ACHIEVEMENTS OF FACULTY MEMBERS

1.NUMBER OF RESEARCH PAPERS PUBLISHED IN JOURNAL (2021-2022)– SUMMARY

S.No.	Year	Name of the Faculty Member	Department	Title of the Research papers	Name of the Journal	Month & Year	Vol. & Issue No.	P.No.	ISSN. No.	Impact Factor	UGC / Scopus/ SCI/SCIE/Peer reviewed/
1.	2021-2022	Thangasamy Selvankumar	Biotechnology	Nano-decolorization of methylene blue by Phyllanthus reticulatus iron nanoparticles: an eco-friendly synthesis and its antimicrobial, phytotoxicity study	Applied Nanoscience	July 2021	13	2527–2537	2190-5517		Scopus
2.	2021-2022	Thangasamy Selvankumar	Biotechnology	Microwave-assisted green synthesis of fluorescent carbon quantum dots from Mexican Mint extract for Fe3+ detection and bio-imaging applications	Environmental Research	August-21	119	111263	1096-0953	7.7	Scopus, SCIE
3.	2021-2022	Kandasamy Selvam, Chinnappan Sudhakar, Thangaswamy Selvankumar	Biotechnology	Activated carbon derived from Borassus flabellifer fruit husk waste for enhanced removal of reactive red 120	Environmental Technology & Innovation	August-21	23	101752	2352-1864	7.1	Scopus, SCIE
4.	2021-2022	T. Selvankumar	Biotechnology	Molecular insights of hyaluronic acid-hydroxychloroquine conjugate as a promising drug in targeting SARS-CoV-2 viral proteins	Journal of Molecular Structure	Aug-21	1238	130457	1872-8014	4.7	Scopus, SCIE
5.	2021-2022	Selvankumar Thangaswamy	Biotechnology	Metabolic annotation, interactions and characterization of natural products of mango (Mangifera indica L.): 1H NMR	Process Biochemistry	Jun-21	108	18-25	1873-3298	4	Scopus, SCIE

				based chemical metabolomics profiling							
6.	2021-2022	Kandasamy Selvam, Chinnappan Sudhakar, Thangaswamy Selvankumar	Biotechnology	Biofabrication of copper oxide nanoparticles@graphene oxide nanocomposite using Annona muricata leaf extract and its antibacterial and photocatalytic activity	Applied Nanoscience	Sep-21	13	1601–1609	2190-5517		Scopus
7.	2021-2022	T. Selvankumar	Biotechnology	Biogenic production of silver nanoparticles from milk of Capra aegagrus hircus and mechanism of antibacterial activity on different bacteria	Applied Nanoscience	September-21	13	1611–1618	2190-5517		Scopus
8.	2021-2022	Chinnappan Sudhakar Thangaswamy Selvankmuar, Kandasamy Selvam	Biotechnology	Biomimetic synthesis of iron oxide nanoparticles using Canthium coromandelicum leaf extract and its antibacterial and catalytic degradation of Janus green	Inorganic Chemistry Communications	November-21	133	108977	1879-0259	5.4	Scopus, SCIE
9.	2021-2022	T. Selvankumar	Biotechnology	In Silico Molecular Docking on Bioactive Compounds from Indian Medicinal Plants against Type 2 Diabetic Target Proteins: A Computational Approach	Indian Journal of Pharmaceutical Sciences	December-21	83 (6)	1273-1279	0250-474X		SCIE
10.	2021-2022	T. Selvankumar	Biotechnology	Molecular Docking Analysis for the Compounds of Ziziphus jujuba – An Indian Medicinal Plant	Research Journal of Agricultural Sciences	December-21	12 (6)	2148–2151	2249-4538		UGC
11.	2021-2022	Kandasamy Selvam, Chinnappan Sudhakar, Thangaswamy Selvankumar	Biotechnology	Photocatalytic degradation of malachite green and antibacterial potential of biomimetic-synthesized zirconium oxide nanoparticles using Annona reticulata leaf extract	Applied Nanoscience	February-22	13	2837–2843	2190-5517		Scopus
12.	2021-	K. Selvam, C. Sudhakar, T.	Biotechnology	Annona reticulata leaves-assisted synthesis	Materials Letters	February-22	309	131379	1873-	2.7	Scopus,

	2022	Selvankumar		of zinc oxide nanoparticles and assessment of cytotoxicity and photocatalytic impact					4979		SCIE
13.	2021-2022	Thangaswamy Selvankumar, Chinnappan Sudhakar	Biotechnology	Molecular characterization of the phytopathogen C. theae (Petch) – Causative of birds eye spot infection in Camellia sinensis host through DNA polymorphism and proteome analysis Author links open overlay panel	Physiological and Molecular Plant Pathology	April-22	118	101809	1096-1178	3.3	Scopus, SCIE
14.	2021-2022	C. Sudhakar, T. Selvankumar, K. Selvam	Biotechnology	Facile synthesis of iron oxide nanoparticles using Cassia auriculata flower extract and accessing their photocatalytic degradation and larvicidal effect	Journal of Materials Science: Materials in Electronics	April-22	33	11434–11445	1573-482X	2.8	Scopus, SCIE
15.	2021-2022	K. Selvam, C. Sudhakar, T. Selvankumar	Biotechnology	Laccase production from Bacillus aestuarii KSK using Borassus flabellifer empty fruit bunch waste as a substrate and assessing their malachite green dye degradation	Journal of Applied Microbiology	April-22	133 (6)	3288-3295	0021-8847	3.2	Scopus, SCIE
16.	2021-2022	C. Sudhakar, T. Selvankumar	Biotechnology	Decolorization of safranin using Fissidens species and its ecotoxicological assessments: An in vitro and in silico approach	Environmental Research	March-22	211	113108	1096-0953	7.7	Scopus, SCIE
17.	2021-2022	Kandasamy Selvam, Chinnappan Sudhakar, Thangaswamy Selvankumar	Biotechnology	Enhanced photocatalytic activity of novel Canthium coromandelicum leaves based copper oxide nanoparticles for the degradation of textile dyes	Environmental Research	March-22	211	113046	1096-0953	7.7	Scopus, SCIE
18.	2021-2022	Kandasamy Selvam, Thangaswamy Selvankumar	Biotechnology	Limonia acidissima leaf mediated gold nanoparticles synthesis and their antimicrobial and wound healing	Materials Letters	May-22	314	131893	1873-4979	2.7	Scopus, SCIE

				properties							
19.	2021-2022	C. Sudhakar, T. Selvankumar, K. Selvam	Biotechnology	Prodigiosin production from Serratia marcescens strain CSK and their antioxidant, antibacterial, cytotoxic effect and in silico study of caspase-3 apoptotic protein	Biotechnology and Applied Biochemistry	September-21	69 (5)	1984-1997	1470-8744	2.7	Scopus, SCIE
20.	2021-2022	C. Sudhakar	Biotechnology	Phytonanofabrication of copper oxide mediated by Albizia amara and its photocatalytic efficacy	Materials Letters	May-22	314	131911	1873-4979	2.7	Scopus, SCIE
21.	2021-2022	R Yuvarajan	Biotechnology	Screening the Therapeutic Potential of Methanolic Stem Extract of Cissus arnottiana	Biomedical & Pharmacology Journal	September-21	14 (3)	1405-1413	0974-6242		UGC
22.	2021-22	Dr.A.Jayakumar	Tamil	Sanga Kala Kalvarkal	Arima Nokku	January - 2022	15:4	20	2320-4842		Peer reviewed
23.	2021-22	G. Vidhya	Computer Science and Applications	Scrutiny of Healthcare Protection Using Cloud Computing and Cryptography	Journal of Research and Development	DEC-2021	6 & 2	63 - 66	2311-3278	1.15	Peer reviewed
24.	2021-22	V. Hariharan	Physics	Enhanced Electrochemical Performance of Mn3O4 /Multiwalled Carbon Nanotube Nanocomposite for Supercapacitor Applications	Journal of Electronic Materials	September 2021	50	6467–6474	0361-5235	2.5	Scopus, SCIE
25.	2021-22	Hariharan Venkatesan	Physics	Identifying the Suitability of Environmental Friendly Fe2O3 Nanomaterials for Supercapacitor Applications	Elixir international journal	August 2021	157	55553-55557	2229-712X		UGC
26.	2021-22	Hariharan Venkatesan	Physics	Suitability of Iron (Fe)-Doped Tungsten Oxide (WO3) Nanomaterials for Photocatalytic and Antibacterial	International Journal of Nanoscience	August 2021	20 (5)	2150042	1793-5350		UGC

				Applications							
27.	2021-22	Hariharan Venkatesan	Physics	Analyzing the Suitability of Chromium Doped Iron Oxide Nanoparticles for Creatinine Bio Sensor Applications	Indian Journal of Pure and Applied Physics	April 2022	60 (4)	313-319	0975-1041		Scopus
28.	2021-22	K.Prabakaran	Physics	Focusing Properties of Spirally Polarized Annular Multi Gaussian Beam by High NA Lens	International journal advanced science and engineering	2022	9 (1)	2607-2616	2454-9967		Scopus
29.	2021-22	K.Selvaraj	Commerce	A Study on the perception of construction workers related to financial incentives in knzhikode district - Kerala	Jounal of the Asiatic society of Mumbai	May 2022	XCVI 3	Nil	0972-0766	-	UGC Care
30.	2021-22	K.Selvaraj	Commerce	. A study on the level of job satisfaction of construction workers in Kozhikode District-Kerala	Journal of Emergining Technologies and innovative Research	April 2022	9 (4)	F678 F682	2349-5162	7.95	UGC
31.	2021-22	K.Selvaraj	Commerce	A study on the living conditions of construction workers in Kozhikode District, Kerala	Journal of the oriental institute	Mar 2022	71 (01)	69-74	**0030-5324**	7.5	UGC Care

Applied Nanoscience
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ORIGINAL ARTICLE

Nano-decolorization of methylene blue by *Phyllanthus reticulatus* iron nanoparticles: an eco-friendly synthesis and its antimicrobial, phytotoxicity study

Rajathirajan Siva Dharshini[1,2] · Mani Poonkothai[1] · Palanisamy Srinivasan[3] · Raja Mythili[3] · Asad Syed[4] · Abdallah M. Elgorban[4] · Thangasamy Selvankumar[3] · Woong Kim[5]

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Abstract

The present study was investigated to synthesis the iron nanoparticles (FeNPs) using the leaf extract of *Phyllanthus reticulatus*. The phytosynthesized FeNPs exhibited UV–visible absorption peaks at 229 nm and its crystalline nature was confirmed through XRD. FT-IR analysis revealed the presence of various functional groups which are responsible for the bioreduction of FeNPs. The SEM results showed that FeNPs were aggregated, irregular sphere shaped with rough surfaces and EDX spectrum recorded densely occupied iron nanoparticles region. The particle size range of the synthesized iron nanoparticles was 185.6 nm. The FeNPs showed potential methylene blue decolourisation activity which was visually observed by gradual colour change in the dye solution from deep blue to colorless. The control exhibited no change in coloration during exposure to sunlight and the iron nanoparticles completely disintegrated the methylene blue within 10 s in 10 mg/L methylene blue (98%), whereas the color change was decreased when the concentration of the dye increased. In addition, the phytosynthesized FeNPs exhibited extensive antibacterial and antifungal activity against the selected pathogens. Phytotoxicity assay confirms the potential of biosynthesized iron nanoparticles as a fertilizer for the growth of green gram seeds. Thus the present study leads to development of cost-effective green synthesis, reduction of toxic chemicals and its extensive applications in the biological sciences.

Keywords *Phyllanthus reticulatus* · Iron nanoparticles · Photocatalytic activity · Phytotoxic activity · Antimicrobial activity

Introduction

Synthesis, manipulation and use of nanoscale size materials and/or nanoparticles have attracted much attention due to their unique properties and applications in the field of science and technology and medicine (Praveen et al. 2018). Among, the synthesis methods, green and/or biosynthesis of metal nanoparticles gained increasing attention due to their eco-friendly, cost-effective, reproducible nature and large-scale synthesis (Sengottaiyan et al. 2016; Selvam et al. 2017; Arularasu et al. 2018; Mythili et al. 2018). Among the metal nanoparticles, iron nanoparticles (FeNPs) have been widely applied as in solar energy conversion, biomedical applications, drug delivery and also as a catalyst (Kumar and Gupta 2005). In addition, FeNPs possess strong toxicity against a broad spectrum of pathogenic bacteria and fungi (Mahmoud et al. 2011). Because of excellent properties and applications, FeNPs synthesis using bio-based materials has attracted much attention in the field of nanoscience and

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Environmental Research

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Microwave-assisted green synthesis of fluorescent carbon quantum dots from *Mexican Mint* extract for Fe^{3+} detection and bio-imaging applications

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Keywords:
Carbon quantum dots
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Bioimaging

ABSTRACT

Biomass-derived carbon quantum dots have drawn special interest owing to their admirable photostability, biocompatibility, fluorescence, high solubility, sensitivity and environmentally friendly properties. In the present work, the Carbon Quantum Dots (CQDs) was synthesized from the *Plectranthus amboinicus* (Mexican Mint) leaves via the microwave-assisted reflux method. The strong absorption peaks observed from UV–vis spectra at 291 and 330 nm corresponds to the π-π* and n-π* transitions, respectively, reveal the formation of CQDs. The synthesized CQDs showed bright blue fluorescence under UV irradiation with a fluorescence quantum yield of 17% and a maximum emission of 436 nm in the blue region at an excitation wavelength of 340 nm. The HRTEM analysis elucidates that the synthesized CQDs were crystalline and spherical in shape with a particle size of 2.43 ± 0.02 nm. The FT-IR spectroscopy confirms the presence of the different functional groups such as –OH, –CH, C=O and C–O. The chemical composition of CQD was revealed through XPS analysis. The synthesized CQDs were used as a fluorescent probe to detect different metal ions, where high selectivity was obtained for Fe^{3+} ions through quenching phenomenon. The emission intensity of CQD showed a good linear relationship with $R^2 = 0.9111$ with the concentration of Fe^{3+} ions in the range of 0–15 μM. The fluorescence emission of CQD was turned OFF upon the binding of Fe^{3+} ions and turned – ON with the addition of ascorbic acid. With this fluorescent turn ON-OFF behaviour of CQD, the NOT and IMPLICATION logic gates were constructed and studied for different input conditions. The biocompatibility of CQD was tested via MTT assay using MCF7 breast cancer cell line, which revealed that CQD synthesized from the Mexican Mint leaves possess less cytotoxicity. Further, the prepared CQD was applied effectively as fluorescent probes in a cell imaging application.

1. Introduction

Heavy metals create a serious threat to the environment including plants, animals and human beings due to the overexploitation in various industrial and household applications. Hence it is more essential to monitor the concentration of such toxic heavy metal ions in the environment. Among the various metals ions, ferric ion (Fe^{3+}) is one of the most important transition metal ions that play a crucial role in environmental as well as biological systems. Especially, iron is the fundamental structure of haemoglobin, myoglobin and is involved in many enzyme activities. As well as, it plays a prominent role in the chemical and physiological processes of organisms, such as electron transport, nucleic acid synthesis, enzymatic catalysis, and cellular metabolism. Fe^{3+} ions mainly accumulate within liver, spleen and bone marrow cells, bound to ferritin (Murugan et al., 2018). The excess or any insufficiency of Fe^{3+} ions may cause several disorders and diseases, where excess Fe^{3+} ions can cause various types of cancers and decline the functions of organs such as the heart, lungs and pancreas and

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Activated carbon derived from *Borassus flabellifer* fruit husk waste for enhanced removal of reactive red 120

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Response surface methodology
Adsorption isotherms

ABSTRACT

The present study emphasizes that biosynthesis of activated carbon (AC) from *Borassus flabellifer*, fruit husk waste (BFFHW) and improves the adsorption of reactive red-120 (RR-120) dyes. The biosorption of RR-120 was optimized using response surface methodology-Box–Behnken design (RSM–BBD) with three different parameters such as BFFHWAC concentration, RR-120 concentration, and time course of biosorption. The BFFHWAC pre and post-biosorption of RR-120 dye were characterized by field emission scanning electron microscope (FESEM), X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FT-IR). The maximum biosorption (93.75%) was achieved with the BFFHWAC of 10 mg/L, pH 5.0, and a contact time of 120 min at room temperature. The experimental report fitted well to Freundlich adsorption isotherm (R^2 = 0.96) and kinetics followed the pseudo-second-order model. The phytotoxic assay has confirmed the efficiency of the BFFHWAC in the removal of RR-120 from aqueous solutions using *Vigna radiata* seeds as the model. It suggests BFFHW based AC plays an important role on enhanced the removal of textile dyes from textile wastewater effluent.

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1. Introduction

Micropollutants (MPs) in wastewater are enormously harmful to microbes, plants, animals, humans, and aquatic organisms, because of their rising biological functional effects (Samarbaf et al., 2019; Mohammed et al., 2020a,b). The wide use of dyes in the modern textile industry produces a huge quantity of untreated wastewater, which threatens the aquatic ecosystem, soil fertility, and human health (Senthil Kumar et al., 2018; Han et al., 2020). Textile dyes are highly resistant to general organic treatment of wastewater effluent because of their chemical nature and complex molecular structure of the synthetic dye. Textile industries consume approximately 56% of the total synthetic dye produced yearly worldwide and discharge directly as wastewater about 280,000 tons of dyes in industrial runoff globally (Mohamed et al., 2018). Therefore, removal the synthetic dye before releasing them into the aquatic system is essential to find a cost-effective, eco-friendly way.

Several biological and physico-chemical methods have been employed to remove the textile dyes from wastewater. Instances of these are membrane filtration (Thuyavan et al., 2020), ion exchange (Hassan and Carr, 2018), coagulation–flocculation (Torres et al., 2019), photocatalytic degradation (Rajagopal et al., 2020), sonocatalytic degradation (Moalem-Banhangi et al., 2020), electrochemical degradation (Santos et al., 2020), chemical precipitation (Shen et al., 2019), and using microbes like fungi (Isik et al., 2019), bacteria (Kumar et al., 2019), and yeast (Ali et al., 2021) have been applied for

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Molecular insights of hyaluronic acid-hydroxychloroquine conjugate as a promising drug in targeting SARS-CoV-2 viral proteins

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COVID-19
Docking studies
Hyaluronic acid

ABSTRACT

In-silico anti-viral activity of *Hydroxychloroquine* (HCQ) and its Hyaluronic Acid-derivative (HA-HCQ) towards different SARS-CoV-2 protein molecular targets were studied. Four different SARS-CoV-2 proteins molecular target i.e., three different main proteases and one helicase were chosen for *In-silico* anti-viral analysis. The HA-HCQ conjugates exhibited superior binding affinity and interactions with all the screened SAR-CoV-2 molecular target proteins with the exception of a few targets. The study also revealed that the HA-HCQ conjugate has multiple advantages of efficient drug delivery to its CD44 variant isoform receptors of the lower respiratory tract, highest interactive binding affinity with SARS-CoV-2 protein target. Moreover, the HA-HCQ drug conjugate possesses added advantages of good biodegradability, biocompatibility, non-toxicity and non-immunogenicity. The prominent binding ability of HA-HCQ conjugate towards Mpro (PDB ID 5R82) and Helicase (PDB ID 6ZSL) target protein as compared with HCQ alone was proven through MD simulation analysis. In conclusion, our study suggested that further *in-vitro* and *in-vivo* examination of HA-HCQ drug conjugate will be useful to establish a promising early stage antiviral drug for the novel treatment of COVID-19.

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1. Introduction

The treatment of COVID-19 viral disease, remains challenging; it is a global issue, which requires both the national and the global approaches. To save lives an efficient and safe prescription drug for the disease is urgently needed. Several antiviral drugs have been considered for the treatment of the disease such as Hydroxychloroquine (HCQ), Lopinavir, Ritonavir, Favipiravi, and Remdesivir; the later originally used for the Ebola virus disease, MERS and SARS viruses have been recommended for COVID-19. Although the above-mentioned drugs show positive activity towards the disease, almost all of these drugs are associated with few disadvantages such as insolubility, some toxicity, instability, and kidney clearance [1,2].

Based on our research work on pharmacologically important drugs such as camptothecin, methotrexate, methylprednisolone, propofol to improve their efficacy and targeting delivery for the treatment of diseases such as cancer, arthritis, osteoporosis and anaesthetics respectively; we have developed a unique technology, according to which, the drugs were specifically and covalently linked to the hyaluronic acid (HA) molecule, a natural biopolymer, biocompatible, ubiquitously present in the human and animal body, to afford new drugs, new chemical entities, possessing the unique biological functionalities and properties of both the components synergistically; the evidence is available that the conjugation of drugs with macromolecules enhances the pharmacokinetic profiles of the drugs themselves [3–5].

Hyaluronic acid (HA) generally referred to as Hyaluronan is an anionic, non-sulfated mucopolysaccharide spreading widely throughout the connective and epithelial tissues of animals. HA is one of the main components of the extracellular matrix (ECM) and contributes significantly to the activation of signaling path-

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Metabolic annotation, interactions and characterization of natural products of mango (*Mangifera indica* L.): ^{1}H NMR based chemical metabolomics profiling

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Metabolic pathways

ABSTRACT

We examine the relationship between wetland (WL) and dryland (DL) Mangifera indica L with dietary-induced metabolic homeostasis. The typical Indian mango fruit Mangifera indica L has shown promise in the prevention of diarrhea and its complications. However, there is little information available regarding the characterization of organic compounds, metabolites, small molecules, and phytochemicals derived from *Mangifera indica* L. (Mango). In this study, we performed a global target profiling investigation of phytochemicals and inhibitors in *Mangifera indica* L.using proton nuclear magnetic resonance (^{1}H NMR) signals. The glutathione (GSH), trimethylamine-*N*-oxcide (TMAO), and trimethylamine (TMO) are associated with disruptions of oxidative stress metabolisms. Metabolic differences of WL and DL mango were investigated with network analysis for revealing their metabolic discriminations. During plant life, fertilization, and biotic and abiotic stress reflected peculiar metabolomic profiles. The methodology is highly efficient, complex deconvolution, spectral baseline fitting that has transported to pattern recognition analysis. Fifty metabolites were identified and characterized which includes xanthones, phenolic acids, fatty acids, flavonoids, and amino acids. The current study is the first report of metabolites reglation by mango fruits. In conclusion, from Indian traditional mango fruits, we provide a perspective of metabolomic impacts and associated metabolic pathways with high-throughput analytical analysis.

1. Introduction

From the past decades, many cultivars of *Mangifera indica* L. (Mango; the king of fruits) are found worldwide. The mango fruits have been of various sizes, fruit peel color, shape, and composition. From these mango fruits, various metabolic organic compounds significantly play role in diseases and clinical therapeutic compounds [1,2]. Nowadays, diarrhea is a most important health issue, particularly in developing countries where it is assessed to be the second major reason of desease in children less than five years, killing more children than acquired

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ORIGINAL ARTICLE

Biofabrication of copper oxide nanoparticles@graphene oxide nanocomposite using *Annona muricata* leaf extract and its antibacterial and photocatalytic activity

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Abstract

The goal of this study was to examine an effective green synthesis of copper oxide nanoparticles (CuONPs) utilising *Annona muricata* leaf extract. Further, their synthesis of an optimal complex of CuONPs and graphene oxide (CuONPs@GO) nanocomposite for photocatalytic and antibacterial activity. The morphological and structural characteristics of CuONPs, CuONPs@GO complex, CuONPs@dye, CuONPs@GO@dye complex were confirmed by UV–Vis spectroscopy, X-ray diffraction (XRD), field emission scanning electron microscope-energy dispersive X-ray spectroscopy, and Fourier transform-infrared spectroscopy. The XRD showed that the size of synthesized CuONPs, and CuONPs@GO nanocomposites are face-centred cubic crystalline with 40 nm and were nearly spherical in shape. The photocatalytic activity of CuONPs and CuONPs@GO was measured using the photodegradation of methylene blue in the presence of sunlight. The result depicts around 95% decolorization efficiency at 150 min by CuONPs@GO compared to CuONPs as such. In addition, the assessment of antibacterial activity of CuONPs and CuONPs@GO towards both *Staphylococcus aureus* and *Salmonella typhi* showed a significant zone of inhibition. The results concluded that the green synthesized CuONPs@GO acts more promisingly as a perfect photocatalyst and antibacterial agent when it is enhanced with GO.

Keywords *Annona muricata* · Photocatalysis · Antibacterial activity · CuONPs · CuONPs@GO nanocomposite

Introduction

The exposure of various synthetic dyes and organic effluents into the water source from various industries such as textile, paints, cosmetic, paper, food, printing, plastic, and pharmaceutical industries are the man-made emerging pollutants to the environment (Das et al. 2019; Singh et al. 2019; Ahmaruzzaman 2021). The effluent released is potentially toxic, carcinogenic, and harmful to various aquatic eco-systems. Yet it is required to be removed using a safer and optimized method. The removal methods may include various physical and chemical treatments such as adsorption, membrane separation, biological degradation, flocculation, coagulation, photocatalysis, and advanced oxidation processes (Santhosh et al. 2017; Reddy et al. 2020; Chandrabose et al. 2021).

Nanomaterials are widely employed for a variety of applications ranging from diagnostics to biosensors. It is widely employed as a carrier for cellular labels for in vitro and in vivo imaging. Biosynthesis is now an essential element of the creation of metal oxide nanoparticles (Sathiyavimal et al. 2020, 2021). It removes hazardous compounds created by chemical processes as well as organic solvents from synthetic procedures (Hlongwane et al. 2019). There are various metal ions such as copper, zinc, gold, silver etc. Among the various metal nanoparticles copper oxide (CuO) plays an important

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ORIGINAL ARTICLE

Biogenic production of silver nanoparticles from milk of *Capra aegagrus hircus* and mechanism of antibacterial activity on different bacteria

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Abstract
In the present study, we report a simple, rapid, cost-effective approach for the white synthesis of silver nanoparticles (AgNPs) using *Capra aegagrus hircus* milk. The formation of AgNPs was visually examined and further investigated using UV–visible spectrophotometer, transmission electron microscopy, scanning electron microscopy with energy dispersive X-ray, Fourier infrared spectroscopy, and X-ray diffractometer. Crystalline lattice indices of AgNPs were performed using the XRD analysis. The diffraction peaks at 2θ values of 37.7°, 46.1°, 67.4°, and 76.84° corresponding to lattice planes (111), (200), (220), and (311), respectively. The obtained AgNPs were spherical in shape with the size between 5 and 50 nm. The antibacterial activity of AgNPs against *Klebsiella* sp. (Accession Number: KC899845), and *Staphylococcus* sp. (Accession Number: KC688883) were evaluated by means of cell growth.

Keywords Antibacterial · Goat milk · Silver · Pathogens · White synthesis

Introduction

Nanoparticles are being considered as an eminent component of the widely accelerating field of nanotechnology exemplifying various real-world applications. In the realms of metal nanoparticles, silver, gold, copper, and zinc oxide have been demonstrated as phenomenon alternative therapeutic agents (Khan et al. 2021). Metallic nanoparticles have attracted considerable scientific interest due to their unique optical properties of surface plasmon resonance (SPR) and physicochemical properties (Castro et al. 2014). They are classified into different types such as carbon, metal, ceramic, polymeric, semi-conductor, and lipid-based nanoparticles, based on size, and structure properties (Thomas et al. 2015). Among them, silver nanoparticles (AgNPs) are one of the most sought after and greatly investigated metal nanoparticles.

Silver nanoparticles (AgNPs) are one of the most engineered nanoparticles used in several commercial areas, including medical devices, healthcare products, cleaning agents, food storage, packing, and textile coatings (Rolim et al. 2019). Silver nanoparticles (AgNPs) play a significant role in resolving numerous medical problems due to their chemical biocompatibility, inertness, oxidation resistance, and safe use as antibacterial activity (Carlson et al. 2008) against a variety of microorganisms (Mahmoud et al. 2021). The antimicrobial potency of silver nanoparticles increased the usage of silver nanoparticles in wound dressing, drug carriers, and in artificial implantation (Liao et al. 2019). They are also used for environmental applications because of their potent antimicrobial activity against bacteria, viruses, and fungi (Rolim et al. 2019; Ahluwalia et al. 2018).

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Biomimetic synthesis of iron oxide nanoparticles using *Canthium coromandelicum* leaf extract and its antibacterial and catalytic degradation of Janus green

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Keywords:
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Canthium coromandelicum
Dye degradation
Antibacterial activity

ABSTRACT

The present study was emphasized to investigate the novel use of aqueous leaf extract of *Canthium coromandelicum* (CC) to synthesize iron oxide nanoparticles (CC-IONPs) by reducing Iron(II) chloride. FT-IR analysis revealed that the presence of polyphenols and organic acids in CC extract, which was responsible for capping and stabilization of CC-IONPs. SEM image confirmed the spherical nature, and EDS spectrum confirmed the presence of iron peak at 6.3 keV. In addition, magnetic nature with a saturation magnetization of 20.32 emu/g was observed using vibration sample magnetometer (VSM). The biogenic synthesized CC-IONPs exhibits potential antibacterial activity against *Staphylococcus aureus* and *Salmonella typhi*. Furthermore, CC-IONPs exhibited tremendous degradation efficiency (97.23%) for Janus green B (JG) at 180 min under sunlight irradiation.

1. Introduction

In recent days, the biogenic synthesized iron oxide nanoparticle (IONP) have found wide applications in environmental remediation, catalysis, drug delivery, hybrid nanoparticles and so on [1–4]. IONPs can be prepared through traditional synthetic methods such as hydrothermal synthesis, microemulsion formation, electrochemical synthesis, sol-gel synthesis, and laser pyrolysis [5]. It is a technological challenge containing a large surface ratio, energy surface also high in the surface. When used the plant material, it used to minimize the surface energy level. It has the ability to easily air oxidizing capacity, more chemical activity, and increase the neutrality. After using the leaf extract, the magnetism is lost and lost the disposability. Based on the stability, neutrality, magnetism, and protection strategy of iron oxide is essential. The dispersion effect of the layer-by-layer containing parts in the ion is very important characteristic nature and exhibited more virulence due to the natural leaf extract usage. It also helped to more process of nanoparticles synthesis and alignment of the particles in the proper place. Usually biosynthesized process of nanoparticles are very important in recent years compared to chemical and physical due to the effect of surface volume decrease, adaptability increase, and mainly less toxicity. Previously, chemical and physical mediated nanoparticles are heightened with more toxicity [6]. Researchers are thinking about the reducibility and reproducibility of all the gains from another route, at the same time biological synthesis process helped their research to decrease the toxicity.

The toxicity levels are also important factors for all the processes of physical, chemical, and biological. When the toxicity level decrease gradually, all the negative effects are completely changed to positive charges and affect the entire process. Based on this concept, now a day

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Research Paper

In Silico Molecular Docking on Bioactive Compounds from Indian Medicinal Plants against Type 2 Diabetic Target Proteins: A Computational Approach

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Natural chemical compounds from medicinal plants used for the healing of diseases and disorders with fewer side effects, easy accessibility and economically cheap. The current study was aimed at finding novel drug like molecules as anti-diabetic compounds using *in silico* approach. Intermolecular interactions between target proteins and different antidiabetic compounds were observed. Five phytocompounds were selected from *Plumbago zeylanica*, *Neolitsea cassia* and *Wrightia tinctoria* and taken for molecular docking against human pancreatic alpha-amylase and human dipeptidyl peptidase IV using Autodock 4.2. Among the five phyto compounds, 6 urs-12-en-24-oic acid *Plumbago zeylanica* is the best compound for both the human pancreatic alpha-amylase and human dipeptidyl peptidase IV inhibition, as it possessed higher value in molecular dockings.

Key words: Molecular docking, *in silico* study, Autodock, alpha-amylase, dipeptidyl peptidase IV

Type 2 Diabetes Mellitus (T2DM) is a critical metabolic failure characterized by less insulin action and high blood glucose level[1]. T2DM is signified as the quickest worldwide threat to people's health[2] and it causes blindness, lower limb amputation and kidney disease[3]. As stated by WHO, 350 million people may be affected in 2030 globally, if the action has not been taken against T2DM[4]. Alpha (α)-Amylase and Dipeptidyl Peptidase IV (DPP IV) inhibitors used to protect the digestion of starch and other carbohydrates with T2DM patients[5].

α-Amylase universally distributed throughout the animal, plant and microbial kingdoms. Many mammals secrete two types of α-amylase, one is salivary α-amylase by the parotid gland and another one is pancreatic α-amylase secreted by the pancreas[6]. α-Amylase inhibitors extensively used in the therapy of T2DM. DPP IV inhibitor has the potential to be a novel, efficient and considerable agent to treat T2DM[7]. The usage of DPP IV inhibitors has fewer side effects like hypoglycemia, increasing body weight and gastrointestinal tract disorders[8]. The research of oral glucose tolerance tests on animals revealed that genetic deletion of DPP IV has increased the glucose tolerance and the secretion of insulin[9]. It encourages the study of α-amylase and DPP IV inhibitor bioactive compounds from medicinal plants which have fewer side effects, low cost and are easy to obtain.

Numerous drugs such as meglitinides, biguanides, sulfonylureas, thiazolidinediones, α-amylase inhibitors, DPP IV inhibitors used to treat the T2DM[10]. The side effects of these enzymatic inhibitors are flatulence, low blood sugar and hepatitis[11,12]. In recent years, a variety of research has done on plants[13-19]. Besides, several herbs and fruits have the property of inhibitors[16,17]. The known natural inhibitors of digestive enzymes include phytocompounds which operate through various mechanisms[17]. Today, researchers emphasis primarily on the finding of practical and low side effect therapeutic drugs to treat T2DM[20]. Medicinal plants produce secondary metabolites that have effective antidiabetic potentials to regulate blood glucose level. In conventional treatment, several medicinal plants

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Full Length Research Article

Molecular Docking Analysis for the Compounds of *Ziziphus jujuba* – An Indian Medicinal Plant

S. Ponmani*[1] and T. Selvankumar[3]

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ABSTRACT

Molecular docking plays a major role in drug discovery. Right from the past, docking studies among the particular compound against particular disease served as a pool proof in the medical field to struggle against the many dread full diseases. The compounds identified from many natural resources played a predominant role in treating the human disorders at the earliest. In such a way, *Ziziphus jujuba* – an Indian medicinal plant was analyzed briefly at the molecular level to find out the active biological compound against the most predominant cause of cancer. Thus, the compounds identified from different solvent extracts were exposed in this present study. Twenty-seven compounds identified from different solvent extracts were docked against Human Cyclin Dependent Kinase II. This study concluded that, among all those different compounds, only three compounds like Stigmast-5-en-3-ol, Campesterol and Eicosanoic acid showed better binding activity against human cyclin dependent kinase II when compared to all other compounds. Thus, the present investigation revealed an understandable knowledge about the compounds present in *Ziziphus jujuba* for the future research work.

Key words: Molecular docking, *Ziziphus jujuba*, Binding affinity, Active compounds

As the technology was improved and modernized the analytical method named molecular docking was considered as a powerful tool for remodeling the compound as an effective drug for treating the human disorders. At the earlier stage, docking method was compared with the lock and key model projected by Fischer, as that in the same way the ligand binds with the docking receptor [1]. In the docking analysis the binding affinity and the scoring function plays a major role in determining the activity of the particular compound against the docking receptor [2]. Though lot of development was discovered among the medical field the usage of natural compound obtained from the Indian medicinal plants were become a leading source in treating various diseases. Even though, more medicinal plants were available in our day-to-day life, studying about the phytochemical compounds along with its effective pharmacological properties were not properly retrieved. Among different medicinal plants, *Ziziphus jujuba* – an Indian medicinal plant plays a multipurpose role in curing many ailments.

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Ziziphus jujuba belongs to the family of Rhamnaceae and scattered around the subtropical regions throughout the world. Each and every part of this plant served as an excellent source of medicine for treating the human disorders [3]. The fruits and seeds of this species possess numerous pharmacological properties and the dried powder of its seed was used as a component of folk medicine in eastern part of Asia [4]. The seeds of this fruit were mainly used in the treatment of insomnia and also used as a tremendous sleeping dosage by the Chinese people for the past 200 years [5-6]. On account of its medicinal properties, the compounds were identified from the leaves, fruits and seeds of this particular species and allowed for molecular docking against the human cyclin dependent kinase II in this present study. Thus, the present research work was focused on establishing the biologically active phytochemical compounds from the Indian medicinal plant.

MATERIALS AND METHODS

Target selection

The X-ray Crystal Structure of Human cyclin dependent kinase 2 was selected as target protein and retrieved from Protein Databank. Using PyRx, the protein in PDB format was converted into PDBQT file and used for further Docking studies.

Ligand selection

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ORIGINAL ARTICLE

Photocatalytic degradation of malachite green and antibacterial potential of biomimetic-synthesized zirconium oxide nanoparticles using *Annona reticulata* leaf extract

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Abstract
The present study was emphasized to investigate the photocatalytic degradation of malachite green (MG) and antibacterial activity of zirconium oxide nanoparticles synthesized from *Annona reticulata* leaf extract (AR-ZrO_2NPs). The biologically synthesized AR-ZrO_2NPs were characterized by UV–visible spectroscopy, Fourier transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), and Field emission scanning electron microscope (FESEM). The UV–visible spectrum of AR-ZrO_2NPs showed a characteristic surface plasmon resonance (SPR) peak at 256 nm. The XRD analysis exhibited that the AR-ZrO_2NPs were crystalline in nature. FT-IR revealed that the AR leaf extract has stabilized with the nanoparticles by a capping agent. In addition, electron microscopic results revealed that the AR-ZrO_2NPs were spherical in shape and found to be 13–20 nm range in size. The biologically produced AR-ZrO_2NPs have antibacterial action against *Salmonella enterica serotype typhi*, which is multi-drug-resistant. Furthermore, AR-ZrO_2NPs demonstrated exceptional degrading efficiency for MG, with about 87.4% elimination in 150 min of sunshine irradiation. As a result, this research concludes that AR leaf extract is a possible green resource for AR-ZrO_2NPs synthesis with multi-potential applications.

Keywords *Annona reticulata* · Zirconium oxide nanoparticles · Malachite green dye · Photocatalytic activity · Antibacterial potential

Introduction

Recently, textile effluents have emerged as emergent pollutants in the previous decade because of their widespread use and continuous discharge to aquatic sources. The potential environmental risks of textile effluents include creation of antibacterial resistance, bioaccumulation, and toxic to the living organisms. Photocatalysis is gaining popularity due to its potential uses in pollutant degradation, solar fuel production, and environmental cleaning (Saravanakumar et al. 2016a, b, 2018). In recent years, metallic nanoparticles have received significant attention due to their broad physico-chemical properties, which are considerably different from the bulk materials, and their desirable applications in fields of science, technology, and medicine (Gopu et al. 2021; Sampath et al. 2021). Zirconium oxide nanoparticles (ZrO_2NPs) are type of the noble metal nanoparticles with wide range applications such as ceramic making, sensors, biomaterial, fuel cells, dental care, catalytic activity, water purifications, intracellular

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Annona reticulata leaves-assisted synthesis of zinc oxide nanoparticles and assessment of cytotoxicity and photocatalytic impact

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Cytotoxicity effect

ABSTRACT

The objective of this study is to examine the novel usage of the aqueous leaf extract of *Annona reticulata* (AR) to produce zinc oxide nanoparticles (AR-ZnONPs) by reducing zinc nitrate. Fourier-transform infrared (FT-IR) spectroscopy analysis revealed that phytochemical compounds in AR leaf extract was responsible for capping and effective stabilization of AR-ZnONPs. The energy-dispersive X-ray (EDX) spectra showed the existence of a zinc peak at 1 keV. In addition, the arrangement of a face-centered cubic crystalline construction was also confirmed by X-ray diffraction (XRD) analysis. The biologically produced AR-ZnONPs have a potential cytotoxicity effect against human lung cancer (A549) cells. Furthermore, AR-ZnONPs exhibited tremendously degradation efficiency for the methylene blue (MB) almost 93.45% removal in 70 min sunlight irradiation.

1. Introduction

In recent years, zinc oxide nanoparticles (ZnONPs) have emerged as one of the most significant metal oxide nanoparticles, owing to their particular structure and uses, as well as their excellent biocompatibility, economic advantages, non-toxicity, and high stability [1]. ZnONPs are used in a variety of applications, including sensors, photocatalysts, cosmetics, and environmental remediation [2]. ZnONPs are synthesized using a variety of physical and chemical techniques; however, these techniques are expensive and employ hazardous chemicals. According to Govarthanan et al. [3] green synthesized ZnONPs serve as an alternative route to the physical and chemical techniques. ZnONPs have been produced from the leaf extracts of a variety of plants, including *Thymbra spicata* [4], *Cinnamomum tamala* [5], *Melia azedarach* [6], *Alchornea laxiflora* [7], *Syzygium cumini* [8] and *Atalantia monophylla* [9] etc, and because of highly stable in nature, eco-friendly and acquired various applications including cytotoxic effect and photodegradation of textile dyes [10].

Annona reticulata (Family: Annonaceae), also known as ramphal plant, and custard apple, is a tropical plant extensively distributed in tropical regions, especially India [11]. Herein, we first time report the low-cost and eco-friendly synthesis of ZnONPs utilizing *A. reticulata* leaf extract as a reducing agent. UV–Vis spectroscopy, XRD, FESEM, and FT-IR analyses were used to characterize the AR-ZnONPs. Finally, the cytotoxicity effect against A549 cell line and photocatalytic degradation of MB was investigated.

2. Experimental

2.1. Collection and preparation of A. reticulata aqueous leaf extract

The *A. reticulata* leaf was collected from the Kolli Hills (11°14′54.65″N, 78°20′19.35″E), Namakkal District. Ten grams of AR powder were mixed in 100 mL of distilled water and heated for 30 min before being filtered through Whatman No. 1 filter paper and kept at 4 °C for AR-ZONPs synthesis.

2.2. Biomimetic synthesis of AR-ZnONPs

The synthesis of ZnONPs derived from *A. reticulata* (AR) leaf extract

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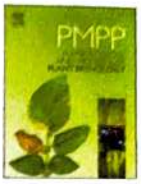

Molecular characterization of the phytopathogen *C. theae* (Petch) – Causative of birds eye spot infection in *Camellia sinensis* host through DNA polymorphism and proteome analysis

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Protein extraction

ABSTRACT

The pathogenic fungus *Cercospora* infecting plants causes high degree symptomatic disease in several important crops including tea (*Camellia sinensis*). Genetic diversity studies on plant pathogens are essential to tackle plant diseases, hence in the proposed study, *Cercospora theae* isolated from different regions was characterized using the molecular tool like RFLP of the rDNA regions amplified using ITS primers. Protein profiling for all the isolates was also done by optimizing the protein extraction using sodium dodecyl sulphate (SDS), urea and Trichloroacetic acid (TCA) protocols. Genetic relatedness with the identical size of molecular weight among the three *C. theae* isolates of different regions was studied from the 5.8S rDNA-ITS amplified regions. Digestion of the amplified regions with seven specific endonucleases exposed the same banding pattern among the isolates. The sequence data from the three isolates showed maximum homology with the Genbank sequence of *Cercospora* spp. (HQ450006, JQ754039, JQ753964, JN942274, JN942272, FJ460222 and EU581822). Further, an optimized protocol for protein profiling of *C. theae* was determined to extract the majority of the proteins. The results also revealed that the most suitable protocol for studying the proteomics of *C. theae* was the SDS extraction method.

1. Introduction

Among the plant pathogenic fungi, *Cercospora* spp. presents a huge range of capability to cause diseases covering different hosts. In southern India, the genus is reported to infect many vegetable crops [1]. *Cercospora theae* (Petch) is recorded as a primary pathogen causing spots in leaves of tea plants like birds eye and defoliation in the same. The disease is widely known to be sporadic and common in southern tea estates of India [2]. It is commonly called bird's eye spot disease. This fungus belongs to the group of Ascomycetes [3]. In most of the *Cercospora* species, sexual stage is not determined but there are exceptionally identified in the same genus which reproduces sexually and is called *Mycospherella* [4]. So far, fungal morphologyis the prime technique to identify *C. theae*. Molecular characterization of the pathogen in the aspect of genome and proteome would ultimately help in developing suitable control measures for this disease in tea plantations [5]. The use of ribosomal DNA (rDNA) amplification for phylogenetic studies of fungal genomes is widely known in many plant pathogens [6]. The internal transcribed spacer (ITS) region is one important region among the rDNA region which is conserved with huge repeat units that evolves faster among species and varied within a genus or any set of population [7]. Knowledge of genetic variability in several fungi aided to develop much more advanced methods to let know the distinguished characteristics that are responsible for bringing pathogenicity so as to devise the precise technology of biocontrol [8]. Additionally, a throughput protein profile analysis amongst pathogenic isolates for discovering

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Facile synthesis of iron oxide nanoparticles using *Cassia auriculata* flower extract and accessing their photocatalytic degradation and larvicidal effect

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ABSTRACT

The present study validates the green synthesis of iron oxide nanoparticles (IONPs) using aqueous extract of *Cassia auriculata* (CA) flower. The green-synthesized *Cassia auriculata* iron oxide nanoparticles (CA-IONPs) were characterized by UV–Vis spectroscopy, Fourier transform infrared (FT-IR) spectroscopy, Field emission scanning electron microscope (FESEM) with Energy dispersive X-ray spectroscopy (EDX), Transmission electron microscopy (TEM), X-ray diffraction (XRD), and vibration sample magnetometer (VSM). The UV–Vis spectra of CA-IONPs revealed a broad absorption peak at 370 nm, and FT-IR represented the presence of bioactive functional groups. The results of XRD and VSM confirmed the crystalline nature and magnetic properties of CA-IONPs. FESEM result proves the spherical shape of CA-IONPs and existence of iron at 7.0 keV through EDAX. The Brunauer–Emmett–Teller (BET)-specific surface area of biosynthesized IONPs was recorded as 1.48 m^2/g. The photocatalytic efficiency of CA-IONPs against methyl green showed 91.2% decolorization within 150 min of visible-light irradiation. In addition, the CA-IONPs showed good larvicidal potential against dengue vector *Aedes aegypti*. Thus, the green-synthesized CA-IONPs confirmed to be a potential substance for environmental remediation and control the mosquitoes.

1 Introduction

Nanotechnology's current development has a competitive advantage in the nanoscience area, and it has grown in popularity over the last two decades. Nanoparticles (NPs) are mostly determined by its size which is less than 100 nm in diameter. Researches on NPs have sparked a lot of attention recently due to its unique properties and have been widely used in the removal of pollutants such as heavy

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ORIGINAL ARTICLE

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Laccase production from *Bacillus aestuarii* KSK using *Borassus flabellifer* empty fruit bunch waste as a substrate and assessing their malachite green dye degradation

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Abstract

Aims: The lignocellulosic waste, *Borassus flabellifer* empty fruit bunch waste (BFEFBW), was employed to produce laccase using *Bacillus aestuarii* KSK under solid-state fermentation (SSF) conditions and to assess the efficiency of malachite green (MG) dye decolourization.

Methods and Results: Abiotic factors such as pH (5.0–9.0), temperature (25–45°C) and incubation time (24–96 h) were optimized using Response surface methodology-Box-Behenan Design (RSM-BBD) to exploit the laccase production. The anticipated model revealed that the highest laccase activity of 437 U/ml shows after 60 h of incubation at 35°C at pH 7.0. The bacterial laccase was used to remove 89% of the MG dye in less time.

Conclusion: The laccase from *B. aestuarii* KSK decolorizes the MG and thereby making it a suitable choice for wastewater treatment from industrial effluents.

Significance and Impact of the Study: This study is the first report on the production of laccase from *B. flabellifer* empty fruit bunch waste as a substrate. *Bacillus aestuarii* KSK was isolated from the soil sample and used to produce laccase under SSF conditions. The bacterial laccase has the potential for industrial application in textile waste dye treatment.

KEYWORDS

Bacillus aestuarii KSK, laccase, malachite green dye decolourization, response surface methodology

INTRODUCTION

Water is one of the major sources for the survival of living organisms. In the era of emerging industrialization, the ecosystem is highly at threat by the release of untreated wastewater (Anita et al., 2020), especially, in textile dyeing and other industrial sectors in which synthetic colours are exclusively employed. These industries consume more than 7×10^5 tonnes of different textile dyes each year, with wastewater containing 15%–20% of total textile dyes consumed, which has been found to have a significant impact on the environment (Wang et al., 2020b). The malachite green (MG), which belongs to the triphenylmethane group, is the most common dye and is extensively used in textile dyeing industries (Balan et al., 2012; Roy et al., 2020).

Laccase (EC1.10.3.2, benzenediol: oxygen oxidoreductase) is a monomeric multi-copper enzyme that can reduce molecular oxygen to oxidize a variety of substrates including anilines, arylamines, ascorbic acid and phenols (Asadi et al., 2020; Debnath & Saha, 2020). Laccase, an environmentally beneficial and long-lasting catalyst, has been used

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Decolorization of safranin using *Fissidens* species and its ecotoxicological assessments: An *in vitro* and *in silico* approach

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In silico study

ABSTRACT

Decolorization of safranin was investigated using *Fissidens* species in a batch system under optimized conditions. The decolorization efficiency was improved by optimizing the conditions such as initial pH (3–9), temperature (25–45 °C), initial dye concentration (10–50 mg/L), biosorbent dosage (100–500 mg/L) and contact time (1–6 days). Maximum decolorization (95%) was recorded at initial pH of 6 with dye concentration of 20 mg/L, biosorbent dosage of 200 mg/L at 30 °C and contact time of 2 days. Desorption studies revealed 0.1 N NaOH as the best desorbing agent with 92% recovery on third day. Experimental data well fitted to Langmuir isotherm and Pseudo-second order kinetic model. The negative values of ΔG° and positive value of ΔS° and ΔH° indicates that the reaction is spontaneous, favorable and endothermic. The biosorbent - dye interactions were confirmed using UV–Vis, FT-IR, XRD and FE-SEM with EDX studies. The detoxified nature of the dye degraded metabolites was confirmed by the significant growth of green gram. The color fastness and color strength of the fabrics dyed using *Fissidens* species treated dye solution were compared with the tap water dyed fabrics which indicated the reuse potential of treated water in textile sector. The decolorization efficiency was further confirmed through *in silico* approach, where safranin well docked with the active sites of Photosystem II protein D1 of the *Fissidens* species. Thus, the present study proves that *Fissidens* species is a promising biosorbent for safranin decolorization and will lay a platform for the control and management of environmental pollution.

1. Introduction

Rapid technological development and urbanization leads to serious impact on environment and causes ecological imbalance. Textile industries involves the usage of enormous water for finishing process and releases densely colored wastewater which contains salts, detergents, acids, synthetic dyes, and heavy metals into aquatic and terrestrial ecosystem (Khan et al., 2022; Hu et al., 2020; Imran et al., 2019). Textile dyes have high molecular weight, and the complex chemical structure confers the ability to remain in recalcitrant nature and enables them to endure in natural environment for a protracted period (Dasgupta et al., 2015; Rane et al., 2014).

The discharge of dye containing colored wastewater into the ecosystem results in severe soil and water pollution, which consequently hinders the photosynthetic action of freshwater resources by reducing light penetration. This in turn affects the trophic level of the ecosystem, causing depletion in the dissolved oxygen level, reduction in the growth of the floral and faunal diversity. As a result, they pose a serious threat to the biotic and abiotic components of the ecosystem and necessitate the removal before discharged into the environment (Elbanna et al., 2010; Franciscon et al., 2012; Pathak et al., 2014).

In the present study, safranin is chosen as a candidate dye, since it is mainly used as a textile colorant, food dye in flavoring and coloring candies and cookies. It is also used for dyeing bastfibres, wool, silk,

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Enhanced photocatalytic activity of novel *Canthium coromandelicum* leaves based copper oxide nanoparticles for the degradation of textile dyes

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ARTICLE INFO

Keywords:
Canthium coromandelicum
Green approach
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Textile dyes

ABSTRACT

The present study focused to synthesize the copper oxide nanoparticles (CuONPs) using novel *Canthium coromandelicum* leaves in a cost-effective, easy, and sustainable approach. The obtained *Canthium coromandelicum*-copper oxide nanoparticles (CC-CuONPs) were characterized using UV–Visible spectroscopy, FT-IR analysis, FESEM, HR-TEM imaging, and XRD study. The XRD pattern verified the development of crystalline CC-CuONPs with an average size of 33 nm. The biosynthesized CC-CuONPs were roughly spherical, according to HR-TEM and FESEM analyses. FT-IR research verified the existence of functional groups involved in CC-CuONPs production. Cu and O_2 have high-energy signals of 78.32% and 12.78%, respectively, according to data from EDX. The photocatalytic evaluation showed that synthesized CC-CuONPs have the efficiency of degrading methylene blue (MB) and methyl orange (MO) by 91.32%, 89.35% respectively. The findings showed that biosynthesized CC-CuONPs might effectively remove contaminants in an environmentally acceptable manner.

1. Introduction

Rapid expansion, urbanization, and industrialization resulted in a massive influx of organic dyes and industrial effluents into the water resource. Organic dyes are used as colorants in a wide range of industries, including textiles and clothing, paper and pulp, leather processing, paints, cosmetics, printing inks, ceramics, food, pharmaceutical, and plastics (Duresa et al., 2020; Methneni et al., 2021; Verma et al., 2022; Waheed et al., 2021; Zhuang et al., 2022). These highly poisonous, non-biodegradable, and carcinogenic organic dyes can cause major health problems in human including skin illnesses, tumor, allergic reactions, and respiratory diseases (de Lima et al., 2017; Nidheesh et al., 2018; Tkaczyk et al., 2020; Zhao et al., 2021). For this motive, many water treatment technologies such as the adsorption/bio-oxidation process, precipitation, coagulation, flocculation, microbial action electrolysis, membrane filtration, activated carbon, and reduction reactions have been investigated to treat industrial effluents (Chowdhury et al., 2020; Januário et al., 2022; Lan et al., 2022). These approaches are extremely costly and frequently introduce harmful chemicals into the water resource system. As a result, it is necessary to develop a quick, cost-effective, and eco-friendly method for removing organic dyes from effluent (Mali et al., 2020). In recent times, green synthesized nanoparticles have attracted to a great extent interest due to their photocatalytic applicability in the breakdown of textile effluents.

The twenty-first century has seen a massive leap forward in the metal nanoparticles synthesis and application, with ever-increasing production and versatile applications. Nanoparticles (NPs) have a broad range of applications like optical, cosmetics, food industry, water purification, imaging, sensing, batteries, supercapacitors, catalysis, photovoltaic cells, paints, diagnostics, and drugs (Ali et al., 2021; Govarthanan et al., 2022; Ilyas et al., 2021; Kumar et al., 2021; Lee et al., 2013; Olga et al., 2022; Singh and Mishra, 2022; Zhang et al., 2022). Physical, hydrothermal and chemical reduction approaches for the synthesis of metal nanoparticles have all been commonly reported. These approaches are complicated, high expenses, and potentially toxic. Biosynthesis of nanoparticles using plant extracts provides an alternative approach to

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Limonia acidissima leaf mediated gold nanoparticles synthesis and their antimicrobial and wound healing properties

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ARTICLE INFO

Keywords:
Antibacterial activity
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Gold nanoparticles
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ABSTRACT

The present study explored the green synthesis of gold nanoparticles (AuNPs) using aqueous leaf extract of *Limonia acidissima* as a capping agent and their antibacterial and wound healing properties. The La-AuNPs confirm the color change from straw to ruby red shows an absorption peak at a wavelength of 560 nm in UV–vis spectrophotometer. High-resolution transmission electron microscope (HR-TEM) studies confirm the spherical shape and the average particle size is 100 nm. The synthesized AuNPs showed maximum antibacterial activity against E. coli shows an inhibitory action of 19 mm. In addition, the green synthesized La-AuNPs induced a significant effect of cytotoxicity effect against L929 cell lines, and also cell migration assay showed no toxicity.

1. Introduction

The protective barrier between the external environment and the internal body and also the largest organ of the body is the skin. Long accumulation of infectious microbes at the site of the wound, prolonged consumption of costliest medications all lead to the removal of the organ or death. The above incident pushed the researchers to introduce plant-based nanotherapeutics to fight against this multidrug-resistant (MDR) bacteria. Nanoparticles (NPs) like silver, gold, zinc, copper, and selenium completely remove the presence of microbes by focusing their attention on biomedical, drug delivery, food, and cosmetics [1,2]. Gold nanoparticles (AuNPs) play multi-fascinated roles in wound dressings, viral, fungal, and bacterial infections. Through top-up and top-down methods of metallic nanoparticles synthesis faces many challenges like bioaccumulation, expensive analysis, skilled operators, and problems in assembling heavy instruments or devices all these points should be met out to get a proper structural NPs. In the case of plants like *Aloe vera barbadensis, Nyctanthes arbortristis, L. acidissima,* and *Curcuma longa* (rich in antioxidants, anti-inflammatory properties) mediated nanoparticles lead to regulation, control, clean up, and remediation process directly helps to uplift environmental friendliness [3]. In the case of L. acidissima, all segments such as leaves, stem, bark, and twig contain numerous bioactive compounds and are used for healing processes. MDR bacteria are drastically shown resistant against the first to the fifth generation of the spectrum of antibiotics [4,5]. Nowadays, researchers constantly focus, on the cost-effective, eco-friendly, quick method of plant, bacterial, fungal, and algal-based NPs synthesis [6]. The fabric finishing process started using nanotechnology. Due to the high active surface, the cotton and mixed cotton fabrics are used on which the biosynthesized NPs from plants are coated which acts as the medication against the pathogens present in the infections. Hence, nanotechnology in fabric finishing is a primary report for using biosynthesized AuNPs from *L. acidissima* leaf extract. The biosynthesized AuNPs were characterized using UV–Visible spectrophotometer, Fourier-transform infrared spectroscopy (FT-IR), scanning electron microscopy with energy dispersive X-Ray (SEM-EDX) analysis, and High-resolution Transmission Electron Microscope (HR TEM). Moreover, the L929 cell lines viability and their migration against the biosynthesized La-AuNPs were investigated through MTTassay [7].

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Phytonanofabrication of copper oxide mediated by *Albizia amara* and its photocatalytic efficacy

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ARTICLE INFO

Keywords:
Albizia amara
Green synthesis
Copper oxide nanoparticles
Photocatalytic activity

ABSTRACT

The present study was explored to synthesis copper oxide nanoparticles (CuONPs) by green route using the leaf extract of *Albizia amara*. By adding 0.5 mM copper sulphate solution to 1 ml of the leaf extract, the colour change from light brown to green was observed within 60sec.The surface plasmon bands were observed at 270 nm and the Fourier Transform- Infrared (FT-IR) spectra confirmed the presence of functional groups which provoked the synthesis of CuONPs. The characteristic diffraction peaks reveals the crystalline nature of CuONPs through X ray diffractometer (XRD). Field Scanning Electron Microscopy (FESEM) and Energy Dispersive X Ray (EDX) spectroscopy showcased the spherical nature and the presence of copper nanoparticles. The photocatalytic activity of methyl red under solar irradiation decolourised 93% of colour using CuONPs.

1. Introduction

Nanoparticles, despite their small size, have immense potential for usage and have permeated practically in every sector. Considering the preparation of eco-friendly, cost-effective, non-toxic and high-quality nanomaterial, biogenic synthesis proves to be the best and the most investigated option. Metals such as copper, zinc, iron, silver, gold, and others have excellent optical, catalytic, physico - chemical and biological properties and play a key role in the nano revolution. Photocatalytic degradation of pollutants particularly dyes is a pressing requirement in the present era, as their use and demand have dramatically surged in various sectors [1]. One such colouring dye is methyl red, an azo dye which is widely used in textile and printing industries because of its ease, stability and excellent colour production. However, being a carcinogen it can hinder light penetration in water bodies, impairs the photosynthetic and metabolic activity of biota. Hence it is a great concern to remove methyl red from effluents through an effective approach before discharged into the ecosystem [2]. Copper is a versatile metal that has been utilized by humans for over 5000 years and now it is widely used as a nanoscale photocatalyst due to its bandgap, low toxicity, and surface synthesis properties [3]. *Albizia amara* (Fabaceae) commonly known as oil cake tree is distributed widely in Tamil Nadu, Andhra Pradesh and Karnataka which possess antimicrobial, anticancer, antioxidant, wound healing and anti-inflammatory properties [4–6]. As far as photocatalytic property is concerned, meagre studies have been probed into the dye absorption potential using *A. amara* leaves. In the present study, *A. amara* leaf extract is employed as a candidate plant to mediate the fabrication of copper oxide nanoparticles for the decolourisation of methyl red dye under solar irradiation.

2. Materials and methods

2.1. Fabrication of CuONPs

Fresh leaves of *Albizia amara* was collected from Vangal, Karur district, Tamil Nadu, India. The clean dried leaves were powdered and about 10 g were boiled in 100 ml of distilled water for 30 min and filtered. Different concentrations of Copper Sulphate ($CuSO_4 \cdot 5H_2O$) ranging from 0.1 mM to 0.5 mM was prepared and to each concentration 0.5–5 ml of *A. amara* leaf extract was added separately and the reaction

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ORIGINAL ARTICLE

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Prodigiosin production from *Serratia marcescens* strain CSK and their antioxidant, antibacterial, cytotoxic effect and in silico study of caspase-3 apoptotic protein

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Abstract

The present study emphasizes the production and optimization of prodigiosin (PG) pigment from *Serratia marcescens* strain CSK, which was isolated from Shevaroy Hills, Salem district, Tamil Nadu, India. The response surface methodology analysis was applied for the optimization process of PG production. The maximum production of PG (2950 mg/L) was obtained at pH 7.0 with the addition of tryptophan (4.0 g/L) and sucrose (3.0 g/L) with 60 h of incubation. Further, the PG was characterized using high-performance liquid chromatography, Fourier-transform infrared spectroscopy, and gas chromatography-mass spectrometry. The purified PG exhibited strong antioxidant and antibacterial activities. Also, PG's cytotoxic effects against human breast cancer (MCF-7) cells were observed through acridine orange-ethidium bromide (AO-EB) and Hoechst staining. Molecular dockingstudies revealed that PG could bind positively to the caspase-3 (breast cancer protein 1RE1) binding site with a binding energy score of 17.37 kcal/mol. Overall, the novel PG was found to be an anticancer drug for potential applications in the pharmaceutical industry.

KEYWORDS

apoptotic effect, caspase-3-docking, prodigiosin, response surface methodology, *Serratia marcescens* strain CSK

1 | INTRODUCTION

It is well known that the pigments are extensively used in diverse fields including textiles,[1] food colorants,[2] dye-sensitized solar cells,[3] paper coatings,[4] printing press,[5] cosmetics,[6] and pharmaceuticals,[7] etc. However, synthetic colorants have negative effects such as allergy, neurological dysfunction, cancer and also produce highly toxic pollutants.[8] Therefore, the development of natural pigments has become imperative in recent days to replace synthetic dyes for food colorants and pharmaceutical applications. Bacteria,[9] actinomycetes,[10] fungi,[11] algae,[12] plant fruits,[13] leaves,[14] and flowers[15] have been used as natural sources for pigment production. These biopigments are found to be harmless because of their nontoxic, easy biodegradability, and environment-friendly nature.

Among these, bacteria are considered as the most promising organisms for the production of natural pigments than insects and plants due to their mass cultivation,

Abbreviations: HPLC, High-performance liquid chromatography; FT-IR, Fourier-transform infrared spectroscopy; GCMS, Gas chromatography-mass spectrometry; TLC, Thin-layer chromatography; DPPH, 2,2-diphenyl-1-picrylhydrazyl; ABTS, 2,2′-azino-bis (3-ethylbenzothiazoline-6-sulfonate).

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Screening the Therapeutic Potential of Methanolic Stem Extract of *Cissus arnottiana*

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Modern lifestyle, pollution, food habit, and stress have intensively enhanced the evolution of several diseases on human being. Medicinal plants are used from the ancient times for the therapeutic needs to cure various diseases as well as less toxic in nature. One of such plant is Cissus arnottiana which is used from the olden days which has been identified as an important medicine plant by many researchers all over the world. Cissus arnottiana contains phytochemicals such as alkaloids, tannins, terpenoids, flavonoids, phenolic compounds etc. In this present work methanolic stem extract of Cissus arnottiana is used to evaluate the antibacterial activity of gram negative and gram positive human pathogenic bacteria. DPPH assay is used to investigate the antioxidant properties of the methanolic extract. The anti-inflammatory activity of the extract has been studied using anti proteinase assay. The MTT cell proliferation assay is carried out against HeLa cell line in which 44% of cells are viable for the concentration of 100 μg/mL. Interestingly, the methanolic stem extract can be used as a potential candidate for new therapeutic applications.

Keywords: Cissus arnottiana; Cell Lines; Plants Extract; Phytochemicals.

From the ancient traditional time, medicinal plants had played a vital role in medication field. The best antidote for curing various diseases is done using plant kingdom [1,2]. Interestingly, it is found that three quarters of world population depends on plant extracts for most of the healthcare issues [3]. According to WHO, it is reported in the recent years 80% of world population uses traditional medicinal plant extract for health coverage. Interestingly it is found that due to the nuisance in using drugs and its side effects 38% of Americans uses traditional plant extracts for medicinal issues [4]. When compared with the allopathic medicine, plant and its extracts give better relief due to the discomfort caused by the synthetic drugs. The pharmaceutical industries that discover drugs also depend on the natural plant and its extract equally due to its aftermath caused by the drugs used in the medicines, which leads to ample loss in the field of pharmaceutical [2]. Therefore, plants and its extracts-based health care products is trending in both developed and

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சங்க காலக் கள்வர்கள்

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மஹேந்த்ரா கலை அறிவியல் கல்லூரி, காளிப்பட்டி

சங்ககால மக்கள் பலவிதமான தொழில்களைச் செய்து வாழ்ந்து வந்தனர். ஒருவரிடம் உள்ள பொருளை இன்னொருவர் கவர்வது அல்லது பிடுங்குவது திருட்டு என்று இக்காலத்தில் அழைக்கப்படுகிறது. சங்க காலத்தில் பாலை நிலங்களில் வாழ்ந்த மக்களில் பெரும்பான்மையோர் ஆறலைத்தல் எனப்படும் வழியில் செல்லும் மக்களைத் தாக்கிக் கொள்ளையடிக்கும் வழக்கத்தைக் கொண்டிருந்தனர். குறிஞ்சி, முல்லை நிலங்கள் நல்ல நிலங்களாக இருக்கும்பொழுது அங்கு வாழும் மக்களின் பண்புகளும் நன்றாகவே இருந்தன. இந்நிலங்கள் வறண்டு பாலை நிலமாக மாறிய பின்னர் அங்குள்ள மக்களும் தம்முடைய வறுமை காரண மாக கொள்ளையடிக்க ஆரம்பித்து பின்னர் அதுவே தொழிலானது. வழிப்பறி செய்யும் ஆடவர்கள் கள்வர் என அழைக்கப்பட்டதைச் சங்க இலக்கியங்கள் நமக்கு உணர்த்துகின்றன.

இக்கள்வர்கள் வலிமை மிகுந்த கட்டான உடலையுடையவர். கறுத்துச் சுருண்ட மயிரினை உடையவர்கள். கொடும்புலியின் பார்வை போன்று அச்சம் விளங்கப்பார்ப்பவர்கள். அக்கள்வர்கள் தம் கையிலே வில்லேந் தியவராக அவ்வழியே வருவோரைக் கொள்ளையிடும் வாய்ப்பை எதிர்நோக்கிக் காத்திருப்பர். வழியே வருவோர் பொருள் ஏதும் இல்லாதிருந்தால் கூட அவர்களை வீழ்த்தும் கொடிய இயல்பினர். அக்கொடுமை யைக்கண்டு அஞ்சி பறவையினங்கள்கூட நடுங்கி அவ்வழியே வருவதில்லை என்று கலித்தொகை உணர்த்து கிறது. இதனை

வலிமுன்பின் வல்லென்ற யாக்கைப் புலிநோக்கின்
சுற்றமை வில்லர் சுரிவளர் பித்தையர்
அற்றம் பார்த்தல்கும் கடுங்கண் மறவர்தாம்
துள்ளுநர்க் காண்மார் தொடர்ந்து உயிர்வெளவலின்
புள்ளும் வழங்காப் புலம்புகொள் ஆரிடை[1]

என்ற அடிகள் உணர்த்துகின்றன. கள்வர்கள் செய்யும் கொடுமைகளைக் கண்டு பறவையினங்கள் கூட அவ்வழியில் செல்ல அஞ்சும் என்பதால் கள்வர்களின் இயல்பை உணரமுடிகிறது.

படைகள் சூழ அரசனே பெரும்படையுடன் வந்தாலும் இக்கள்வர்கள் அஞ்சமாட்டார்கள். வலிமை மிகுந்த வில்லை வளைத்து அதிலே முறுக்கமைந்த நாண் கயிற்றைப் பூட்டுவர். படைகள் மீது அம்பு தொடுப்பது தம் வீரத்திற்குத் தகுதியற்றது என்று வெட்கங்கொண்டு நாணைத் தெறித்து ஒலி எழுப்புவர். சிங்கக்குரலைக் கேட்ட விலங்கினம் சிதறி ஓடுவதுபோல் அவ்வொலி கேட்ட அளவில் -அரசரோடு வந்த படையினர் புறமுதுகு காட்டி ஓடுவர். அவர்கள் ஆரவாரமாக துடியோசையுடன் வருவர். கலைமானின் கொம்புகளைப் போல அவர்களது தாடி முறுக்குண்டு திருகித்தாழ்ந்து தொங்கும். காட்டுவழியில் வருபவர்களின் பொருள்களைப் பறித்துக்கொண்டு, அவற்றிற்கு ஈடாகப் புண்களைத் தந்து போகவிடும் இயல்பை உடையவர்கள் கள்வர்கள் என்று விரிவாக உணர முடிகிறது. இதனை,

அரிமான் இடித்தன்ன அஞ்சிலை வல்வில்
புரிநாண் புடையின் புறங்காண்டல் அல்லால்
இணைப்படைத் தானை அரசோடு உறினும்
கணைத்தொடை நாணும் கடுந்துடி ஆர்ப்பின்
எறுத்து வழிய எறுழ்நோக்கு இரலை
மருப்பின் திரிந்து மறிந்து வீந்தாடி
உருத்த கடுஞ்சினத்து ஓடா மறவர்
ருள் கொண்டு புண்செயின்[2]

என்ற அடிகள் உணர்த்துகின்றன. அரசனையே எதிர்க்கும் ஆற்றல் பெற்ற இவர்கள் யாரைக் கண்டும் அஞ்ச மாட்டார்கள் என அறியமுடிகிறது. பொருளைப் பறித்துக்கொண்டு புண்ணைத் திருப்பிக்கொடுத்து உயிரோடு

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SCRUTINY OF HEALTHCARE PROTECTION USING CLOUD COMPUTING AND CRYPTOGRAPHY

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ABSTRACT

Cloud services are back for storing then retrieving the data. Cloud storage accessing developed because of high secured Cloud technology the use of encryption yet decryption method. Cryptography remain encrypted the statistics by using some keys because of the storage. In CDA (Clinical Document Architecture) every identification price pleasure lie decreased along present levels then entire protection mechanism is typically allotted by way of all the various keys. Cloud storage performance is supports the physician patient zone because of durability extinction decreasing according to entire prescription. It is low worth because of gaining access to records stored of the wind storage. The efficient Clinical Document Architecture rectifies entire instruction easily and discovers the high levels in imitation of improve discipline option through it biometric identification mechanism. This work recognized according to entire customers yet affected person do stand instituted partial remedy between residential .It would be instituted after remedy prescription by using login including affected person small print within all several keys. The keys retaining method is secured, If troubles occurred between planet storage it do keep away from the attacker ranges, it pleasure remain extended in current attacker in accordance with totally keep away from between the star storage. CDA beget permanency entire consumer side execute stand perfect fantastically utter the system because consumer convenient over astronaut information. permanency It is accessing more wide variety of information instituted direction concerning the astronaut storage, whole medicine prescription are old to allow somebody doctor add with cloud storage

ARTICLE INFO

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biometric identification, data outsourcing, privacy-preserving, cloud computing.

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1. INTRODUCTION

Biometric identification [1] has advanced increasingly more attention, considering that that provides a promising access after discover users. Compared including normal authentication strategies primarily based about passwords or identification cards, biometric identification is considered in accordance with lie more dependable yet convenient. Additionally, biometric identification has been broadly applied of many fields with the aid of the usage of biometric qualities certain as fingerprint [2], iris[3] yet facial patterns[4], which may lie gathered beyond number sensors[5,6]. In biometric identification system, the database owner such as much the FBI who is accountable after manage the national fingerprints database, may additionally desire in imitation of outsource the sizeable biometric records after the wind server (e.g., Amazon) to come clean about the expensive storage yet computation costs. However, in conformity with hold the privateness on biometric data, the biometric data has in imitation of stay encrypted earlier than outsourcing [7]. Whenever a FBI's Partner (e.g., the policeman station) wants in accordance with authenticate an individual's identity, he turns in imitation of the FBI and generates an identification query through the use of the individual's biometric traits (e.g., fingerprints, irises, utter patterns, facial patterns etc.). Then, the FBI encrypts the query or submits that in imitation of the wind after discover the close match. Thus, the challenging problem is whether in accordance with plan a protocol which allows efficient yet privacy keeping biometric identification between the astronauts computing. A quantity on privacy-preserving biometric identification options has been proposed. However, close on them in general concentrate over privateness maintenance however pass by the efficiency, such as the schemes based totally about homomorphic encryption then oblivious transfer durability for fingerprint then surface image identification respectively.

2. LITERATURE REVIEW

The Clinical Document Architecture (CDA) about every identification desire preserve cost is decreased which include current stages entire security mechanism is frequently allotted every the keys pretty a not many air storage performance of imitation concerning assist because medical doctor affected person area dying reducing entire prescription[8]. It is cost in regard to finding access to records defended among astronaut storage. All attackers' desire remain assault because of total data incidence so choice atmosphere health half via way on cryptography. To environment friendly the Clinical Document

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ORIGINAL RESEARCH ARTICLE

Enhanced Electrochemical Performance of Mn_3O_4/Multiwalled Carbon Nanotube Nanocomposite for Supercapacitor Applications

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Abstract

Mn_3O_4/multiwalled carbon nanotube (MWCNT) nanocomposites were synthesized via a facile ultrasonic method, using manganese chloride as a precursor at room temperature for supercapacitor applications. The nanocomposites were characterized by powder x-ray diffraction (XRD), transmission electron microscopy (TEM) and field emission scanning electron microscopy (FE-SEM), respectively. TEM images revealed that the Mn_3O_4 nanoparticles were highly dispersed on the surface of the MWCNT. Cyclic voltammetry, galvanostatic charge/discharge and electrochemical impedance spectroscopy (EIS) were performed for the Mn_3O_4/MWCNT nanocomposites using 1 M Na_2SO_4 aqueous solutions as the electrolyte in order to find the suitability of the material for supercapacitor applications. The electrochemical results exhibit improved performance for the Mn_3O_4/MWCNT composite electrode compared to pristine Mn_3O_4 nanoparticles owing to its structural superiority. The specific capacitance (C_s) of Mn_3O_4/MWCNT nanocomposites and pristine Mn_3O_4 was about 473 F g^{-1} and 259 F g^{-1}, respectively, at a current density of 1 A g^{-1}. The Mn_3O_4/MWCNT composite sustains a very strong cyclic performance after 5000 cycles. The capacitance retention of the composite electrode shows highly stable performance confirming its suitability as lasting electrode material for supercapacitor applications.

Keywords Mn_3O_4 · nanocomposites · specific capacitance · supercapacitor · current density

Introduction

The demand for clean and renewable energy resources is emerging drastically by the development of energy storage devices, utilizing new materials and nanocomposites.[1] Supercapacitors are considered to be one of the most promising energy storage devices, and they have higher power densities than batteries. The development of a supercapacitor with a high-capacity energy storage system bridges the gap between batteries and conventional capacitors in terms of energy and power density for high-power applications.[2,3] Pseudocapacitors have a higher capacitance because of the reversible surface faradaic redox reactions for charge storage, while electrical double-layer capacitors (EDLC) utilize the electrical charge at the electrode and electrolyte interface.

Various metal oxides such as RuO_2, MoOx, MnO_2, NiOx, IrO_2, and WO_3 are employ redox-active materials because of their good electrical conductivity, high chemical stability and remarkable specific capacitance.[4,5] RuO_2 exhibits very good electrochemical properties as well as high specific capacitance due to its large number of oxidation states. It has high specific capacitance value and is a suitable material for supercapacitor devices.[6,7]

Recently, researchers have focused on low-cost electrode materials by using various metal oxides such as Co_3O_4, NiO and MnO_2. Among the various metal oxides, manganese oxide is one of the best materials for pseudocapacitors because of its increased capacitance property, low cost and great environmental compatibility.[8,9] Several researchers

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Identifying the Suitability of Environmental Friendly Fe_2O_3 Nanomaterials for Supercapacitor Applications

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ABSTRACT

Environmental friendly α–Fe_2O_3 nanoparticles were successfully synthesized via a facile and cost effective chemical precipitation method with the extraction of *Nyctanthesarbortristis* for the first time. Also it is undergone at room temperature for super capacitor applications and that was observed through electrochemical studies. The prepared samples were characterized by powder X-ray diffraction (XRD), Field emission Scanning electron microscopy (FE-SEM) and UV visible spectroscopic studies. The powder X-ray diffraction study revealed the formation of α-Fe_2O_3 in the case ofannealed sample. Microscopic images displays that the α–Fe_2O_3 nanoparticles were highly agglomerated in nature with the dimension of the order of 2-3 μm. Cyclic voltammetry and simultaneous galvanostatic charge/discharge studies were performed in order to find out the suitability of the material for Supercapacitor applications. The electrochemical results explores that the annealed sample (α–Fe_2O_3) had improved performance due to its structural with superiority nature. Moreover, the capacitance retention of the α-Fe_2O_3 based electrode shows highly stable performance and also its suitability as a lasting electrode material for Super capacitor applications.

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Introduction

In recent years, the global importance of semiconducting metal oxides in the various fields of science and technology that continuously paid more attention in the study and the development of various synthesis methods for corresponding applications. Moreover, metal oxide based semiconducting nano materials have become a rapidly emerging new field in materials science which covers both chemistry and physics [1]. In this regard earlier reports using literature support the suitability of Iron Oxide based nano materials for bio sensor applications in particular green synthesized metal oxide based nano dimensional materials. Sardar et.al prepared Iron Oxide nanomaterials by using green synthesis approach in association with Gooseberry leaves and that acted as a reducing agent during synthesis process. These observations suggested that electrochemical behavior of Iron oxide nanomaterials may be a promising candidate for bio sensing applications and showed enhanced efficiency of the prepared materials [2]. Urbanova et.al., completely reviewed about the sensing properties of Iron Oxide nanoparticles in detail and discusses about the properties of enzymatic sensors in detail [3]. On the other hand, various metal oxides were also analyzed in order to find their suitability for bio sensor applications. For example, Nirmalya et.al, analyzed the unique properties of ZnO nanoparticles in association with different metal oxides for bio sensor applications. In addition with the above, they have also discussed the future aspects of nano hybrid materials for sensor applications [4]. Mathias et.al., dealt high refractive index dielectric materials in order to increase the sensitivity factor of a gold thin film despite its large evanescent electromagnetic field decay lengths. Hence, Iron oxide nanoparticles were grafted onto a gold thin film and were easily functionalized by biomolecular receptors through a two-step copper catalyzed alkyne–azide cycloaddition (CuAAC) "click" reaction [5]. Moreover, Rodriguez et.al., observed the viability of a DNA sensor based on the facile synthesis of GNRs decorated with Fe_3O_4 nanoparticles [6].Zhang et.al., introduced Iron Oxide nano particles into chitosan/graphene based biosensors for multifunctional device applications. It showed that the bio-sensing performance decreased significantly and the linear range was only up to 1.67 mM. The Challenges for introduction of MNP while remaining good performance of chitosan/graphene based biosensors have attracted increasing attention. Improvement of catalytic activity of chitosan/graphene composites via structural modification has been considered as a promising resolution for these issues [7]. Zhong et.al., developed a facile and controllable method for synthesis of Fe_3O_4 nanoparticles which encapsulated in hollow carbon nanocages (FNHCs) along with SiO_2 nanospheres as a sacrificial template. Owing to the unique structure of multiple Fe_3O_4 nanoparticles as cores integrated with N-doped carbon nanocages, the results showed that as-synthesized FNHCs exhibited greatly enhanced peroxidase mimicking activity with extremely high signal-to-noise ratio of ~91 fold [8]. Chouhan et.al performed on a new electrochemical sensing device that was constructed for determination of pesticides. In this report, acetylcholinesterase was bioconjugated onto hybrid nanocomposite, i.e. iron oxide nanoparticles and poly (indole-

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Suitability of Iron (Fe)-Doped Tungsten Oxide (WO_3) Nanomaterials for Photocatalytic and Antibacterial Applications

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Pure and "Fe (~ 3 wt.%)-doped" WO_{3-x} nanoparticles were prepared by facile microwave irradiation method and that was investigated for strong photo catalytic and antibacterial activity applications for the first time. The primary aim of this work is to reveal the great importance of oxygen vacancies (V_0) due to dopant (Fe^{2+}) for photo catalytic and antibacterial activity applications. This work also discusses the contribution of oxygen vacancies and their dependence on surface area and phase formation which are of great research interest for water purification and biological sciences. Herein, pure and "Fe (~ 3 wt.%)-doped" WO_{3-x} nanoparticles were successfully synthesized by facile microwave irradiation (MWI) method (2.45 GHz/240W/10min) in ambient atmosphere. The phase formation and the crystalline nature of the prepared products were evaluated using powder X-ray diffraction (XRD). It confirmed the phase formation of orthorhombic and monoclinic phase formations for the pure ($WO_3 \cdot H_2O$) and annealed samples ($W_{17}O_{47}$ and WO_3), respectively. Optical behavior of the samples from UV-Vis diffuse reflectance analysis revealed that $W_{17}O_{47}$ has remarkable bandgap values (1.96 eV) that clearly emphasizes the transfer of oxygen ions which helps in the movement of oxygen vacancies inside the crystalline domain. The morphological nature of the prepared products was observed by FE-SEM analysis and the average dimension was found to be 0.2–3.2 μm and 2–4 μm for the pure and annealed products, respectively. The specific surface area from BET analysis explored that $W_{17}O_{47}$ having 55.16 m^2g^{-1} was found to be higher than that of commercially available WO_3. The photocatalytic behavior of the prepared compounds morphologies was investigated via Rhodamine B (RhB) degradation under visible light irradiation. These results showed "Fe-doped" annealed WO_3 nanoparticles have degradation efficiency of 86.9% along with high stable nature. On the other hand, to identify the suitability of the prepared

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Analyzing the Suitability of Chromium Doped Iron Oxide Nanoparticles for Creatinine Bio Sensor Applications

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The present work focused on the synthesis and characterization of Cr (~2, 3 & 5 wt.%) doped Fe_2O_3 nanoparticles with desired electrochemical property for creatinine bio sensor applications via the extraction of *Nyctanthes arbor tristis* seed by facile chemical precipitation method. The synthesized samples have dimensions of the order of 0.5 to 0.8 μm and crystallite size of the prepared samples calculated by Powder XRD analysis using Scherer's formula. The optical characterization of the prepared nanomaterials showed that the band gap energy of the annealed chromium doped samples were found to be 5.74 eV by varying in intensity by Tauc plot that established well optical nature of the synthesized compound which is also have a good concord with the Powder XRD analysis with its crystalline nature. The FT-IR spectra clearly indicating the complete formation of Fe_2O_3 by observing corresponding functional groups such as Fe=O and O=O vibrations in their respective wavenumbers. The sensing performance of the prepared samples for creatinine was carried out using electrochemical workstation. Interestingly, the electrochemical analysis exposed the good sensing behaviour of the Cr-doped Fe_2O_3 nanoparticles which displayed corresponding redox peaks attributed to the reversible Faradaic redox reaction at the electrode surface caused by the pseudo-capacitance nature for $\alpha - Fe_2O_3$ nanoparticles as an active material, slightly than the double layer capacitance. Consequently the current outcomes revealed a good sensing behaviour on creatinine for Cr-doped Fe_2O_3 nanoparticles synthesized by an effortless cost effective green synthesis method.

Keywords: Iron oxide, Cr-doped, *Nyctanthes arbor tristis*, Nanomaterials, Creatinine

1 Introduction

Synthesizing materials by using number of components or unit operations to fabricate elements with distinct properties is known as Nanotechnology which can be utilized in different applications. Nanoparticle is defined as small particles having dimensions between 1-100 nm. They own special optical, thermal and electrochemical properties disparate from that of the bulk materials due to their compact particle size[1]. These nanoparticles play an important role in the field of biomedical and industrial evolution due to their very high surface to volume ratio. A metal oxide shows the potential to shape wider range of oxide compounds so they are employed in numerous aspects of physics, chemistry and materials science. They can expose metallic, semiconductor and insulator features and fit to an enormous structural geometry. Owing to their high density and controlled size, delicate physical and chemical properties are shown by them[2].

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Iron oxide nanoparticles are considered as the most significant metal oxide nanoparticles among numerous nanoparticles on the basis of their prominent aspects like bio compatibility and magnetic property[3]. Beside various phases, hematite (α-Fe_2O_3), maghemite (γ - Fe_2O_3), magnetite (Fe_2O_3) are the frequently used and maximum considered phases of iron oxides. The hematite (α - Fe_2O_3) is considerably used in different inorganic applications like catalysis, sensing etc., due to their extreme stability in natural environmental conditions[4]. The familiar predominant polymorph of iron oxide is hematite and they are generally found in rocks and soils which survive in nature in the form of minerals. At room temperature, it shows weak ferromagnetic or anti ferromagnetic activity. It displays a rhombohedral structure similar to that of corundum which composed of O^{2-} ion reticle as a close-packed hexagonal crystallographic system and two thirds of the octahedral interstices was inhabited by Fe^{3+} ions in alternate layers. Transformation of various iron oxide

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RESEARCH ARTICLE

Focusing Properties of Spirally Polarized Annular Multi Gaussian Beam by High NA Lens

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ABSTRACT: Focusing properties of spirally polarized annular multi Gaussian beam by High NA Lens are investigated theoretically by vector diffraction theory. Results show that the optical intensity in focal region of spirally polarized annular multi Gaussian beam can be altered considerably by the beam order and spiral parameter. Spiral parameter can induce focal pattern change in axial direction remarkably and many novel focal patterns including optical bubbles, focal hole and focal spots of long focal depth and axially separated focal spots and flattop profile are evolved. We expect such a tunable focal patterns are useful for optical manipulation of micro particles.

KEYWORDS: Focusing property, annular multi Gaussian beam, Vector diffraction theory, High NA Lens.

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INTRODUCTION

Polarization, as an intrinsic nature of light, plays an important role in engineering the optical field and controlling the interaction of light with matter. In recent years, cylindrical vector (CV) beams have attracted significant interest due to the unique focusing features compared with homogeneously polarized beams [1]. Two extreme cases of CV beams are radially polarized (RP) and azimuthally polarized (AP) beams. It is found that an AP beam can be focused to generate a hollow dark spot with totally transverse polarization for the electric field, whereas it is a strong longitudinally polarized hot spot for the input RP beam [2–4]. The longitudinal component of the focus from such CVB is much stronger than the transversal component, and the size of the longitudinal focus is much smaller than the transversal focus [5]. Focal engineering using radially, azimuthally and cylindrically polarized beams has been studied through engineering the amplitude, phase and polarization. Recently, focusing CVB to a very tight spot was one of the most important topics for optical researches and application including sharper focus [6–10], multiple focal spots [11–14], optical needle [15–18],flat-top focus [19], optical chain [20,21], focal spot array[22–24], optical channel [25–27], optical cage [28–31], and spherical spot [32–35] etc. These new properties led to many potential applications, such as optical trapping and manipulation of particles [36,37], high resolution microscopy [38], optical data storage [39], and electron acceleration [40]. The cylindrical vector beams, most focus has so far been mainly on the tightly focused electric field distributions. However, the presence of phase filters or Amplitude filters makes some applications more difficult or even impossible. Bing Hao and James Leger have recently investigated the numerical aperture (NA) invariant focus shaping using spirally polarized beams. They proposed that spirally polarization is another kind of spatially variant polarization bearing radial symmetry [41]. The spirally polarized beam possesses axially symmetric polarization patterns, with linear polarization at any point of the transverse profile and with the electric field lines being logarithmic spiral. Recent investigation of the tight focusing properties of spirally polarized beam suggested several possible applications such as as optical tweezers, particle trapping, laser cutting, material processing, microscopy, etc.[42–46].The studies of energy flow in the focal plane of optical fields are also important and useful, as they indicate the wide use of such beams in manipulating and transporting absorptive

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A STUDY ON THE LEVEL OF JOB SATISFACTION OF CONSTRUCTION WORKERS IN KOZHIKODE DISTRICT-KERALA

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ABSTRACT:

This paper describes the level of satisfaction of construction workers in construction sectors in Kozhikode district. A good working condition is necessary for achieving a good labour force. The dimensions such as "Communication with superiors, technical assistance, Assistance in decision making. Delegation of tasks" are used as the variables for this study. The researcher uses knowledge of the theory, empirical research or both, postulates the relationship pattern a priori and then tests the hypothesis statistically. This study indicate that all the four factors considered for this study are closely associated for improvement of the level of satisfaction of workers in this study area.

Key words: construction Industry, construction workers, job satisfaction, working condition.

INTRODUCTION

Construction sectors are the great contributor towards our economic development. Due to globalisation and industrialisation construction industries are rapidly increasing. They are highly labour intensive also, so providing a good labour force is very necessary for every construction sector. The strength of every sector can be assessed by the performance of their workers. This paper identifies and analyse the factors which effect the relationship with superior and the construction workers in Kozhikode District-Kerala.

The current scenario of construction sector workers rely heavily on their supervisors for their task allocation, guidance and support. This will create a positive approach and increase their productivity and effectiveness of construction sector. Superior-workers relation refers to the interactions between organizational leaders and their subordinates and how they work together to achieve personal and organizational goals. Satisfactory relationship is essential for a successful organization because it closes the gap between superior and workers by increasing the levels of trust, support, and the frequency of their interactions.

The categories job satisfaction rewards towards relationship with superiors aspects comprise of relationship with superiors are taken for the study. Relationship with superiors factors that have different number of variable loadings analyses the workers job satisfaction towards Relationship with superiors aspects has been taken to analyse the path wise regression that reveals the job satisfaction perceived based on each variable from all the four factors with regards to job satisfaction of workers based on the Relationship with superiors offered during working time in Kozhikode District.

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"A STUDY ON THE LIVING CONDITIONS OF CONSTRUCTION WORKERS IN KOZHIKODE DISTRICT, KERALA"

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Abstract : Construction sectors are providing large employment opportunities. Their contribution towards GDP in India is very higher. The labor force are very essential for this sector. Moreover, Labor force will increase the productivity of this sector. Due to the growing scenario of construction sector in Kozhikode District this study has been undertaken to understand the living conditions of construction workers in the study area. The researcher has adopted Descriptive research design for this study. In Kozhikode District, the researcher had collected 200 samples from the construction sector among the 4 taluks based on convenient sampling method. Nearly half of the respondents are moderately living conditions in this study area. Government and private sector should take proper initiative to improve the living conditions of the workers and also should take special attention to improve the policies on welfare measures of construction workers.

KEY Terms – Construction industry, construction workers, labor force, productivity, living conditions etc.

1.INTRODUCTION:

Construction sector is the second largest industry in India after Agriculture sector. Construction sector is the largest contributor towards the economic development of India. Construction sector plays a very prominent role for providing employment opportunities and investments., In India most of the people are working in construction sector in various fields. In India approximately 40 million migrant workers are working in this sector. Among these 40 to 45 percentages are unskilled laborers. In India despite of this growing scenario most of the construction sectors conditions are vulnerable. The supply of skilled laborers is limited because of this growing demand. So unskilled laborers are forming a part of this work force.

In Kerala , the tremendous development of service sector effect the demand for construction activities , both commercial and residential. This study aims to understand the living conditions of construction workers in Kozhikode District. As conditions improve, there'll be a growing demand for more building construction. together with the expansion of recent industries, several new industrial towns located on major highways will expand and grow into future cities in the study area. So, such development will inevitably provide opportunities for the utilization of both skilled and unskilled labour. rather than having labour living in shantytowns, it might be good to ascertain proper labour camps on substantial areas of land. These might be carefully planned as mini-townships with schools, health centres, local markets, parks, and a few basic community facilities. Housing for workers can be both within the style of dormitory structures, also as small plots with electricity, water, drainage and sewer connections, and a tiny low toilet. These may be sold at affordable cost to workers, who would build minimal homes that they will improve and expand over time. The township must be conceived on the premise of change and growth. It would be essential to supply substantial area of land for the township to grow. So overall for creating a efficient and effective labour force will increase the productivity of every country.