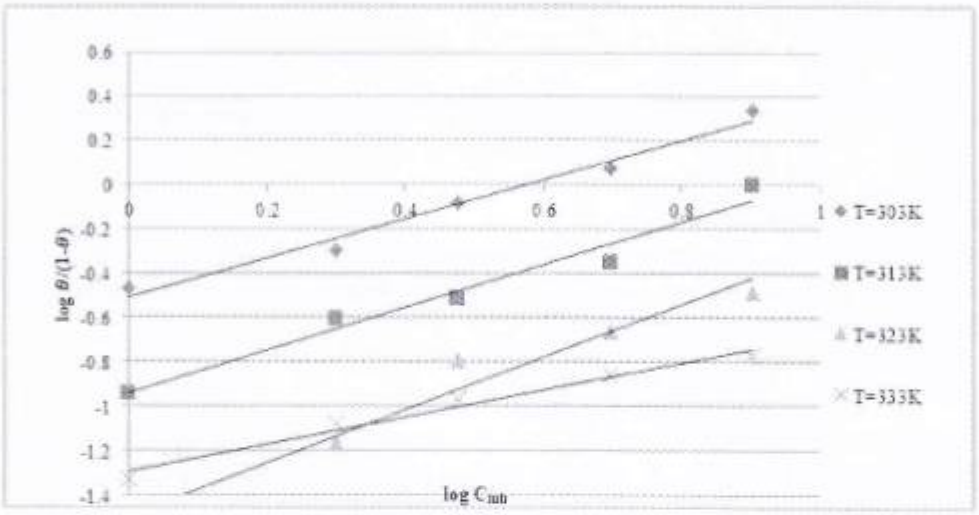

Figure 5 Langmuir adsorption isotherms of *Ziziphus jujuba* fruits on mild steel surface in 1M HCl at different studied temperatures

Adsorption isotherm and Gibbs energy

The nature of adsorption can be explained by the process at metal/electrolyte interface. Further to understand the nature of adsorption, obtained surface coverage θ were fitted in different adsorption isotherms. Langmuir adsorption isotherm was the best fit. The mathematical expressions for Langmuir adsorption isotherm can be expressed by the following equation [24-28].

$$\frac{C}{\theta} = \frac{1}{Kads} + C_{inh} \quad (6)$$

Rearranging the above equation (6) we get

$$\frac{\theta}{1-\theta} = K_{ads}C_{inh} \quad (7)$$

$$\log\left(\frac{\theta}{1-\theta}\right) = \log K_{ads} + \log C_{inh} \quad (8)$$

Where K_{ads} is the equilibrium constant of adsorption, θ is the surface coverage, (1-θ) is the uncovered surface, C_{inh} is the concentration of inhibitor. Values of K_{ads} were calculated from the intercept of Langmuir adsorption isotherm drawn according to the equation (8) between log (θ /1- θ) and log C_{inh} (**Figure 5**). The value of K_{ads} obtained from Langmuir adsorption isotherm is related to Gibbs energy according to the following equation (9).

$$Kads = 1/CH2O\exp^{(-\Delta G/RT)} \quad (9)$$

It can be written as:

$$\Delta G_{ads} = -2.303\ RT \log (K_{ads}, C_{H2O}) \quad (10)$$

Where CH_2O is the concentration of water in (mL / L) at metal/solution interface, R is universal gas constant and T is absolute temperature. The values of ΔG_{ads} were tabulated in **Table 5**. Obtained values of Gibbs energy were plotted against temperature in accordance with the following basic equation [29].

$$\Delta G_{ads} = \Delta H_{ads} - T\Delta S_{ads} \quad (11)$$

Intercept of graph between ΔG_{ads} vs T in **Figure 7** gives value of ΔH_{ads} and by putting the value of intercept in equation (11) values of ΔS_{ads} were obtained. These obtained adsorption parameters Gibbs free energy of adsorption (ΔG_{ads}), enthalpy of adsorption (ΔH_{ads}) and entropy of adsorption (ΔS_{ads}) are in **Table 5**. ΔG_{ads} values have been found negative at all studied temperatures indicating spontaneous adsorption process of inhibitor molecules on metal surface [30-33]. Generally values of ΔG_{ads} upto -20 KJ/mol are consistent with electrostatic interactions (physical adsorption) between charged molecules and charged metal surface and values upto -40 KJ/mol or higher involve charge sharing or transfer from inhibitor molecules to metal surface to form coordinate type of bond (chemical adsorption) [34-38]. The obtained values of ΔG_{ads} were found less than -20kJ/mol indicated physical adsorption of inhibitor molecules. It has been observed that adsorption of negatively charged species is facilitated due to the positively charged metal. But positively charged species can also be adsorbed and protect the positively charged metal surface acting with a negatively charged intermediate such as acid anions, adsorbed on metal surface.

Values of ΔH_{ads} have been found negative indicating the exothermic adsorption process [39], which further indicates lower %IE at higher temperatures, due to desorption of inhibitor molecules. The exothermic process is attributed to either physical or chemical adsorption or mixture of both [40]. In exothermic process, values of ΔH_{ads} predict physisorption or chemisorptions in exothermic process. For physisorption values of ΔH_{ads} is lower than 40kJ/mol while for chemisorption it reaches to 100kJ/mol [41,42]. Values of ΔH_{ads} in **Table 5** indicate physisorption. Negative values of ΔS_{ads} indicate decrease of entropy of adsorption process. This behaviour can be explained as that before the adsorption of inhibitor molecules onto mild steel surface, they might freely move in bulk solution (inhibitor molecules were chaotic), but with the process of adsorption, inhibitor molecules became orderly and adsorbed onto the steel surface as a result decrease in entropy is observed. A more interesting behaviour is observed from **Table 5** that negative ΔH_{ads} value is accompanied with negative ΔS_{ads} value. This further agrees that when the adsorption is an exothermic process, it must be accompanied by a decrease in the entropy change and vies versa.The obtained positive values of ΔS_{ads} are the algebraic sum of the adsorption of organic molecules and the desorption of water molecules [43]. Therefore the positive values of entropy of adsorption may result due to substitution process, which can be attributed to the solvent entropy and more positive water desorption entropy [44].

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Table 5 Adsorption parameters for mild steel corrosion in 1 M HCl solution with *Ziziphus jujuba* fruits

Temperature(°C)	Δ G_{ads}(kJ/mol)	Δ H_{ads}(kJ/mol)	Δ S_{ads}(J/mol/K)
30°C	-7.9698	-50.55	-140.53
40°C	-6.7525		-139.93
50°C	-3.4369		-145.86
60°C	-4.3658		-138.69

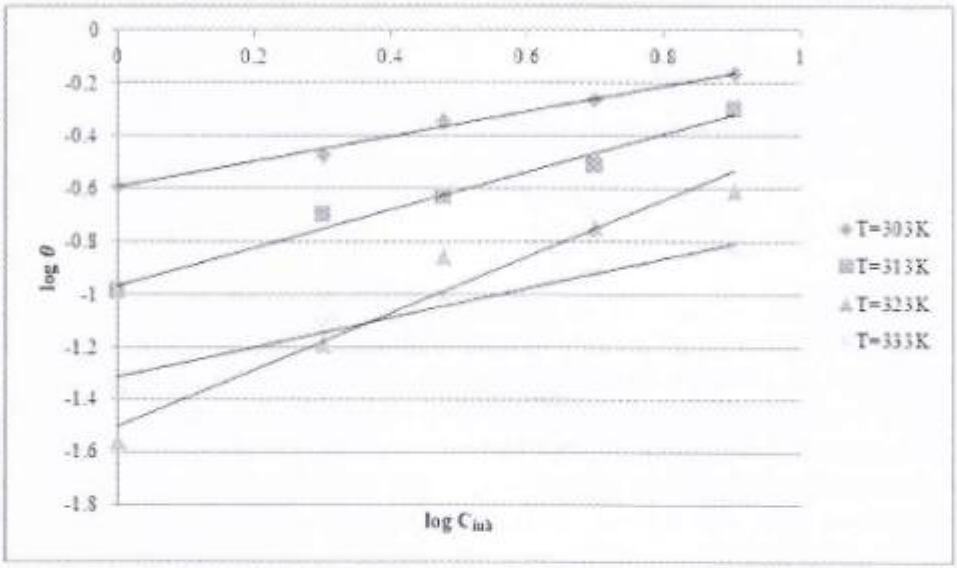

Figure 6 Freundlich adsorption isotherms of *Ziziphus jujuba* fruits on mild steel surface in 1M HCl at different studied temperatures

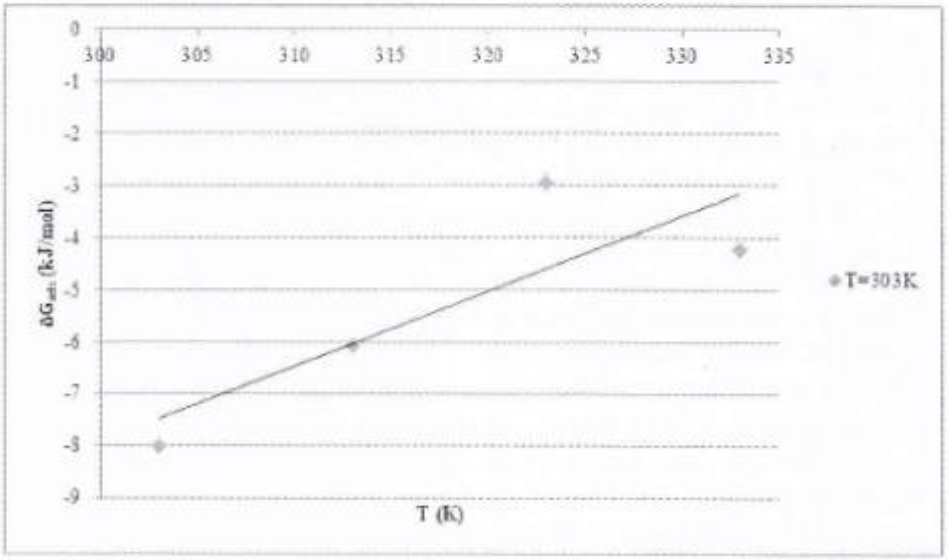

Figure 14 The Variation of ΔG_{ads}(kJ/mol) with T (K) for mild steel corrosion in 1M HCl solution with *Ziziphus jujuba* fruits

Conclusions

Result showed that ZIZIPHUS JUJUBA FRUITS are good corrosion inhibitors for mild steel in 1M HCl solution. Corrosion rates with in temperature and decrease with in inhibitor concentration. Inhibition efficiencies at lower temperature suggests the physisorption process of inhibitor on mild steel surface. Apparent activation energy with in inhibitor concentration also suggests physisorption. Enthalpy of adsorption show exothermic and physical adsorption process of inhibitor. Nagative values of Gibbs free energies shows spontaneity of corrosion inhibition process of mild steel in 1 M HCl in Ziziphus jujuba stem and fruits.

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Anti-inflammatory and Anti-arrhythmic Activities of 1-(Alkanoylphenoxy/ Thiophenoxy)-3-(N^4-Phenylpiperazinyl) Propane

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ABSTRACT

Synthesis and pharmacological screening of 1-(o-, m-,p-alkanoyl-, p-benzoyl-, p-cinnamoyl-, p-α-hydroxypropyl- p- α -acetoxypropyl-, p- α-oximainopropyl-, p- α -ureidiminopropyl-phenoxy/ p-propionylthiophenoxy)-3-N^4-(phenylpiperazinyl)propanes, 1-(p-propionylphenoxy)-3-substituted aminopropane, 1-(p-propionylphenoxy)-3-N^4-(phenylpiperazinyl) ethane and butanes and B-(p-propionylphenoxy)-N^4-(N^4-phenylpiperazinyl) propionamide are reported. Some of the compounds possess Anti-inflammatory and Anti-arrhythmic activity.

Keyword: pharmacological screening, Anti-inflammatory, Anti-arrhythmic activity, anti-depressant activity, IR spectra, etc.

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INTRODUCTION

During the course of structure-activity relationship study of 1-(P-Propionylphenoxy)-2-hydroxy -3-(N^4-phenyl piperazinyle) as antidepressant, it was found that the corresponding 2-desoxy compound 5 though devoid of any antidepressant activity in had significant anti-diabetic activity in carrageenan-induced oedema in mice and anti-arrhythmic activity in electrically driven isolated guinea-pig auricles. This lead to the synthesis and pharmacological screening of other analogues of 5, which are described in this paper.

Condensation of alkanoyl- and aroylphenols and thiophenols (1) with 1-choloro 3-(N^4-phenylpiperazinyl) propane (2) gave compounds 5-11 and 16, $NaBH_4$ reduction of 5 furnished the corresponding hydroxyl compound 12 which on acetylation gave the actoxy compound 13. Treatment of 5 with $NH_4OH.HCl$ and $H_2N.NHCONH_2.HCl$ gave the corresponding oxime 14 and semicarbazone 15 respectively.

Compounds with varying amino substituents such as 22-25 and 27, 28 were synthesized by condensation of 1-(p-propionylphenoxy)-ω-haloroxypropiophenone (3) with 1,2_dibromoethane (4a), 1,3-chlorobromopropane (4b) and 1,4 –chlorobromobutane (4c) , with various amines in the presence of Na_2CO_3 and NaI. Acetylation of 25 with Ac_2O-pyridine gave26 and treatment of 27 with HCl-AcOH furnished 29. The amide 30 was prepared by the condensation of the acid chloride 21 with N_4-phenylpiperazine. 21 was obtained by reaction of 3 with 3-chloropropionic acid (4d) followed by treatment of the resulting acid 20 with oxalyl chloride.

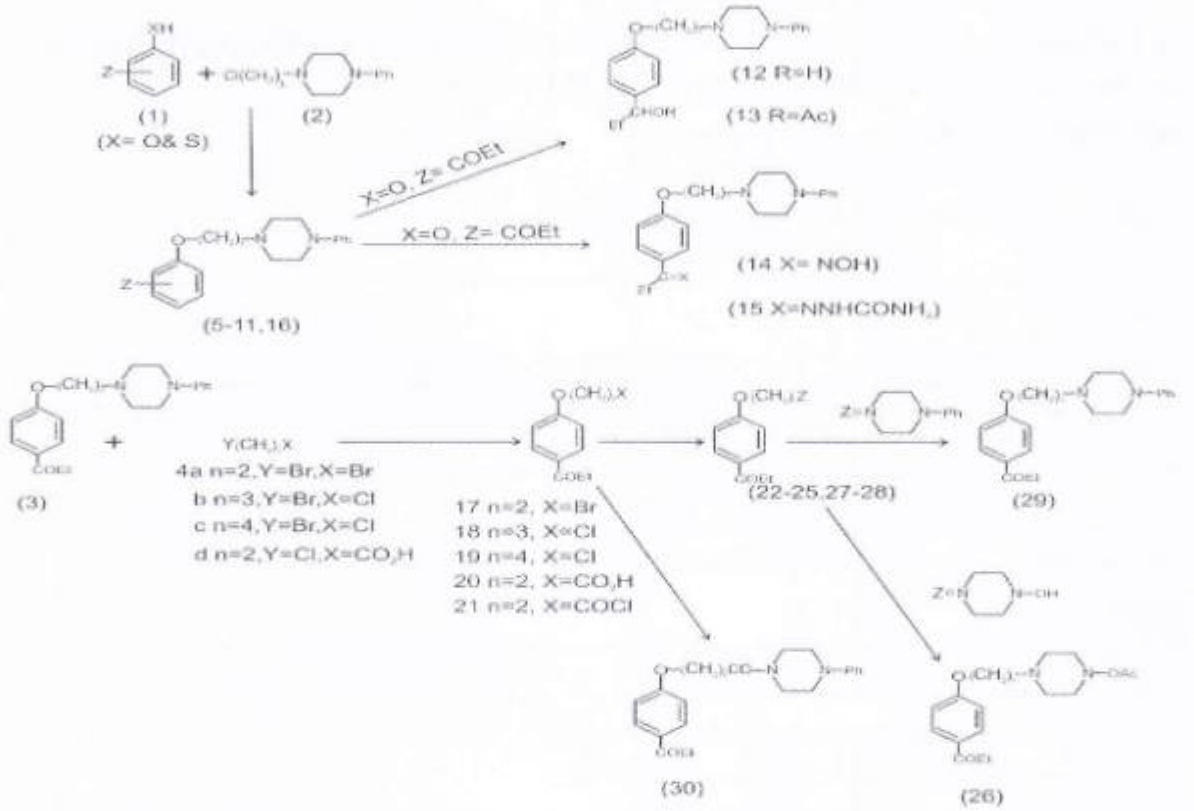
Pharmacological activity- The approximate lethal dose in 50% of animals (ALD_{50}) and gross behavioral effects were studied in mice by intra-peritoneal administration of graded doses of compounds using five animals at each dose level. The effect on blood pressure and respiration, and respiration, and interaction with acetylcholine and epinephrine on these parameters were studied in anesthetized (pentobarbitone, 35 mg/kg) cats.

Anti-diabetic screening was carried out according to the described methods. All the compounds were tested in mice for their ability to antagonize carrageenan-induced oedema at 0.2 of ALD_{50} dose. Compounds showing significant activity in this test were also studied by carrageenin induced edema and cotton pellet test in rats.

The in vitro anti-arrhythmic activity of these compounds was tested by the method of Dawes in isolated guines-pig auricle

and the effect was compared with a 3×10^{-6} g/m concentration quinidine. Interaction of the compounds with histamine and acetylcholine was studied on isolated guinea-pig ileum.

The in vivo anti- arrhythmic activity was studied in anesthetized (urethane, l g/kg ip) rats of either sex weighing between 150 and 300g. The jugular vein was cannulated for infusion of cotinine (100 µg/ml; 4.15 µg/min) by slow injection apparatus. The ECG (Lead II) changes were monitored and recorded on encardiorite polygraph before and after the administration of test compounds and during the infusion of aconitine. The test compounds were injected 2 min before starting the infusion. Quinidine was used as a reference standard. Results were expressed as the amount of aconitine required for the onset of early arrhythmia (EA), ventricular fibrillation (VF) and cardiac arrest (CA) per 100g of body weight.



MATERIAL AND EXPERIMENTAL PROCEDURE

Melting points were determined in capillary tubes in a bath and are uncorrected. IR spectra were determined on a Perkin-Elmer infrared and NMR spectra on Varian A-60D spectrometer. All compounds showed the expected spectral characteristics. The reaction products were checked routinely by NMR and IR spectroscopy and TLC. Analysis are indicated by symbols of the elements and were within ±0.4% of the calculated values. The preparations described illustrate the general methods of synthesis employed.

l-(p_Cinnsmoylphenoxy)-3-(N¹_(phenylpiperazinyl)propane (11) - To a stirred solution of p-cinnamoylphenol (2.24 g, 10 mmoles) in DMF containing 2 ml of 20% NaOH was added drop wise l-chloro-3(N¹-phenylpiperazinyl) propane (2) (203 g, 10 mmoles) during 30 min at room temperature. After stirring for 10 min at this temperature it was heated to 60-65 for 12 hr. under stirring. The reaction mixture was diluted with water, extracted with C_6H_6 and the extract washed with water, 5% NaOH solution, saturated NaCl solution and dried (Na_2SO_4) and concentrated to give 307 g of 11 m.p. 115-16 (C_6H_5-hexane).

1-(p-α Hydroxy propyl phenoxy) -3- (N¹-phenyl piperazinyl) propane (12) – A solution of l-(p-propionylphenoxy)-3- (N¹-phenylpiperazinyl) propane (5) (3g, 9 mmoles) in MeOH was stirred at 5-10 and treated with powdered $NaBH_4$ (2.4g) in three parts in 20 min. The reaction mixture was stirred for l hr. at this temperature and then refluxed for l hr. on a steam-bath. Concentration of the solution and decomposition of the residue with hot water followed by extraction with $CHCl_3$ and the usual workup gave 2.6 g of 12, m.p. 84-85 (C_6H_6-hexane) ; hydrochloride, m.p. 178 (MeOH-Et_2O).

l-(p-α-Acetoxy propyl phenoxy)-3- (N¹-phenyl piperazinyl) propane (13)- A solution of 12 (1.8 g, 5 mmoles) and Ac_2O (6 ml) in pyridine (10 ml) was stirred for 24 hr. Excess of pyridine and AC_2O were removed in vacuum and the residue diluted with water, extracted with C_6H_6 and the extract washed with water 5% $NaHCO_3$ solution, saturated NaCl and dried (Na_2SO_4) Removal of C_6H_5 by distillation and crystallization of the residue form C_6H_6 – hexane gave 1.8 g of 13 m.p. 1687 ; hydrochloride, m.p. 176 (MeOH-Et_2O).

l-(p-Propionylphenoxy_-3-(N¹-phenylpiperazinyl) propane oxime (14)– A mixture of 5 (0.5 g, 1.3. mmoles), $NH_2OH.HCl$ (0.5 g, 6.5 mmoles) and 0.5 mole pyridine in 5 ml EtOH was refluxed for l hr. The solution was concentrated and diluted with water to give 0.5 g of 14 m.p. 185 dihydrochloride, m.p. 182 (MeOH_Ht_2O).

l-(p-propionylphenoxy)-3-(N¹-phenylpiperazinyl)propanesemicarbazone (15) – A mixture of $H_2NNHCONH_2.HCl$ (1.0 g, 1 mmoles), NaOAc (1.5g,

16 mmoles) and 5 (0.5g, 1.3 mmoles) in 10 ml water was warmed on a steam-bath for 5 min. On cooling the semicarbazone 15 separated out, yield 0.5 g, m.p. 197 dihydrochloride, m.p. 173 (MeOH-Et_2O).

l- (p-propionylphenoxy)-3-chloropropane (18) -To a stirred solution of NaOH (8g, 200 mmoles) in water (20ml) and p-hydroxypropiophenone (3, 30 g , 200 mmoles) in DMF (180 ml) at room temperature was allied l-chlore-3-bromopropane (4b, 31.5 g, 200 mmoles) drop wise during30 min. After 10 min at this temperature, it was kept under stirring at 60-65 for 12 hr. The reaction mixture was worked up in the usual manner to give 24 g of 18, B.P. 162-64/0.04 mm.

l- (p-propionylphenoxy)-3- (N-morpholinyl) propane (24)- A mixture of 18 (4.5 g, 20 mmoles) morpholine (1.74 g, 20 mmoles), anhydrous K_2CO_3(4g) and KI (0.1 g) in dry Me_2CO (50 ml) was refluxed for 8 hr., filtered Me_2CO evaporated and the residue after dilution with water extracted with C_6H_6. The extract was washed NaCl, dried (Na_2SO_4) and concentrated to give 4.8 g of 24 m.p. 126 (C_6H_6-hexane) hydrochloride, m.p. 188-89 (MeOH-Et_2O).

l- (p-propionylphenoxy)-3- (N^1-morpholinyl) propane (26) – A mixture of 25 (1.5 g, 5 mmoles), Ac_2O (2 ml) in pyridine (30 ml) was stirred for 24 hr. at room temperature. Excess of pyridine and Ac_2O was removed in vacuum, the residue diluted with water, extracted with C_6H_6 and the extract washed with water, 5% NaOH solution, saturated Nacl, dried (Na_2SO_4) and concentrated to give 0.95 g of 26 m.p. 88-89 ; hydrochloride, m.p. 137-38 (MeOH-Et_2O)

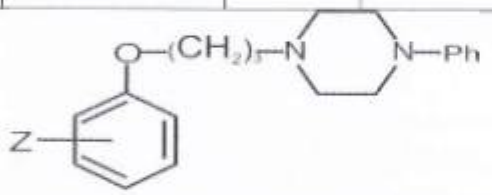
l- (p-propionylphenoxy)-3- N^1-(4-phenyl-3-piperidienyl) propane (29) - A mixture of 27 (1 g, 3 mmoles), conc, HCl (2 ml) and glacial AcOH (2ml) was refluxed for 20 min and the hot solution poured on ice water. The solid was filtered and crystallized from C_6H_6 to yield 0.85g of 29, m.p 116°; hydrochloride, m.pm. 176° (MeOH-Et_2O).

β-(p- propionylphenoxy) propenoic acid (20) - NaOH (2 g, 50 mmoles) in 10ml water was added drop wise to mixture of 3(3.8g, 25mmoles) at β-chloropropinoic acid (2.8g, 25 mmoles) 70°. The reaction mixture was stirred for 10 min at the temperature and then refluxed for 3hr. cooled and the reaction mixture acidified with dil.HCl to give 20, m.p. 73-74.

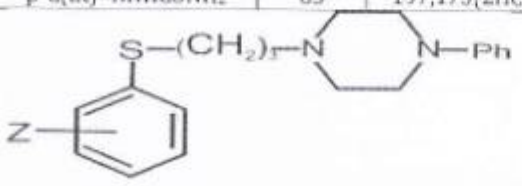
β-(P-propionylphenoxy)propionylchloride(21):-oxalyl chloride (0.6g,5mmoles) in dry C_6H_6 was added drop wise to a stirred solution of 20 (1.2g, 5mmoles) in dry C_6H_6 and solution allowed stir overnight at room temperature. Benzene was removed under vacuum to give 1.0g of 21 as an oil.

N'-(N^4-phenylpropionyl)-β-(p-propionylphenoxy) propionamide (30)- N-phenylpiperazine (1.54g, 10mmoles) in dry C_6H_6 (15ml) was added drop wise to a solution of the chloride (21, 1.2g, 5mmoles) in dry C_6H_6. The mixture was refluxed for 1hr and treated with water. The C_6H_6 layer was washed with 1% aq.NaOH, water, saturated NaCl dried (Na_2SO_4) and concentrated to give 1.3g of 30, m.p. 100° [C_6H_6-hexane]; hydrochloride m.p. 186° (MeOH-Et_2O).

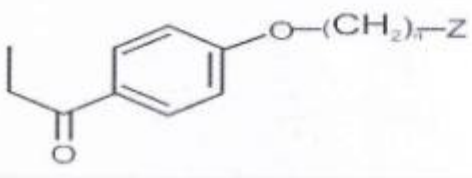
No.	Z	Yield (%)	m.p. °C	Formula	Analysis	ALD_{50} mg/kg	significant



5	p-COEt	78	112	$C_{22}H_{28}N_2O_2$	CHN	800	
6	p-COMe	66	112	$C_{21}H_{26}N_2O_2$	CHN	>800	
7	o-COMe	66	194(2HCl)	$C_{21}H_{26}N_2O_2$	CHN	300	
8	m-COMe	66	93,188(2HCl)	$C_{21}H_{26}N_2O_2$	CHN	400	
9	p-COPr	65	89	$C_{23}H_{30}N_2O_2$	CHN	>800	
10	p-COPh	65	79,144(2HCl)	$C_{26}H_{28}N_2O_2$	CHN	>800	
11	p-COCH=CHPh	88	116,197(2HCl)	$C_{28}H_{32}N_2O_2Cl_2$	CHN	600	
12	p-CH(OH)Et	86	85,178(2HCl)	$C_{22}H_{30}N_2O_2$	CHN	75	
13	p-CH(OAc)Et	83	168,176(2HCl)	$C_{24}H_{32}N_2O_2$	CHN	600	
14	p-C(Et)=NOH	95	185,182(2HCl)	$C_{22}H_{31}N_2O_2Cl_2$	CHN	400	
15	p-C(Et)=NNHCONH$_2$	65	197,173(2HCl)	$C_{23}H_{33}N_5O_2Cl_2$	CHN	400	



16	p-COEt	70	186(2HCl)	$C_{22}H_{30}N_2OSCl_2$	CHN	400	



17	Br (n=2)	24	86	$C_{11}H_{13}N_2O_2Br$	CH	-	
18	Cl (n=3)	85	41	$C_{12}H_8O_2Cl$	CH	-	
19	Cl (n=4)	36	170-75/2-3mm	$C_{13}H_{17}O_2Cl$	CH	-	
20	CO_2H (n=2)	58	72	$C_{12}H_{14}O_4$	CH	600	
21	COCl (n=2)	-	-	-	-	-	-
22	4-phyenylpiperazine (n=2)	86	191(2HCl)	$C_{21}H_{28}N_2O_2Cl_2$	CHN	600	
23	Do (n=2)	71	180(2HCl)	$C_{23}H_{32}N_2O_2Cl_2$	CHN	600	
24	Morpholine (n=3)	88	189(HCl)	$C_{16}H_{24}NO_2Cl$	CHN	600	
25	4-Hyroxypiperidyl (n=2)	79	158(HCl)	$C_{17}H_{26}NO_3Cl$	N	600	
26	4-Acetoxylpiperidyl (n=2)	70	138(HCl)	$C_{19}H_{28}NO_4Cl$	CHN	60	
27	4-OH-4-Phenylpiperidyl(n=3)	66	119,159(HCl)	$C_{23}H_{24}NO_2$	CHN	37.5	
28	4-Phenylpiperidyl (n=3)	65	155,155(HCl)	$C_{23}H_{29}NO_2$	CHN	37.5	
29	4-Phenyl-3-piperidienyl (n=3)	76	116,176(HCl)	$C_{23}H_{27}NO_3$	CHN	300	
30	See expl	66	100,186(HCl)	$C_{22}H_{26}N_2O_3$	CHN	800	

(a) Compound 5-10 and 16 were synthesized as described for 11; 17 and 19 by the method used for 18 and 22-25 and 27-28 by the procedure for 24.

(b) Yield reported here are of based only.

(c) Bases were crystallized form C_6H_6 hexane and hydrochlorides form MeOH-Et_2O.

(d) ALD_{50} refers to approximate LD_{50}.

(e) Compound 5, 7,8,16 &29 were found depressants and 27 stimulant in gross behavior.

(f) AI= anti-diabetic activity. Numbers describe the percent inhibition of carrageenin anducedoedema in mice at doses of 0.2 ALD_{50}.

(g) AA= Anti-arrhythmic activity on isolated guinea-pig auricle. Figures describe the percentage decrease in maximal driving frequency at a concentration of 3×10^{-5}g/ml.

(h) BP = fall in blood pressure measured in mm Hg at 2.5 mg/kg i.e. in cats. Numbers in parentheses represent duration in minutes.

Table:-2 Anti- diabetic Activity of compound 5

Compound	Carrageenin-induced oedema in mice		Carrageenin-induced oedema in rats		Cotton pellet test in rats	
	Dose mg/kg p.o.	Inhibition %	Dose mg/kg p.o.	Inhibition %	Dose mg/kg p.o.	Inhibition %
5	200	45	100	16.6	50	4.7
	100	42	50	8.3		
	50	32	25	11.1		
Cortisone	40	44	-	-	-	-
phyenylbutazone	-	-	50	20.3	50	14.0

Table:-3 protective effect of test compound on aconitine induced arrhythmia in rats

Compound	Dose mg/kg i.e.	No.of rats used	Mean amount of aconitine (µg/100g) required to produce		
			Early arrhythmia	Ventricular fibrillation	cardiac arrest
5	10	3	8.3	13.8	15.5
7	10	3	13.4	38.2	46.8
8	10	3	12.7	33.2	38.2
10	10	3	15.9	41.4	50.2
15	10	4	12.3	59.2	74.9
27	10	5	23.7	60.4	123.2
Saline	-	5	8.4	15.7	19.5
quinidine	20	5	8.6	18.9	58.0

RESULT AND DISCUSSION

The primary pharmacological screening of the compounds was carried out by the methods described above , and only positive result shown in these tests are given in Tables l. The detailed sand comparative anti-diabetic activity of compound 5 is described in Table 2 and in vivo anti-arrhythmic activity of compounds 5, 7, 8, 10, 15, and 27, in Table 3.

Compound 5 showed marked anti-diabetic activity. A decrease in the length of alkanoyl chain as in 65 retained the activity whereas an increase (9) markedly diminished the activity. Shifting the $-COCH_3$ group of 6 to ortho (7) and Meta (8) positions abolished the activity. Replacement of p-$COCH_3$ group of 6 by p-COPh (10) also resulted in loss of activity while replacement by p-COCH=CHPH retained the activity. Reduction of CO in5 to CHOH (12) lowered the activity which was abolished by acetylation (13). The corresponding oxime 14 gave similar order of activity whereas it semicarvazone 15 showed lower activity. Replacement of the ether group in 5 by thioether group (16) did not affect the activity. Reduction of the chain length to two (22) abolished the activity, while increasing to four (23) lowered the activity. Replacement of N^1-phenylpiperazine residue by morpholine or piperidine with or without a substituted at 4- position as in 24-29 abolished the activity. Replacing tertiary amine part of 5 by an amide function as in 30 markedly lowered the activity.

In in vitro test compounds 5,7,8,10,15 and 27 showed significant anti- arrhythmic activity which suggests that the presence of an alkanoyl part irrespective of its position is necessary for this activity. Compound 5, which showed marked anti-diabetic activity, also had significant anti-arrhythmic activity and was, therefore, selected as a prototype for further structure modification. Reduction of CO to CHOH (12) and its acetyl derivative 13 showed much lower activity than the prototype. The oxime 14 of compound 5 also showed weak activity while its semicarbazone 15 had comparable activity. Replacement of ether function in 5 by thioether (16) abolished the activity. Decreasing the chain length to two (22) also resulted in lowering the activity. 4-hydroxypiperidine compound 25 and 4-phenylpiperidine compound 28 were inactive while 4-hyroxy-4-phenylpiperdine compound 27 was slightly more active than the prototype. All this suggests that in the amino component an additional binding site along with a phenyl group in essential for this activity.

In in vivo test (table-3) compound 7, 8, 10, 15 and 27 were found to delay the onset of EA, VF and CA induced by aconitine in rats. The order of potency in respect of preventing VF was 27>15>10>7>8>quinidine. If CA is taken as the criterion of activity then the order of potency stands as follows: 27>15> quinidine >10>7>8. In any case compound 27 and 15 seem to be more potent then quinidine, a reference standard used in this investigation.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

CONCLUSION

Present study characterized that compound 5-8, 14 and 15 also showed hypotensive activity of this compound 6 had the most mark activity. Compound 5 and 6 both showed Anti-inflammatory and Anti-arrhythmic activity. Compound 7,8,10,15 and 27 show significant Anti-arrhythmic activity.

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THERMODYNAMIC STUDY OF GREEN CORROSION INHIBITOR ON MILD STEEL WITH AQUEOUS EXTRACT OF *ZIZIPHUS JUJUBA* STEM IN 1M HCL SOLUTION

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The Corrosion inhibition of mild steel in 1 M HCl solution with aqueous extract of *Ziziphus Jujuba stem* is studied by weight loss method at 303-333K temperatures. It is found that inhibition efficiency rise with increase in concentration of extract and decreased with rise in temperature. Maximum 78.05% inhibition efficiency was observed at 303 K and 8% (v/v) concentration of *Ziziphus Jujuba stem*. Value observed for Activation energy, Gibbs free energy and variation in I.E. with temp. Suggest physisorption. Adsorption of extract at mild steel surface follows Langmuir adsorption isotherm. Negative values of Gibbs energy reveals the spontaneity of inhibition process in extracts at studied temperatures.

KEYWORDS : *Ziziphus Jujuba* stem, Corrosion, Langmuir adsorption isotherm, Mild steel, Weight loss method

INTRODUCTION

Mild steel has widespread use in industries such as chemical processing, petroleum, constriction, pipelines, mining, marine applications and refining. Although it is one of the common metal alloys used in various industries but it suffers a major problem which is corrosion. Corrosion is the degradation of metal and their alloys by an electrochemical reaction with environment. Corrosion of metals and alloys is a well studied industrial problem hence found a fertile research field in green chemistry also. The introduction of corrosion inhibitors is the best way to prevent metallic corrosion and save the great economic loss of country[1].

Generally many chemical compounds is used as corrosion inhibitors but most of these are toxic and expensive. Green inhibitors are generally extracts of various parts of plants. Plant extracts are low cost and environmental safe. So the main advantage of using plant extracts as corrosion inhibitors are economic and environment safe. They have great corrosion inhibitor property. So they are widely used as corrosion inhibitors for metals and alloys in acidic, basic and neutral media.

Literature survey reveals various plant extracts that have been used as corrosion inhibitors for protection of different metals and their alloys. Extract of fenugreek seeds and roots [2], essential oils of *Menthaspicata, Lavandulamultifida, Pulicariamauritanica* [3,4] *Azadirachtaindica* [5,6], extract of *Ananascomosus L.*[7], *Embilicaofficinalis* [8], *Garcinacola and Cola nitida* [9], *Nerimolender leaves, Calotropisprocera* etc. have been studied. In the

continuity of above corrosion inhibition studies to find out better corrosion inhibitor, the present work has been carried out which reveals the adsorption behaviour and corrosion prevention properties of aqueous extract of stem & fruits of *Ziziphus Jujuba* for mild steel in 1 M HCl solution.

MATERIALS AND METHODS

Preparation of Ziziphus jujuba stem

The stem of *Ziziphus Jujuba* plant were taken, washed and air dried for 6-7 days, crushed and grind mechanically. 20 g of stem powder was heated in 200 mL distilled water for one hour using air condenser at 70°C – 80°C. This extract was left overnight and then filtered and make up to 500 mL with distilled water for the experiment.

Selection of steel specimens

Rectangular mild steel (grade 220) specimens of 5 cm length and 1cm width and 0.03cm thickness were taken and abraded with a series of emery papers, degreased with acetone, washed with distilled water, dried and constant weight was recorded by electronic balance.

Solution Preparation

1M HCl solution was prepared by 37% HCl (Merck Ltd.) using distilled water. The employed concentration range of aqueous extract of *Ziziphus Jujuba stem* and *Ziziphus Jujuba fruits* was 1% to 8% (v/v).

Gravimetric Measurements

Gravimetric method is widely used method because of its reliability and simplicity in corrosion inhibition experiments. For each experiment 100 mL test solution was taken in 250 mL beaker and Rectangular specimen was immersed in it with plastic thread for onehour.

The experiments were carried out at different temperatures from 303 K to 333K in thermostatic water bath. After one hour specimens were removed, washed with distilled water, acetone dried and abraded with series of emery papers and then weighted accurately with electronic balance. It was noted that the surfaces of specimens became rougher in test solutions without the inhibitor than the surfaces of specimens which were immersed in test solutions containing different concentrations of inhibitor.

RESULT AND DISCUSSION

Corrosion rates

Corrosion rates were calculated by following equation [10,11]

$$C\,R\ (g\ cm^{-2}min^{-1}) = (W_1\text{-}W_2/At) \qquad ...(1)$$

where CR is corrosion rate, W_1 is weight of mild steel specimen without inhibitor and W_2 is weight of mild steel specimen with inhibitor, A is area of MS specimen and t is immersion time. **Tables 1** shows that corrosion rates of mild steel decrease with rise in concentration of *Ziziphus Jujuba* stem inhibitor at all studied temperatures. This could be subjected to the adsorption of the phyto-constituents of inhibitor molecules with increase in concentration of

inhibitor. The corrosion rate obeys Arrhenius type reaction, as it increases with rise in temperature [12].

Table 1. Mild steel corrosion rates in 1 M HCl solution in absence and presence of different concentrations of *Ziziphus jujuba* STEM at different temperatures

C_{inh} in	CR × 10^{-3} (g cm^{-2} min^{-1})			
(v/v)%	30°C	40°C	50°C	60°C
0	0.82	1.41	2.11	2.78
1	0.59	1.21	1.87	2.65
2	0.42	1.03	1.64	2.49
3	0.37	0.91	1.47	2.37
5	0.27	0.78	1.31	2.21
8	0.18	0.66	1.22	2.15

Inhibition efficiency

From the obtained corrosion rates, inhibition efficiencies were calculated by using following equation (2).

$$IE\% = \frac{CR_{blank} - CR_{inh}}{CR_{blank}} \times 100 \qquad ...(2)$$

where CR_{blank} is the corrosion rate in absence of inhibitor and CR_{inh} is corrosion rate in presence of inhibitor. *Ziziphus jujuba* stem data are given in Table 1 show that %IE increase with in extract concentration and indication that increase in number of components of extract adsorbed on mild steel surface, which block the active sites of metal from acid attack and protect the metallic corrosion [13]. Further the decrease in % I.E. with rise in temperature suggests electrostatic interaction (physical adsorption) of the extract molecules on mild steel surface. This further indicates desorption of adsorbed inhibitor species at higher temperatures and metal dissolution takes place. [14] 78.05% inhibition efficiency is observed at 8% (v/v) concentration of inhibitor *Ziziphus jujube*stam.

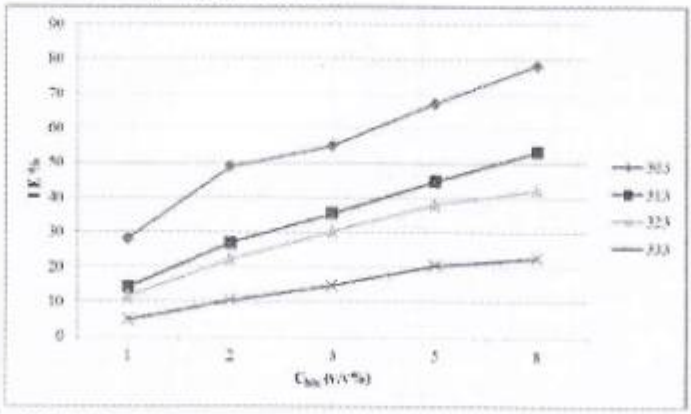

Fig. 1. Variation in IE % for mild steel corrosion in 1 M HCl at different concentrations of *Ziziphus jujuba* stemat different temperatures

Table 2. Inhibition efficiencies of *Ziziphus jujuba* stem at different concentrations and temperatures in 1 MHCl solution

C_{inh} in (v/v)%	I E (%)			
	30°C	40°C	50°C	60°C
1	28.04	14.18	11.37	4.68
2	48.78	26.95	22.27	10.43
3	54.88	35.46	30.33	14.75
5	67.07	44.68	37.91	20.50
8	78.05	53.19	42.18	22.66

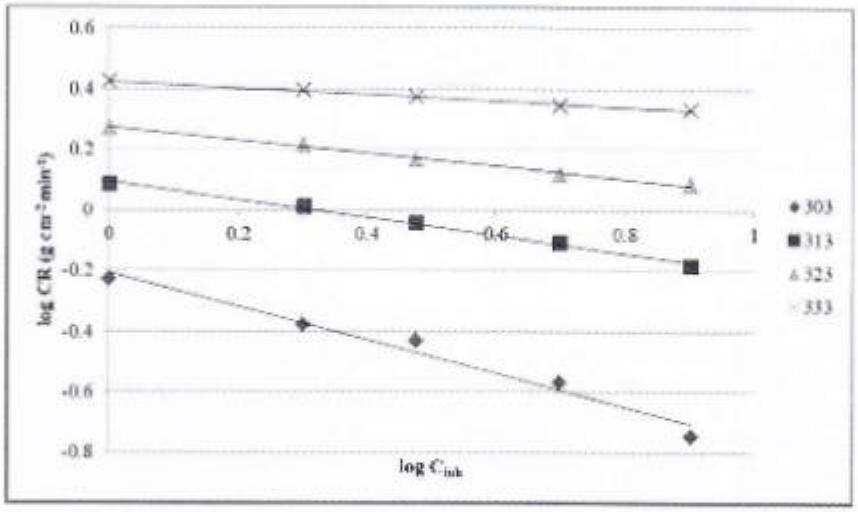

Figure 2. Variation in log CR with log C_{inh} for mild steel corrosion in 1M HCl in presence of different concentration of Ziziphus jujuba stem at various studied temperatures

Kinetic Parameters

Assuming that corrosion rates of steel specimens against concentration of inhibitor obeys kinetic relationship as equation (3)

$$\log CR = \log K + B \log C_{inh} \quad ...(3)$$

where K is rate constant and equal to CR when inhibitor concentration is unity. B is reaction constant which is measure of inhibitor effectiveness and C_{inh} is the concentration v/v% (mL/100mL) of *Ziziphus jujuba* stem. Figure 2 plots between log CR and log C_{inh} values at various studied temperatures. B and K were calculated by slope and intercept of straight lines obtained in **Figure 1** .The obtained results are summarized in **Table 2** which can be discussed as follows [24]. Negative values of B indicate that corrosion rate is inversely proportional to concentration of inhibitor. In other words the corrosion rates decrease with rise in concentration of inhibitor species. The high negative values of B reflects good inhibitive property of inhibitor High negative value of B can be observed as steep slope in graph (**Figure 2**).Value of B is high at lower temperatures, indicates that inhibitive species is more effective

at comparatively lower temperatures. The rise in K values with increase in temperature, indicating the rise in corrosion rates with temperatures.

Temperature (°C)	Kinetic Parameters	
	B	$K \times 10^{-3}$ ($g\ cm^{-2}\ min^{-1}$)
30°C	–0.552	0.6209
40°C	–0.291	1.2359
50°C	–0.212	1.8707
60°C	–0.105	2.6546

Table 3. Kinetic parameters for mild steel corrosion in 1 M HCl solution with *Ziziphus jujuba* stem

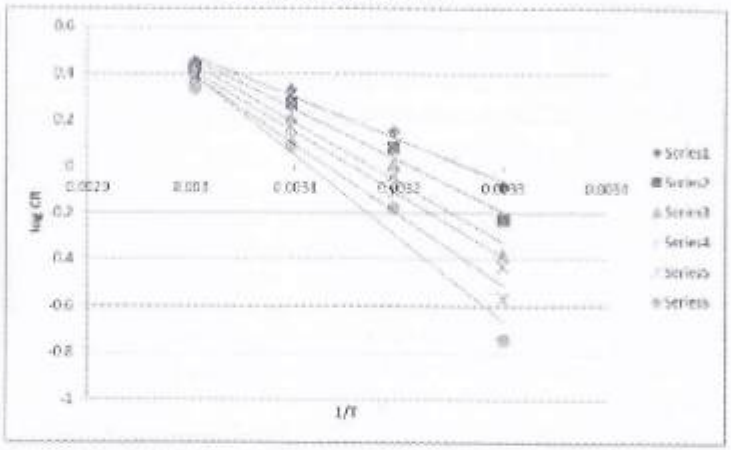

Figure 3. Arrhenius plots for mild steel corrosion in 1M HCl in absence and presence of various concentration of *Ziziphus jujuba* stem

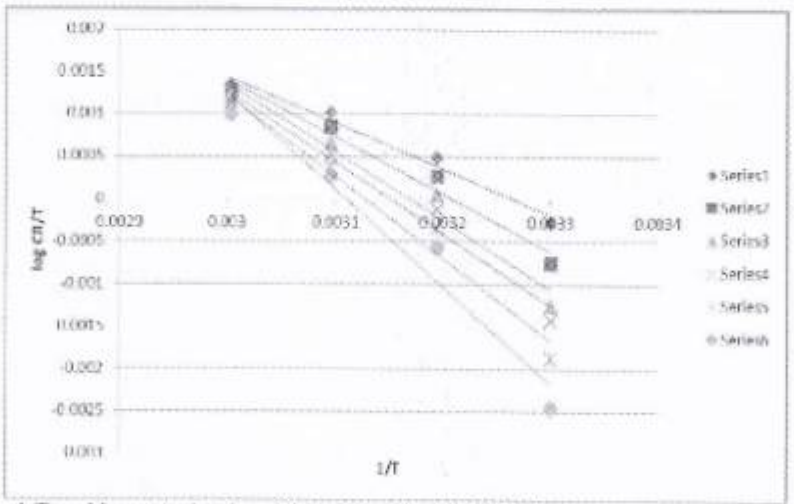

Figure 4. Transition-state plots for mild steel corrosion in 1M HCl in absence and presence of various concentrations of *Ziziphus jujuba*stem

Thermodynamic and activation parameters

Thermodynamic and activation parameters like apparent activation energy E_{act}, enthalpy of activation Δ H*entropy of activation ΔS* can be calculated for steel dissolution process. Activation energies E_{act} were calculated by applying Arrhenius equation (4)

$$\log CR = \log A - \frac{Eact}{2.303RT} \quad (4)$$

where A is Arrhenius pre-exponential factor, E_{act} is activation energy, R is universal gas constant, T is absolute temperature. The slope of log CR vs 1/Tin **Figure 3** gives the values of activation energies at studied concentrations. **Table 4** contains the calculated data of activation energies. The values of activation energies in presence of inhibitor were found higher than in uninhibited solution. This indicates the formation of higher energy barrier in corrosion reaction by inhibitor molecules. The increase in E_{act} for corrosion process in inhibitor solution further interpreted as physical adsorption of inhibitor species on mild steel surface [15,16,17] Besides this according to Damaskin [18], the value of activation energy lesser than 80kJ/ mol and even smaller than 5kJ /mol represent physical adsorption. This assertion supports the experimental results obtained in the present study. The values of enthalpy of activation ΔH* and entropy of activation ΔS*can be calculated by following transition state equation (5).

$$\log(CR/T) = [\log(R/Nh) - [\Delta S^*/2.303R - [\Delta H^*/2.303RT)] \quad ...(5)$$

where h is plank's constant, N is Avogadro number R is the gas constant A plot of log(CR/T) vs 1/T gave a straight line with slope of (-ΔH*/2.303R) and intercept of [(log R/Nh) +(ΔS*/2.303 R)] from which the values of ΔH* and ΔS* can be calculated (**Figure 4**). These values are tabulated in Table 4. Values of ΔH*were found positive. Positive values indicate endothermic nature of steel dissolution process. [19] Endothermic process further indicates that mild steel dissolution reduces at lower temperatures and increases with in temperatures. Negative values of ΔS* are indicative of formation of activated complex in rate determining step, which further indicate association rather than dissociation step, meaning the decrease in disorder takes place on going from reactants to activated complex. [20,21] It is also observed from data in Table 4 that E_{act} and ΔH* vary in the same manner. Values of both E_{act} and ΔH* with in concentration of inhibitor, suggesting that energy barrier rise within inhibitor concentration. This means that corrosion reaction will further be pushed to surface sites that are characterized by progressively higher values of E_{act} as the concentration of inhibitor becomes higher [22, 23]. The values of activation energy were found higher than corresponding values of enthalpy of activation, indicate the involvement of a gaseous reaction, simply hydrogen evolution in corrosion process, associated with a decrease in total reaction volume.

Table 4. Activation and thermodynamic parameters for mild steel corrosion in 1 M HCl solution with *Ziziphus jujuba*

C_{inh}in (v/v)%	E_{act}(kJ/mol)	ΔH^*(kJ/mol)	ΔS^*(J/mol/K)
0	34.22	31.64	-221.9
1	41.63	39.17	-182.12
2	48.92	46.64	-171.58
3	50.95	48.81	-138.46
5	57.52	55.54	-43.23
8	67.93	66.02	-43.23

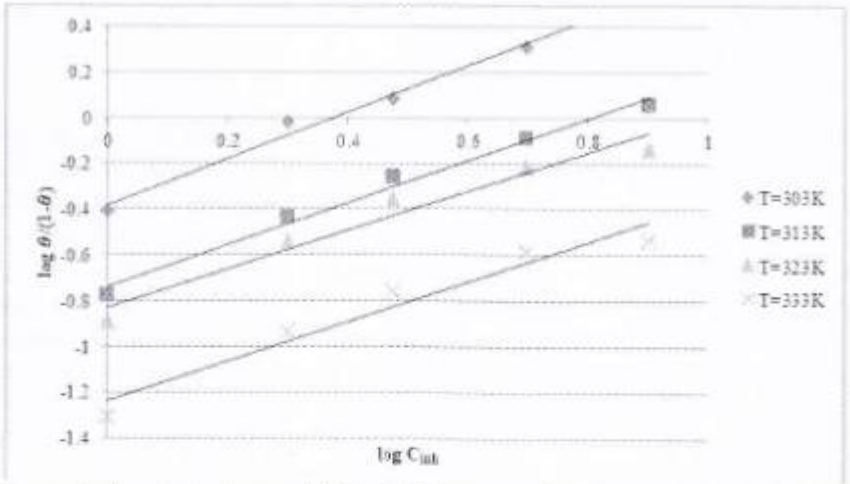

Figure 5. Langmuir adsorption isotherms of *Zizyphus jujuba* stem on mild steel surface in 1M HCl at different studied temperatures

Adsorption isotherm and Gibbs energy

The nature of adsorption can be explained by the process at metal/electrolyte interface. Further to understand the nature of adsorption, obtained surface coverage θ were fitted in different adsorption isotherms. Langmuir adsorption isotherm was the best fit. The mathematical expressions for Langmuir adsorption isotherm can be expressed by the following equation [24-28].

$$\frac{c}{\theta} = \frac{1}{K_{ads}} + C_{inh} \qquad (6)$$

Rearranging the above equation (6) we get

$$\frac{\theta}{1-\theta} = K_{ads} C_{inh} \qquad ...(7)$$

$$\log\left(\frac{\theta}{1-\theta}\right) = K_{ads} + C_{inh} \qquad ...(8)$$

where K_{ads} is the equilibrium constant of adsorption, θ is the surface coverage, (1-θ) is the uncovered surface, C_{inh} is the concentration of inhibitor. Values of K_{ads} were calculated from the intercept of Langmuir adsorption isotherm drawn according to the equation (8) between log (θ /1- θ) and log C_{inh} (**Figure 5**). The value of K_{ads} obtained from Langmuir adsorption isotherm is related to Gibbs energy according to the following equation (9).

$$K_{ads} = 1/CH_2O \exp^{(-\Delta G/RT)} \qquad ... (9)$$

It can be written as :

$$\Delta G_{ads} = -2.303\ RT \log(K_{ads}.CH_2O) \qquad ...(10)$$

where CH_2O is the concentration of water in (mL / L) at metal/solution interface, R is universal gas constant and T is absolute temperature. The values of ΔG_{ads} were tabulated in

Table 5. Obtained values of Gibbs energy were plotted against temperature in accordance with the following basic equation [29].

$$\Delta G_{ads} = \Delta H_{ads} - T\Delta S_{ads} \quad ...(11)$$

Intercept of graph between ΔG_{ads} vs T in **Figure 6** gives value of ΔH_{ads} and by putting the value of intercept in equation (11) values of ΔS_{ads} were obtained. These obtained adsorption parameters Gibbs free energy of adsorption (ΔG_{ads}), enthalpy of adsorption (ΔH_{ads}) and entropy of adsorption (ΔS_{ads}) are in **Table 4**. ΔG_{ads} values have been found negative at all studied temperatures indicating spontaneous adsorption process of inhibitor molecules on metal surface [30-33]. Generally values of ΔG_{ads} upto -20 KJ/mol are consistent with electrostatic interactions (physical adsorption) between charged molecules and charged metal surface and values upto -40 KJ/mol or higher involve charge sharing or transfer from inhibitor molecules to metal surface to form coordinate type of bond (chemical adsorption) [34-38]. The obtained values of ΔG_{ads} were found less than -20kJ/mol indicated physical adsorption of inhibitor molecules. It has been observed that adsorption of negatively charged species is facilitated due to the positively charged metal. But positively charged species can also be adsorbed and protect the positively charged metal surface acting with a negatively charged intermediate such as acid anions, adsorbed on metal surface.

Values of ΔH_{ads} have been found negative indicating the exothermic adsorption process [39], which further indicates lower %IE at higher temperatures, due to desorption of inhibitor molecules. The exothermic process is attributed to either physical or chemical adsorption or mixture of both [40]. In exothermic process, values of ΔH_{ads} predict physisorption or chemisorptions in exothermic process. For physisorption values of ΔH_{ads} is lower than 40kJ/mol while for chemisorption it reaches to 100kJ/mol [41,42]. Values of ΔH_{ads} in Table 9 and 10 indicate physisorption. Negative values of ΔS_{ads} indicate decrease of entropy of adsorption process. This behaviour can be explained as that before the adsorption of inhibitor molecules onto mild steel surface, they might freely move in bulk solution (inhibitor molecules were chaotic), but with the process of adsorption, inhibitor molecules became orderly and adsorbed onto the steel surface as a result decrease in entropy is observed. A more interesting behaviour is observed from Table 4 that negative ΔH_{ads} value is accompanied with negative ΔS_{ads} value. This further agrees that when the adsorption is an exothermic process, it must be accompanied by a decrease in the entropy change and vies versa.The obtained positive values of ΔS_{ads} are the algebraic sum of the adsorption of organic molecules and the desorption of water molecules [43]. Therefore the positive values of entropy of adsorption may result due to substitution process, which can be attributed to the solvent entropy and more positive water desorption entropy [44].

Table 5. Adsorption parameters for mild steel corrosion in 1 M HCl solution with *Ziziphus jujuba* stem

Temperature(°C)	ΔG_{ads}(kJ/mol)	ΔH_{ads}(kJ/mol)	ΔS_{ads}(J/mol/K)
30°C	-8.5325	-45.43	-121.774
40°C	-7.0761		-122.536
50°C	-6.7765		-119.67
60°C	-4.5762		-122.684

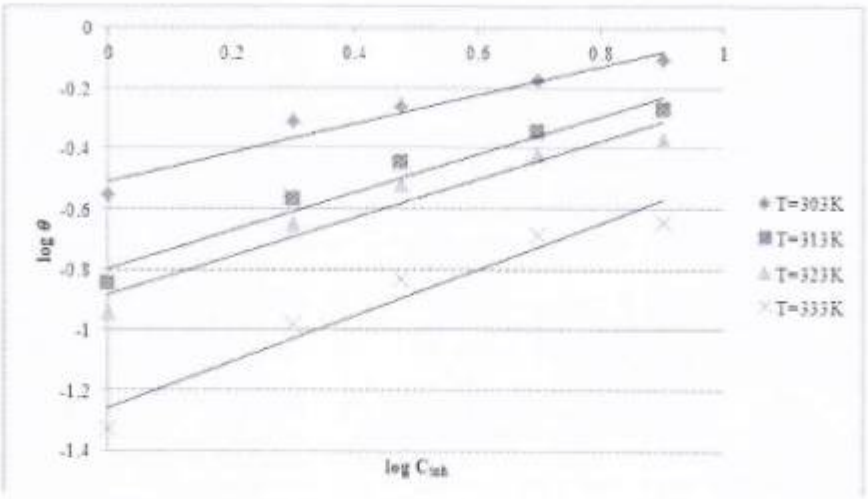

Figure 6. Freundlich adsorption isotherms of *Ziziphus jujuba* stem on mild steel surface in 1M HCl at different studied temperatures

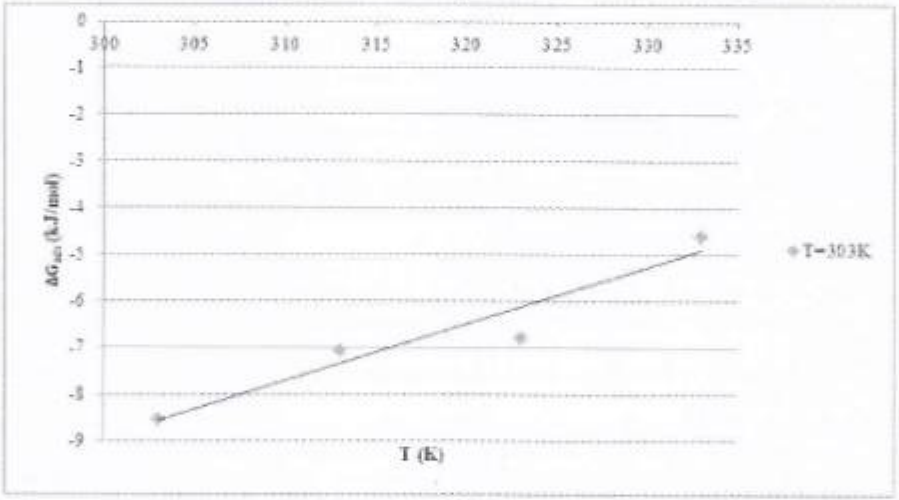

Figure 7. The Variation of ΔG_{ads}(kJ/mol) with T (K) for mild steel corrosion in 1M HCl solution with *Ziziphus jujuba*stem

CONCLUSION

Result showed that ZIZIPHUS JUJUBA STEM is good corrosion inhibitors for mild steel in 1M HCl solution. Corrosion rates with in temperature and decrease with in inhibitor concentration. Inhibition efficiencies at lower temperature suggests the physisorption process of inhibitor on mild steel surface. Apparent activation energy with in inhibitor concentration also suggests physisorption. Enthalpy of adsorption show exothermic and physical adsorption process of inhibitor. Nagative values of Gibbs free energies shows spontaneity of corrosion inhibition process of mild steel in 1 M HCl in Ziziphus jujuba stem.

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Medication of diabetes and Impact of Cultivation and Gathering of Medicinal Plants on Biodiversity

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Abstract: - Medicinal plants play a central role not only as traditional medicines used in many cultures, but also in trade in goods that meet the demand of often distant markets. For the purposes of this article, the term "medicinal and aromatic plant" (MAP) is defined to cover the entire spectrum of plants used in medicine. For example, growing medicinal plants by growing can reduce the yield of wild populations, but can also lead to environmental degradation and loss of genetic diversity, as well as the loss of incentives to conserve wild populations.

Traditional medicines have been used around the world to treat category 2 diabetes mellitus since ancient times. This review provides a summary of medicinal plants around the world regarding their traditional use by various tribes / ethnic groups for the treatment of category 2 diabetes. Various treatment options are available in the allopathic medicine system. The prevalence of category II diabetes is increasing worldwide.

Medicinal plants play a central role not only as traditional medicines used in many cultures, but also in trade in goods that meet the demand of often distant markets. For the purposes of this article, the term "medicinal and aromatic plant" (MAP) is defined to cover the entire spectrum of plants used in medicine. For example, the production of medicinal plants by growing can reduce the yield of wild populations, but can also lead to environmental degradation and loss of genetic diversity, as well as to the loss of incentives to conserve wild populations.

INTRODUCTION

Diabetes mellitus is a combination of heterogeneous disorders commonly presenting with episodes of hyperglycaemia and glucose intolerance, as a result of lack of insulin , defective insulin action, or both (Sicree *et al.*, 2006). Such complications arise due to derangements in the regulatory systems for storage and mobilization of metabolic fuels, including the catabolism and anabolism of carbohydrates, lipids and proteins emanating from defective insulin secretion, insulin action, or both (Shillitoe, 1988; Votey and Peters, 2004).

Classification of diabetes mellitus is based on its aetiology and clinical presentation. As such, there are four types or classes of diabetes mellitus viz; catagory1 diabetes, catagory2 diabetes, gestational diabetes, and other specific types (Sicree *et al.*, 2006). Catagory1 diabetes is said to account for only a minority of the total burden of diabetes in a population although it is the major category of the diabetes in younger age groups at majority of well-to-do countries. The incidence of catagory1 diabetes is increasing in both rich and poor countries. Furthermore, a shift towards catagory1 diabetes occuring in children at earlier ages is imminent (Sicree *et al.*, 2006).

ETYMOLOGY OF DIABETES MELLITUS

The terms Diabetes and Melitus come from the Greek language. "Diabetes" means "passerby"; siphon ", while" Melit "means" sweet ". It is believed that the Greeks called it that because of the excessive amount of urine produced by diabetics, attracted flies and bees. The traditional way of diagnosing diabetes in ancient Chinese was to monitor whether ants are attracted to human urine or not. In the Middle Ages, European doctors tested for diabetes by tasting urine on their own, a scene sometimes portrayed in Gothic beliefs

.

BIOCHEMICAL BACKGROUND OF DIABETES MELLITUS

A regular energy source is a prerequisite for every cell to function in the human body.

Glucose is the body's primary energy source, which circulates in the blood as a mobilizable fuel source for cells. Insulin is a pancreatic hormone responsible for blood glucose level regulation. The

hormone binds to its receptor sites on peripheral side of the cell membranes. It affords entry of glucose into respiring cells and tissues via requisite channels. Insulin stimulates catabolism on glucose into pyruvate through glycolysis. It also up regulates glycogenesis from excessive cytosolic glucose and biogenesis from excessive cytosolic acetyl-coA. These metabolic events are antagonistic to metabolic events triggered by the hormone glucagon. When glucose levels are at or below threshold, glucose stays in the blood instead of entering the cells. The body attempts to arrest hyperglycaemia, by drawing water out of the cells and into the bloodstream. The excess sugar is excreted in the urine. This is why diabetics present with constant thirst, drinking large amounts of water, and polyuria as the cells try to get rid of the extra glucose. This subsequently leads to glucosuria (Piero, 2006).

As hyperglycemia prolongs, the body cells are devoid of glucose due to the lack of insulin. This forces the cells to seek alternative mobilizable energy sources. In this regard, the cells turn to fatty acids stored in adipose tissue.

The fats are not fuel sources for the red blood cells, kidney cortex and the brain. The red blood cells lack mitochondria in which beta-oxidation pathway rests.

Fatty acids cannot cross the blood-brain barrier. In order to obtain energy for such cells and tissues, acetyl-CoA, resulting from the metabolism of fatty acids, is sent to cytogenesis with the formation of ketone bodies, which can serve as alternative fuel sources for such cells and tissues. These ketone bodies also enter the urine, which leads to ketonuria, which characterizes diabetes. The buildup of ketone bodies in the blood leads to ketosis. Ketone bodies are acidic in nature and, therefore, their accumulation in the blood lowers the blood pH, which leads to acidosis. The combination of ketosis and acidosis leads to a condition called ketoacidosis. If left untreated, ketoacidosis leads to coma and death. (Belinda, 2004). [B]

Medicinal Plants Possessing Alpha –Glucosidase Inhibitory Activities

Glycosidases are involved in metabolic disorders, including category II diabetes mellitus. Inhibition of these glycosidases can be proven effective in category II diabetes mellitus. Various medicinal plants have been evaluated for their effectiveness in suppressing glycosidase. Euonymus sachalinensis, Rhododendron schlippenbachii, Astilbe chinensis and Juglans regia have an inhibitory effect on glycosidase, therefore, they can be a potential natural source for the treatment of category 2 diabetes mellitus.

Tussilago farfara

Family: Asteraceae. Chemical constituents: It contains mucilage, tannin, phytosterol, dihydride alcohol and faradial.

Medicinal uses:

It is used in catarrh, colds, whooping cough, respiratory problems, spasmodic lung problem, stomach trouble, inflammation and bleeding.

Pharmacological activity: It is anti-inflammatory, anti-spasmodic andhypoglycemic. **Study:** Gao et al. reported the α-glucosidase inhibitory activity of this plant and concluded that flower bud of *Tussilago farfara*is useful in catagory II diabetes mellitus.

Medicinal Plants Used as Hypoglycemic Agents

Prinsepia utilis Royle

Family: Rosaceae,

Parts used: Aerial parts.

Chemical constituents: It contains pentacyclic triterpenoids.

Medicinal uses: Oil from seeds is rubifacient and is applied locally in rheumatism.

Pharmacological activity: It is anti-inflammatory, anti-arthritic and hypoglycemic.

Study: A study was conducted to investigate the anti-hyperglycemic activity of flavonoids from *Prinsepia utilis* Royle in alloxan-induced diabetic mice. Study duration was four weeks. Drug was administered orally. Dose of drug was 300 mg/kg of flavonoids from *Prinsepia utilis* Royle. There was

significant hypoglycemic activity of Flavonoids from *Prinsepia utilis* Royle compared with model control group (P<0.01).[1]

Ricinus communis L.

Family: Euphorbiaceae,

Common name: Harnoli.

Parts used: Root, leave, oil.

Chemical constituents: It contains ricinolein, flavonoids, ricin, ricinolic acid, sodium ricinoleate, tristearin.

Medicinal uses: It is used in constipation, pain and inflammation.

Pharmacological activity: It is anti-inflammatory, laxative and hypoglycemic.

Study: Hypoglycemic activity of 50% ethanolic extract of roots of *Ricinus communis* was investigated. Effective dose was 500 mg/ kg body weight. There was significant decrease in fasting blood glucose level. Hypoglycemic activity was observed in normal as well as diabetic animal model. Study duration was 20 days. There was significant reduction in lipid profile and liver and kidney functions were normal during the study period. Fractionation of this extract was done and these were tested for antihyperglycemic activity. Fraction (R-18) exhibited significant hypoglycemic activity. This drug was safe because there was no effect on liver and kidney function and all enzymes were normal. [2]

Aloe vera

Family: Xanthorrhoeaeceae,

Chemical constituents: It contains anthraquinone glycosides, free anthaquinones, resins, glucomannan, steroids, organic acids, enzymes, antibiotic principles, amino acids, cinnamic acid and salicylic acid, essential oil.

Medicinal uses: It is used in inflammation, wounds and bacterial infections. **Pharmacological activity:** It is soothing, anti-inflammatory, emmengogue, emollient, and antibacterial.

Study: Rajasekaran et al. reported the hypoglycemic effect of *Aloe vera* gel on streptozotocin-induced hyperglycemia in experimental rats [3]. Okyar et al. reported the antidiabetic effect of *Aloe vera* in catagory II diabetic rat models.

Crataeva nurvala Buch

Family: Capparidaceae. **Parts used:** Leaves.

Chemical constituents: It contains tannin and saponin.

Medicinal uses: It is used in diabetes mellitus.

Pharmacological activity: It is hypoglycemic.

Study: Sikarwar and Patil reported the antidiabetic activity of *Crateva nurvala* stem bark extracts in alloxan-induced diabetic rats .[4]

Hyssopus officinalis

Family: Lamiaceae.

Chemical constituents: It contains glycosides, essential oil, tannins, resins, fats, sugar, mucilage, flavonoid glycoside.

Medicinal uses: It is used in abdominal pain, respiratory tract infections, insomnia, constipation, viral infections and gastrointestinal disorders.

Pharmacological activity: It is antispasmodic, expectorant, sedative, carminative, diaphoretic, antiviral, astringent, tonic and stomachic.

Study: Miyazaki et al. has studied the inhibitory effect *Hyssopus officinalis* extracts on intestinal alpha-glucosidase activity and postprandial hyperglycemia.[5]

Trigonella foenum-graecum L.

Family: Fabaceae,

English Name: Fenugreek.

Local Name: Maithi.

Chemical constituents: It contains trigonelline, flavonoid, glycosides, saponin, ascorbic acid, fenugreekine.
Medicinal uses: It is used in catagory II diabetes mellitus, respiratory tract infections, swelling, body pain, stomach pain, piles, dandruff, baldness, breast pain, lungs infection, ulcer and diarrhea.
Pharmacological activity: It is anti-inflammatory, tonic and hypoglycemic.
Study: Trigonelline produces hypoglycemic effect in diabetic rats which lasts for 24 hours.[6]

Smilax chinensis
Family: Liliaceae,
Chemical constituents: It contains beta sitosterol, oil, diosgenin, smilacin, resin, tannin, starch, gum, sarsapogenin, sapogenins, parallin, sarsaponin and saponins.
Medicinal uses: It is used in inflammation, cancer and catagory II diabetes mellitus. **Pharmacological activity:** It is anti-inflammatory and anti-diabetic.
Study: The antidiabetic effects of the methanol extracts of the *Smilax chinensis* L.
(MESC) on alloxan induced hyperglycemia were evaluated on albino wistar rats.
Ethanolic extract of *Smilax chinensis* exhibited potential hypoglycaemic effect with potential hypolipidemic effect (Venkidesh et al. 2010) [7,8]. The anti-diabetic effects of the methanol extracts of the *Smilax chinensis* L. on alloxan induced hyperglycemia were evaluated on albino wistar rats. Ethanolic extract of *Smilax chinensis* exhibited a potential hypoglycemic effect with potential hypolipidemic effect.

Salvadora oleoides Decne
Family: Salvadoraceae,
Common name: Peelu.
Parts used: Fruit, root, seed.
Medicinal uses: It is used in anemia, constipation and pyorrhea.
Pharmacological activity: It is anti-anemic, laxative and anti-septic.
Study: Yadav et al. reported the hypoglycemic activity of ethanolic extract of *Salvadora oleoides.[9]*

Urginea indica
Family: Liliaceae.
Tibbi name: Jangli Piyaz.
Chemical constituents: It contains glycosides, scillaren A and scillaren B.
Medicinal uses: It is used in urinary tract infections and catagory II diabetes mellitus.
Pharmacological activity: It is anti-septic and hypoglycemic.
Study: The extract of this plant has hypoglycemic activity.**[10]**

Acacia nilotica
Family: Fabaceae;
Local name: Kikar;
Parts used: Wood, leave and gum.
Chemical constituents: It contains gum arabic, tannins, mucilage, magnesium, potassium, calcium, catechin, arabic acid, malic acid and flavonoid compounds.
Medicinal uses: It is prescribed for treatment of catagory II diabetes mellitus.
Pharmacological activity: It is astringent and hypoglycemic.
Study: Usmanghani et al. documented its anti-diabetic activity.[11]

Achyranthes aspera
Family: Amaranthaceae;
Parts used: Leaves, stems and roots.

Chemical constituents: Saponins, ecdysterone, inokosterone, achyranthine, and potassium, ash of leaves, stems and root contains considerable amount of potassium.
Medicinal uses: It is used in diabetes mellitus.
Pharmacological activity: It is hypoglycemic.
Study: A study was conducted to evaluate its efficacy in diabetic rat. Alcoholic extract of whole plant was given to albino rat. Alcoholic extract exhibited hypoglycemic activity in albino rats. [12]

Luffa aegyptiaca Mill
Family: Cucurbitaceae;
Medicinal uses: It is used in joint pain, backache, colic, splenitis and phlegmatic diseases. **Pharmacological activity:** It is anti-inflammatory and hypoglycemic.
Study: El-Fiky et al. investigated the efficacy of oral administration of the ethanolic extracts of *Luffa aegyptiaca* on blood glucose levels both in normal and streptozotocin diabetic rats. Hypoglycemic activity was observed significantly in streptozocin diabetic rats during the first three hours of treatment. In normal rats, hypoglycemic activity was insignificant compared to glibenclamide treatment.[13]

Citrus paradisi
Family: Rutaceae;
Medicinal uses: It is used in diabetes mellitus catagory II and bacterial infections. **Pharmacological activity:** Antibacterial and hypoglycemic.
Study: Adeneye reported that methanol seed extract of *Citrus paradisi* lowers blood glucose, lipids and cardiovascular disease risk indices in normal Wistar rats.[14]

Aegle marmelos
Family: Rutaceae;
Part used: Fruits, leaves.
Medicinal uses: It is used in chronic constipation, piles, dysentery, hyperacidity, abdominal pain and catagory II diabetes mellitus.
Pharmacological activity: It is mucilaginous, antidiabetic and antidysentric.
Study: A study was conducted on normal and diabetic rats. Fruit of this plant exhibited hypoglycemic activity in normal rats. [15]
Bougainvillea glabra
Family: Nyctaginaceae,
Parts used: Leaves, flowers and stems.
Chemical constituents: It contains alkaloids, flavonoids, pinitol and betacynin.
Medicinal uses: It is used in inflammation and diabetes mellitus catagory II. **Pharmacological activity:** It is anti-inflammatory, insecticidal and hypoglycemic.
Study: Bhat et al. reported the antidiabetic properties of *Bougainvillea spectabilis*. This study justifies its use as herbal drug in catagory II diabetes mellitus [16].

Ferula assafoetida
Family: Umbelliferae.
Chemical constituents: It contains organic sulphur compounds, volatile oil, foetidae, luteolin. The gum resins contain coumarins, 5-hydroxyumbelliprenin, assafoetidin, ferocolicin, asacoumarin A and B, farnesiferol A, B, C and disulphide, asadisulphide and sec-butylpropenyl disulphide.
Medicinal uses: It is used in constipation, abdominal pain, cough, intestinal worms, urinary tract infections and sexual disorders.
Pharmacological activity: It is stimulant, carminative, antispasmodic, expectorant, slightly laxative, anthelmintic, diuretic, aphrodisiac, emmenagogue, nerve and pulmonary surfactant. **Study:** Abu-

Zaiton reported the anti-diabetic activity of *Ferula assafoetida* extract in normal and alloxan-induced diabetic rats [17].

Ficus bengalensis
Family: Urticaceae.
Parts used: Latex, bark, fruits, roots, root bark, buds and aerial roots.
Chemical constituents: It contains triterpine, friedelin, sitosterol, tigilic acid, quercetin, rutin, tannins, waxes, albuminoids and carbohydrates.
Medicinal uses: It is used in diabetes mellitus catagory II.
Pharmacological activity: It is hypoglycemic.
Study: Singh et al. reported the antidiabetic effect of *Ficus bengalensis* aerial roots in experimental animals [18]

Cymbopogan citratus
Family: Poaceae;
Medicinal uses: It is used in catagory II diabetes mellitus, gouty arthritis and tuberculosis.
Pharmacological activity: It is anti-inflammatory and hypoglycemic.
Study: Mirghani et al. documented the hypoglycemic activity.[19]

Aerva lanata
Chemical constituents: It contains galactoside and kampferol.
Medicinal uses: It is used in kidney stones, constipation and diabetes mellitus catagory II.
Pharmacological activity: Diuretic, purgative, emetic and hypoglycemic.
Study: Vetrichelvan and Jegadeesan reported the anti-diabetic activity of alcoholic extract of *Aerva lanata* in rats and concluded that this plant can be prescribed to treat diabetes mellitus catagory II.[20]

Laurus nobilis
Parts used: Leaf and berry, **Chemical constituents:** It contains cineole, eugenol, geraniol, alpha and beta pinene, lauric acid, palmitic acid, linoleic acid, reticuline, boldine, laurostearine, methyl eugenol.
Medicinal uses: It is used in hysteria, colic, indigestion, loss of appetite.
Pharmacological activity: It is antirheumatic, antiseptic, bactericidal, digestive, diuretic, emmenagogue, stomachic, hypotensive and sedative.
Study: Khan et al. reported that Bay leaves improve glucose and lipid profile of people with catagory II diabetes mellitus.[21]

Sesamum indicum
Family: Pedaliaceae.
Tibbi name: Til, Kunjad.
Chemical constituents: It contains molybdenum, thiamine, niacin, carbohydrates, methionine, tryptophan, lecithin, sesamin, sesamolin, phytosterol, cobalt, iodine, iron, zinc, calcium and sitosterol.
Medicinal uses: It is used in cough, sexual debility, asthma, thorax complaints, inflammations and bleeding piles.
Pharmacological activity: It is aphrodisiac, anti-inflammatory and hypoglycemic.
Study: Takeuchi et al. documented hypoglycemic activity of this plant.[22]

Ginkgo biloba
Family: Ginkgoaceae.
Chemical constituents: It contains flavonoids and terpenoids.
Medicinal uses: It is used in dementia, intermittent claudication, anxiety, glaucoma, macular degewneration, premenstrual syndrome, cardiovascular disorders and diabetes mellitus catagory II.
Pharmacological activity: It is hypoglycemic and antioxidant.

Study: Chen et al. reported that *Ginkgo biloba* extract reduces high-glucose-induced endothelial adhesion by inhibiting the redoxdependent interleukin-6 pathways [23].

Ziziphus mauritiana Lam.
Common names: Beri,
Parts used: Leaves, fruit.
Medicinal uses: It is used in catagory II diabetes mellitus.
Pharmacological activity: It is hypoglycemic.
Study: Bhatia and Mishra reported the hypoglycemic activity of *Ziziphus mauritiana* aqueous ethanol seed extract in alloxaninduced diabetic mice [24].

Allium cepa L.
Local name: Kashuh,
Parts used: Leaves and bulbs.
Chemical constituents: It contains phytoncides, vitamins, allicin, flavonoids allylpropyl disulfide, essential oil, quercetin, scordine and fatty oil.
Medicinal uses: It is used in ear pains, flatulence and skin diseases.
Pharmacological activity: It is aphrodisiac and hypoglycemic.
Study: Mathew and Augusti reported the hypoglycemic activity of *Allium cepa* and concluded that this plant can be prescribed to treat catagory II diabetes mellitus [25].

Ammi visnaga
Medicinal uses: It is used in angina and catagory II diabetes mellitus.
Pharmacological activity: It is vasodilator and hypoglycemic.
Study: Jouad et al. reported the hypoglycemic effect of aqueous extract of *Ammi visnaga* in normal and streptozotocin-induced diabetic rats [26].

Berberis lyceum Royle
Part used: Root.
Medicinal uses: It is used in arthritis, osteoarthritis, inflammations, opthalmia, mouth ulcers, skin ulcers and conjunctivitis.
Pharmacological activity: It is hypoglycemic and anti-inflammatory.
Study: Gulfraz et al. reported the antidiabetic activity of *Berberis lyceum* root extract and berberine in alloxan-induced diabetic rats [27].

Hippophea rhamnoide L.
Parts used: Fruit, stem, and leaves.
Medicinal uses: It is used in skin problems, lung problems, cancer, ulcer, wounds, skin infection, joint pain, hair fall, catagory II diabetes mellitus, and blood pressure, jaundice and heart problems.
Pharmacological activity: It is antidiabetic.
Study: Arshad and Bibi reported the ethnomedicinal uses of *Hippophea rhamnoide* L. in catagory II diabetes mellitus [28].

Lavandula stoechas
Arabic name: Mumsik al-Arwah,
Persian name: Anis al- Arwah, Ustukhudoos.
English name: Arabian Lavender.
Chemical constituents: It contains fenchone, sitosterol, ursolic acid, lavanol, camphor, and 7-methoxy coumarin.
Medicinal uses: It is used in neuralgic headache, thoracic diseases and catagory II diabetes mellitus.
Pharmacological activity: It is deobstuent, resolvent and tonic.

Study: Gamez et al. reported the hypoglycemic activity in various species of the genus Lavandula and concluded that it can be used as hypoglycemic agent in patients with catagory II diabetes mellitus [29].

Panax ginseng
Family: Araliacaea.
Medicinal uses: It is used in asthma, bronchitis, altitude sickness and catagory II diabetes mellitus.
Pharmacological activity: It is anti-diabetic.
Study: Attele et al. reported the anti-diabetic effects of *Panax ginseng* berry extract [30].

Fagopyrum tataricum
Family: Polygonaceae.
Parts used: Leaves.
Medicinal uses: It is used in diabetes mellitus.
Pharmacological activity: It is hypoglycemic.
Study: Lee et al. reported that *Fagopyrum tataricum* (buckwheat) improves high-glucose-induced insulin resistance in mouse hepatocytes and catagory II diabetes mellitus in fructose-rich diet-induced mice [31].

Semecarpus anacardium linn
Family: Anacardiaceae.
Parts used: Fruit, seeds, gum, oil, juice of pericarb, seed kernels.
Chemical constituents: It contains tryptophan, phenylalanine, nicotinic acid, riboflavin, thiamine, bhilanwanol, fixed oil, anacardol, catechol, cardol, anacardic acid.
Medicinal uses: It is used in infected wounds, boils and catagory II diabetes mellitus.
Pharmacological activity: It is antiseptic and hypoglycemic.
Study: Khan et al. reported the antidiabetic and antioxidant effect of *Semecarpus anacardium* Linn. nut milk extract in a high-fat diet STZinduced catagory2 diabetic rat model [32].

Glycyrrhiza glabra
Family: Fabacaea.
Parts used: Roots.
Medicinal uses: It is used in obesity, peptic ulcers, stress, eczema, asthma, hay fever, arthritis, gastritis, abdominal colic, hyperacidity, heart burn, indigestion, constipation, cough, bronchitis and other respiratory infections.
Pharmacological activity: It is expectorant, febrifuge, antibacterial, anti-inflammatory, anti-allergy, estrogenic, demulcent, antispasmodic, laxative, anti-allergic, antacid and antiseptic.
Study: Aoki et al. reported the hypoglycemic activity of this plant [33].

Matricaria chamomilla
Medicinal uses: It is used in headache, chest pain and conjunctivitis.
Pharmacological activity: It is stimulant, demulcent, brain tonic and diuretic.
Study: Cemek et al. reported the antihyperglycemic and antioxidative potential of *Matricaria chamomilla* L. in streptozotocininduced diabetic rats and concluded that it can be prescribed to treat hyperglycemia [34].

Environmental Threats to Human Health
People experience the environment in which they live as a combination of physical, chemical, biological, social, cultural, and economic conditions that differ according to the local geography, infrastructure, season, time of day, and activity undertaken. The different environmental health threats can be divided into "traditional hazards, which are associated with lack of devel- opment, and the "modern hazards," which are associated with unsustainable development. The changing pattern of

environmental health hazards and associated health risks from traditional to modern with time and economic development has been called the "risk transition." This transition in risks occurs before the "epidemiologic transition," which is the term applied to the frequently observed shift in the relative importance of traditional (for example, infectious) and modem (for example, chronic) diseases that accompanies development.

Traditional hazards are related to poverty and insufficient development. They include lack of access to safe drinking water; inadequate basic sanitation in the household and the community; food contamination with pathogens; indoor air pollution from cooking and heating using biomass fuel or coal; inadequate solid waste disposal; occupational injury hazards in agriculture and cottage industries; natural disasters, including floods, droughts, and earthquakes; and disease vectors, mainly insects and rodents.

Modem hazards are related to rapid development that lacks health and environment safeguards and to unsustainable consumption of natural resources. These hazards include water pollution from populated areas, industry, and intensive agriculture; urban air pollution from automobiles, coal power stations, and industry; solid and hazardous waste accumulation; chemical and radiation hazards due to introduction of industrial and agricultural technologies; emerging and re-emerging infectious disease hazards; deforestation, land degradation, and other major ecological change at local and regional level; climate change; stratospheric ozone depletion; and trans boundary pollution.

One of the differences between traditional and modern environmental health hazards is that the former are often rather quickly expressed as disease. A person drinks polluted water today and develops severe diarrhea tomorrow, for example. The incidence of diarthea can accordingly be a relatively useful measure of the risk and of our efforts to control it. For many modem environmental health hazards, however, a long period may pass
before the health effect manifests itself A cancer-causing chemical released into the environment today may not reach a person until it has passed through the food chain for months or years, for instance, and even then may not cause development of a noticeable tumor for decades.

Similarly, environmental change, caused by human activities, that occurs over several decades, such as stratospheric ozone depletion due to chlorofluorocarbon emissions, may undermine the life-supporting functions of Earth. So, for modem environmental health hazards, understanding the environmental pathways through which the hazards move is particularly important.

TABLE 1. Environmental Health Indicators within the DPSEEA* Framework: example of Microbiological Water Contamination (Modified from Ref 16)

	Descriptive Indicator	**Action Indicator**
Driving force	Level of poverty in the community Percentage of households without safe drinking-water supply	Expenditure on water and sanitation improvements Number of unserved households provided with clean water supply per year
State	Coliforms in water	Extent of water quality surveillance and water treatment
Exposure	Percentage of population exposed to hazardous water contaminants	Extent of public education programmes on water and treatment in the home
Effect	Morbidity and mortality from diarrheal diseases	Number of cases treated in hospitals and clinics

* ***DPSEEA*** **= driving force, pressure, state, exposure, effect, action.**

Conclusions

Sustainable development policies should incline us toward longer-term, broad-spectrum interventions, touching upon the driving forces operating in human society. In many developing countries, this would mean tackling inequities, poverty, and population growth and thereby contributing, for example, to the control of land degradation and deforestation, biodiversity loss, soil erosion food insecurity, and decline in water quality. In developed countries, inequities are also of importance, as sizeable population groups live in squalor and relative poverty. In addition, emphasis should be placed on reducing unsustainable consumption, curbing the use of nonrenewable fuels, and reducing generation of solid wastes to minimize transboundary pollution, toxic waste problems, and global environmental change. All of these actions would have long-term and sustained beneficia effects on human health.To implement successfully proactive preventive approaches, development policies and planning need a long time horizon. In addition, health and environment concerns must become an integral part of the planning within the framework of sustainable development.

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Effect of succinic acid on compression strength concrete material

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ABSTRACT

The aim of this research is to determine the effect of succinic acid on concrete strength. Butanedioic acid, also known as amber acid and succinic acid, is a 1, 2-ethanedicarboxylic acid. In nature, succinic acid is found in its pure or esterified forms. Maleic anhydride is converted to succinic acid through catalytic hydrogenation. Succinic acid is used as a construction additive. Succinic acid is applied to concrete at a concentration of 0 to 2% by weight. Succinic acid has a plasticizing effect. Compression intensity increased as succinic acid concentration increased. Succinic acid performs optimally at a concentration of 1% in M30, M25, and M20 concrete.

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1. Introduction

Concrete being basic in nature, is extraordinarily susceptible to acid attack. The mechanism for this process is very simple. In acid attack mechanism $Ca(OH)_2$ of cement react with acid and form salt of calcium as a byproduct which is soluble in water. By product calcium salts is eliminated by dissolving in water from the cement paste. This reaction of acid with $Ca(OH)_2$ is given as [1].

$$Acid + Ca(OH)_2 \rightarrow Calcium\ Salt + H_2O$$

In the agro-food and nuclear waste industries reaction of cement with short chain organic acid change the durability and structure but this can be used for improving the other properties of concrete like workability, strength etc.

Due to less negative effects of organic acids their salts are used in fresh or hardened concrete cement matrix to improve some properties. Acid cannot change the stability of calcium silicate hydrate gel and solubility of $Ca\text{-}C_4H_4O_4$ is a moderate [2,3].

The interactions mechanism of cement and organic acids is very intensive. The physical and chemical mechanisms of attack of organic acid have been investigated by experiment. Two types of acids have been used (i) organic acid which form soluble salt, like propionic acids, butyric acid and lactic acid (ii) organic acid which form insoluble salt, like tartaric acids oxalic, malic, and succinic [4,5]. The mechanisms of organic acid which form soluble salt is similar to mechanism of strong acid like HCl and HNO_3 [4,6,7]. The chemical and physical properties of organic acid which form insoluble salt change properties like volume, solubility etc [8].

2. Experimental program

2.1. Materials

2.1.1. Cement

Cement is a material which is a binder in nature which is used in construction for harden and setting with some other alternative materials by binding together. In this study 43 grade Ordinary Portland cement (OPC) was used.

2.1.2. Aggregates

Aggregates are those materials which provide volume, stability and wear resistance to the finished products. Aggregates which are used in concrete are of two types:

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(1) 10 mm fine aggregates consist of sand, very small gravel, crushed clinker.
(2) 20 mm coarse aggregates having gravel, small stone.

2.1.3. Additives

Additive is the artificial or natural materials which are added in concrete besides cement, aggregate and water to improve its properties. For improve the quality of concrete, chemical additive succinic acid is added during mixing. Succinic acid also works as plasticizer material.

2.2. Concrete mix design

The IS: 10262–2009 [9] code method of concrete mix design was used to design M30, M25 and M20 concrete. Mixing of components is done according to IS for M30, M25 & M20 concrete. The amount of additives is 0.5, 1.0, 1.5 and 2.0% by cement weight is added. The components of concrete are totally blended in mixer computing device until uniform consistency is obtained. Initially mould is greased with oil then the concrete is filled in iron mould after filling concrete is compacted by the vibrator. Now sample is removed from the iron mould after 1 day and then cured in water for a period of 7 and 28 days.

3. Experimental results and discussion

3.1. Concrete compression strength

Compression strength for concrete on 7th and 28th day with different proportion of succinic acid is presented in Table 1. In this

Table 1
M20 Concrete compression strength on 7th and 28th day at various proportion of Succinic acid.

S. No.	% of Succinic acid	7th day Compression strength (MPa)	28th day Compression strength (MPa)
1	0.0	20.33	28.45
2	0.5	20.95	28.40
3	1.0	21.75	30.22
4	1.5	21.45	28.50
5	2.0	19.25	27.40

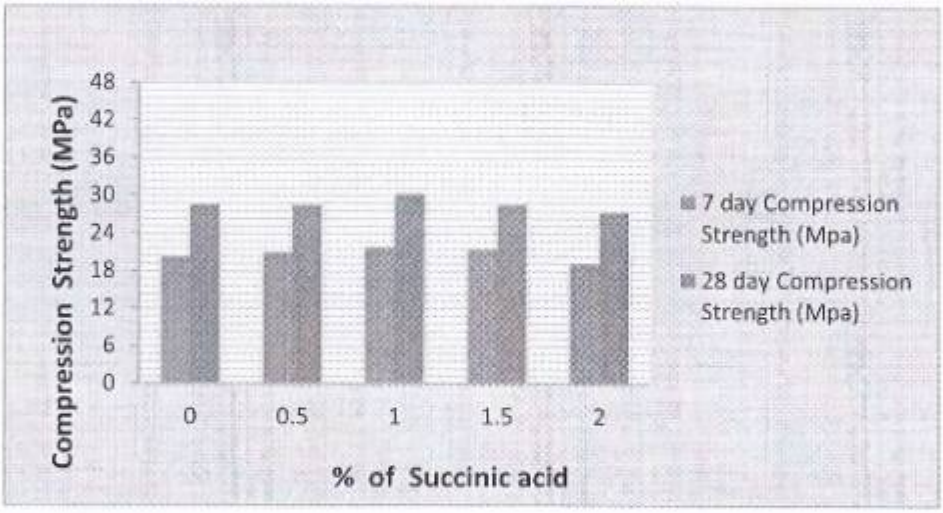

Fig. 1. M20 Concrete compression strength on 7th and 28th day at various proportion of Succinic acid.

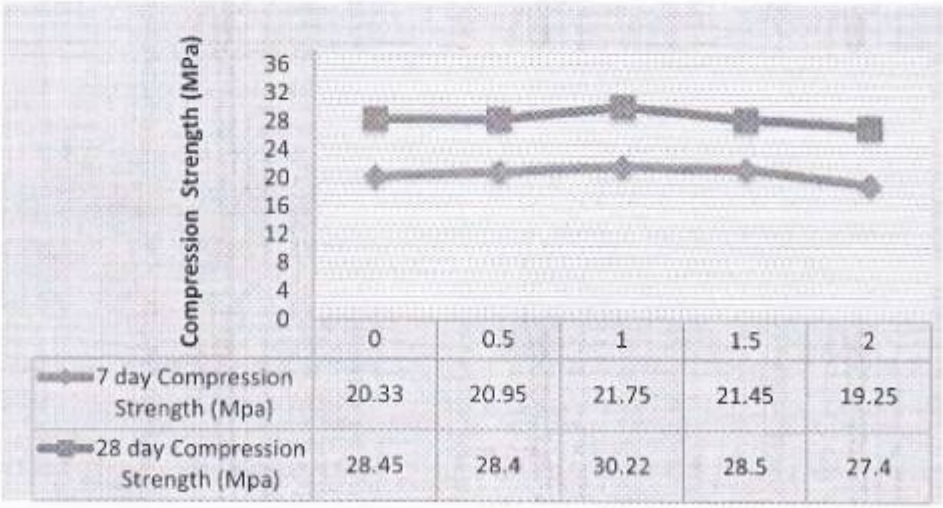

Fig. 2. Modification in Compression strength of M20 concrete on 7th and 28th day at various proportion of Succinic acid.

Table 2
M25 Concrete compression strength on 7th and 28th day at various proportion of Succinic acid.

S. No.	% of Succinic acid	7th day Compression strength (MPa)	28th day Compression strength (MPa)
1	0.0	25.68	36.36
2	0.5	26.55	36.95
3	1.0	28.85	37.85
4	1.5	27.45	36.75
5	2.0	26.02	35.60

study. Succinic acid was added up to 2% of the cement weight in M30, M25 and M20 Concrete. Fig. 1 shows the M20 Concrete compression strength on 7th and 28th day at various proportion of Succinic acid and Fig. 2 shows the Modification in Compression strength of M20 concrete on 7th and 28th day at various proportion of Succinic acid.Table 2.

Concrete compression strength on 7th day for M20 varied from 20.33 to 21.75 N/mm^2 with 0% to 1% concentration of the additive succinic acid and then decreased to 21.45 and 19.25 N/mm^2 with 1.5% and 2% respectively. Concrete compression strength on 28th day for M20 varied from 28.45 to 30.22 N/mm^2 with 0% to 1% concentration of the additives succinic acid and decreased to 28.50 and 27.40 N/mm^2 with 1.5% and 2% respectively. Table shows the M25 Concrete compression strength on 7th and 28th day at various proportion of Succinic acid.

Fig. 3 shows the M25 Concrete compression strength on 7th and 28th day at various proportion of Succinic acid and Fig. 4 shows the Modification in Compression strength of M25 concrete on 7th and 28th day at various proportion Succinic acid. Concrete compression strength on 7th day for M25 changed from 25.68 to 28.85 N/mm^2 with 0% to 1% concentration of the additives succinic acid and then decreased to 27.45 and 26.02 N/mm^2 with 1.5% and 2% respectively. Concrete compression strength on 28th day for M25 varied from 36.36 to 37.85 N/mm^2 with 0% to 1% concentration of the additives succinic acid and then decreased to 36.75 and 35.60 N/mm^2 with 1.5% and 2% respectively. Table 3 represent the M30 Concrete compression strength on 7th and 28th day at various proportion of Succinic acid.

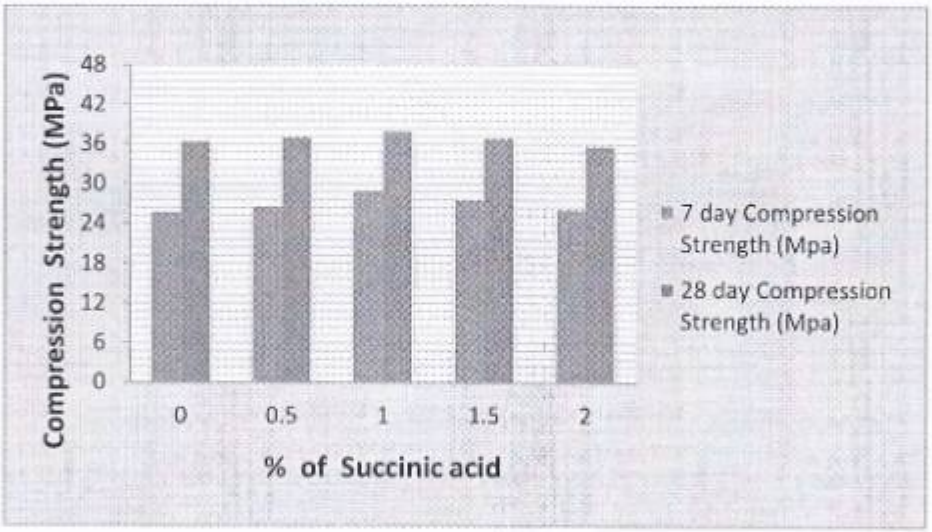

Fig. 3. M25 Concrete compression strength on 7th and 28th day at various proportion of Succinic acid.

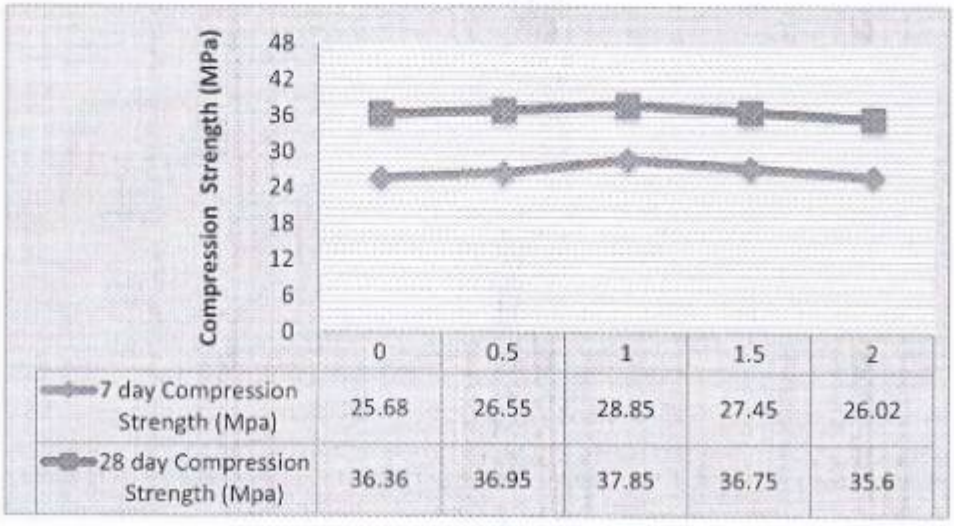

Fig. 4. Modification in Compression strength of M25 concrete on 7th and 28th day at various proportion Succinic acid.

Table 3
M30 Concrete compression strength on 7th and 28th day at various proportion of Succinic acid.

S. No.	% of Succinic acid	7th day Compression strength (MPa)	28th day Compression strength (MPa)
1	0.0	30.38	40.39
2	0.5	31.50	40.50
3	1.0	32.70	42.45
4	1.5	31.25	40.90
5	2.0	30.10	38.50

Fig. 5 shows the: M30 Concrete compression strength on 7th and 28th day at various proportion of Succinic acid and Fig. 6 shows the Modification in Compression strength of M30 concrete on 7th and 28th day at various proportion of Succinic acid. Concrete compression strength on 7th day for M30 changed from 30.38 to 32.7 N/mm^2 with 0% to 1% concentration of the additives succinic acid and then decreased to 31.25 and 30.10 N/mm^2 with 1.5% and 2% respectively. M30 Concrete compression strength on 28th day changed from 40.39 to 42.45 N/mm^2 with 0% to 1% concentration of the additives succinic acid and then decreased 40.90 and 38.50 N/mm^2 with 1.5% and 2% respectively.

4. Conclusion

Succinic acid worked as plasticizer and retarder. Succinic acid reacts with hydrated cement phases and affects structure durability and modifies cement properties. As the proportion of succinic acid from 0 to 2% increases, initially compression strength increased then decreased. Succinic acid gives optimum results with 1% addition for M30, M25 and M20 due to its reaction with extra lime and forms calcium succinate.

$$Succinic\ acid + CaO \rightarrow Calcium\ Succinate + H_2O$$

Use of succinic acid makes the concrete more workable, pumpable and placable and it is economically cheaper then cement based concrete.

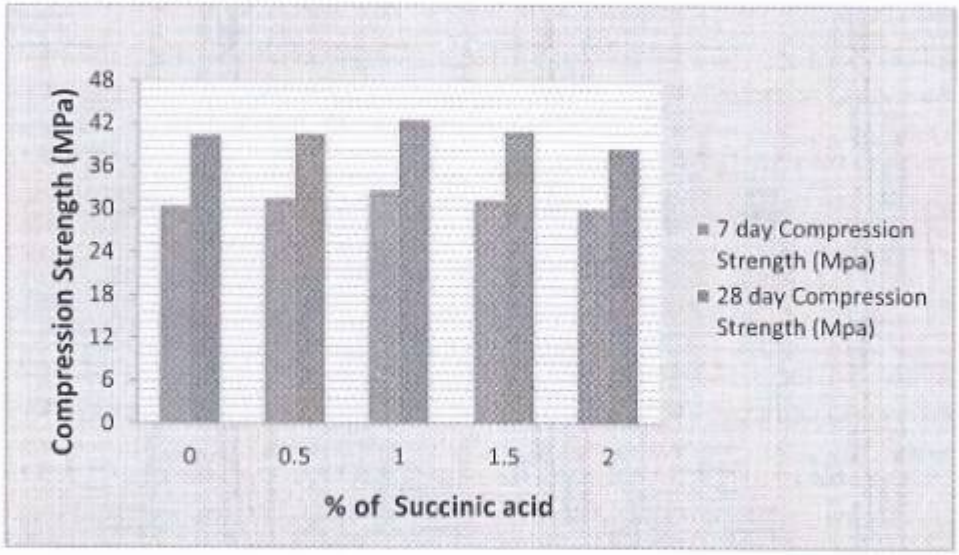

Fig. 5. M30 Concrete compression strength on 7th and 28th day at various proportion of Succinic acid.

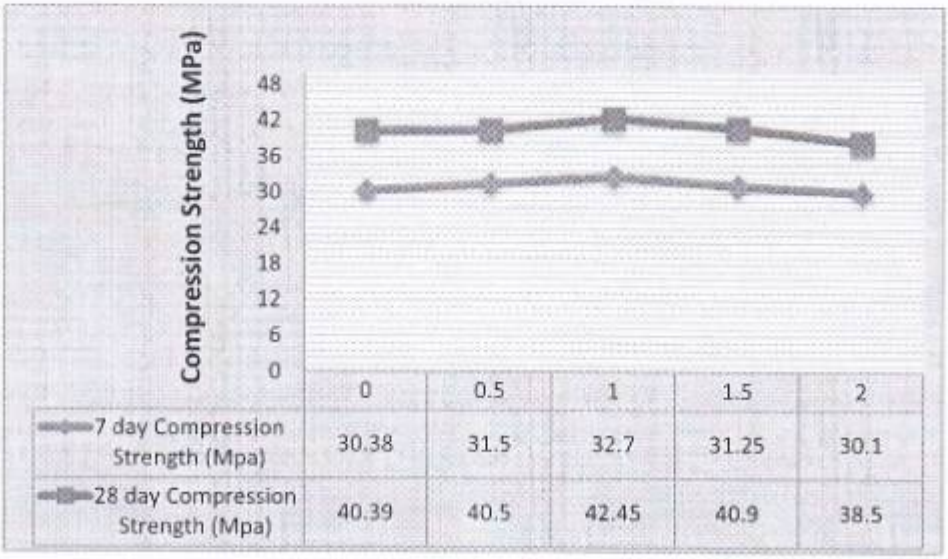

Fig. 6. Modification in Compression strength of M30 concrete on 7th and 28th day at various proportion of Succinic acid.

CRediT authorship contribution statement

Keshav Parashar: Investigation, Writing - original draft. **Dr. Rakesh kumar Dubey:** Conceptualization, Writing - review & editing, Supervision. **M. Padmaja:** Formal analysis, Data curation. **Khongdet Phasinam:** Conceptualization. **Dr. J. Tracy Tina Angelina:** Writing - review & editing. **Piyush Gupta:** Conceptualization.

Declaration of Competing Interest

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

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Green synthesis and characterization of silver nanoparticles using *Enicostemma axillare* (Lam.) leaf extract

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ABSTRACT

In the present article, the facile green synthesis of silver nanoparticles (AgNPs) using aqueous leaf extract of *Enicostemma axillare* (Lam.) has reported. This is a simple, cost-effective, stable for a long time and reproducible aqueous synthesis method to obtain a self-assembly Ag nanoparticles. The size and shape of Ag nanoparticles were characterized by XRD, TEM, and SEM-EDS. The formation and stability of the reduced silver nanoparticles in the colloidal solution were monitored by UV–Vis spectrophotometer analysis. Zeta potential was confirmed by DLS study. The mean particle diameter of silver nanoparticles was calculated from the TEM, SEM and the size of the particles was measured between 15 and 20 nm. TEM analysis revealed the spherical shape of the particles. Crystalline nature of the nanoparticles in the face-centred cubic structure are confirmed by the peaks in the XRD pattern corresponding to (111), (200), (220) and (311) planes. This study showed the biogenic, environmentally friendly and cost-effective synthesis and characterization of the silver nanoparticles.

1. Introduction

In recent years, Nanoscience has been extensively studied and the rapidly growing technology of producing and utilizing nano-sized particles, due to their unique properties and biological applications [1,2]. Nanoparticles can be synthesized by various approaches like chemical, physical and biological methods [3]. The physical and chemical methods for synthesis of nanoparticles include laser ablation, pyrolysis, chemical or physical vapour deposition, sol-gel, lithography electro-deposition most of them have toxic effects on human health, which limits their immense application [4,5]. The biological synthesis of nanoparticles is considered as a clean, nontoxic and environmental-friendly method compared to other physical and chemical methods [6]. Different types of inorganic metal nanoparticles such as silver, gold, zinc, copper, titanium, magnetite and nickel are synthesized using different parts of the plants. The plant extracts work as reducing and capping agents and is lead to the formation of crystalline nanoparticles with a variety of shapes with sizes between 1 and 100 nm [7]. Among various inorganic nanoparticles, silver nanoparticles (AgNPs) are of special interest and draw more attention of researchers because of its numerous application in the areas of biomolecular detection and diagnostics [8], therapeutics [9], catalysis [10], micro-electronics [11]. Researches have also shown that the medical use of AgNps includes its use as antifungal [12], antibacterial [13], anti-inflammatory [14], anti-diabetic [15] antioxidant agents [16] and also reported in the cancer treatment and diagnosis [17].

Plant *Enicostemma axillare* (Lam.) Syn. *Enicostemma littorale* is a medicinal plant belongs to family Gentianaceae, found throughout India common in coastal areas [18]. In India, the plant is traditionally used in the treatment of rheumatism abdominal ulcers, hernia, swelling and insect poisoning [19]. Swertiamarin [20,21], alkaloids, steroids, saponins, triterpenoids, flavonoids, phenolic acids and xanthones were isolated from *Enicostemma axillare* [22]. *Enicostemma axillare* is also a good source of macro and micro-minerals. In Indian ayurvedic medicine, *Enicostemma axillare* is taken in combination with other herbs, especially for diabetes. The plant is administered in ayurvedic pill form for treating type II diabetes since it plays a major role in reducing blood glucose level and increase serum insulin level [23].

In this paper, we present a green synthesis of silver nanoparticles using *Enicostemma axillare* plant extracts. This method was environmentally friendly, single step, cost-effective and nontoxic for human health. Characterization of the synthesized silver nanoparticles was done using FTIR, DLS, XRD, SEM and TEM imaging.

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2. Materials and methods

2.1. Collection of the plant materials

The leaves of *Enicostemma axillare* (Lam.) were collected from a local area of Udaipur Rajasthan, India, during August and September. The leaves were rinsed with water thrice followed by deionized water to remove the fine dust materials and then, plant leaves were shaded dried for 1 week to completely remove the moisture.

2.2. Preparation of leaf extract

The dried leaves were pulverized well with a domestic blender to make a fine powder. 2.5 g of powder sample was mixed into 100 ml of deionized water and the mixture was boiled at 60 °C on a hot magnetic stirrer for 30 min. After cooling the leaf extract was filtered with Whatman No. 1. The extract was filtered again with 0.22 μm (HiMedia, Mumbai, India)) cellulose nitrate membrane by vacuum filtration unit. The filtrate was stored at 4 °C for further use.

2.3. Determination and synthesis of silver nanoparticles

For the synthesis of silver nanoparticles, 2 ml of the aqueous extract of *Enicostemma axillare* add into Erlenmeyer flask containing 60 ml of 1 mM silver nitrate ($AgNO_3$ Sigma-Aldrich, St. Louis, USA.) solution and kept for incubation at 50 °C for 2 h. The overall reaction process was carried out in a dark room condition to minimize the photoactivation of silver nitrate. After incubation, the colour of the solution turns into a reddish-brown Fig. 1 (b). The colour change of the reaction solution was observed for the characterization of silver nanoparticles. After the synthesis and completion of the reaction, the solution was centrifuged at 15,000 rpm for 20 min. The transparent solution was discarded and the pellets of silver nanoparticles were collected. The solution was dried in the oven at 45–50 °C to obtain pellets.

2.4. Characterization of silver nanoparticles

The bioreduction of silver nitrate to silver nanoparticles was measured periodically by UV–visible spectroscopy (ELICO SL-159 UV–visible spectrophotometer). The sample was diluted with deionized water and UV–vis spectrograph was recorded by using a quartz cuvette with deionized water as a reference. The spectrometric reading was recorded at a scanning speed of 300–700 nm Fig. 1 (a). The mean particle size, polydispersity index (PDI) and zeta potential of developed nanoparticles were performed by DLS on Zetasizer HPPS-5001 (Malvern, UK) at 25 °C at a scattering angle of 90° Fig. 2(a–b). FTIR analysis was employed to find out possible functional groups responsible for reduction and capping of silver nanoparticles Fig. 2 (d). X-ray diffraction (XRD) pattern of silver nanoparticles was obtained using a powder diffractometer (X-ray diffractometer Ultima IV, Rigaku, Japan) with Kα radiation (λ = 1.54059 nm) in the 2θ range from 20° to 90°. The sample was prepared for electron microscopy observations. Electron microscopy experiments were carried out in an FEI Tecnai G2 20 high-resolution transmission electron microscope, operating at 200 kV, with a resolution point of 2.04 nm. Samples for electron microscopy observations were prepared by ultrasonically dissolving the AgNP powder in ethanol. A drop of the solution was subsequently deposited onto a lacey C film supported on a Cu grid and allowed to evaporate under ambience conditions. Field emission-scanning electron microscopy (FESEM), using JEOL SM-7600F, Japan model was used for the surface morphology analysis of the synthesized nanoparticle. The elemental constituent of the nanoparticle (AgNps) was analyzed through energy dispersive X-rays spectrometry (EDS) using Oxford-EDS system. Processing of the EDS spectra was accomplished using the INCA Microanalysis Suite software.

3. Result and discussion

In recent two decades, the synthesis of nanomaterial by means of green methods has increased the attention of researchers due to

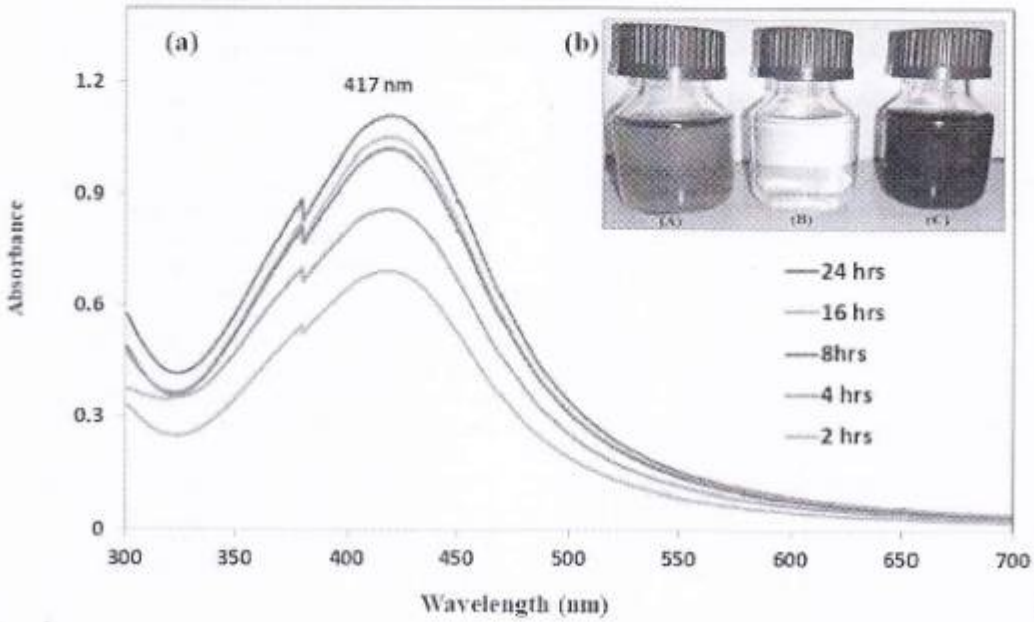

Fig. 1. (a) UV–visible spectra recorded as a function of reaction of 1 mM aqueous solution of AgNO3 with aqueous leaf extracts of the *Enicostemma axillare*. (b) A. Plant extract B. $AgNO_3$ solution 1 mM C. After synthesis of $AgNO_3$ nanoparticles.

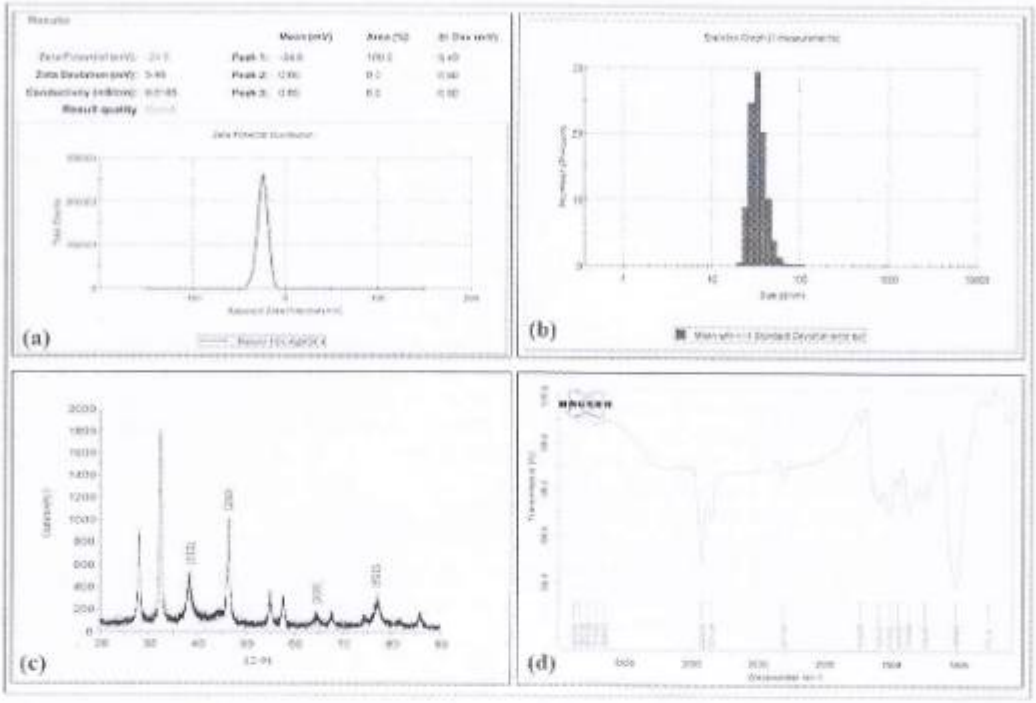

Fig. 2. (a) Zeta potential measurement (b) particle size distribution (c) XRD analysis (d) FTIR analysis of silver nanoparticles.

their application in various fields [24]. Synthesis of silver nanoparticles is easily observed due to changes in the colour of the solution. The extract of *Enicostemma axillare* was mixed; the solution starts changing colour from yellow to reddish brown at 2 h incubation at 50° C. in the same procedure the colour of control solution remain unchanged during this period of the experiment [25].

3.1. UV–visible spectroscopy analysis

The synthesis of silver nanoparticles was examined using a spectrophotometer and the Surface Plasmon Resonance showing the homogenous particle size as it is not aggregated and not settled down. The nanoparticles were stored for two months but they were still in the solution form and were not settled down by agglomeration. Fig. 1 (a) shows the UV–vis spectra of the aqueous component as a function of time variation of leaf extract with 1 mM aqueous $AgNO_3$ solution. Metal nanoparticles have free electrons, which give surface plasmon resonance (SPR) absorption band, due to the combined vibration of electrons of metal nanoparticles in resonance with a light wave. The sharp bands of silver colloids for the Plasmon resonance appeared in the visible range at 417 nm which is increasing with the passage of time.

3.2. Dynamic light scattering (DLS) analysis

Dynamic light scattering (DLS) analysis was used to find out the hydrodynamic size, polydispersity index and surface zeta potential of the synthesized silver nanoparticles in a colloidal aqueous environment. Fig. 2 (b) shows green synthesized silver nanoparticles size distribution range between 25 and 80 nm. The dispersity index (PDI) value of silver nanoparticles was 0.412. The PDI value '0' represents monodisperse distribution whereas the value '1' represents polydisperse distribution. In the present study, the negative zeta potential was found at −24.6 mV Fig. 2 (a). High absolute value of zeta potential specifies a high electrical charge on the surface of the nanoparticles, which can cause strong repellent force among the particles to prevent agglomeration [26,27]. The stability of nanoparticles was determined by keeping the purified nanoparticles solution at room temperature for different day intervals.

3.3. FTIR analysis of silver nanoparticles I

FTIR analysis was carried out to identify the possible biomolecules in leaf extract responsible for capping agents to efficient stabilization of the silver nanoparticles Fig. 2 (d) [28]. Stretching vibration of C–H bonds at 2920 cm^{-1} arise from plant metabolites, stretching vibrations of O–H at 2400 cm^{-1} peak arise from a carboxylic acid. A peak at 1500 cm^{-1} corresponds to C–C stretching vibrations from aromatic rings, all from plant metabolites [29]. Two peaks at 1010 cm^{-1}, 1190 cm^{-1} correspond to C–O stretching from alcohol, carboxylic acid, ester and ether; all due to functional groups of proteins and metabolites capping the silver nanoparticles. The peak at 800 cm^{-1} is accredited to aromatic groups. After bioreduction, there is a shift of the absorption band of 1601–1595 cm^{-1} indicating the formation of AgNPs and is capped with the biomoites. It confirms, the water-soluble fractions in the extract played complicated roles in the bioreduction of the precursors and shape evolution of the nanoparticles.

3.4. X-ray diffraction analysis

The crystalline nature of AgNPs was confirmed by the examining of XRD pattern as shown in Fig. 2 (c). The XRD spectrum shows prominent peaks at $2\theta = 38.12°$, 46.28°, 64.04° and 76.84° represent the (111), (200), (220) and (311) Bragg's reflections of the face-centred cubic structure of silver, respectively. However, the diffraction peaks are broad which indicates that small crystalline size is obtained [30] was matched with a database of Joint Committee on Powder Diffraction Standards (JCPDS) file No. 04–0783.

The lattice constant calculated from this pattern was $a = 3.87$ Å. The mean grain size of silver nanoparticles formed in the bioreduction process was measured using the Debye-Scherrer formula given as $D = k\lambda/\beta \cos\theta$, where D is the average crystalline size (Å), k is a constant equal 1, 'γ' is the wavelength of X-ray source (0.1541 nm), λ the X-ray wavelength used (nm), β the angular line full width at half maximum (FWHM) intensity (radians) and θ the Braggs angle [31]. The average size of the Ag nanoparticles was estimated as in the range between 16 and 31 nm.

3.5. Transmission Electron Microscopy analysis

Transmission Electron Microscopy (TEM) experiments proved the formation of nanocrystalline silver particles, as shown in Fig. 3. The nanoparticles predominately adopt a spherical morphology and are often agglomerated into small aggregates, as Fig. 3 illustrates. The obtained nanoparticles are quite uniform in size and average size 18.12 nm. In rare cases, particles with higher sizes were also observed in the sample, but their numbers were rather low. The TEM images revealed that the small particle aggregates are coated with a thin organic layer, which acts as a capping organic agent. This also may well explain that fact that the nanoparticles showed a very good dispersion inside the bio-reduced aqueous solution, even in the macroscopic scale [32].

3.6. Scanning electron microscopy (SEM) and energy-dispersive X-ray analysis (EDS)

Surface morphology of the *Enicostemma axillare* mediated synthesized nanoparticles by field emission scanning electron microscopy (FE-SEM) Fig. SEM images show the particles are uniformly spherical in shaped. The average sizes of the particles were around 20.13 nm for Plant extract mediated synthesized silver nanoparticles and it can also be observed that larger particles of AgNPs are formed due to aggregation of nanoparticles during sample preparation [33]. The FESEM micrographs were taken at 1 μm (low resolution) and 100 nm (high resolution) as depicted in the inset of Fig. 4 (a, b). The rough surface of the spherical silver nanoparticles was clearly elucidated by the FE-SEM images. The chemical analysis of the synthesized nanoparticles was analyzed by means of EDS. The EDS spectrum shows the presence of Ag and the organic components that cover the Ag aggregates such as O, C, Cl and Cu atoms. The Ag, C, O, Cl and Cu are present at 68.72, 8.01, 7.8, 13.49 and 1.96 respectively [34]. The presence of Ag is certainly due to the formation of AgNPs while the presence of C, O and Cl atoms is due to the plant extract as shown in the inset of Fig. 4 (c, d). the EDS spectrum analysis also revealed that the AgNPs are in metallic form with no formation of Ag_2O in them and free from any other impurities.

4. Conclusion

The rapid biological synthesis of silver nanoparticles using leaf extract of *Enicostemma axillare* provides an eco-friendly, simple and cost-efficient green route for the synthesis of benign nanoparticles. The AgNPs are predominantly spherical, with diameters in the range 15–20 nm and calculated with theoretically and instrumental method. The reduced silver nanoparticles were characterized using UV–Vis, SEM and HRTEM techniques. These reduced silver nanoparticles were surrounded by an organic thin layer. From a scientific point of view, the plant-mediated synthesized silver nanoparticles have potential applications in the biomedical field and this simple procedure has several advantages such as cost-effectiveness, compatibility for biomedical and pharmaceutical

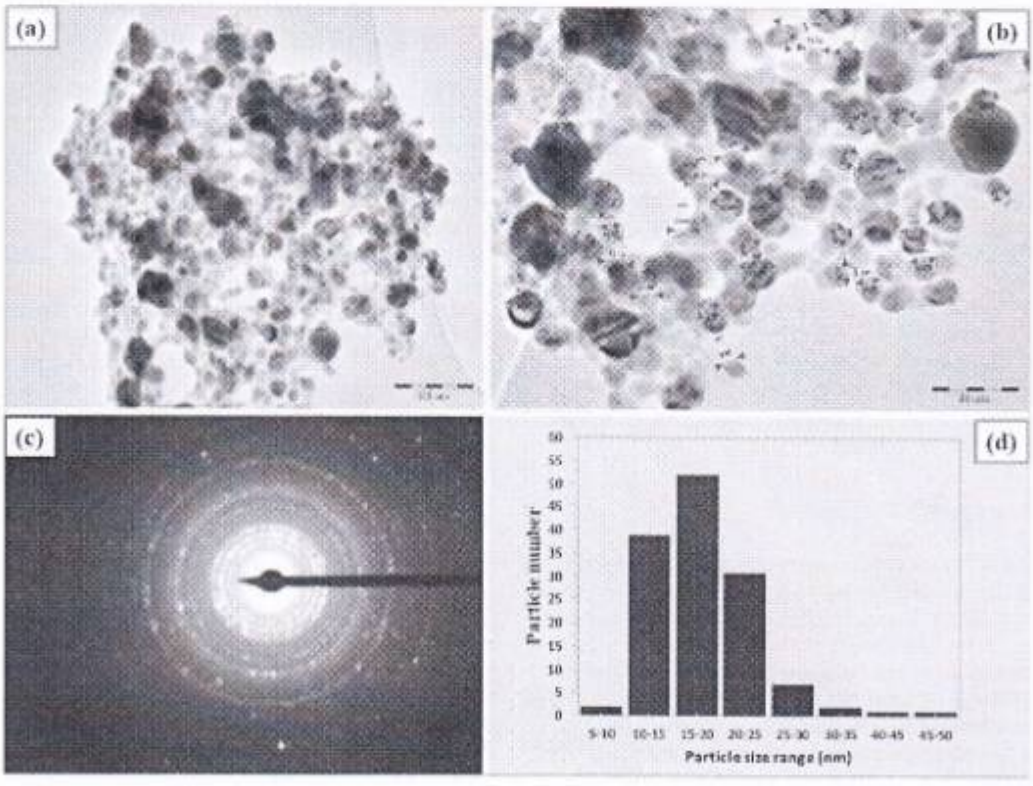

Fig. 3. TEM micrograph of AgNPs synthesized from 1 mM $AgNO_3$ and plant extract with different magnification (a–b), SAED pattern (c) and size distribution histogram of AgNP (d).

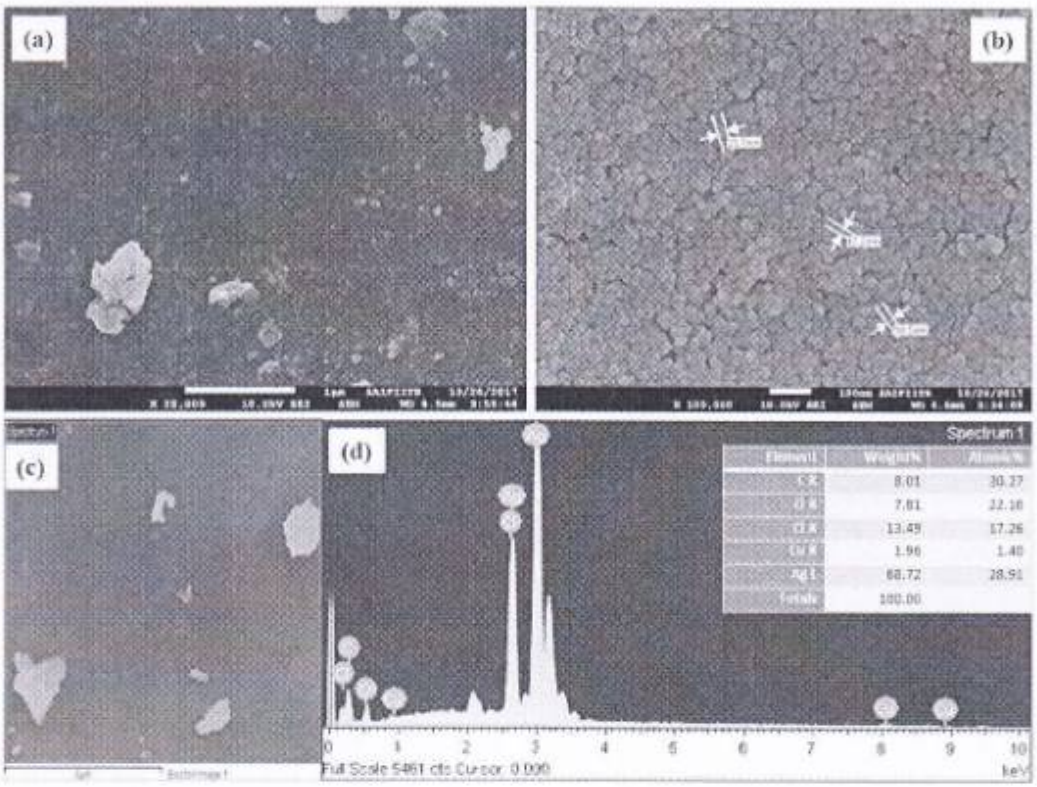

Fig. 4. Scaning electron microscopic analysis (a–b) silver nitrate nanoparticles; (c–d) EDS spectram.

applications such as antibacterial and antifungal, as well as large-scale marketable production.

Conflicts of interest

The Author declares no conflict of interest.

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Biosynthesis of copper oxide nanoparticles using *Enicostemma axillare (Lam.)* leaf extract

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ABSTRACT

In the present study copper oxide nanoparticles (CuONPs) were synthesized via simple and eco-friendly green route using leaf extract of *Enicostemma axillare* (Lam.). Characterization of synthesized nanoparticles (NPs) was undertaken. The characteristic absorption peak of CuONPs was in range 264nm in UV–Vis spectrum. Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) studies revealed the morphological and structural character of green NPs. The mean particle size was calculated to 30nm. Energy dispersive spectroscopy (EDS) showed high intense metallic peak of copper (Cu), oxygen (O) and low intense peaks of carbon (C), sulfur (S), phosphorus (P) elements due to the capping action of biomolecules of plant extract in CuONPs formation. The X-ray diffraction (XRD) pattern showed distinctive peaks corresponding to (200), (211) and (310) planes revealing the high crystalline nature of synthesized CuONPs with a primitive phase. Zeta potential and size distribution of synthesized green NPs was concluded by Dynamic light scattering (DLS) studies.

1. Introduction

NPs can be metallic or nonmetallic of the size range of 1–100 nm. NPs are attracting wide attention from varied disciplines of science due to their immense application in diverse field. NPs of Ag, ZnO and CuO are of prime importance due to their optical, electrical and thermo stability with various functionalities [1]. Synthesis of nanoparticles is by two technique namely top down and bottom up approaches [2]. These two approaches include three different methods of synthesis namely: chemical, physical and biological. The physical methods follows on top down approach and rest of two relies on bottom up approaches [3]. The bottom-up approach includes chemical synthesis [4], electrochemical synthesis [5], sonochemical synthesis [6,7], and polyol reduction [8] of nanoparticles. The chemical mediated synthesis of nanoparticles lead to toxicity to the environment due to the usage of toxic chemicals [9]. The biological methods can be carried out by microorganisms (bacteria, fungi, actinomycete, yeast, and viruses) [10–14] and plant mediated synthesis (plant extract from leaf, peel, flower, fruit and root) [15–20]. The microorganism mediated synthesis of nanoparticles is a tedious process and often leads to contaminants. To overcome above mentioned drawback most of the researchers have focused towards plant mediated synthesis of NPs which can be also stated as green synthesis or eco-friendly synthesis. *Enicostemma axillare* is a perennial herb belonging to family Gentianaceae and is cosmopolitan in occurrence in India. The plant acts as a laxative, helps in curing fever, obesity, rheumatism, snake bite, skin disease, abdominal disorders and regulate blood sugar levels. The plant constituents have been reported for possessing antioxidant [21], hypolipidaemic, antiulcer [22], hypoglycemic [23], anti-inflammatory, hepatoprotective [24], and antimicrobial [25] properties. Different kind of active compounds are found in this plant such as steroids, catechins, sapogenin, saponins, flavonoids, triterpenoids, xanthones [26] and different amino acids like tryptophan, L-glutamic acid, serine, alanine, L-tyrosine, iso leucine, aspartic acid, L-proline, phenyl alanine, methionine, threonine, L-histidine monohydrochloride, L-arginine monohydrochloride, L-Glycine, 2-amino butyric acid, DOPA, and valine [27]. These active compounds may play important role in reduction of copper ions into copper nanoparticles. (see Table 1)

2. Materials and methods

2.1. Collection of plants

Leaf samples of plant *Enicostemma axillare* was collected from local area around Udaipur region. Collected plant materials was authenticated by University of Rajasthan, Jaipur, India (RUBL211634).The leaves were washed thrice with tap water followed by double distilled water to remove dust particles and shade dried for 1 h to remove

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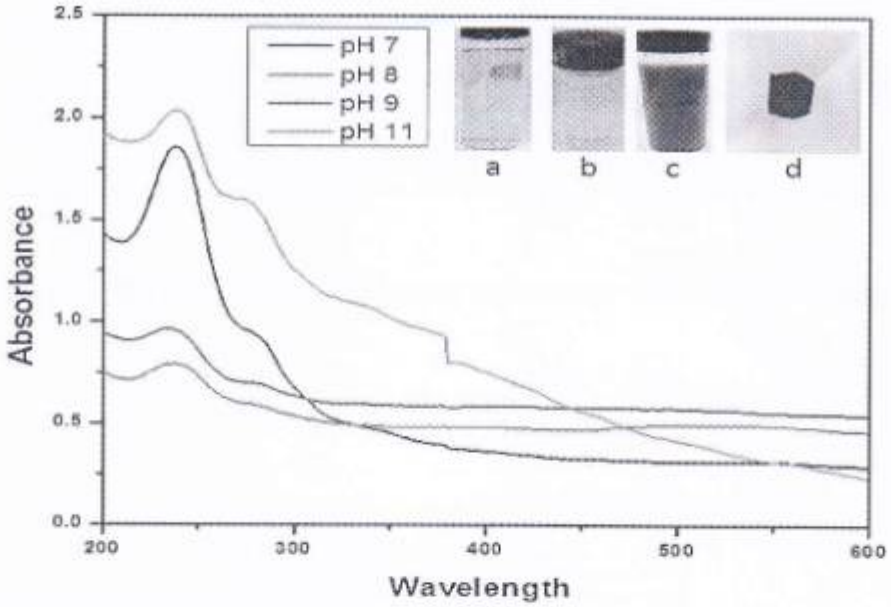

Fig. 1. UV–Visible absorption spectrum of CuONPs at different pH (a) plant extracts (b) CuSO4 solution (c) CuONPs (d) CuONPs powder.

Table 1
UV–Vis absorption spectrum of CuONPs at different pH values.

pH values	Wavelength (nm)
7	234
8	228
9	225
11	229

moisture content.

2.2. Preparation of plant extract

Extract was prepared by mixing 10 gm of fresh leaves in 100ml deionized water and boiled at 80 °C temperature for 30 min in water bath. The extract was filtered with Whatman filter paper of retention size 11μm (HiMedia, Mumbai, India) and cellulose nitrate membrane by vacuum filtration unit. The filtrate was stored at 4 °C for further use.

3. Synthesis of copper oxide nanoparticles

The CuONPs was synthesized by dissemination of 50 ml of 5mM copper sulfate (Sigma-Aldrich, St.Louis, USA.) with 5ml of the prepared aqueous plant extracts in a 100 ml conical flask. The change in color from reddish brown to viscous green at pH 7.0 indicated the formation of CuONPs (as monitored by UV–Vis spectra of the solution (Fig. 1). The viscous precipitate was centrifuged at 10,000 rpm for 10mins and washed 3–4 times with autoclaved deionized water. The transparent solution was discarded and the viscous layer of CuONPs was collected. The pellet was obtained after drying the viscous layer in the oven at 45° to 50° C for 24 h.

4. Characterization of synthesized CuONPs

Synthesized CuONPs primarily characterized by UV–Visible spectroscopy (ELICO SL-159 UV–Visible spectrophotometer). The UV–Visible absorption spectrum was recorded using quartz cuvette with deionized water as a reference. The spectrometric reading was recorded at a scanning speed of 200 to 700 nm (Fig. 1). The mean particle size, polydispersity index (PDI) and zeta potential of CuONPs was measured using Malvern ZS-Nano analyzer (Malvern instrument Inc., London U.K). The analysis was carried out at the parameters of temperature of 25 °C. X-ray diffraction pattern of CuONPs was obtained using a powder diffractometer (X-ray diffractometer Ultima IV, Rigaku, Japan) with Kα radiation (λ = 1.54059 nm) in the 2θ range from 20° to 80°. Mean particle size concluded out by transmission electron microscopy experiments in an FEI Tecnai G2 20 transmission electron microscope, operating at 200 kV, with a resolution point of 2.04 nm. Scanning Electron Microscopy performed using JEOL SM-7600F, Japan model to record morphological characters of synthesized nanoparticles. Energy dispersive X-rays spectrometry was performed to analyze the elemental constituent of the nanoparticle using Oxford-EDS system.

5. Results and discussion

5.1. UV–visible absorption spectra of CuONPs

The leaf extract of *Enicostemma axillare* was added to the aqueous copper sulfate solution which changes color from reddish brown to dark green indicating the formation of CuONPs (Fig. 1). Further characterization was performed using UV–Vis spectrophotometry, which showed a distinct peak at 234nm similar to other studies on the green synthesis of CuONPs using plant extract [28]. UV–Visible absorption spectrum was performed between pH ranging from 7 to 11. The surface Plasmon absorbance of copper colloids was obtained for all pH except at pH 10.

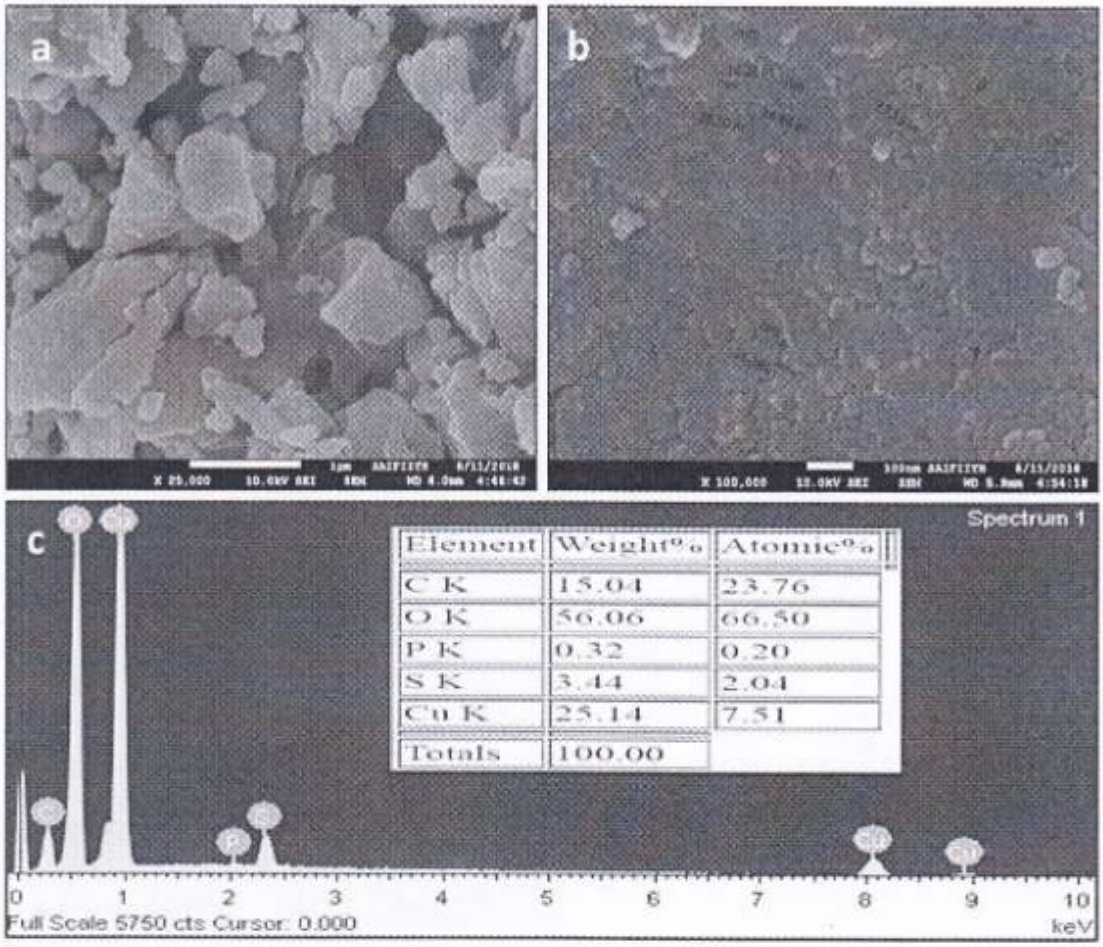

Fig. 2. SEM analysis of CuONPs (a & b) CuONPs micrograph (c) EDS spectrum.

The Plasmon resonance is clearly visible for pH-7 at 234nm.This probably indicates very small particles at such low pH due to Surface Plasmon Resonance excitation of CuONPs. UV–Vis absorption spectra by different pH values mentioned in Table 1.

5.2. Morphological characterization of CuONPs

The morphological characterization of CuONPs was performed using FE-SEM and TEM analysis.

5.2.1. FE-SEM and EDS analysis

FE-SEM showed the nanoparticles are agglomerated in some amount due to sticky nature of the plant extract. The FE-SEM micrographs shows average size of 30nm of CuONPs indicating well established synthesized nanoparticles. The FE-SEM micrographs were taken at 1μm (low resolution) and 100 nm (high resolution) as depicted in the inset of (Fig. 2a-b). EDS analysis revealed the purity of synthesized CuONPs. Oxygen with copper in EDS spectrum indicate the copper in the form of oxide or dioxide. The weight compositions for copper (Cu) and oxygen (O) were 25.14% and 56.06%, respectively. The atomic compositions were then calculated as 7.51% and 66.50%, respectively (Fig. 2c). Carbon, Sulfur, Calcium, Potassium and Phosphorus were detected in small amount owing to interactions with extract during bioprocessing.

5.2.2. TEM analysis

Crystalline nature of CuONPs was reported by TEM analysis which is in agglomerated cluster structure as depicted in the (Fig. 3a-b). The obtained CuONPs are quite uniform in size with average size of 6.44nm. Fig. 3c Shows the size distribution of NPs.The TEM images revealed that the small particle aggregates are coated with a thin organic layer, which acts as a capping organic agent. Presence of intermittent dots in Selected Area Electron Diffraction (SAED) on the concentric circles confirmed the crystalline nature of synthesized CuONPs as shown in the Fig. 3d. This may well explain that the nanoparticles show a very good dispersion inside the bio-reduced aqueous solution, even in the macroscopic scale.

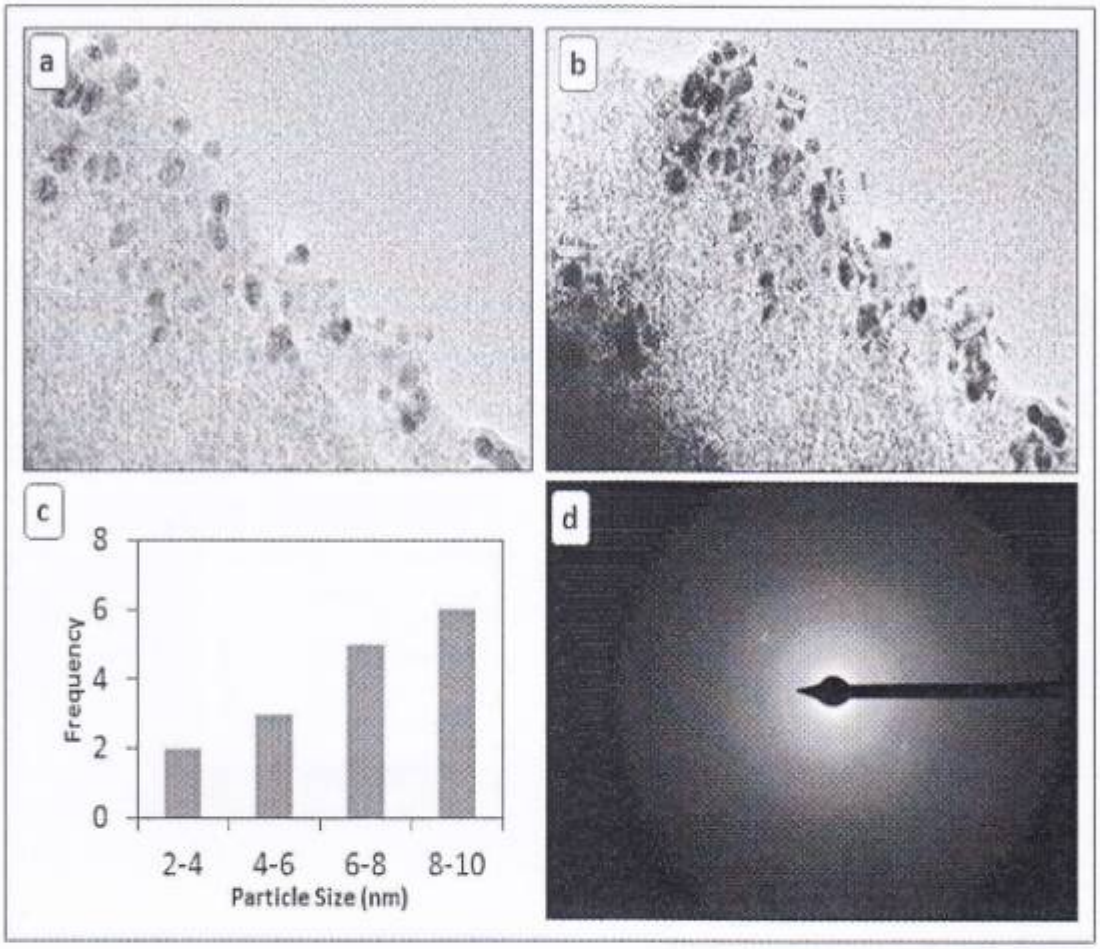

Fig. 3. TEM micrograph (a–b) CuONPs with different magnification (c) Size distribution (d) SAED image.

5.3. XRD analysis

XRD pattern analysis revealed the crystalline nature of CuONPs as shown in Fig. 4b. The XRD spectrum showed various small distinct diffraction peaks at 37.46, 50.09 and 70.48. This represents (200), (211) and (310) of primitive structure of copper oxide nanoparticles respectively. XRD pattern of NPs was matched with a database of Joint Committee on Powder Diffraction Standards (JCPDS Card No. 05–0667, [31]). The mean grain size of CuONPs formed in the bioreduction process was measured using the Debye-Scherrer formula $D = k\lambda/\beta\cos\theta$, where D is the average crystalline size (Å), k is a constant 1, 'λ' is the wavelength of X-ray source (0.1541nm), β is the angular line full width at half maximum (FWHM) intensity in radians and 'θ' the Bragg's angle [29,30]. The XRD pattern showed the average particle size 22.95nm.

5.4. Zeta potential and size distribution measurements by dynamic light scattering (DLS)

Nano size distribution studied using DLS analysis revealed the negative charge of about -19.5mV. Higher negative zeta potential denoted the strong repulsion force between the particles indicating stability and quality. DLS is one of the most commonly used techniques to determine the size of nanoparticles. The size distribution ranged from 88 to 307nm. From the peak position, the Z-average diameter of synthesized CuONPs was found to be 470nm. From the particle size analysis the polydispersity index (PDI) was 0.782 (Fig. 4a).

6. Conclusion

In this article, CuONPs were successfully synthesized through green process using *Enicostemma axillare* leaf extract. The green synthesized CuONPs were characterized using various analytical techniques UV–Vis spectroscopy, SEM, TEM, XRD and DLS studies. The novelty of the study is that NPs were synthesized without any toxic reagent and expensive technique. The phyto-chemical compound present in the leaf extract helped in the formation of nanoparticles. SEM and XRD results showed that the synthesized NPs are in nano scale in size.

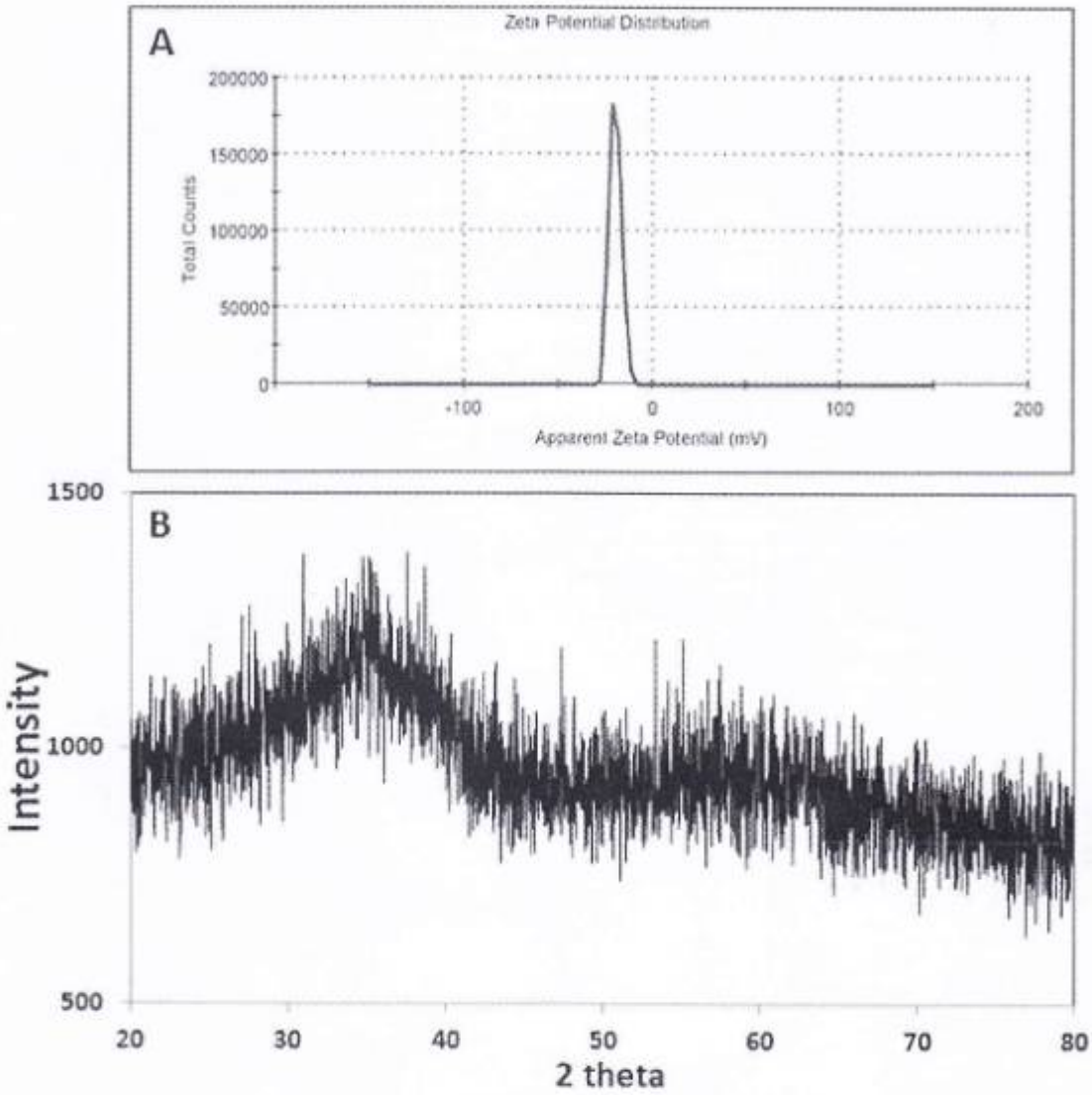

Fig. 4. (a) XRD spectrum of CuONPs (b) Zeta potential.

Declaration of competing interest

The Author declares no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.bbrep.2019.100699.

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Nanotechnology a novel approach to enhance crop productivity

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ABSTRACT

Nanobiotechnology provides novel set of tools to manipulate and enhance crop production using nanoparticles, nanofibres, nanoemulsions, and nanocapsules. Nanomaterials provide a platform to deliver agrochemicals and various macromolecules needed for plant growth enhancement and resistance to stresses. Smart delivery of agrochemicals increases the yield by optimizing water and nutrient conditions. Another added advantage is controlled release and site-directed delivery of agrochemicals. Further enhancement in quality and quantity in agriculture can be achieved by nanoparticle-mediated gene transformation and delivery of macromolecules that induces gene expression in plants. Various types of nanomaterials have been tested so far and the results have been promising in terms of productivity and quality enhancement.

1. Introduction

The present century is facing a major challenge of how to feed the constantly growing human population. According to McCalla [1], world human population could reach eight billion by 2025. Most of the population of the world is directly or indirectly dependent on agriculture. A conventional method to enhance food production includes use of chemicals like pesticides and fertilizers. A great variety of pesticides are used to combat biotic stresses in agriculture but these have a major side effect on crop quality and soil health. Delivery of large amounts of fertilizers, in the form of ammonium salts, urea, nitrate or phosphate compounds leads to deterioration in the soil quality [2]. Much of the chemical fertilizers applied to plants are not absorbed by plants and lost as run-off causing water pollution. Indiscriminate use of fertilizers, pesticides, herbicide results in depletion of nutrients and fertility of the soil [3]. Agriculture sector is the backbone of developing countries. So, there is a dire need to develop a technology that can enhance the modern agriculture in a more productive, cost-effective and eco-friendly way. Various eco-friendly methods like biopesticides and bioinsecticides are already in use to control pests by non-toxic mechanism.

Nanotechnology is an innovative, novel and scientific approach that leads to design, manipulation and development of useful nanomaterials. Nanotechnology generates materials in nanometer scale ranging in size from 1 to 100 nm (nm). Due to the small size, the ratio between surface area and volume is increased in the nanomaterials (compared with bulk forms), improving the biochemical reactivity and conferring unusual and valuable physical properties. It is a potential rising field of science which has brilliant applications in basic and applied sciences (Fig. 1) [4]. The use of nanotechnology in agriculture is increasing rapidly to enhance food values, reduced agricultural inputs, improved nutrient contents and longer shelf life. Many nano-agricultural products are now developed to reduce the use of toxic chemicals. Nanotechnology includes many aspects of food security, disease treatment, new tools for pathogen detection, effective delivery systems and packaging materials [5]. A variety of nanomaterials like nanopesticides, nanoinsecticide, nanoemulsions, and nanoparticles were developed using nanotechnology (Table 1). A variety of materials are used to develop and coat nanomaterials, such as metal oxides, plant extracts, ceramics, silicates, lipids, polymers and emulsions (Fig. 2) [6]. Surface coated nanomaterials or nano-coated fertilizer particles hold the material more strongly to the plant due to higher surface tension than conventional surfaces. Moreover, nanocoatings provide surface protection for larger particles. A nanocapsule is composed of a shell that contains an active compound, like a chemical or biological agent for the protection of plant against pests and diseases. The shell consists of different elements, such as lipids, polymers, viral capsids or nanoclays.

The capsid of the virus is the protein coat protecting the nucleic acid inside and size of ranges from 30 to 140 nm in some viruses, so they are robust and show interesting features as carriers and delivery systems. In *in vitro* conditions capsid protein self-assemble into stable viral-like particles and can change their shape and size according to external factors, such as pH, leading to open or closed nanopores allowing for the

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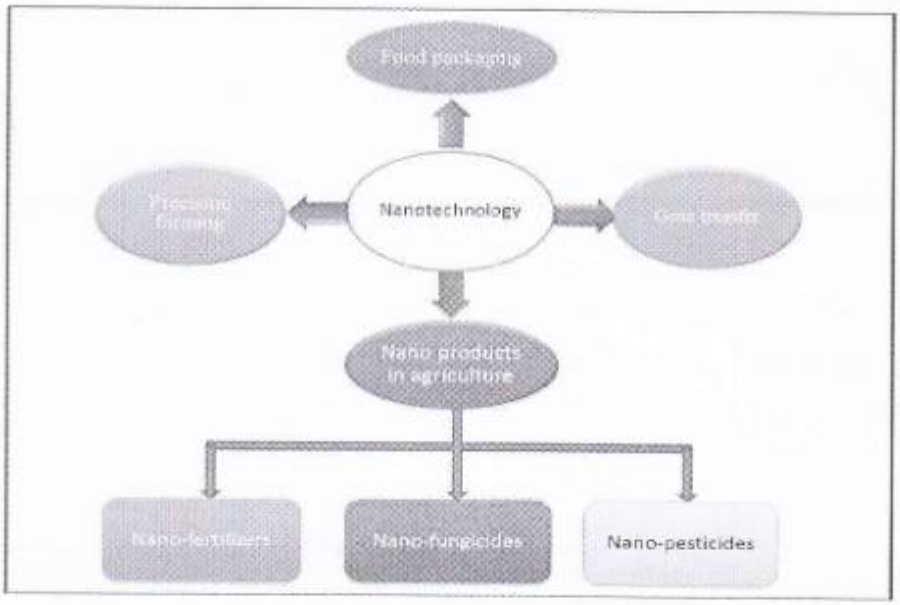

Fig. 1. Nanotechnology applications.

Table 1
Relevant agricultural applications of nanotechnology.

Products	Applications	Examples	References
Plant protection products Fertilizers	Nanocapsules, nanoparticles, nanoemulsions and viral capsids as smart delivery systems of active ingredients for disease and pest control in plants	Neem oil (*Azadirachta indica*) nanoemulsion as larvicidal agent	[24]
		Macronutrient Fertilizers Coated with Zinc Oxide	[25]
	Nanocapsules and nanoparticles enhancement of nutrients absorption by plants and the delivery of nutrients to specific sites.	nanoparticles and NPK controlled delivery Nano-coating of sulfur using Chitosan Nanoparticles	[26]
Soil improvement	Water/liquid retention: Nanomaterials, e.g. zeolites and nanoclays, for water or liquid agrochemicals retention in the soil for their slow release to the plants	Soil-enhancer product, based on a nanoclay component, for water retention and release	[27]
Genetic material delivery	DNA	Gold (10–15 nm)	[28]
		Gold (5–25 nm)	[29]
		Starch (50–100	[30]
Nanosensors and diagnostic devices	Nanomaterials and nanostructures (e.g. electrochemically active carbonnanotubes, nanofibers and fullerenes) that are highly sensitive Electrochemical sensors to closely monitor environmental conditions, plant health and growth	Pesticide detection with a liposome-based nano-biosensor	[31]

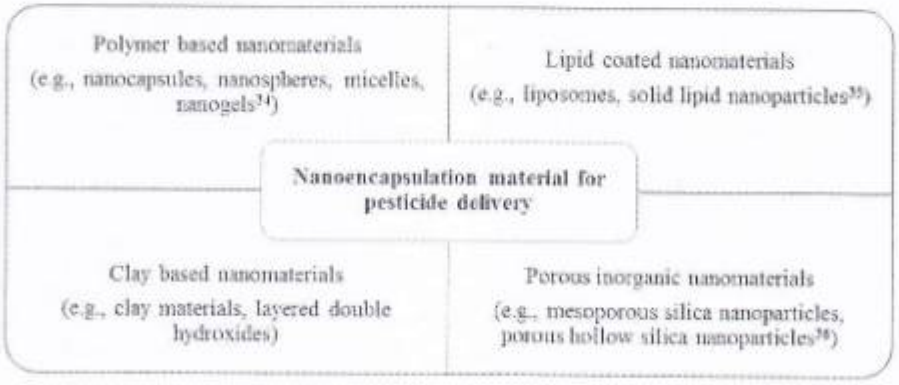

Fig. 2. Nano encapsulation Ref. [34–36].

entry or release of substances. Furthermore, alteration of the surface properties of the viral capsids can be used for coating agricultural chemicals in order to generate new nanomaterials [7]. The main function of nanocapsules is to protect the active compound until it is released; it also improves the solubility and the penetration of the compound into the plant tissues. Depending on the specific characteristics of the shell, the active compound can be released slowly and gradually or completely after the shell opens. This opening can be achieved by pH change or enzymatic degradation. Nanoparticles have a solid core or a matrix that is composed of different materials (such as metals or polymers) and is surrounded by linkers and biomolecules [8].

2. Nanotechnology potent applications

2.1. Nano-pesticides

Pesticides are compounds that are used to control pests and pathogens. The term pesticide includes the following chemicals like herbicides, insecticides, nematicides, molluscicides, rodenticides, bactericides, antimicrobials and fungicides to control biotic stress agents. They also include disinfectants, sanitizers and repellants [9]. These chemicals control pathogen, pests, weeds and herbivores. Pesticides can cause acute and delayed deleterious health effects in humans also. Pesticide exposure can cause irritation of skin and eyes in animals. It can also affect nervous system, mimic hormones causing reproductive problems and also cause cancer. Pesticide use raises a number of environmental concerns. About 95% of herbicides and 98% of insecticides are sprayed on crops that reach destinations other than their target species, including non-target species, air, water, and soil [10]. Thus causing loss of biodiversity, water pollution, air pollution and soil contamination [11].

Excessive use of pesticides leads to resistance against them (pesticide resistance), resulting in search of new pesticides which are more strong, potent and dangerous not just to the pest but to human and environment also. Nanotechnology has the potential to reduce the amount of use of these active compounds to save the environment and reduce the cost in crop production. "Nano-encapsulation" can be used to improve the insecticidal assessment. In nano-encapsulation method, the nano-meter size active pesticide ingredient is encapsulated by a thin-walled sac [12]. The successful approach in this regard is "controlled release of the active ingredient" that would greatly improve efficiency and reduce the amount of pesticide input and related environmental hazards.

2.2. Nano-herbicides

Continuous use of herbicides results in development of resistance in weed towards that particular herbicide [13]. Nanotechnology has the potential of targeted and concise delivery of nano-herbicides to weeds in an eco-friendly manner, without leaving any active compound in soil and environment. Carboxy methyl cellulose (CMC) nanoparticles have been reported as future nano-herbicides [14].

2.3. Nano-insecticides

Food is a basic need for rapidly growing human population and subsequent worldwide demand for food has urged for a better protection of agricultural crops from infestation by different insects. Compared to bulk substances, nano-insecticides have following advantages such as enhanced efficiency of natural and chemical insecticides by controlled release, less environmental contamination due to reduced rate of application, easy and safe handling, more susceptible to photo degradation and less toxic to non-target organisms compared with bulk. Polymer-based nano formulations have been exploited for the encapsulation of most of the insecticides.

Different kinds of polysaccharides such as chitosan, alginates, starch and polyesters (e.g., poly-ε- caprolactone and polyethylene glycol) have been considered for the synthesis of nano-insecticides [17]. Different forms of polymer and non-polymer based nanoformulations like nanoparticles [18], nanofibres, nanogels, nanosphere, micelles, nanoemulsions, and nanocapsule have been exploited for encapsulation of insecticides [12]. Among these, nanocapsules are by far the most widely used for controlled release of insecticides. Nanoformulation of many natural insecticides (e.g. neem oil) is also used [19]. Currently increasing awareness of environmental pollution leads to the sophisticated use of biodegradable and biocompatible polymers of natural origin over the synthetic ones for encapsulation.

Table 2
Nanobionics applications.

Nanoparticles in nanobinics	Applications	References
SiO_2 nanoparticles	Enhance the photosynthesis rates by improving activity of carbonic anhydrase (supplies CO_2 to Ribulose 1, 5-bisphosphate carboxylase-RuBisCo) and synthesis of photosynthetic pigments.	[22]
TiO_2 nanoparticles	Enhance the photosynthetic carbon assimilation by activating RuBisCo. Enhancement of RuBisCo carboxylation with high rate of photosynthetic carbon reaction as a result of nano-anatase induced marker gene for RuBisCo activase mRNA, enhanced protein level, and activities of RuBisCo activase.	[24]
Cerium oxide nanoparticles (nanoceria)	Inside chloroplasts (*in vivo*) augments ROS scavenging and photosynthesis of *Arabidopsis thaliana* plants under excess light	[25]

2.4. Nanobionics

A diversity of nanomaterials mostly metal-based and carbon-based are been exploited for their absorption, translocation, accumulation and promotory effects on growth and development in crop plants. A number of positive effects have been shown by many crop plants. Enhancement of various physiological parameters such as enhanced photosynthetic activity and nitrogen metabolism using metal-based nanomaterials has also been reported in soybean, spinach and peanut [15,16]. Photosynthesis is the process by which plants can convert solar energy into chemical energy in food supplies and carbon-based fuel. Approximately, 100 TW energy is captured by photosynthesis from sunlight that is six times higher than the power consumption need of human civilization [20]. Nanobionics or the application of nanoparticles for enhancement of functions of pant cell organs by studying the electronic interactions in biological systems is fast gaining momentum (Table 2).

The interaction of plant cell organelles and nanoparticles is endowing enhanced native functions to cell leading to a new field of nanobioengineering. There have been a number of studies that have shown enhanced photosynthesis by use of nanomaterial like SWNTs (single-walled carbon nanotubes). SWNT-chloroplast assemblies have shown a higher rate of leaf electron transport *in vivo* through a mechanism consistent with augmented photo-absorption. Plasmon resonance of metal nanoparticles can increase the absorption of solar energy and lead to enhance carbon fixation [21]. However, the deleterious effect of nanomaterial's if any has to be assessed and taken care before their wide application for sustainable development.

2.5. Nanobiosensors

Nanotechnology has led to the development of nanoscale biosensors that have exquisite sensitivity and versatility. The sensors based on nanomaterials can be very versatile in terms of their sensing, detection, and monitoring. They allow the detection of contaminants such as pests, microbes and abiotic plant stresses due to drought, temperature or lack of nutrients [22,23]. These nanosensors could be distributed throughout the field where they can monitor soil conditions and crop growth. Nanoparticles or nano-emulsions can be engineered to trigger a chemical or electrical signal in the presence of a contaminant such as a bacterium. Ultimately, precision farming, with the help of smart sensors can lead to enhanced productivity in agriculture by providing accurate information, thus helping farmers to make better decisions. The ultimate goal of nanobiosensors is to detect any biochemical and biophysical signal associated with a specific stress at the level of a single molecule or cell.

3. Conclusion

21st century is facing many challenges in agriculture sector to produce more food to feed a growing population with a smaller rural labor force, changing climate and urbanization. These problems will further escalate when we would have feed over 9 billion population by 2050. Hence, it is essential to improve the yield of agricultural products in a sustainable way. Mainly in developing countries with higher populations, the raw materials from agriculture will soon be viewed as the foundation of commerce and manufacturing. To deal with this scenario, agriculture-dependent countries have to adopt more efficient methodologies, minimize labor force and sustainable production methods. Nanotechnology has the potential to increase agricultural efficacy to harvest higher yields in an eco-friendly way even in harsh environment. Worldwide many countries have predicted the potential of nanotechnology in agriculture. The adoption of nanotechnology would play an important role to nourish the growing population with declining natural resources. However, the deleterious effect of nanomaterial's if any has to be assessed and taken care before their wide application for sustainable development. If we overcome these considerations, the bright and beneficial future is at the doorstep of developing nations.

Declaration of competing interest

The Author declares no conflict of interest.

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Green synthesis of copper nanoparticles using *Celastrus paniculatus* Willd. leaf extract and their photocatalytic and antifungal properties

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ABSTRACT

This research aimed to explore the eco-friendly green synthesis of copper nanoparticles (CuNPs) using *Celastrus paniculatus* leaves extract. Primarily, the biosynthesized CuNPs characterized by UV–vis spectroscopy showed an absorption peak at 269 nm. Further, The SEM and TEM studies revealed the spherical shape of particles with size ranged between 2–10 nm with an average particle diameter of 5 nm. FT-IR analysis confirmed the presence of functional groups —OH, C=C and C—H triggers the synthesis of CuNPs. The negative zeta potential -22.2 mV indicated the stability of CuNPs was confirmed by DLS and the composition and purity by EDS studies. Further, the photocatalytic property of the CuNPs was divulged by their methylene blue dye degradation potential. The reaction kinetics followed pseudo-first-order with k-values (rate constant) 0.0172 min^{-1}. In addition, this material was found to be a good antifungal agent against plant pathogenic fungi *Fusarium oxysporum* showed 76.29 ± 1.52 maximum mycelial inhibition.

1. Introduction

Modernization and industrialization discharged a bulk amount of industrial effluents along with organic dyes into the water bodies. Organic dyes are widely used as a colorant in various industries such as textile, leather tanning, paper, cosmetics, pharmaceutical, and plastic [1]. These organic dyes highly toxic, carcinogenic, and non-degradable, can cause serious health problems such as skin diseases, cancer, allergic reactions, and mutation for people [2,3]. For such purposes, numerous water treatment approaches have been explored for the treatment of industrial wastewater effluents such as precipitation, coagulation, electrolysis, activated carbon, oxidation, and reduction reactions [4]. However, these techniques are costly and often transfer toxic pollutants to water bodies. Therefore, need to develop an eco-friendly and cost-effective method for the degradation of an organic pollutant from wastewater [5]. Recently, biosynthesized nanoparticles (NPs) attracted much attention due to their photocatalytic application in the degradation of organic dyes [6]. Different types of plants and their derived products have been used successfully in the synthesis of different green nanoparticles of zinc oxide [7,8], platinum [9], palladium [10], silver [11,12], cobalt [13], magnetic [14], and gold [15].

However, there are several studies on CuNPs synthesis using different plants extract [16–23] have been reported but the study of application of CuNPs on the treatment of dye effluent is limited. The agriculture sector exploits different kind of pesticides, herbicides, and antimicrobial [24,25] substances to control plant diseases. These substances are responsible for soil pollution as well as biomagnification in living organisms [26,27]. Despite photocatalytic activity, CuNPs attracted more attention due to its nontoxic, antimicrobial efficacy in controlling plant diseases. An extensive literature survey revealed that the antifungal activity of CuNPs mostly tested against human pathogenic fungi [28]. The least study conducted on CuNPs antifungal activity on plant pathogenic fungi, so, there is a crucial need for more assessment and evaluation in this field [29].

Nowadays nanomaterials are of huge interest due to a wide range of applications in chemical, biological, and environmental sciences [30,31]. The NPs exhibited a variety of applications, including optical, electrical, thermal conductivity, catalysts, antioxidant, antimicrobial, and anticancer activity. Among the NPs, CuNPs have great attention due to its catalytic, high electrical conductivity, optical, antifungal, and antibacterial properties [6,32–34]. The unique physical and chemical properties of NPs which are not exhibited by the bulk materials, received much attention to synthesis of NPs. In the last few years ago several methods such as physical, chemical, and biological used for the NPs synthesis. The physical methods for NPs synthesis such as pulse laser ablation, mechanical/ball milling, pulsed wire discharge,

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sputtering [35–39], etc. have been reported. The chemical synthesis includes colloidal [40,41], electrochemical [42,43], Chemical reduction [44], and photochemical [45] methods. The toxicity and relatively high material cost of these methods restricted their use in a better way. Biological method for NPs synthesis attracted researchers due to its simple, direct, non-toxicity, and ecofriendly characteristics upon chemical and physical methods. The biological method of NPs synthesis carried out by various sources bacterial, fungal, actinomycetes, yeast, algal, viruses [46–51], and plant extracts. Plants are reservoir of phytochemicals such as flavonoids, polyphenols, alkaloids, terpenoids, saponins, vitamins, polysaccharides, and proteins which act as reducing, capping and stabilizing agents for the biosynthesis of NPs [52]. *Celastrus paniculatus (C. paniculatus)* commonly known as black oil plant, Malkangani, and Jyotishmati is a traditional ayurvedic medicinal plant of family Celastraceae. The phytochemicals in crude extracts of *C. paniculatus* found alkaloids, flavonoids, phenylpropanoids, diterpenoids, triterpenoids, tetraterpenes, β-dihydroagarofuranoids, lignans, etc. [53].

This study reports a green route for the synthesis of CuNPs using *C. paniculatus* leaf extract, evaluation of its antifungal activity against phytopathogenic fungi *Fusarium oxysporum* (*F. oxysporum*), and its photocatalytic efficiency in the decomposition of organic dye. There is no report of *C. paniculatus* leaf extract mediated green synthesis of CuNPs and application in antifungal and photocatalytic activity to date.

2. Materials and methods

2.1. Materials

Copper (II) Sulfate pentahydrate ($CuSO_4 5H_2O$, CAS-No: 7758-99-8), was purchased from Sigma Aldrich. Methylene blue AR (RM116) was obtained from Himedia and *F. oxysporum* (ITCC No. 4998) procured from IAARI, New Delhi. The leaf samples of *C. paniculatus* were collected from Madan Mohan Malviya Government Ayurvedic College, Udaipur (Raj.) India. Collected plant material was authenticated by Herbarium, Botany Department, University of Rajasthan, Jaipur, India (No. RUBL211672). Deionized water was used to prepare plant extract and copper sulfate solution.

2.2. Methodology

2.2.1. Preparation of plant extract

Collected leaves were rinsed with tap water to remove dust particles. Further, leaves were rinsed with double distilled water (DDW) and shade dried for 1 week to remove the moisture content. The dried leaves were powdered in grinder mixer and powder stored in dark at ambient temperature. To prepare the plant extract, 2 gm of dried leaf powder was added in 200 mL deionized water in 500 mL flask, mixed well on a magnetic stirrer with hot plate at 60 °C for 20 min. The prepared extract was filtered using Whatman filter paper with size 11 μm followed by vacuum filtration using cellulose nitrate membrane. The filtrate was used immediately or stored at 4 °C for further use.

2.2.2. Synthesis of nanoparticles

For the synthesis of *C. paniculatus* copper nanoparticles, 50 mL (5 mM) copper sulfate solution was mixed with 5 mL of aqueous plant extract [54]. The pH value 7.0 adjusted for the mixture by the addition of NaOH (1 N) solution. Further, the green color mixture was obtained. The mixture centrifuged, pellets collected and dried overnight in a hot air oven at 60 °C. A dark green color powder obtained was stored at room temperature for further use.

2.2.3. Photocatalytic activity

The Photocatalytic activity of the CuNPs was evaluated by the degradation of MB in an aqueous solution under sunlight irradiation. Stock solution (10 mg/l) of MB was prepared. In the experiment, 10 mg CuNPs mixed with 100 mL of 10 mg/l MB solution and pH adjusted to 9.0 in the dark at ambient temperature [55]. Afterward, the resulting solution was kept under direct sunlight with a solar flux of 1100 lx measured by lux meter. About 3 mL aliquot of the suspension was taken and centrifuged at selected time intervals (every 15 min) to remove suspended CuNPs. The rate of dye degradation was determined by measuring the absorption spectrum using a UV–vis spectrophotometer at 664 nm. The photocatalytic degradation efficiency was assessed based on the formula.

$$\% \text{ Degradation efficiency} = \frac{(C_0 - C)}{C_0} \times 100$$

Where, C_0 is the initial MB concentration, C is residual MB concentration after time t.

2.2.4. Antifungal activity

Antifungal activity of CuNPs was accessed using poison food technique against *F. oxysporum*. In this study, seven treatments (one control with water and three CuNPs at 0.12, 0.18 and 0.24 %, w/v in water along with 0.1 %, 1 % $CuSO_4$, and plant extract) were performed to evaluate antifungal activity. These treatments carried out in triplicate and the experiment was repeated thrice. The treated plated compared with control (without CuNPs) to calculate the % mycelial inhibition rate by using the formula given by Vincent [56].

$$(\% \text{ Inhibition rate}) = \frac{(M_c - M_t)}{M_c} X\ 100$$

Where M_c is the mycelial growth in control, M_t is the mycelial growth in treatment.

3. Characterization of CuNPs

The absorbance spectrum of green synthesized CuNPs was analyzed using UV–vis spectroscopy (ELICO SL-159 UV–vis spectrophotometer) in the range of 220 - 540 nm. The morphological features of CuNPs were studied by using the transmission electron microscopy (TEM) (FEI Tecnai G2 20) and scanning electron microscopy (SEM). The elemental composition of the particles was examined by Energy-Dispersive X-ray spectroscopy (EDS) using JEOL SM-7600 F, Japan model. Fourier-transform infrared spectroscopy (FT-IR) analysis was employed to find out the role of biomolecules in leaf extract for metal reduction in the range of 500-4000 cm^{-1}. The charge and size distribution of CuNPs was measured using Malvern Zetasizer (Malvern Instrument Inc., London, U.K). Dynamic light scattering (DLS) measurements were performed by dispersing 20 mg CuNPs powder in 40 mL deionized water. The solution was stirred in a vortex mixer for 5 min to break up any aggregates and then 1–2 ml was transferred to the zeta-disposable cell.

4. Results and discussion

4.1. UV–vis spectra of CuNPs

Primarily, the formation of CuNPs confirmed by the change in color from yellow to green upon the addition of plant extract into aqueous $CuSO_4$ solution. The interaction between conduction electrons of metal NPs and incident photons was responsible for color change [57]. Further, CuNPs synthesis confirmed by a characteristic peak obtained at 269 nm (Fig. 1) [58,16]. In this

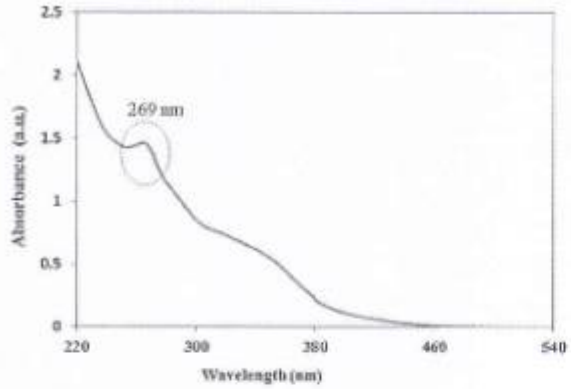


Fig. 1. UV–vis absorption spectrum.

experiment, effect of pH 7 on reduction of $CuSO_4$ into CuNPs was assessed by UV–vis spectroscopy. The neutral pH sharp absorbance peak was observed which may be due to the ionization of the phenolic groups present in plant extract [59]. The peak value was found to be gradually decreased with an increase in particle size (Fig. 1). This experiment concluded that the pH 7 is optimum for reduction of Cu^{2+} ions into CuNPs.

4.2. FT-IR characterization of CuNPs

FT-IR studies find out the possible biomolecules in plant extract which are responsible for the reduction and stabilization of CuNPs. FTIR spectra of *C. paniculatus* leaf extract have shown in Fig. 2, where the spectra of *C. paniculatus* leaf extract depicted broad peaks at 3315.28 cm^{-1} representing the hydroxyl (—OH) functional group in alcohols and phenolic compounds and 1635.50 cm^{-1} can be assigned to the aromatic bending of alkene group (C=C), while smaller peaks at 526.98–452.95 cm^{-1} are also assigned to the aromatic bending vibration of alkane groups (C—H) (Fig. 2). The FTIR spectrum of CuNPs depicts the distinctive characteristic bands at 3264.52 and 1636.62 cm^{-1} corresponds to the *C. paniculatus* leaf extract bands (Fig. 3). These peaks indicate the presence of flavonoid and other phenolic compounds in the plant leaf extract [60,61]. The flavonoid biomolecules transformed enol-form to the keto-form by releasing a reactive hydrogen atom and that can reduce Cu^{2+} ions to form CuNPs. These biomolecules stabilizes NPs by chelating with metal ions with their carbonyl groups or π-electrons [62]. Thus, results conclude that the surface of synthesized CuNPs was capped and stabilized by flavonoid and other phenolic compounds in the *C. paniculatus* leaf extract.

4.3. Morphological characterization of CuNPs

4.3.1. SEM, TEM and EDS analysis

The morphological characterization of CuNPs was carried out using SEM-EDS and TEM analyses. SEM analysis revealed the presence of spherical particles with some agglomeration due to sampling preparation (Fig. 4a-b). The size of the particles was calculated by the TEM and SEM analysis was found to be in the range of 2–10 nm with an average particle diameter of 5 nm as displayed in size distribution histogram (Fig. 5b).

The EDS analyses confirmed the composition and stability of synthesized CuNPs (Fig. 4c). The purity levels of the particles were examined, which indicated that *C. paniculatus* mediated CuNPs had 79.87 % of Cu and some weak signals of C, O, Si, S, Ca and Zn elements (Table 1). These weak signals may be due to the X-ray emission from the macromolecules like flavonoids, phenolic compounds, carbohydrates, glycosides, steroids and tannins present in the extracts [63].

4.4. Dynamic light scattering (DLS) studies

DLS analysis was used to find out the size and surface charge of NPs through the colloidal solutions. In the present study, the negative zeta potential was found at -22.2 mV and zeta deviation was 3.61 mV (Fig. 6a). The high negative value of zeta potential specifies a strong repellent force among the particles and prevents agglomeration [64,65]. The polydispersity index value of CuNPs was 1.000. Fig. 6b shows green synthesized CuNPs average particle size distribution was 290 nm. The larger size of CuNPs due to the measured size included biomolecule and water layer covering the surface of NPs [66]. It suggested that the size and charge

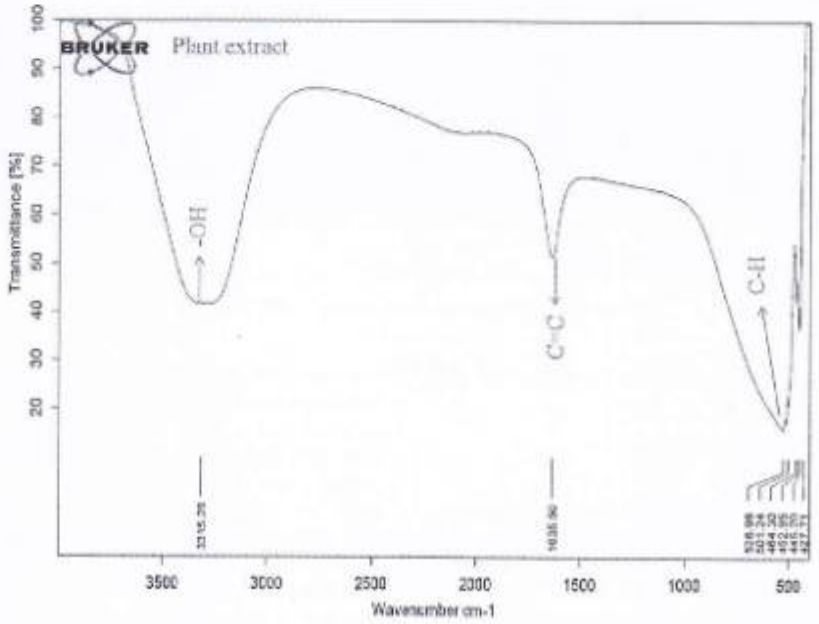


Fig. 2. FT-IR spectra of aqueous *C. paniculatus* leaves extract.

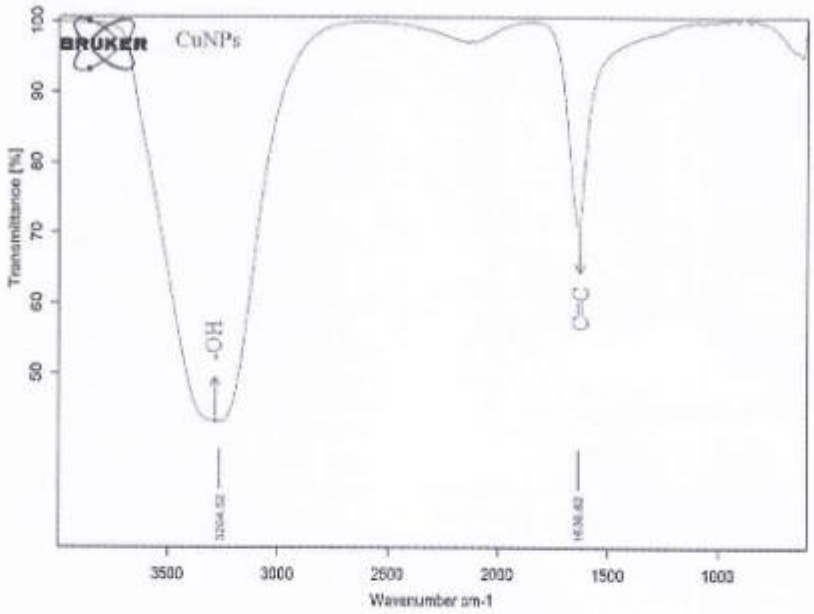


Fig. 3. FT-IR spectra of synthesized CuNPs.

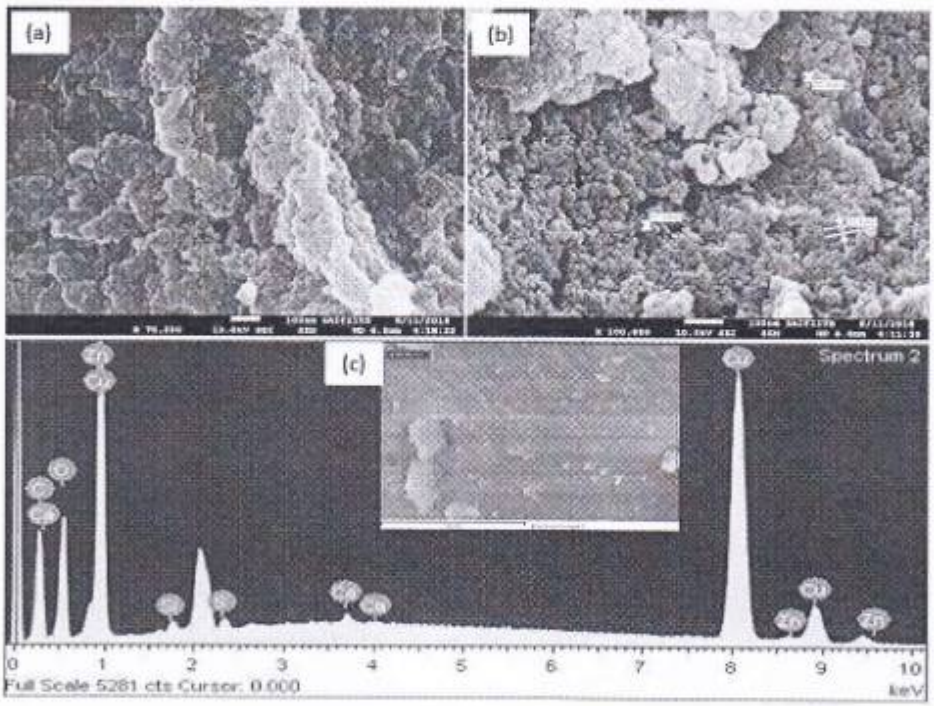


Fig. 4. (a-b) SEM micrographs of CuNPs, (c) EDS spectrum.

distribution of the synthesized NPs promoted or enhanced the biological property of CuNPs [67].

4.5. Photocatalytic degradation of MB

The potential of synthesized CuNPs for photocatalytic degradation of MB was examined under direct sunlight. The time dependent decrease in the absorption band intensity of MB dye was observed after the addition of CuNPs under solar light exposure. The photocatalytic degradation efficiency measured using spectrophotometer at 664 nm. In the experiment 10 mg L^{-1} concentration of MB mixed with 10 mg dosages of photocatalyst. Almost complete degradation of MB seen in 120 min (Fig. 7). In the presence of CuNPs the photodegradation was significantly enhanced at basic pH (pH = 9). The basic pH influences the surface charge properties of photocatalyst, the anionic dye molecule is negatively charged adsorbed on the photocatalyst surface [68]. The high pH favors adsorption of dye on the photocatalyst surface. The calculated degradation efficiency for MB was 90 % plotted in Fig. 8. The degradation experiments were performed with control (both in presence and absence of catalyst) were carried out in the dark to nullify any possibility of dye self-degradation, dye adsorption and

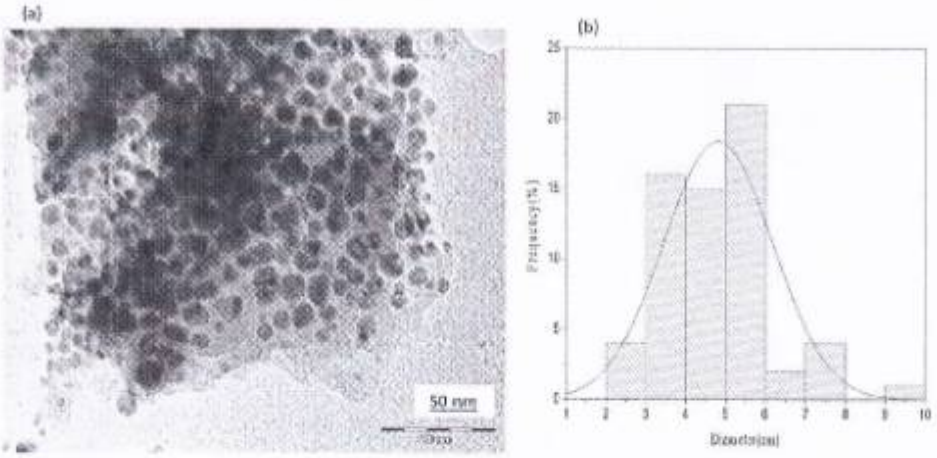


Fig. 5. (a) TEM micrograph of CuNPs. (b) Size distribution histogram of CuNPs.

Table 1
Compositional and particle stability analysis of CuNPs.

Element	Weight%	Atomic%
C K	13.02	39.92
O K	5.32	12.25
Si K	0.27	0.35
S K	0.40	0.46
Ca K	0.28	0.26
Cu K	79.87	46.29
Zn K	0.84	0.47
Totals	**100.00**	

catalytic activity of CuNPs in dark. Under dark conditions, CuNPs have not exhibited any insignificant effect on degradation of dye. Thus, experiments concluded that the dyes were not significantly degraded in dark conditions. Besides, dye degradation experiments performed under direct sunlight in the absence of catalyst showed negligible dye degradation while with catalyst dye almost completely degraded (Fig. 8). These experiments depicted that dye degradation was driven by a photocatalytic process.

In general, there were following steps in the photocatalytic degradation which is summarized below.

$$Cu + h\nu \rightarrow Cu\,(e^- + h^+) \quad \text{(i)}$$

Firstly, the CuNPs absorbed the solar irradiation get photo excited due to SPR influence (Eq. (ii)). Secondly, the electron and holes produced can react with O_2 (Eq. (iii)) and H_2O (Eq. (iv)) particles to provide active hydroxyl radical (OH^-), and anionic superoxide radical (O_2^-), respectively (Eq. (v)).

$$Cu + h\nu \rightarrow Cu\,(e^-) + Cu\,(h^+) \quad \text{(ii)}$$

$$Cu\,(e^-) + O_2 \rightarrow O_2^- \quad \text{(iii)}$$

$$Cu\,(h^+) + H_2O \rightarrow OH^- \quad \text{(iv)}$$

$$O_2^- \text{ or } OH^- + \text{Dye} \rightarrow \text{degraded product} \quad \text{(v)}$$

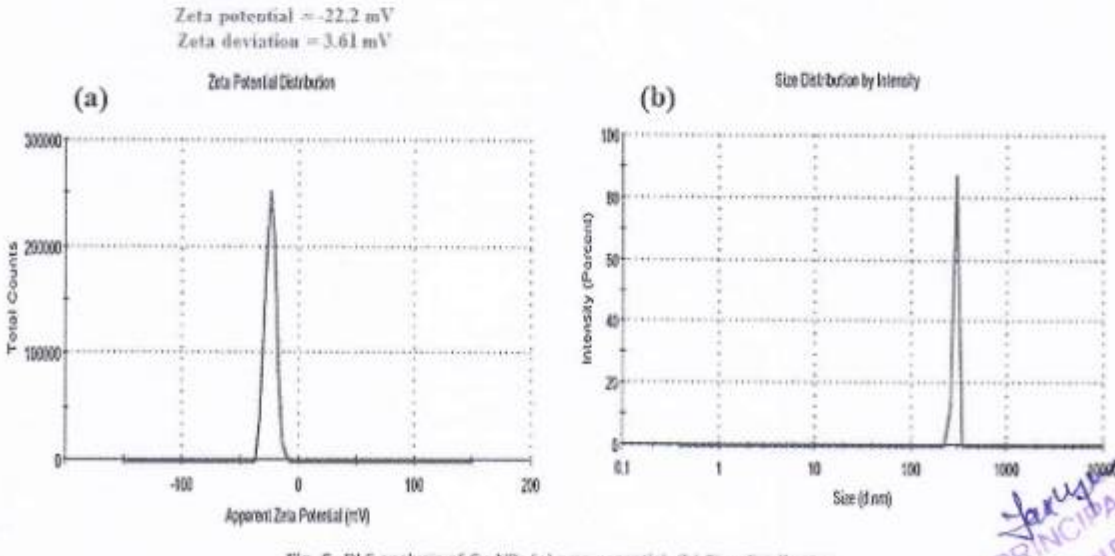


Fig. 6. DLS analysis of Cu NPs (a) zeta potential, (b) Size distribution.

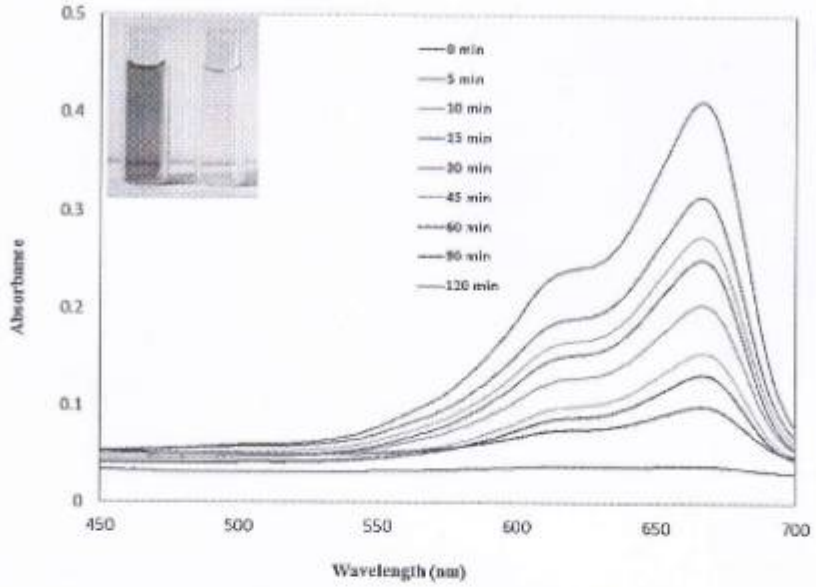


Fig. 7. Photocatalytic degradation of MB using CuNPs.

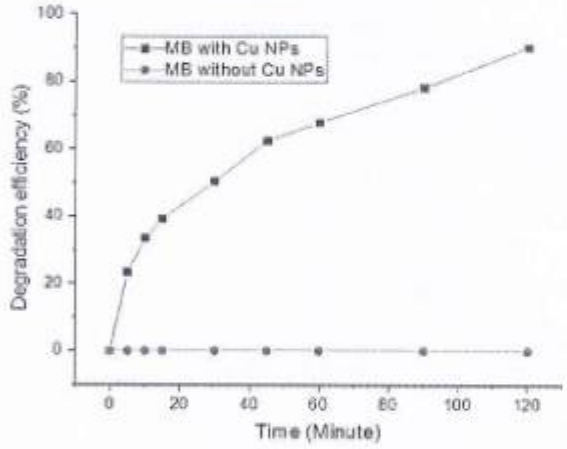


Fig. 8. Photocatalytic degradation efficiency of MB under sunlight irradiation.

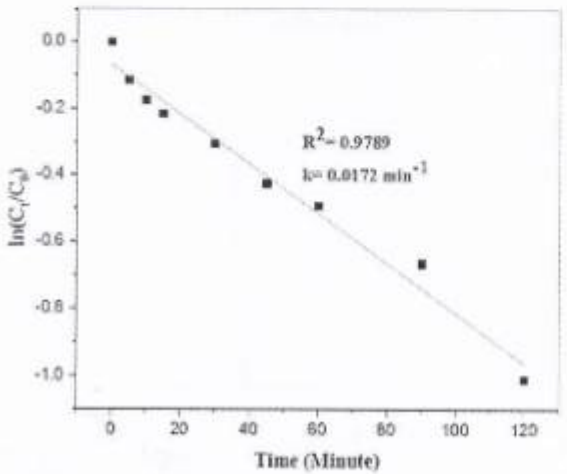


Fig. 9. Kinetic data for the degradation of aqueous MB under sunlight irradiation.

Finally, both oxidation as well as reduction proceeds on the photocatalyst surface. These highly reactive $^{\cdot}OH$ and $^{\cdot}O_2$ radicals can interface with the MB aromatic ring and possibly break the bond producing CO_2, H_2O, and numerous ions as by-products. The literature sharma and dutta [69] described that hydroxyl radical were dominant reactive oxygen species that contributed to degradation using NPs. Thus, their study provided the suitable justification for active species based photocatalytic degradation of dyes when using CuNPs, as discussed in our work.

The kinetics of the photocatalyzed decolorization process described by a pseudo first-order reaction for the concentration of MB [70].

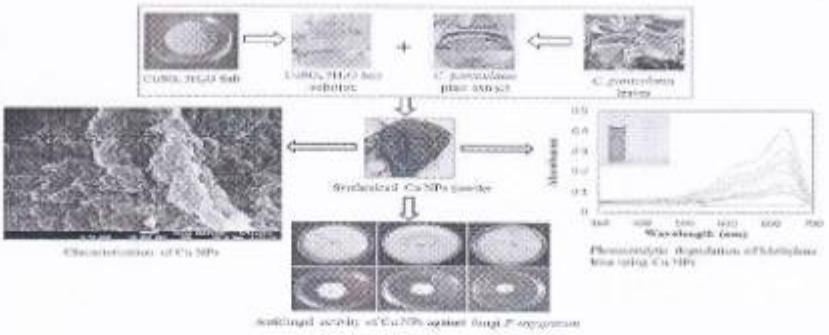
$$\ln\frac{C_t}{C_0} = -K_t$$

Where, C_0 is the initial MB concentration and C_t is the MB concentration at the irradiation time (t) and k is the rate constant (min^{-1}). The linear relationship between $\ln(C_t/C_0)$ vs irradiation time (t) described in Fig. 9 showed good linear correlation with the values of correlation coefficient (R^2>95). The slope of the linear fitting line as shown in Fig. 9 concluded the rate constant (k) of the reaction was found 0.0172 min^{-1}. From this study we have concluded that the time duration for degradation of MB dye was 120 min. pseudo first-order kinetics resulted that obtained value of rate constant was found to be 0.0172 min-1. A comparative study of photocatalytic reduction of MB using different types of photocatalyst described in Table 2.

Table 2
Comparison of various photocatalysts in the reduction of MB.

S. No	Photocatalyst	Time	Ref.
	AuNPs	8 min	[71]
	AgNPs	45 min	[72]
	SnO_2 NPs	70 min	[73]
	$rGO/TiO_2/Co_3O_4$ NPs	120 min	[74]
	Sb-ZnO NPs	210 min	[75]
	CuNPs	120 min	This work

Degradation mechanism of MB



5. Antifungal assay of CuNPs

The antifungal activity of the synthesized CuNPs was assessed against *F. oxysporum* by measuring the mycelial radial growth. Study results showed that *F. oxysporum* exhibited mycelial growth inhibition at 0.24, 0.18, and 0.12 % CuNPs concentration (Fig. 10). CuNPs showed 76.29 ± 1.52, 73.70 ± 1.52 and 59.25 ± 0.57 mycelial growth inhibition at 0.24 and 0.18 and 0.12 %, respectively (Table 3). Maximum mycelial growth inhibition observed at 0.24 % CuNPs. The experiment, confirmed that mycelial growth inhibition depends on NPs concentrations. Commercial fungicide bavistin (0.1 %) was used as a positive control showing 100 % inhibition of fungal mycelial growth (Fig. 10). Whereas $CuSO_4$ (1.0 %) showed 20.74 ± 1.52 inhibition and plant extract was found ineffective in inhibiting mycelial growth and spore germination. Possible mechanisms of action of CuNPs are based on changes in the structure and function of fungi cell. Furthermore, these particles can affect macromolecule DNA, its replication and protein synthesis which ultimately lead to death of fungi. Similar studies have been reported for the antifungal activity of CuNPs against different fungi [76,77].

6. Conclusion

In the present study, CuNPs synthesized by a simple and benign method from leaf extract of *C. paniculatus*. The characterization studies revealed the morphological parameters and role of stabilizing agents during CuNPs synthesis. The TEM and SEM results concluded that the particles were spherical shaped and monodispersed with size ranging from 2 to 10 nm. The purity of green synthesized examined by EDS studies. The flavonoid and other phenolic compounds present in the *C. paniculatus* leaf extract reduce Cu^{2+} ions into CuNPs confirmed by FT-IR studies. The DLS studies revealed that biological property of CuNPs enhanced by the size and charge distribution of the NPs. The synthesized CuNPs exploited as photocatalyst exhibited excellent degradation efficiency on organic dye MB under

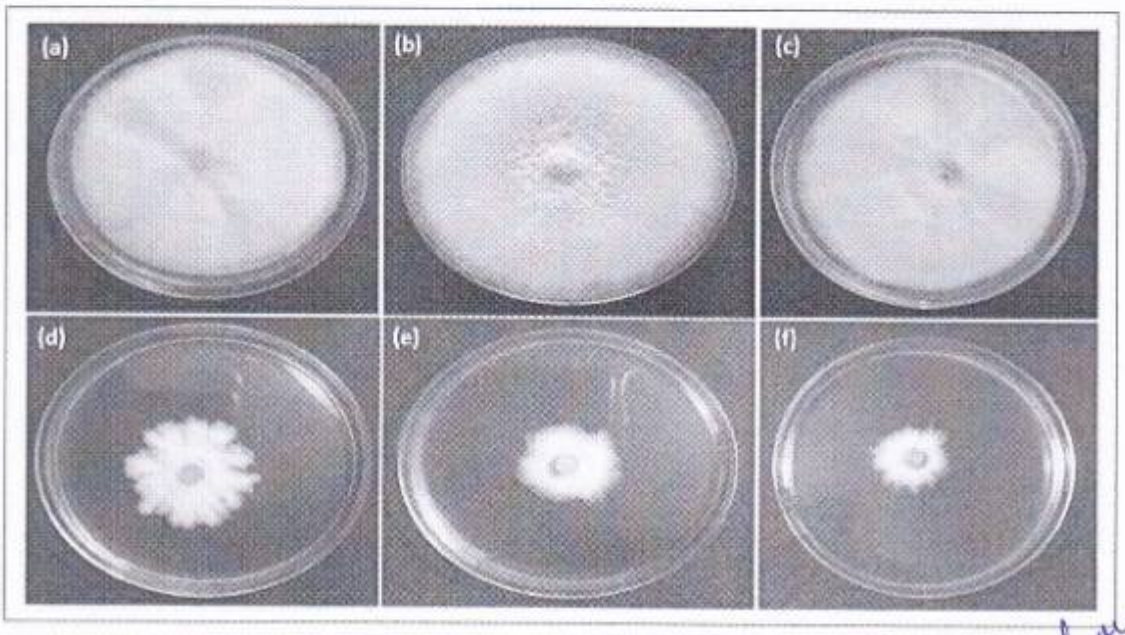


Fig. 10. Antifungal activity (a) control, (b) plant extract, (c) 1 % $CuSO_4$, and CuNPs (d, e, f) 0.12, 0.18 and 0.24 % respectively.

Table 3
Effect of CuNPs on *in vitro* mycelial growth of *F. oxysporum*.

Treatment (%)	% Inhibition (mycelial growth) *F. oxysporum*
Control	0.0 ± 0.0
CuNPs	
0.12	59.25 ± 0.57
0.18	73.70 ± 1.52
0.24	76.29 ± 1.52
$CuSO_4$ (1%)	20.74 ± 1.52
Plant extract	0.0 ± 0.0
Bavistin (0.1 %)	100 ± 0.0

The mycelial growth inhibition of CuNP was performed in triplicate. Standard deviation values are given in the above mentioned table.

sunlight. The dye adsorption results were compared with previously reported literature. The synthesized CuNPs showed significant antifungal activity against *F. oxysporum* as demonstrated using the poison food technique. The overall study revealed that CuNPs successfully synthesized by green route and used as photocatalyst and antifungal agents.

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.btre.2020.e00518.

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Review on biogenic synthesis of copper nanoparticles and its potential applications

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ABSTRACT

In materials science, "green" synthesis of metal/metal oxides nanoparticles has gained much attention as a sustainable, reliable, and eco-friendly protocol. Copper nanoparticles have gain significant attention due to its application in diverse fields. A number of microorganisms including plants, algae, bacteria, and fungi have been found to be capable of synthesizing copper nanoparticles. Plants extract comprises active compounds derived from various parts such as leaves, fruits, shoots, flowers, roots, seeds, and bark, which act as reducing and stabilizing agents in the bio-reduction of metal ions to novel metal nanoparticles. All scientific reports reveal the unique properties of copper nanoparticles such as antifungal, antibacterial, anticancer drugs, and catalytic natural action towards degradation of hazardous dyes. Herein, the green synthesis of copper nanoparticles using plant entities and their potential applications have been evaluated and discussed.

1. Introduction:

Nanotechnology is concerned with the design, production, and manipulation of particles ranging in size from 1 to 100 nm [1]. This size range alters the various chemical, physical and biological properties of the nanomaterials from their corresponding bulk materials [2]. Nanoparticles are becoming more popular as a result of their optical, electrical, and catalytic properties, and also their large surface area to volume ratio. Nanoparticles are predominantly classified into two categories: organic (fullerenes) and inorganic (magnetic, AuNPs and AgNPs and semiconductor nanoparticles such as TiO_2 and ZnO) etc. The synthesis of nanoparticles is accomplished through top-down (physical) and bottom-up (chemical and biological) methods [3]. Physical and chemical procedures are expensive, toxic, and environmentally hazardous. As a result, the biological method of nanoparticles synthesis is a promising scientific area of study [4,5]. Biotic resources such as plants [6,7], algae [8,9], fungus [10], microorganisms [11], and actinomycetes [12] are used in the biological synthesis of nanoparticles. Several current findings have shown that plant extracts can be used as a potential precursor for environmentally friendly nanomaterial manufacturing. Proteins, phenolics, polyphenols, carbohydrates, and enzymes are active substances found in plant extracts. Metal ions were capped, stabilized, and reduced into metal nanoparticles by these active compounds [13]. Copper nanoparticles have recently attracted attention and interest due to their chemical and physical properties. They were suitable candidate for a variety of commercial and domestic applications, including catalysis, imaging, cosmetics, medical, pharmaceuticals, energy-based research, and environmental applications [14]. Copper nanoparticles are widely employed as giant magneto resistance material [15], gas sensors [16,17], and agents in the preparation of organic–inorganic nano-composites [18]. They are utilized in industry as thermal conductors, catalysts, battery, and solar cells [19]. Copper nanoparticles play an essential role in medicine as antioxidants, antibacterial [20], and antifungal agents [21]. The review subsequently focused on the biosynthesis of copper nanoparticles from plant entities, and also characterization methodologies and prospective uses.

Abbreviations: NPs, Nanoparticles; CuNPs, Copper nanoparticles; CuONPs, Copper oxide nanoparticles; AuNPs, Gold nanoparticles; AgNPs, Silver nanoparticles; TiO_2, Titanium oxide; ZnO, Zinc oxide; SEM, Scanning Electron Microscopy; AFM, Atomic force microscopy; FTIR, Fourier-transform infrared spectroscopy; TEM, Transmission electron microscopy; SAED, Selected Area Electron Diffraction; XRD, X-ray diffraction; DLS, Dynamic light scattering; EDX/ EDS, Energy-dispersive X-ray spectroscopy; XPS, X-ray photoelectron spectroscopy; TGA, Thermogravimetric analysis; BET, Brunauer-Emmett-Teller; NTA, Nanoparticle Tracking Analysis; DNA, Deoxyribonucleic acid.

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2. Synthesis of nanoparticles

NPs are produced in many natural processes, including volcanic eruptions, sea mist, forest fires, fine sand, and erosion by plants and animals. Human made NPs are mainly classified into two categories: "accidental" and "designed" NPs [22]. Accidental NPs are a consequence of anthropogenic activities; they are mostly uncontrolled sized and shaped, and they can be made up of a variety of materials. Large- scale running of diesel engines, mining and intolerance of fire exercises results in accidental NPs. Designed NPs are, specially created and intentionally synthesized by humans. Their sizes, shapes, and compositions are, of course, meticulously controlled. Despite the fact that engineered NPs are getting more and more advanced with each passing year, simple engineered NPs can be created by relatively simple chemical reactions that have been in the purview of chemists for centuries [23]. This means that long before people could "see" NPs through an electron microscope, humans were intentionally and accidentally generating a variety of these materials.

3. Methods of nanoparticles synthesis

The synthesis of NPs is accomplished through physical, chemical and biological methods shown in Fig. 1.

3.1. Physical methods

Physical methods generate NPs by melting, condensation, evaporation, and material abrasion, using high-energy radiations, mechanical pressure, thermal energy, or electrical energy. These approaches, which predominantly use a top-down approach, are favorable because they produce consistent monodisperse NPs with no solvent contamination. High-energy ball milling [24], laser ablation and pulse laser deposition [25], electro spraying [26], inert gas condensation [27,28], physical vapour deposition [29], laser pyrolysis [30,31], flame spray pyrolysis [32], and melt mixing [33] are some of the most common physical approaches for producing NPs.

3.2. Chemical methods

Some of the most commonly used chemical methods for NPs synthesis include the sol gel method [34], micro emulsion technique [35], hydrothermal synthesis [36], polyol synthesis [37], chemical vapour synthesis [38], and plasma enhanced chemical vapour deposition technique [39]. Cu NPs were synthesized by mixing Cu (II) sulphate pentahydrate salt (0.01 M) solution and polyethylene glycol 6000 (0.02 M) solution in a chemical reduction method. During the synthesis process and in storage, ascorbic acid (natural vitamin C) is used as a protective agent to prevent the nascent Cu NPs from oxidation [40]. High radiation and extremely concentrated reductants and stabilizing agents have been used in physical and chemical procedures, which are detrimental to the environment and human health. Hence, biological nanoparticle synthesis is a single-step bioreduction process that uses less energy to produce eco-friendly NPs.

3.3. Biological methods

Green nanotechnology is the discipline of making NPs with specific functions by combining biological principles with physical and chemical methods. It is based on lowering the risk of producing and applying nanomaterials. The synthesis of NPs may benefit from the development of "green chemistry" procedures that are clean, non-toxic, biodegradable, and environmentally acceptable. They may include living organisms such as plants, algae, fungi and bacteria (Fig. 2).

3.3.1. Synthesis of Cu NPs using bacteria

Microorganisms are useful systems for the production of biocompatible metal NPs. A bacterial mediated synthesis of CuO NPs is reported in strains isolated from the midgut of common Indian mosquitoes and Stibara, an insect beetle found in the Northwestern Ghats of India. Synthesized CuO NPs produce UV–Visible absorption maxima near 590 nm and 630 nm. The shape and size of CuO NPs were analyzed by Transmission electron microscopy (TEM). The analysis reveal that the particles are polydispersed and vary from 10 to 30 nm in diameter [41]. Cu NPs, produced by *B. cereus*, surface plasmon resonance (SPR) peaks

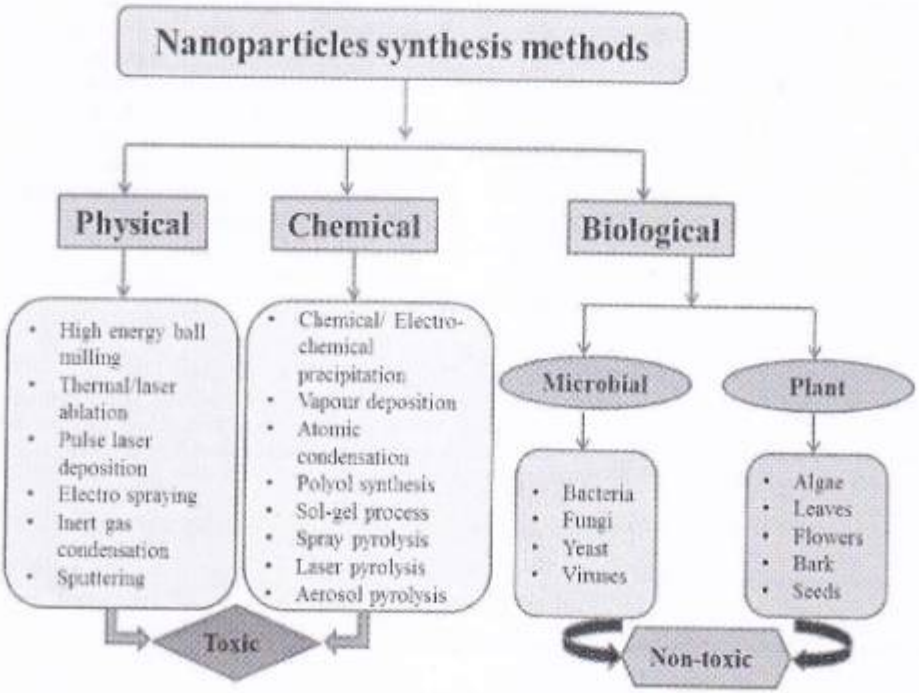

Fig. 1. Methods of nanoparticles synthesis.

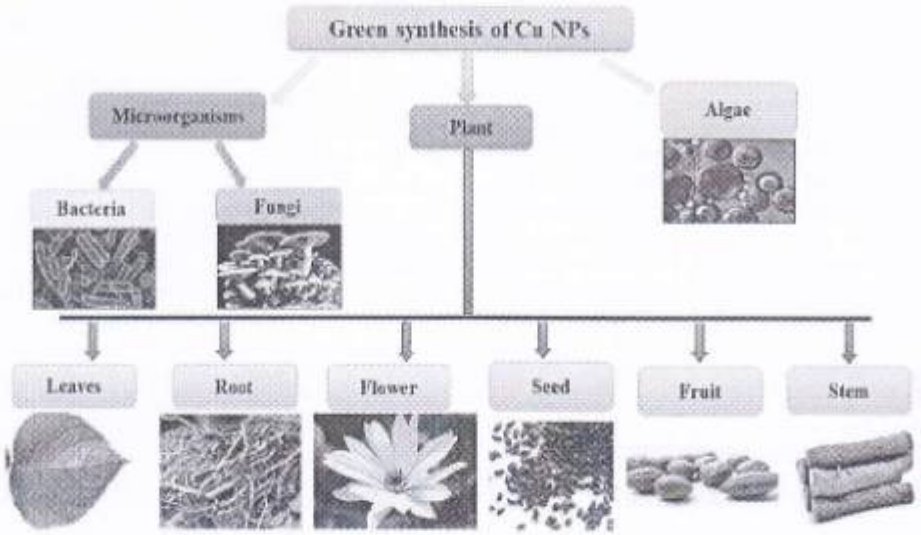

Fig. 2. Biological entities used for green synthesis of copper nanoparticles. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

were recorded between 570 and 620 and 350–370 nm. Their particle size distribution, polydispersity index and zeta potential were found to be 11–33 nm, 0.433 and (−) 19.6 mV, respectively. Scanning electron microscopy (SEM), TEM and atomic force microscopy (AFM) analyses confirmed the uniform morphology; X-ray Diffraction (XRD) spectrum revealed the crystalline nature; Fourier transform infrared spectroscopy (FTIR) spectrum disclosed the presence of protein with Cu NPs [42]. Cu NPs synthesized using cell-free supernatant of *P. fluorescens* reaction mixtures changed color from blue to dark green. The UV–vis absorption spectrum of this solution showed a clear absorption peak in the region of 550–650 nm. The average particle size of synthesized Cu NPs was found to be 49 nm with spherical and hexagonal shapes. Antimicrobial activity was tested against *E. coli* and *Bacillus* [43]. A facile biological method was reported for synthesis of Cu NPs using *E. coli*. The average particle size ranged between 10 and 40 nm with high percentage of quasi-spherical NPs [44]. Biosynthesis of Cu NPs was achieved by addition of culture supernatant of *S. typhimurium* with aqueous copper nitrate solution (1 mM). Synthesized Cu NPs exhibited absorbance peak at 565 nm and average diameter 49 nm obtained [45].

3.3.2. Synthesis of Cu NPs using fungi

Green synthesis of metal oxide NPs using microorganisms like fungi is an important area of research in nano-biotechnology. Cu NPs were synthesized and stabilized using fungal isolates *P. aurantiogriseum*, *P. citrinum* and *P. waksmanii* showed fluorescence spectrum at 448 nm. The synthesized NPs were spherical in shape as determined by SEM analysis. Dynamic light scattering (DLS) studies was carried out by nano zetasizer to evaluate the size and polydispersity of Cu NPs [46]. The white-rot fungus *Stereum hirsutum* was used for synthesis of Cu NPs under different pH conditions and in the presence of three different copper salts ($CuCl_2$, $CuSO_4$, and $Cu(NO_3)_2$. TEM analysis confirmed the spherical shape and size in the range of 5 to 20 nm [47]. Extracellular biosynthesis of Cu NPs using *Aspergillus* species was performed by Pavani *et al.* (2013) [48]. UV–vis spectroscopic analysis showed absorption peak on 300 nm. SEM micrographs revealed the average NPs size with 600 to 684 nm and were spherical in shape. *A. niger* fermentation filtrate was used as reducing agent in 1:1 ratio with copper nitrate tri-hydrate solution [$Cu(NO_3)_2{\cdot}3H_2O$] used for biosynthesis of Cu NPs. Characterization techniques revealed that Cu NPs were spherical in shape and polydisperse with 500 nm in size. Antimicrobial activity of the synthesized NPs were evaluated against *E. coli*, *S. typhi*, *S. aureus* and *C. albicans* [49].

3.3.3. Synthesis of Cu NPs using algae

Alga is an aquatic organism and is a good source of biomolecules. Since algae contains proteins, pigments, nucleic acids, fats, carbohydrates and secondary metabolites such as alkaloids. Some secondary metabolic compounds such as aromatic, peptides, terpenes and macrolides, act as reducing agents to produce NPs from metal ions without producing any toxic by-product. Abboud *et al.* (2014) [50] reported for the first time biosynthesis of CuO NPs using brown alga (*Bifurcaria bifurcata*) showing strong resonance at about 260 nm and of diameter 5 to 45 nm. Further, the antibacterial activity of synthesized NPs was tested against two different strains of bacteria *Enterobacter aerogenes* (Gram negative) and *S. aureus* (Gram positive). UV–visible spectrum of Cu NPs synthesized by *B. braunii* exhibited absorption peaks at 258 nm. The size of algal synthesized Cu NPs was found to be in range of 10–70 nm. The size of the synthesized Cu NPs was found in range of 10–70 nm. The average size of synthesized Cu NPs was calculated using the Debye Scherer equation and was found to be around 58 nm. Antifungal activity of synthesized Cu NPs was tested against fungus *F. oxysporum* [51].

3.3.4. Synthesis of Cu NPs using plant enzymes

Several current finding have showed that plant extracts can be used as potential precursor for the fabrication of environmentally friendly nanomaterials. The bioreduction of metal oxide NPs by a combination of biomolecules found in plant extracts (enzymes, proteins, amino acids, vitamins, polysaccharides, and organic acids such as citrates) and the respective role of phytochemicals was studied by [52]. Metal ions are capped, stabilized, and reduced to metallic NPs by these active compounds.

3.3.5. Synthesis of Cu NPs using leaves extract

Plant extract mediated synthesis of NPs have recently received a lot of attention because of their wide range of physicochemical features and applications. Cu NPs synthesized from natural resources have been studied exclusively. Cu NPs are synthesized from a variety of plant parts, such as stems, leaves, roots, bark, fruit, seed, and flowers in various sizes and forms [53,54]. The shape and size of Cu NPs can be altered by varying metal concentrations and the amount of plant extract in the reaction mixture [55]. Plant leaves extract contains a number of bioactive metabolites, such as flavonoids, phenols, proteins, terpenoids, and tannins, which function as stabilizing and reducing agents, reducing the metallic salts to NPs [56,57]. The phytochemicals reacts with the Cu ion, leading to the reduction and convert ion into Cu NPs. Polyphenolic

compounds and flavonoid groups found in *Thymbra spicata* extract act as reducing and capping agents in the synthesis of CuO NPs by combining their hydroxyl groups with Cu^{2+} and then reacting with the oxygen in the air. Their antibacterial and antibiofilm properties have been examined [58]. Gas Chromatography/Mass Spectrometry (GC–MS) analysis confirmed the capping of CuO NPs by esters such as di-propyleneglicol diacrylate, -monoolein, and isooctyl phthalate is reported in *Cymbopogon citratus* extract. They were essential in Cu^{2+} or Cu^{3+} reduction and surface functionalization. FTIR studies showed phenolic, sugar, and protein mediated nucleation and stabilization of CuO NPs. XRD and TEM revealed CuO NPs between 11.4 and 14.5 nm. Synthesized CuO NPs exhibited excellent antibacterial and antibiofilm efficacies [59]. The green synthesized CuO NPs using *Annona muricata* leaf extract exhibited an absorbance peak around 327 and 540 nm as confirmed by SPR. XRD pattern 2θ peaks were at 32.77, 34.66, 38.72, 48.20, 52.24, 57.35 and 61.27, which were assigned to the (110), (−111), (111), (−202) (020), (202) and (−113) planes, respectively revealed monoclinic structure and crystalline nature of synthesized CuO NPs [60]. Cu NPs were synthesized using *Centella asiatica* leaf extract [61] and their photocatalytic and catalytic activity has been studied. *Carica papaya* leaf extract mediated synthesized CuO NPs were analyzed for their antimicrobial effects [62]. Hydroalcoholic extract of *Moringa oleifera* leaves were used to synthesize Cu NPs. A color change from brown to black indicates the formation of Cu NPs. The synthesized Cu NPs have an amorphous nature and particle size of 35.8 to 49.2 nm. The synthesized Cu NPs utilized for their anti-fungal activity against *A. niger*, *A. flavus*, *C. albicans*, and *C. glabrata* [63]. CuO NPs as a p-type semiconductor gave an absorption peak at 359 nm and the nature of the absorption peaks seen could be attributed to oxygen vacancies, surface effects, interstitial ion effect, and electron recombination between the donor and acceptor level defects of the NPs [64]. Cu^{2+} ions reduced to Cu NPs by flavonoids and phenolic functional groups in the leaf extracts of *Eryngium caucasicum* Trautv. The SEM analysis showed nearly spherical shapes and sizes of less than 40 nm of NPs [65]. FTIR spectra of Cu NPs synthesized from *C. sinensis* showed broad peaks due to the intermolecular and intramolecular interactions of OH groups. Energy dispersive X-ray (EDX) analysis strong signals for Cu confirmed the formation of Cu NPs. The EDX spectrum also showed the intense peaks of O, Cl and Si in addition to Pt and C present in *C. sinensis* leaves extract that reduced and stabilized Cu NPs [66]. *Populus ciliata* mediated synthesized CuO NPs was tested against Gram positive and Gram negative bacterial strains by agar well diffusion method [67]. *G. glauca* and *P. zeylanica* plant extract contain coumarins like xanthyletin, seselin, 5-methoxyseselin, xanthoxyletin, and suberosin apart from flavonoids, alkaloids, simple phenolics, reducing sugars, tannins, lignin, glycoside, and saponins which have a high potential to synthesize and stabilize NPs [68]. Leaves extract of *Citrofortunella microcarpa* (Calamondin) was used for synthesis CuO NPs which were spherical in shape with size range of 54 to 68 nm. The synthesized CuO NPs exhibited SPR at 270–300 nm [69]. *Cissus incanus* leaf extract was used to biologically synthesize CuO NPs showed UV–vis spectral band at 290 nm. SEM and TEM analysis confirmed that the synthesized CuO NPs were of spherical structure with size range of about 15–25 nm [70]. Studies were also conducted on Cu NPs synthesis using leaves extract of *Commersonia bartramia* [71], Green and black tea [72], *Cassia occidentalis*[73], *Tilia* [74], *Centella asiatica* L. [75], *Alchornea laxiflora* [76], *Prosopis cineraria* [77], *Cissus quadrangularis* [78], *Abutilon indicum* [79], *Eclipta prostrata* [80], *Convolvulus pericus* [81], green tea [82] and *Terminalia catappa* [83].

3.3.6. Synthesis of Cu NPs using fruits extract

Hemmati *et al.*, (2020) [84] synthesized eco-friendly Cu NPs using *Fragaria ananassa* fruit extract. TEM images exhibited a uniform spherical shape and diameters of 10–30 nm. Synthesized Cu NPs revealed antioxidant properties assayed using 2,2-diphenyl-1-picryl- hydrazyl-hydrate (DPPH) free radical scavenging test. The synthesized Cu NPs were spherical in shape and were investigated for antifungal activity against *C. albicans*, *C. guilliermondii*, *C. parapsilosis*, *C. krusei*, and *C. glabrata*. Cu NPs were synthesized using seedless date' extract as reducing agent by Mohamed, (2020) [85]. UV–vis Spectroscopy revealed the SPR peak of Cu NPs at 576 nm and spherical shape. DLS analysis showed that the synthesized Cu NPs had an average particle size of 78 nm and zeta potential of + 41 mV, indicating a good stability of the particles. Cu NPs prepared using aqueous *Rhus coriaria* L. fruits extract displayed an absorption peak at 560 nm. TEM analysis revealed semi-spherical shapes with diameter of 22 to 27 nm. The XRD studies revealed that the average crystalline size was 18 nm [86]. *Capparis spinosa* fruit extract mediated synthesized Cu NPs showed SPR at wavelength of 414 nm. SEM analysis concluded the particle size was between 17 and 41 nm [87]. The absorption peaks were observed at 370 nm in CuO NPs synthesized from *Terminalia belerica* extract. HRTEM micrograph of CuO NPs showed almost spherical and uniformly distributed size ranging 9 to 14 nm [88]. The UV–vis spectra of the CuNP synthesized from *Duranta erecta* extract showed a distinct absorption peak at 588 nm. FE-SEM revealed the average size of the synthesized Cu NPs was 70 nm having monodispersity [89]. The monodispersed and stable Cu NPs were prepared with an average size 200 nm using Hawthorn berries (*Crataegus*) extract [90]. Fruit extracts of *Ziziphus spina-christi* (L.) Willd. was used as reducing agents for the green synthesis of Cu NPs. UV–Vis spectrum of Cu NPs showed absorption band at 551 nm. XRD analysis calculated the size range of the Cu-NPs between 8 and 15 nm with cubic shape. The FESEM micrographs of synthesized Cu NPs showed the size range of 5 to 20 nm [91].

3.3.7. Synthesis of Cu NPs using Seed, flower, rhizome, root, and husk extract:

Caesalpinia bonducella seed extract was used to synthesize CuO NPs which showed a sharp absorption peak at 250 nm. XRD analysis revealed the crystalline size 13.07 nm. Synthesized CuO NPs was tested for their antibacterial efficacy against *S. aureus* and *Aeromonas*. Bioactive substances which are responsible reduction and stabilizing CuO NPs are citrulline, phytosterinin, and β-carotene [92]. The *ortho*-phenolic hydroxyl group of ellagic acid of *Punica Granatum* seeds loses hydrogen during the esterification process of the carboxylic and hydroxyl groups, resulting in reduction in the size of metal ion. SEM images confirmed the size of the Cu NPs was in the range of 40 to 80 nm with semi spherical shape and uniform distribution. Their photocatalytic efficacy was evaluated by degradation of methylene blue dye [93]. Jasrotia *et al.* (2020) [94] synthesized Cu NPs using *Allium cepa*, *Vigna radiata* and *Cicer arietinum* extract. The antioxidant nature of synthesized Cu NPs was evaluated using DPPH radical scavenging. Besides, the antimicrobial activity was also performed using bacterial strains of *S. aureus*, *E. coli*, and *S. typhi* and fungal strain *Aspergillus* sp. *Persea americana* seed extract was used to synthesize Cu NPs which showed SPR band at the range of 357 nm. The XRD studies calculated the average diameter of the Cu NPs in the range of 42 to 90 nm. The SEM studies state that the Cu NPs are spheroid in shape and polydisperse in nature with particle size ranging from 45 to 100 nm. The antifungal activity was determined using the agar well diffusion assay method against *A. niger*, *A. fumigatus*, and *F. oxysporum* [95]. Flower extract of *Euphorbia pulcherrima* [96], *Eichhornia crassipes* [97], and *Stachys lavandulifolia* [98], Rhizome extract of *Curcuma longa*, *Zingiber officinale* [99,100], root extract of *Asparagus racemosus* [101], *Rheum palmatum* L. [102] and husk extract of *Zea mays* L. [103] have been used for green Cu NPs synthesis (Table1).

4. Techniques used for characterization of nanoparticles

The characterization process performed to assess the shape, size, crystallinity, zeta potential, particle sizes, surface area, porosity, solubility, aggregation, adsorption potential, and fractal dimensions of NPs [104] (Fig. 3). Several techniques, such as UV–vis spectroscopy, SEM, AFM, FTIR spectroscopy, TEM, selected area electron diffraction (SAED) pattern, XRD, DLS analysis, EDX/EDS, X-ray photoelectron spectroscopy

Table 1
Green synthesis of copper nanoparticles using plants.

Plant	Plant's part	Shape	Size (nm)	Substrates	Substrate Concentration	References
Thymbra spicata	Leaves	Spherical	26.8, 21	$CuSO_4$	1 mmol	[58]
Cymbopogon citratus	Leaves	Spherical	14.5 ± 2	$CuSO_4$	0.25 mM	[59]
Annona muricata	Leaves	Spherical	30–40	$CuSO_4$	5 mM	[60]
Centella asiatica	Leaves	Spherical	20–30	$CuSO_4$	1, 5, 20 mM	[61]
Carica papaya	Leaves	Square	–	$CuSO_4$	0.01 M	[62]
Moringa oleifera	Leaves	–	35–49	Cu (II)	0.04 M	[63]
Alchornea cordifolia	Leaves	Spherical	75.22	$CuSO_4$	2 mM	[64]
Phoenix dactylifera L.	Fruit	Spherical	78	$CuSO_4$	–	[85]
Fragaria ananassa	Fruit	Spherical	10–30	$CuSO_4$	0.04 M	[84]
Caesalpinia bonducella	Seed	Rice-grain shaped	13.07	$Cu(NO_3)_2$	0.01 M	[92]
Allium cepa	Seed	Cubic	20	CuCl	10 mM	[94]
Euphorbia pulcherrima	Flower	Cubic	19.2	$Cu(CH_3COO)_2$	–	[96]
Curcuma longa	Rhizome	Spherical	5–20	$Cu(CO_2CH_3)_2$	0.01 M	[99]
Zingiber officinale	Rhizome	Spherical	20, 150	$CuSO_4$	0.5, 1, 5 mM	[100]
Citrofortunella microcarpa	Leaves	Spherical	54–68	$Cu(NO_3)_2$	1 M	[101]
Capparis spinosa	Fruit	Spherical	17–41	$CuSO_4$	0.01 M	[87]
Sumaq (*Rhuscoriaria* L.)	Fruit	Semispherical	22–37	$CuSO_4$	0.01 M	[86]
Crataegus	Fruit	–	200	$Cu(CH_2COO)_2$		[90]
Populus ciliata	Leaves	Spherical	87.79	$Cu(NO_3)_2$	1 mM	[57]
Eryngium caucasicum Trautv	Leaves	Spherical	40	$Cu(NO_3)_2$	10 mM	[55]
Gaidia glauca	Leaves	Quasi-spherical	1–5	$CuSO_4$	1 mM	[68]
Camellia sinensis	Leaves	Spherical	60 ± 6	CuCl	1 M	[66]
Cistus incanus	Leaves	Spherical	15–35	$CuNO_3$	–	[70]
Commersonia bartramia	Leaves	Spherical	5–17	$CuCl_2$	5 mM	[71]
Terminalia belerica	Fruit	Spherical	9–14	$Cu(NO_3)_2$	0.1 M	[88]
Duranta erecta	Fruit	Spherical	70	$CuSO_4$	5 mM	[89]
Zea mays L.	Husk	Spherical	17.7	$Cu(CO_2CH_3)_2$	–	[102]
Asparagus racemosus	Root	Rod	50–100	$Cu(NO_3)_2$	1 M	[103]
Eichhornia crassipes	Flower	Spherical	12–15	$CuSO_4$	20 mM	[97]
Camellia sinensis	Leaves	Spherical	26–40	$CuSO_4$	1 mmol	[72]
Cassia occidentalis	Leaves	Spherical, oval	5–30	$Cu(NO_3)_2$	1 mM	[73]
Tilia	Leaves	Hemispherical	4–17	$CuSO_4$	–	[74]
Centella asiatica L.	Leaves	Spherical	–	$CuCl_2$	5 mmol	[75]
Alchornea laxiflora	Leaves	Spherical	3.29	$CuSO_4$	1 mM	[76]
Ziziphus spina-christi (L.) Willd	Fruit	Spherical	9	$CuSO_4$	0.02 M	[91]
P. granatum	Seed	Semi-spherical	43.9	$CuCl_2$	1 M	[93]
Persea americana	Seed	Spherical	42–90	$CuSO_4$	–	[95]
Azadirachta indica	Leaves	Cubical	48	$CuCl_2$	–	[121]
Prosopis cineraria	Leaves	Spherical	32.09	$Cu(CH_3COO)_2$	5 mM	[77]
Cissus quadrangularis	Leaves	Spherical	30 ± 2	$Cu(CH_2COO)_2$	1 mM	[78]
Abutilon indicum	Leaves	Hexagonal	16.78	$Cu(NO_3)_2$	–	[79]
Convolvulus pericus L.	Leaves	Spherical	15–30	$CuSO_4$	1 mM	[81]
Camellia sinensis	Leaves	Spherical	20	$CuCl_2$	1 mM	[82]
Terminalia catappa	Leaves	Spherical	21–35	$CuSO_4$	5, 25, 125, 250 mM	[83]

(XPS), thermal gravimetric analysis (TGA), Brunauer- Emmett–Teller (BET), Nanoparticle Tracking Analysis (NTA), and particle size analyzer (PSA), are used for NPs characterization. UV–Visible spectra give characteristic peaks at the range of 200–800 nm primarily evidence the synthesis of NPs [97]. The XRD pattern determines crystallinity and elemental composition of NPs. FTIR spectroscopy used to determine the associated functional groups and structural features of biological extracts with NPs. Microscopic techniques such as AFM, TEM and SEM Mainly used for morphological studies of NPs. These techniques determine shape, size, topology, and crystallographic structure of NPs [105–107] SAED analysis helped in determines surface lattice reflections. BET helped to determine specific surface areas of NPs. NTA was used to visualize and measure particle size, concentration, and fluorescent properties of NPs [108,109]. PSA measured the distribution of size in the sample of solid or liquid particulate materials [110] (Table 2).

5. Plant biomolecules responsible for bio-reduction of Cu NPs

Various active compounds found in plants, these includes polyphenols [111], flavonoids, tannins [112], polysaccharides [113,114], and proteins [115], which improve the size, structure, and stability of synthesized NPs. Flavonoids are a class of polyphenolic chemicals that can actively bind to metal ions and reduce them to NPs [116]. They comprise anthocyanins, isoflavonoids, flavonols, chalcones, flavones, and flavanones. Quercetin is a flavonoid with extremely significant chelating activity, because it can chelate at carbonyl and hydroxyl at the C3 and C5 positions, and the catechol group at the C3′ and C4′ sites [117]. Various metal ions, such as Fe^{2+}, Fe^{3+}, Cu^{2+}, Zn^{2+}, Al^{3+}, Cr^{3+}, Pb^{2+}, and Co^{2-}, are chelated by these groups. This suggests that they are involved in the stages of nanoparticle nucleation and further aggregation, in addition to the bioreduction step [118]. Metal NPs can also be synthesized by the help of sugars found in plant extracts. Monosaccharide's like glucose (linear and having an aldehyde group) can act as reducing agents. Furthermore, the capacity of disaccharides and polysaccharides to reduce is dependent on the ability of any of their monosaccharide components to adopt an open chain form within an oligomer and, as a result, enables the access (of a metal ion) to an aldehyde group [119].

6. Factors influencing the synthesis of nanoparticles

The synthesis of NPs is influenced by a number of physical and chemical factors. These factors include temperature, pH, reaction duration, plant extracts, and substrate concentration (Fig. 4). Cu NPs synthesized by varying factors such as the pH, temperature, and molar ratio of reactants, with various morphologies, including rods, spherical, and submicron polyhedrons by Biçer & Şişman, (2010) [120]. They

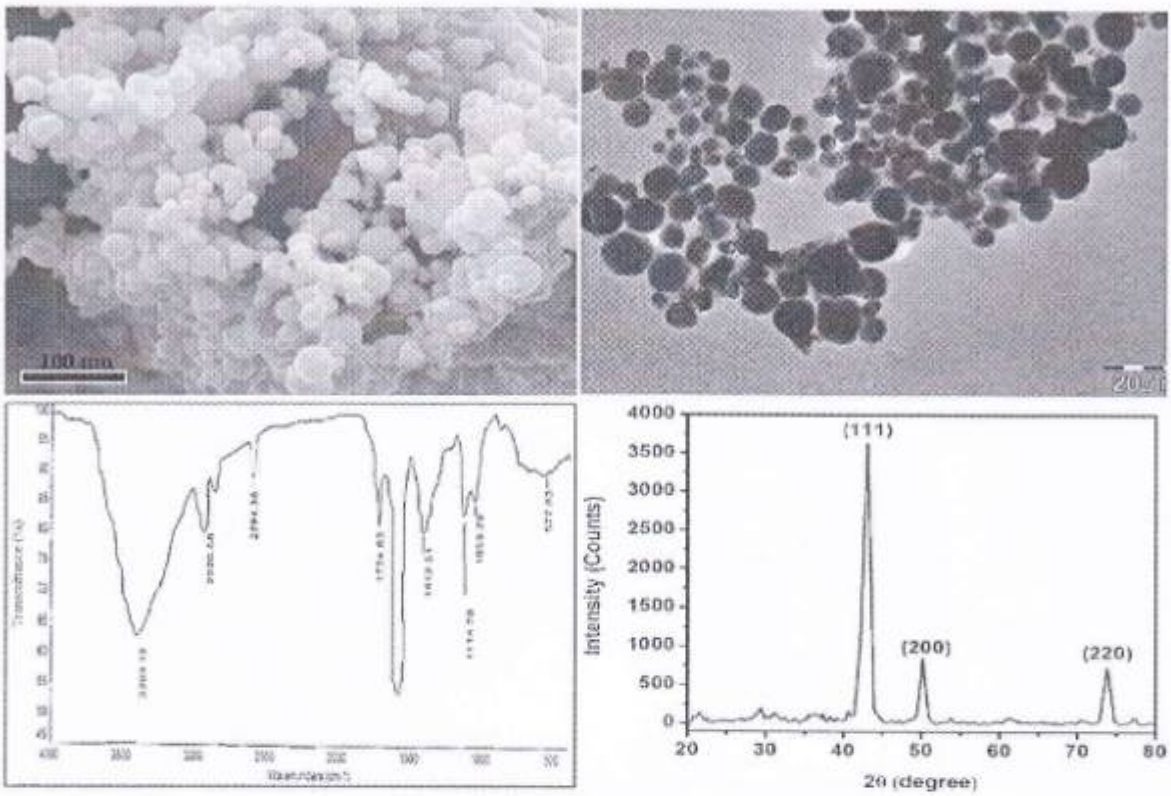

Fig. 3. Techniques used for characterization of nanoparticles.

Table 2
Different characterization techniques and their applications.

Techniques	Applications	References
TGA	Determine the amount of coating on the surface of the nanoparticles	[96]
UV–vis, DLS, FTIR	Determine quantitative analysis, polymorphism, surface chemistry of nanoparticles	[97]
HRTEM	Determine the shape, size, topology and crystallographic structure	[107]
BET	Determine specific surface area of nanoparticles	[108]
NTA	To visualize and measure particle size, concentration, and fluorescent properties of nanoparticles	[109]
PSA	To measure the distribution of size in the sample of solid or liquid particulate materials	[110]
XRD, XPS, EDX/EDS	Determine crystallinity and elemental composition of nanoparticles	[148]
SAED	Determine surface lattice reflections	[149]
AFM	Determine Size, morphology and surface texture	[105,150]
SEM	Determine the morphology (size) by direct visualization	[151–153]

observed that as the molar ratio of reactant and pH rises, particle size decreases. Optimizing the pH value of the solution medium can affect the size and texture of the NPs. The pH affects the shape and size of the synthesized Cu NPs, reported by Nagar & Devra, (2018) [121]. Temperature is another important parameter for biosynthesis of NPs with different sizes and shapes. In study conducted by Sivaraj *et al.* (2014) [122] for the synthesis of Cu NPs solution kept for continuous stirring (7–8 h) at 100 °C. Concluded that at optimum temperature, the dynamics of structure formation was relatively faster and the reduction of Cu ions is likely to occur within well-formed particles. The shape, size and stability of green synthesized NPs is greatly influenced by the length of time for which the reaction medium is incubated.

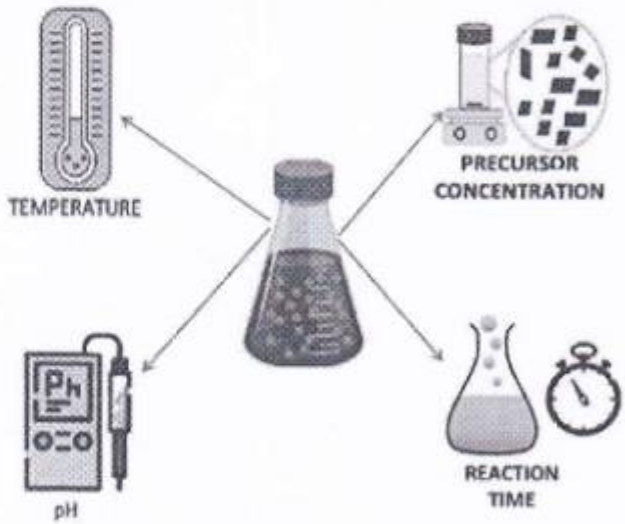

Fig. 4. Factors influencing the synthesis of nanoparticles.

7. Applications of copper nanoparticles

7.1. Antibacterial activity of Cu NPs

Several studies conducted have shown that Cu NPs has high antibacterial activities. Kala *et al.* (2016) [123] have reported the antimicrobial activity of Cu NPs from leaf extract of *Datura innoxia* against *Xanthomonas oryzae* pv. oryzae, the causative organism of bacterial leaf blight of paddy by well diffusion method. Sivaraj *et al.* (2014) [122] evaluated antibacterial activity Cu NPs from *Tabernaemontana divaricata*

leaf extract against *E. coli* found highest zone of inhibition with a zone diameter of 17 ± 1 mm at a concentration of 25 μg/ml. Acharyulu *et al.* (2014) [124] studied the antimicrobial activity of biosynthesized CuO NPs from *Phyllanthus amarus* leaf extract against multidrug-resistant Gram-positive (*B. subtilis* and *S. aureus*) and Gram-negative (*E. coli* and *P. aeruginosa*) bacteria. *Datura metel* mediated synthesized Cu NPs antibacterial activity was evaluated against *S. aureus*, *E. coli*, *Bacillus megaterium* and *B. subtilis* by Parikh *et al.* (2014) [125]. Abboud *et al.* (2014) [50] reported that CuO NPs produced by using brown algae extract (*Bifurcaria bifurcata*) showed high antibacterial activity against two different strains of *E. aerogenes* and *S. aureus*. The radial inhibition zone exhibited by CuO NPs for *E. aerogenes* and *S. aureus* are 14 and 16 mm, respectively. Antimicrobial activity was examined against human pathogens *E. coli* and *S. aureus* by Caroling *et al.* (2015) [126]. The antibacterial activity of CuO NPs was evaluated against *E. coli* using a spread plate method. The inhibition rate of *E. coli* was 14.9 % and 45.4 % observed at 2 and 10 mg/L concentration after 2 h contact time [127]. Angrasan *et al.* (2014) [128] reported antibacterial activity of synthesized Cu NPs from leaf extract of *Vitis vinifera* against *E. coli*, *S. aureus*, *B. subtilis*, *S. typhi* and *K. pneumonia*. In this susceptibility test, *S. aureus* was more sensitive to biologically synthesized NPs 18 mm zone of inhibition and followed by *E. coli* 14 mm, and *K. pneumonia* 12 mm, *S. typhi* 8 mm, *B. subtilis* 9 mm all the experimental bacteria showed resistant biologically Cu NPs and Chloropenicol, throughout the experiment. Padil & Černik, (2013) [129] studied the antimicrobial activity of CuO NPs against common pathogens *E. coli* and *S. aureus*. The zone of it inhibition was around 14.5 ± 0.8 mm observed for the bacteria strain *S. aureus*, and for *E. coli* was 16.2 ± 0.8 mm at 50 μg (100 μL) of CuO NPs using agar well method. Das *et al.* (2013) [20] revealed the antibacterial and antioxidant activities of these NPs, whereas Hariprasad *et al.* (2016) [130] observed their good antibacterial activity against *E. coli*, *S. aureus*, *B. cereus*, and *P. aeruginosa*. According to Naika *et al.* (2015) [131], the synthesized CuO NPs were effective against the pathogenic bacteria *S. aureus* and *K. aerogenes*. The Cu NPs were effectively disrupting the polymer subunits of cell wall in pathogenic microorganisms. Cu NPs disrupted cell walls of *E. coli* and *S. aureus* bacterial strains, resulting in rapid DNA degradation and a reduction in bacterial respiration [132]. Besides, Cu NPs increased cellular ROS levels, causing protein oxidation, lipid peroxidation, and DNA degradation that resulted in bacterial cell death [133,134]. Cu NPs released Cu ions that permeated the bacterial cell membrane, causing damage to the structure of the cell membrane by disturbing the negatively charged cell wall. Furthermore, Cu ions are involved in the crosslinking of bacterial DNA molecule. These results in a disordered helical shape of DNA, severe denaturation of proteins, and other biochemical procedures in the cell lead to the bacterial cell's total destruction [135]. In addition, the Cu^{2+} ions bonded with O and rejoined with sulfhydryl (-S—H) groups in the cell wall, forming R—S—S—R bonds, effectively stopped the bacterial cell's respiration pathway and killed it [136] (Table 3).

7.2. Antifungal activity of Cu NPs

Biologically synthesized copper nanoparticles showed antifungal activity against various types of plant pathogenic fungi. Huang *et al.* (2021) [137] reported antifungal activity against *Bipolaris maydis* by applying different concentrations of CuO NPs 12.5, 25, 50, 100, and 200 μg/ml. At 200 μg/ml, the suppression rate reached 62.78 %, and spore germination was totally inhibited. Benassai *et al.* (2021) [138] evaluated antifungal activity of Cu NPs on *S. cerevisiae* and *C. albicans*. *Syzygium aromaticum* mediated synthesized Cu NPs exhibited fungicidal activity against *Penicillium* spp. Cu NPs exhibited fungicidal activity against *Penicillium* spp. with a zone of inhibition of 6 mm at 16 μL of Cu NPs concentration [139]. *Citrus medica* Linn. (Citron juice) mediated synthesized Cu NPs showed fungicidal activity against some selected species of plant pathogenic fungi *F. culmorum*, *F. oxysporum* and *F. graminearum* using Kirby-Bauer disk diffusion method [140]. *Cissus quadrangularis* Cu

Table 3
Antibacterial activity of biologically synthesized Cu NPs.

Plant	Test organisms	Methods	References
Bifurcaria bifurcata	*Enterobacter aerogenes* and *S. aureus*	Agar disc diffusion	[50]
Tabernaemontana divaricata	*E. coli*	Kirby Bauer disk diffusion	[122]
Datura innoxia	*Xanthomonas oryzae*	Well-diffusion	[123]
Phyllanthus amarus	*B. subtilis* and *S. aureus*, *E. coli* and *P. aeruginosa*	Well-diffusion	[124]
Datura-metel	*S. aureus*, *E. coli*, *B. megaterium* and *B. subtilis*	Disc diffusion and Kirby Bauer disk diffusion	[125]
Guava (Fruit extract)	*E. coli* and *S. aureus*	Kirby Bauer disk diffusion	[126]
Vitis vinifera	*E. coli*, *S. aureus*, *B. subtilis*, *S. typhi* and *K. pneumonia*	Agar well-diffusion	[128]
Sterculia urens (Gum karaya)	*E. coli* and *S. aureus*	Agar well diffusion	[129]
Aerva lanata	*E. coli*, *S. aureus*, *Bacillus cereus* and *P. aeruginosa*.	Disc diffusion	[130]
Gloriosa superba L.	*S. aureus* and *Klebsiella aerogenes*	Agar well diffusion	[131]

NPs synthesis reported by Devipriya & Roopan, (2017) [78] were subjected to anti-fungal against two strains namely *A. niger* and *A. flavus*. The fungal strain *A. niger* resulted in 83 % of inhibition at 500 ppm, 86 % of inhibition at 1000 ppm and *A. flavus* resulted in 81 % of inhibition at 500 ppm, 85 % of inhibition at 1000 ppm respectively. Vanathi *et al.* (2016) [141] reported green synthesis of CuO NPs from an aquatic noxious weed, *Eichhornia crassipes* was used as fungicide against *F. culmorum* and *A. niger*. Highest zone of inhibition was observed in *F. culmorum* (21.26 ± 1 mm) and *A. niger* (18.33 ± 1 mm) at a concentration of 100 μg ml^{-1}, which is more than that of positive control (19.33 ± 1 mm and 16.66 ± 1 mm). Similarly, the lowest zone of inhibition was obtained in *A. fumigatus* (9.10 ± 1 mm) at a concentration of 25 μg ml^{-1}. Cu NPs were shown to inhibit fungal growth by lowering metabolic activity. Cu NPs can damage fungal cells by interfering with DNA and interrupting replication and transcription pathways. Cu NPs may also cause growth inhibition by interacting with proteins' –SH (sulfhydryl) groups. Cu NPs induced oxidative stress in microorganisms may lead to cell death [142] (Table 4).

7.3. Catalytic activity of green synthesized copper nanoparticles

The extensive literature survey revealed that green synthesized copper nanoparticles exhibited excellent catalytic activity on a variety of dyes. The reaction mechanism proposed as Cu/MgO nanocomposite reduced 4-NP in two step electron transfer process. First step includes π–π stacking interactions of 4-NP and BH_4 on catalyst surface in aqueous solution. In second step, hydrogen atoms produced by electron transfer between the electron mediator BH4- (reductant) and the oxidant 4-NP

Table 4
Antifungal activity of biologically synthesized Cu NPs.

Plant	Test organisms	Methods	References
Cissus quadrangularis	*A. niger* and *A. flavus*	Clinical and Laboratory Standards Institute method	[78]
Syzygium aromaticum	*Penicillium* spp.	Kirby-Bauer disc diffusion	[139]
Citron juice (Citrus medica Linn.)	*F. culmorum*, *F. oxysporum* and *F. graminearum*	Kirby-Bauer disk diffusion	[140]
Eichhornia crassipes	*F. culmorum* and *A. niger*.	Well-diffusion method	[141,153]

(oxidant), BH4 − attack, reduce the 4-NP molecule. Further, the corresponding product was desorbed from the catalysts surface [143,144]. According to another investigation, Copper oxide nanoparticles can transport electrons from BH − to 4-NP, which are absorbed by the catalyst, resulting in the formation of 4-AP. As a nucleophile attack, BH4 − can donate electrons to copper oxide nanoparticles. In addition, 4-NP can accept electrons from copper oxide nanoparticles as an electrophile reaction. 4-AP eventually desorbs from the supports, resulting in a free surface, and the catalytic cycle restarts [145]. Catalytic activities of copper nanoparticles tested on various dyes such as reactive red 120, methyl orange, methyl red, phenol red, and eosin y, bromophenol blue, rhodamin B dye, 2,4-dinitrophenylhydrazine, Congo red, methylene blue, 4-nitrophenol, 2-nitrophenol, and Acid Black 210.

7.4. Anticancer activity of green synthesized copper nanoparticles

Copper nanoparticles were found to be one of the most effective inorganic materials against a variety of cancers cell lines reported in the literature. Various cancer treatments have been developed, however they have drawbacks including cost and various adverse effects [146,147]. Kayalvizhi *et al.* [60] tested cytotoxic property on human breast cancer cell lines MCF-7, Elemike *et al.* [64] on cervical cancer by MTT assay method using Hela cell lines. Hassanien *et al.* [74] studied the cytotoxicity effect on aco-2, HepG2 and Mcf-7 cells using MTT assay. Copper nanoparticles were found to suppress colon cancer growth in a dose-dependent manner with an IC50 value, Caco-2 cells weighed 11.21 μg, HepG2 cells weighed 19.88 μg, and Mcf-7 cells from human breast cancer weighed 12.21 μg performed an MTT test [77] indicated that copper nanoparticles have a cytotoxic effect on MCF-7 cancer cells, with an IC50 of 37.02 μg/ml.

8. Conclusion

In summary, it is concluded that during the last decade many attempts have been undertaken for the nanoparticles green synthesis. Green synthesis method advantageous over chemical and physical methods as it is cost-effective, ecofriendly and effectively scaled up for large-scale synthesis. An increasing awareness towards green chemistry and utilization of green route for production of metal nanoparticles, especially copper nanoparticles led a desire to develop eco-friendly methods. Organisms ranging from straightforward bacteria to highly complex eukaryotes can be utilized for the synthesis of nanoparticles with desired size and shape. However, the development of the microorganisms and vast scale formulation residue are tricky compared with others. The low synthesis rate and limited number of size and shape distributions produced, oriented the study towards utilization of plants. For the production of copper nanoparticles using plants can be advantages over other biological entities which can overcome the slow route of using microorganisms and sustain their culture which can lose their potential towards the production of nanoparticles. Copper nanoparticles synthesized by green route have important aspects of nanotechnology through numerous applications. Copper nanoparticles have emerged in present and future era, with a variety of applications incorporating antifungal, antibacterial, anticancer drugs, and catalytic degradation of hazardous dyes and many more.

Declaration of Competing Interest

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

Data availability

Data will be made available on request.

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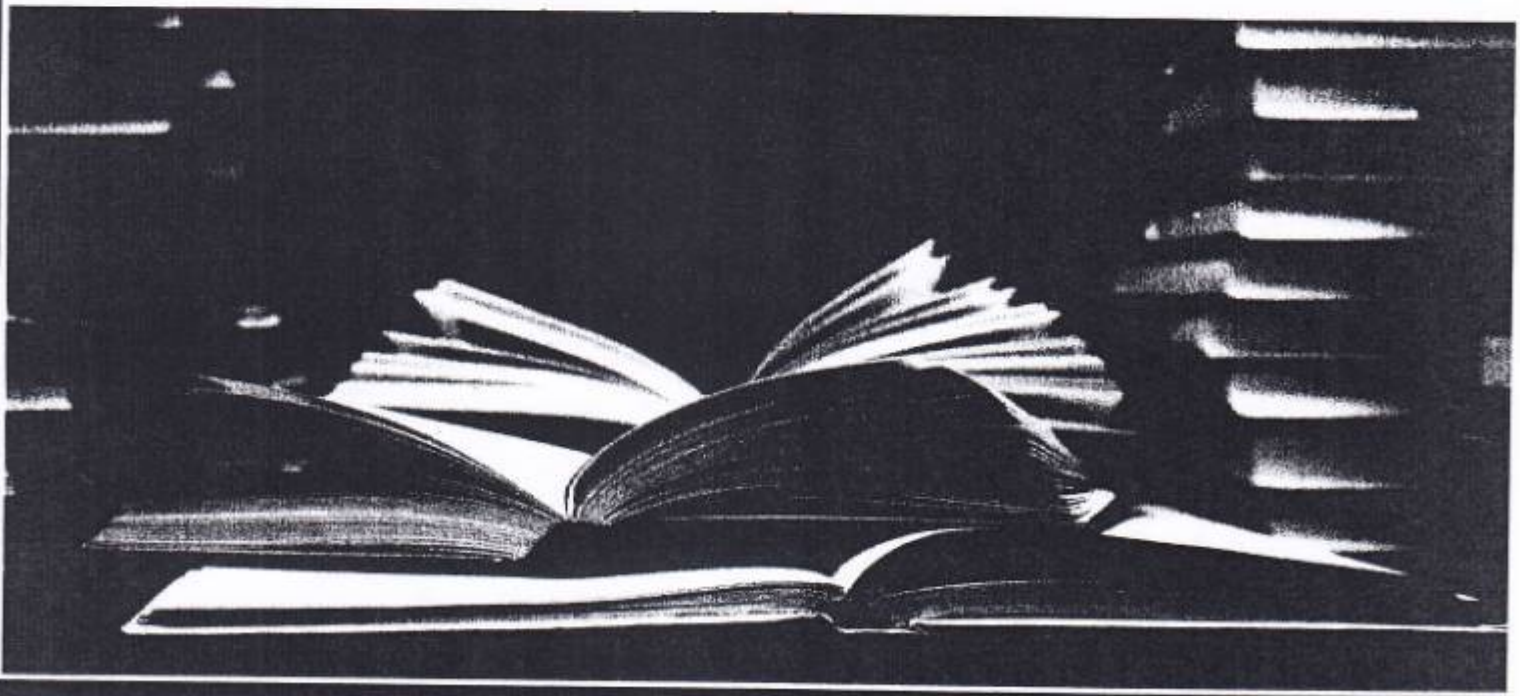

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राजनीति में नारी की भूमिका

मुनेश कुमार मीना

सहा. आचार्य राजनीति विज्ञान अग्रवाल कन्या महाविद्यालय, गंगापुर सिटी

विश्व में महिलाओं की भूमिका को स्वीकार करते हुये 8 मार्च 1914 से विश्व महिला दिवस मनाने की घोषणा की गई ।

नारी दिवस बस एक दिवस क्यों नारी के नाम मनाया है
हर दिन हर पल नारी उत्तम मानो यह नया जमाना है।

प्राचीनकाल से ही राज-नीति के क्षेत्र में नारी की महत्वपूर्ण भूमिका रही है। प्राचीनकाल में कुषाण काल की प्रभावती गुप्त नामक महिला के पास शासन चलाने की शक्ति थी और मुगलकाल में नूरजेहां का शासन पर पूरा अधिकार था। वैदिक काल से शिक्षित नारी ने अपनी प्रतिभा का राजनीति के साथ-2 विभिन्न क्षेत्रों-सामाजिक, धार्मिक, वैधानिक में उत्कृष्ट प्रदर्शन किया है। इस तरह नारी की एक नई छवि उभर रही है। आज वह नारी जिसे अबला समझा जाता था वह पुरूषों से कई ज्यादा सक्षम व सबल है जिनमें कुछ महिलाऐं निम्न है इंदिरा गॉधी, मार्गेट थैचर, प्रतिभा पाटिल आंग सान सू की, शीला दीक्षित, वसुंधरा राजे और किरण बेदी।

शिक्षित साहसी निडर बनकर मे करूगी दृढ का दान
राज-नीति मे आगे बढकर मे करूगी राष्ट्र उत्थान।।

इंदिरा गॉधी जिसने राज-नीति में महिलाओं के लिए एक मिशाल कायम की है। और पहली महिला प्रधानमंत्री के रूप में भारत को बढाया है जिन्होंने अपनी राज-नीतिक प्रतिभा के दम पर ऑपरेशन ब्लू स्टार जो स्वर्ण मंदिर अमृतसर में आतंकवादी गतिविधियों की आंशका के मद्देनजर चलाया गया (1984) शिमला समझौता जो 3 जुलाई 1972 को इंदिरा गांधी और जुल्फिकार अली भुट्टो के बीच भारत पाक सम्बन्धों को लेकर हुआ था।

किरण बेदी पहली महिला आई पी एस जिन्होने अन्ना हजारे के साथ भ्रष्टाचार को जड से खत्म करने के लिए लोकपाल बिल को लाने में अहम भूमिका निभायी।

इसी दिशा में आंग सान सू की ने म्यांमार में लोकतंत्र की स्थापना में अहम भूमिका निभायी। इंदिरा गॉधी ने 1971 में गरीबी हटाओं का नारा चौथी पंचवर्षीय योजना के दौरान दिया इन्होने प्रिवी पर्स को भी समाप्त भी की थी। अपने राजनीतिक कार्यकाल के दौरान इन्होने 1969 में 14 बैंकों का राष्ट्रीकृत किया। मारग्रेट थैचर ने ब्रिटेन में लोगों की आय पर प्रत्यक्ष करों को कम कर दिया और अप्रत्यक्ष करों को बढा दिया इन्होने सामाजिक सेवाओं जैसे शिक्षा और आवास पर खर्च को कम कर दिया। ब्राजील की राष्ट्रपति डिल्मा रूसेफ ने सितं इब्सा सम्मेलन के दौरान भारतीय प्रधानमंत्री मनमोहन सिंह के साथ गरीबी उन्मूलन भुखमरी के लिये आपस में बातां की । दिल्ली की पूर्व मुख्यमंत्री शीला दीक्षित ने वर्ष 2013 का बजट 38 हजार 450 करोड रूपये का और इस बजट मे योजना मद में 16 हजार करोड रूपये के प्रावधान प्रस्ताव किया और गैर योजना मद में 21 हजार करोड का।

इस महिलाओं के योगदान की वजह से ही आज भारत की अर्थव्यवस्था विश्व की श्रेष्ठ अर्थव्यवस्थाओं में शामिल हो गई है। राजनीति में आज आम महिलाऐं ही नही किन्नी महिलाऐं भी सक्रिय है जैसे गणेशन, हेमामालिनी, जया बच्चन। वर्तमान काल में नारी की इस भूमिका को देखते हुये यह अनुमान लगाया जाता है की भविष्य में नारी राजनीति के क्षेत्र में नये-2 चेहरे उभर रहें है प्रियंका गॉधी, सोनिया गॉधी, (यूपीए अध्यक्ष), वसुंधरा राजे (राजस्थान पूर्व मुख्यमंत्री), जयललिता (तमिलनाडु), मारग्रेट अल्वा (राजस्थान पूर्व राज्यपाल), सुषमा स्वराज (लोकसभा विपक्ष की पूर्व नेता) व श्रीमती द्रोपती मुर्मु (राष्ट्रपति भारत) इसी क्रम में प्रतिभा पाटिल भारत की पहली महिला राष्ट्रपति तथा लोकसभा अध्यक्ष पी. मीरा कुमार ने भी राजनीति के क्षेत्र में उल्लेखनीय कार्य कियहै। हाल ही में वसुंधरा राजे ने 60 दिन में 11 हजार करने का वादा किया है जो प्रक्रिया में है।

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जिन्दगी की असली उडान अभी बाकी है,
आपके इरादों का इम्तिहान अभी बाकी है।
अभी तो नापी है मुटठी भर जमीन,
आगे अभी सारा आसमान बाकी है।।

इसी दिशा में कई महिलाओं ने अपने राजनीति अधिकारों का प्रयोग करते हुये कई आंदोलन किये है। जैसे इमरती बाई का विधको आंदोलन (उत्तराखण्ड) मेधा पाटेकर का नर्मदा बचाओं आंदोलन और आंध्रप्रदेश का ताडी विरोधी आंदोलन आदि प्रसिद्ध है। राजनीति में महिलाओं की भूमिका को स्वीकार करते हुये यह ज्ञात होता है कि 1000 में से व्यक्ति पुरूषों का लीडर है बाकी 999 में महिलाओं का अनुमान करते है। इसलिये नारी का सम्मान किया जाना चाहिये और कहा भी गया है कि

नारी ही शक्ति है नर की,
नारी ही है शोभा घर की।
जो उसे उचित सम्मान मिले,
घर में खुशियों के फूल खिले ।।

नारी शोषण के विभिन्न आयाम

कोई भी मुल्क यश के शिखर पर तब तक ही पहुँच सकता।
जब तक उसकी महिलाएँ कंधे से कंधा मिलाकर न चले।।

संदर्भ

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