

### 3.3 RESEARCH PUBLICATIONS AND AWARDS

#### SUPPORTING DOCUMENT FOR 3.3.1.1

3.3.1.1: Number of research papers in the Journals notified on UGC CARE list year wise during the last five years.

S. No.	Year	Number of research papers in the Journals notified on UGC CARE list	Page no.
1	2017-18	21	1-21
2	2018-19	29	22-51
3	2019-20	33	52-85
4	2020-21	54	86-143
5	2021-22	74	144-217
	<b>Total</b>	<b>211</b>	



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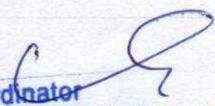


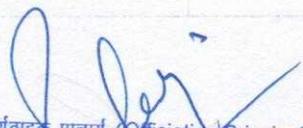
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**3.3.1.1: Number of research papers in the Journals notified on UGC CARE list year wise during the last five years.**

S.No	Title of paper	Page no.
1	Crystal structure of UDP-N-acetylglucosamine-enolpyruvate reductase (MurB) from Mycobacterium tuberculosis	1
2	Isolation and characterization of bacteriophages from India, with lytic activity against Mycobacterium tuberculosis.	2
3	One-pot and catalyst-free synthesis of pyrroloquinolinediones and quinolinedicarboxylates	3
4	Microwave assisted synthesis of spiro heterocyclic systems: A review	4
5	A robust replenishment model for deteriorating items considering ramp-type demand and inflation under fuzzy environment	5
6	An analysis of replenishment model of deteriorating items with ramp-type demand and trade credit under the learning effect	6
7	Supply chain model with two storage facility for stock dependent demand incorporating learning and inflationary effect under crisp and fuzzy environment.	7
8	Controlling room temperature ferromagnetism and band gap in ZnO nanostructured thin films by varying angle of implantation	8
9	Inhibition of gut proteases and development of dengue vector, Aedes aegypti by Allium sativum protease inhibitor	9
10	Assessment of Achyranthes aspera induced toxicity and molecular analysis of RAPD-PCR profiles of larval genomic DNA of Aedes aegypti L. (Diptera: Culicidae)	10

  
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11	A facile and rapid method for green synthesis of <i>Achyranthes aspera</i> stem extract-mediated silver nanocomposites with cidal potential against <i>Aedes aegypti</i> L. Saudi	11
12	Emamectin Benzoate: Potential larvicide and antifeedant agent against cotton boll worm <i>Helicoverpa armigera</i> (Lepidoptera: Noctuidae)	12
13	Taxonomic and morphogenetic description of the freshwater ciliate <i>Aponotohymena isoaustralis</i> n. sp. (Ciliophora; Oxytrichidae) isolated from Sanjay lake, Delhi, India.	13
14	Sld5 Ensures centrosomal resistance to congression forces by preserving centriolar satellites.	14
15	Diversity and abundance of ammonia-oxidizing bacteria and archaea in a freshwater recirculating aquaculture system	15
16	The study of effect of various temperatures on the abundance of ammonia oxidizing archaea and bacteria.	16
17	Beyond the "Code": a guide to the description and documentation of biodiversity in ciliated protists (Alveolata, Ciliophora)	17
18	Assessment of heavy metal toxicity in four species of freshwater ciliates (Spirotrichea; Ciliophora) from Delhi, India	18
19	Estimating the parameter of selected uniform population under the squared log error loss function	19
20	Influence of copper and cadmium toxicity on the activity of an antioxidant enzyme, superoxide dismutase in freshwater ciliates	20
21	Cellular and molecular basis of heavy metal induced stress in ciliates: A review	21

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22	Sighting of <i>Jamides bochus</i> (Stoll, 1782) and <i>Prosotas Nora</i> (C. Felder 1860) (Insecta: Lepidoptera: Lycaenidae) From Urbanized Parts Of New Delhi, India.	22
23	Floral contrivances and specialised pollination mechanism strongly influence mixed mating in <i>Wrightia tomentosa</i> (Apocynaceae).	23
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25	Occurrence of subdioecy and scarcity of gender-specific markers reveal an ongoing transition to dioecy in Himalayan seabuckthorn ( <i>Hippophae rhamnoides</i> ssp. <i>turkestanica</i> ).	25
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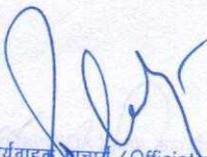
  
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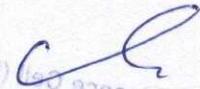
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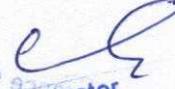
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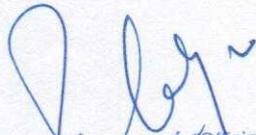
  
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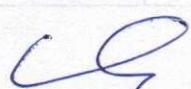
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## Crystal structure of UDP-*N*-acetylglucosamine- enolpyruvate reductase (MurB) from *Mycobacterium tuberculosis* ☆

Kandasamy Eniyan <sup>a,1</sup>, Sudhaker Dharavath <sup>b,1</sup>, Ramachandran Vijayan <sup>b</sup>, Urmi Bajpai <sup>a</sup>    
, Samudrala Gourinath <sup>b</sup>  

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### Highlights

- The crystal structure of MurB enzyme at 2.0 Å resolution from *M. tuberculosis* in complex with its prosthetic group (FAD) is reported here.
- MtbMurB belongs to type I category, shared conserved domains commonly found in Gram-negative bacteria.
- Also the residues involved in the FAD binding were found to be highly conserved.
- Lobe 2 of domain III undergoes conformational change upon binding with the substrates.

Article

f t in

## Isolation and characterization of bacteriophages from India, with lytic activity against *Mycobacterium tuberculosis*

This article has been corrected. [VIEW CORRECTION](#)

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### Abstract

Bacteriophages are being considered as a promising natural resource for the development of alternative strategies against mycobacterial diseases, especially in the context of the wide-spread occurrence of drug resistance among the clinical isolates of *Mycobacterium tuberculosis*. However, there is not much information documented on mycobacteriophages from India. Here, we report the isolation of 17 mycobacteriophages using *Mycobacterium smegmatis* as the bacterial host, where 9 phages also lyse *M. tuberculosis* H37Rv. We present detailed analysis of one of these mycobacteriophages — PDRPv. Transmission electron microscopy and polymerase chain reaction analysis (of a conserved region within the TMP gene) show PDRPv to belong to the *Siphoviridae* family and B1 subcluster, respectively. The genome (69 110 bp) of PDRPv is circularly permuted double-stranded DNA with ~66% GC content and has 106 open reading frames (ORFs). On the basis of sequence similarity and conserved domains, we have assigned function to 28 ORFs and have broadly categorized them into 6 groups that are related to replication and genome maintenance, DNA packaging, virion release, structural proteins, lysogeny-related genes and endolysins. The present study reports the occurrence of novel antimycobacterial phages in India and highlights their potential to contribute to our understanding of these phages and their gene products as potential antimicrobial agents.





From the journal:  
**Green Chemistry**

## One-pot and catalyst-free synthesis of pyrroloquinolinediones and quinolinedicarboxylates



Xiaofeng Zhang,<sup>a</sup> Gagan Dhawan,<sup>ab</sup> Alex Muthengi,<sup>a</sup> Shuai Liu,<sup>a</sup> Wei Wang,<sup>c</sup> Marc Legris<sup>a</sup> and Wei Zhang<sup>id</sup> <sup>\*a</sup>

Author affiliations

### Abstract

A method for the catalyst-free synthesis of pyrroloquinolinediones and quinolinedicarboxylates is developed through a one-pot synthesis involving denitrogenation of azide, benzisoxazole formation, aza-Diels–Alder cycloaddition, and dehydrative aromatization. Only stoichiometric amounts of  $N_2$  and  $H_2O$  are produced as by-products. A comprehensive green chemistry metrics analysis indicated that this method is much more efficient and greener than two reported methods for the synthesis of pyrroloquinolinediones.







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Review Article

### Microwave Assisted Synthesis of Spiro Heterocyclic Systems: A Review

**Author(s):** Pankaj Khanna, Leena Khanna, Sean J. Thomas, Abdullahi M. Asiri and Siva S. Pandar\*

Volume 22, Issue 1, 2018

Page: [67 - 84] Pages: 18

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**Abstract**

Background: Microwave irradiation has emerged as a useful synthetic strategy for chemists and drug developers due to enhanced yields, regioselectivity, and faster reaction times. One area of importance in its practice has been the design of spiro compounds, which possess great interest on account of their natural occurrence and medicinal capabilities. The increasingly large number of these scaffolds and unlimited amount of methodologies utilized in their preparation have made them good candidates for the microwave assisted approach.

Conclusion: Therefore, this review emphasizes the use of microwave irradiation in the synthesis of spiro heterocyclic compounds.

**Keywords:** Spiro compounds, heterocycles, microwave, green synthesis

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## A robust replenishment model for deteriorating items considering ramp-type demand and inflation under fuzzy environment

Archana Sharma, Usha Sharma and Chaman Singh

 Published Online: October 6, 2017 · pp 287-307 · <https://doi.org/10.1504/IJLSM.2017.086964>


### Abstract

Supply chain performance directly depends on demand pattern, inventory management and control strategies of organisations apart from other supply chain activities. Effective replenishment policy can increase the performance of logistics and supply chain activities and customer satisfaction. Optimal inventory model can also reduce overall replenishment cost and improve financial performance of the organisation. This study focuses on developing a replenishment model for deteriorating products with ramp-type demand rate under the consideration of inflation and partial backlogging. The nature of the demand function is a piecewise exponential function. The proposed model is developed under fuzzy environment, which can easily handle uncertainty and impreciseness associated with parameters. The illustrative numerical example has given in crisp as well as in fuzzy sense to demonstrate the solution procedure for the proposed approach. Sensitivity analysis is also performed to check the robustness of the proposed model.



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### Keywords

supply chain

## An analysis of replenishment model of deteriorating items with ramp-type demand and trade credit under the learning effect

Archana Sharma, Usha Sharma and Charan Singh

Published Online: May 13, 2018 · pp 313-342 · <https://doi.org/10.1504/IJPM.2018.091668>



### Abstract

Effective management and control strategies are prerequisites in order to optimise inventory related decisions. Robust replenishment model can reduce overall inventory cost and increase financial surplus for the organisation. Adoption of trade credit strategy for deteriorating items provides economic benefits to the retailer (buyer) in settling the account for the fixed period and boosts the sales of the organisation. Therefore, in this proposed model trade credit is introduced and demands pattern follows ramp-type which is quadratic function of time for decaying items. Shortages are allowed and partially backlogged where the backlogging rate is dependent of waiting time. The inflation factor is also considered to propose realistic environment. Additionally, this study also considered the cost components which are followed by learning curve to improve the total inventory cost with strategic scheduling. Finally, the model is analysed through numerical examples and the sensitivity analysis is performed to test the robustness of the model.



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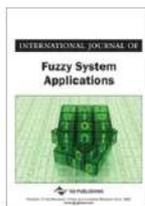


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## Supply Chain Model with Two Storage Facility for Stock Dependent Demand Incorporating Learning and Inflationary Effect under Crisp and Fuzzy Environment

Chaman Singh (Acharaya Narendra Dev College, University of Delhi, New Delhi, India) and Shiv R. Singh (Department of Mathematics, C.C.S. University, Meerut, India)

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### Abstract

In this paper, a supply chain model with power form stock-dependent demand rate is developed, incorporating the effect of learning and inflationary environment. In order to bring their research closer to reality, all the cost parameters involved in the model are considered fuzzy in nature. The demand rate is assumed to be a polynomial form of current inventory level in Own-warehouse. To display the items, retailer has one warehouse of finite capacity, treated as own warehouse (OW) and may hire another warehouse of large capacity, treated as rented warehouse (RW) to storage the excess inventory. Learning effect is incorporated on retailer's selling price, purchasing cost, part of holding cost, deterioration cost and ordering cost. Proposed model is illustrated with some numerical example along with sensitivity analysis of parameters.

Cite this: *RSC Adv.*, 2018, 8, 6278

## Controlling room temperature ferromagnetism and band gap in ZnO nanostructured thin films by varying angle of implantation

Rajesh V. Hariwal,<sup>a\*</sup> Hitendra K. Malik,<sup>b</sup> Ambika Negi<sup>c</sup> and Asokan Kandasami<sup>b</sup>

The defects in the host lattice play a major role in tuning the surface roughness, optical band gap and the room temperature ferromagnetism (RTFM) of ZnO thin films. Herein, we report a novel approach to tailor the band gap and RTFM of a ZnO nanostructure by varying the angle of implantation of 60 keV N ions keeping the ion fluence of  $1 \times 10^{16}$  ions per  $\text{cm}^2$  and the beam size of 3 mm constant. The implantation was performed by changing the thin films' orientations at  $30^\circ$ ,  $60^\circ$  and  $90^\circ$  with respect to the incident beams. Remarkably, an enhancement of  $\sim 6$  times in RTFM, tuning in band gap from 3.27 to 3.21 eV and  $\sim 60\%$  reduction in surface roughness were noticed when the ion implantation was done at  $60^\circ$  to the normal. This novel technique may be suitable for tuning the physical properties of nanostructures for their application in the spintronics, semiconductor and solar cell industries.

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### 1. Introduction

The ion beam implantation technique has been widely used for the last two decades to tune material properties by generating defects in a very controlled and reproducible manner.<sup>1–3</sup> In order to alter the physical properties, mainly the magnetic and optical properties of nanostructures by nonmagnetic ion implantation in metal oxides like ZnO, TiO<sub>2</sub>, SnO<sub>2</sub>, MgO, etc., various research groups have extensively investigated varying the ion beam parameters such as current, energy, fluence and ion species.<sup>4–10</sup> ZnO is selected due to its high exciton binding energy (60 meV), better resistance to radiation damage, high optical gain ( $320 \text{ cm}^{-1}$ ) and wide band gap of  $\sim 3.37$  eV at room temperature.<sup>11,12</sup> N ion beam implantation has an advantage over other dopants in producing shallow acceptor levels with higher hole binding energy ( $\sim 400$  meV) by replacing O ions in the ZnO nanostructure due to its ionic radius ( $\sim 1.46$  Å) being comparable to oxygen ( $\sim 1.38$  Å).<sup>13–15</sup> In general, the room temperature ferromagnetism (RTFM) evolves in ZnO due to increase in the oxygen vacancies ( $V_o$ ) induced by the various defects like substitutions, interstitials, local structure transformations, etc.<sup>16–20</sup> The defects induce the lattice distortion which results in the mechanical stress near dislocations and this leads to increase in band gap (compressional stress) or reduction (tensile stress) due to the forming of the bands and accumulating the defects. The incorporation of N induces the

local lattice distortion due to the formation of pairs Zn<sub>2</sub>-N<sub>2</sub> and Zn<sub>2</sub>-O, which results in change in the polarity of Zn-O.<sup>21–23</sup> This leads to the magnetism in nanostructures which needs to be controlled by tuning the defects in the host lattice. Pham *et al.*<sup>24</sup> have reported the evolution of RTFM due to the substitution of N at O site in Zn-O nanostructure on the basis of *ab initio* study of spin-polarized total energy of various defects and nonmagnetic dopants having different charge states. They concluded that when N replaces O, it shortens the bond length of Zn-N due to the difference in N and O ionic radii. Jindal *et al.*<sup>25</sup> have also investigated the RTFM by the substitution of N at the O sites in ZnO host lattice and concluded that the ferromagnetism may be controlled by varying the laser energy densities during thin film growth and it was mediated by the hole concentrations. In order to understand this phenomenon, more importantly the controlling of ferromagnetism in pure and N ion implanted ZnO nanostructures, many systematic efforts have been made till date but the origin of the ferromagnetism is still controversial and under discussion. Recently, it was reported that the tuning of RTFM and optical band gap have been carried out just by controlling the ion beam profiles and keeping other ion beam parameters constant.<sup>26</sup> Further, the angle dependent implantation studies have been performed in nano-patterning with the realization of cascade collisions and mass redistributions on the surface produced by the transfer of energy and momentum of the incident charged particles under certain conditions of energy range, and fluence.<sup>27</sup> In the present study, we report for the first time to control the ferromagnetism, band gap energy, surface roughness and grain size in N implanted ZnO nanostructured thin films by changing the implantation angles only and keeping other ion beam parameters such as current, energy, fluence and beam size constant.

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## Inhibition of gut proteases and development of dengue vector, *Aedes aegypti* by *Allium sativum* protease inhibitor

Tooba Naz Shamsi<sup>a</sup>, Rontana Parveen<sup>a</sup>, Afique Ahmad<sup>b</sup>, Roopa Rani Samal<sup>c</sup>, Sarita Kumar<sup>d</sup>, Sadaf Fatima<sup>e</sup> 

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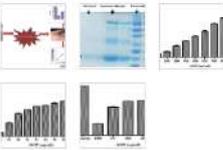
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**Abstract**

The paper describes the bio efficacy of a protease inhibitor; isolated from *Allium sativum* 'garlic' (ASPI); against *Aedes aegypti* mosquito, a well-known transmitter of dengue and Chikungunya. The purification of protease inhibitor from *Allium sativum* 'garlic' (ASPI) was carried out by ammonium sulfate precipitation followed by Fast Protein Liquid Chromatography using akta DEAE-Cellulose column. The protein fraction demonstrating trypsin inhibitory activity was further evaluated for its insecticidal activity using gut protease inhibition assay and larvicidal assay. ASPI is an inhibitor of porcine trypsin (IC<sub>50</sub> of 650.726 µg/mL) and has molecular weight of ~15 kDa determined by SDS PAGE similar to other inhibitors of the Kunitz-type family (14–26 kDa). ASPI demonstrated 50% reduced activity of *Ae. aegypti* midgut proteases and showed a dose-dependent acute toxicity on *Ae. aegypti* 3rd instars exhibiting LC<sub>50</sub> value of ~50.827 µg/mL. After ten days of larval exposure ASPI resulted in a 24-h delay of larval development and ~72% mortality at 61.5 µg/mL. These results suggest that ASPI may serve as potent insecticidal agent and hence opens a new gateway in the field of phyto-remediation.

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## Assessment of *Achyranthes aspera* induced toxicity and molecular analysis of RAPD-PCR profiles of larval genomic DNA of *Aedes aegypti* L. (Diptera: Culicidae)

[Aarti Sharma](#), [Sarita Kumar](#)  & [Pushplata Tripathi](#)[Journal of Parasitic Diseases](#) **41**, 1066–1073 (2017) | [Cite this article](#)**218** Accesses | **5** Citations | [Metrics](#)

### Abstract

Current studies investigated the anti-mosquito potential of *Achyranthes aspera* against the dengue vector, *Aedes aegypti*. The stems and leaves of *A. aspera* were extracted in hexane and evaluated for their toxicity against early fourth instars of *A. aegypti*. The larvicidal efficacy of the extract was validated as per WHO protocol. The mortality counts were made after 24 h and LC values were calculated at different levels. The adverse impact of extracts was also explored on the larval genomic DNA. The larvae were exposed to extracts at LC<sub>50</sub> levels and the alterations in *g*-DNA was evaluated through RAPD-PCR technique using three random primers; MA-09, MA-12 and MA-26. Our investigations ascertained the larvicidal efficacy of both the leaf and stem extracts of *A. aspera* resulting in respective LC<sub>50</sub> values of 0.068 and 0.082 mg/mL. The extracts also caused variable genotoxic effects with significant changes in the RAPD profiles. The results showed appreciable modifications in larval *g*-DNA with loss of certain bands and gain of unique bands with 82.35% DNA polymorphism. These alterations suggest the probable DNA damage and mutations in the larval *g*-DNA caused by certain phytochemicals which could be the possible reason of larval mortality. Our studies evidenced the anti-mosquito potential of *A. aspera* extracts against *A. aegypti* causing appreciable larval mortality and significant changes in *g*-DNA. The *A. aspera* extracts are suggested as efficient and eco-friendly control agent against *A. aegypti*, yet further investigations are needed to identify the bioactive constituent and ascertain its effectiveness in the field conditions.



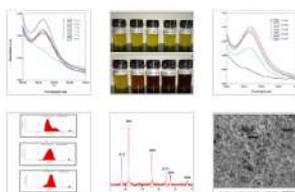
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Saudi Journal of Biological Sciences

Volume 26, Issue 4, May 2019, Pages 698-708



Original article

## A facile and rapid method for green synthesis of *Achyranthes aspera* stem extract-mediated silver nano-composites with cidal potential against *Aedes aegypti* L.

Aarti Sharma <sup>a</sup> , Sarita Kumar <sup>b</sup> , Pushplata Tripathi <sup>a</sup> Show more ▼
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## Abstract

*Aedes aegypti* L. is the primary vector associated with transmission of globally concerned diseases; Zika, yellow fever, dengue and Chikungunya. Present study investigates an efficient, alternative and comparative approach for mosquito control which is safe to environment and non-target organisms. The silver nano-composites (AgNCs) were synthesized from the aqueous stem extract of *Achyranthes aspera* (AASE) using different concentration of aqueous silver nitrate (AgNO<sub>3</sub>). The synthesis was tracked by UV-vis spectrophotometer and particle size analyser (DLS). The evaluation of their larvicidal potential against early fourth instars of *Ae. aegypti* showed significant potency, the toxicity increasing with the concentration of silver nitrate. The 24, 48 and 72 h bioassays resulted in respective LC<sub>50</sub> values of 26.693, 1.113 and 0.610 μg/mL (3 mM AASE-AgNO<sub>3</sub>) 9.119, 0.420 and 0.407 μg/mL (4 mM AASE-AgNO<sub>3</sub>) and that of 4.283, 0.3 and 0.248 μg/mL (5 mM AASE-AgNO<sub>3</sub>). Keeping in view the significantly high larvicidal efficiency at lower concentration of silver nitrate, the 4 mM nano-composites were selected over 5 mM composites for further biophysical characterization carried out by X-ray Diffraction (XRD), Fourier transform infrared spectrometer (FTIR), Scanning electron microscopy (SEM), Energy dispersive X-ray (EDX) spectroscopy and Transmission electron microscopy

## Emamectin benzoate: Potential larvicide and antifeedant agent against cotton Boll worm *Helicoverpa armigera* (Lepidoptera: Noctuidae)

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### Abstract

*Helicoverpa armigera*, a global polyphagous pest, attacks a wide variety of crops causing huge agricultural loss. Overuse of conventional insecticides for *Helicoverpa* control has made *Helicoverpa* resistant to insecticides leading to more severe attacks on crops diverting interest of researchers to explore alternate control agents. Present study investigates the larvicidal and antifeedant potential of Emamectin benzoate; a semi-synthetic avermectin derived from the soil actinomycetes, *Streptomyces avermitilis*; against early IV instars of *H. armigera*. Larvae were fed on the castor leaf discs (3.5 cm diameter) dipped in different concentrations of Emamectin benzoate; ranging from 0.05 µg/mL-1.5 µg/mL. The leaf disc areas were measured pre-and post-larval feeding to estimate the antifeedant potential of compound. The effect of feeding was also assessed on the survival of larvae by scoring the larval mortality till 96 h. Our investigations showed significant larvicidal potential of Emamectin benzoate against *H. armigera* revealing respective LC<sub>50</sub> values of 0.26 µg/mL, 0.095 µg/mL, 0.043 µg/mL and 0.027 µg/mL after 24, 48, 72 and 96 h feeding. Furthermore, a remarkable decrease of 93.59% was observed in larval feeding potential indicating significant antifeedant efficacy of Emamectin benzoate. A strong correlation between antifeedant index and the Emamectin benzoate concentration resulted in 1.48-fold index reduction with a decrease in concentration. Our results demonstrated efficacy of Emamectin benzoate as an effectual larvicidal and antifeedant agent against *H. armigera*. Employing selective insecticide can tackle issues of pest resistance and pest resurgence after ascertaining in the fields as *Helicoverpa* control agent and negating impact on non-target organisms.

**Keywords:** Antifeedant, Emamectin benzoate, *Helicoverpa armigera*, Larvicidal, Leaf dip assay

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### INTRODUCTION

*Helicoverpa armigera* (Lepidoptera: Noctuidae) is one of the most devastating polyphagous pests of crop fields in Asia, South America, Australasia and Africa causing extensive crop loss each year. Regarding monetary value, Indian agriculture suffers an annual loss of about US\$ 42.66 million due to insect pests (Sharma, 2001; Thakur *et al.*, 2006; Singh *et al.*, 2014). Various conventional synthetic insecticides have been used for the control of this pest, such as emamectin benzoate, on

the pesticides are targeted against *H. armigera* which results in the consumption of a major proportion of total insecticides in the market just to control this pest (Ahmad, 2007; Lammers and Macleod, 2007).

Over the years, the extensive use of chemical insecticides has led to the development of insecticide resistance in lepidopterans which not only increased insecticide cost due to frequent and recurrent applications with higher quantities, but has also contributed significantly to the environ-

## Taxonomic and Morphogenetic Description of the Freshwater Ciliate *Aponotohymena isoaustralis* n. sp. (Ciliophora; Oxytrichidae) Isolated from Sanjay Lake, Delhi, India

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**Abstract.** Morphology, morphogenesis and molecular phylogeny of a freshwater oxytrichid ciliate, *Aponotohymena isoaustralis* n. sp. collected from Sanjay Lake (28°36'51"N, 77°18'14"E), Delhi, India, were studied. The described species is characterized by a flexible body, with body size (*in vivo*) of about 148 × 46 µm and yellowish green cortical granules. Morphological characters exhibit: undulating membranes in *Notohymena*-pattern; two macronuclei and absence of micronucleus (amicronucleate); about 36 adoral membranelles; 18 frontoventral-transverse (FVT) cirri; one right and one left marginal row separated posteriorly; 6 dorsal rows; 7 caudal cirri arranged in 2 + 2 + 3 pattern (constant). In the present study, a detailed description of all the developmental stages is also provided. Prominent distinguishing features of the new species are the absence of micronucleus, 7 caudal cirri (constant), yellowish green cortical granules aligned along the margins and irregularly distributed throughout the cell. They may also be randomly concentrated as clusters along the left margin and posterior end of the cell. Molecular phylogeny based on small subunit rDNA sequence data suggests sister relationship of *Aponotohymena isoaustralis* n. sp. with *Notohymena apoaustralis* and *Aponotohymena australis* (*Notohymena australis*) which cluster in a clade with *Paraurostyla weissei* and *Paraurostyla coronata*. Further analysis of nucleotide sequence of SSU rDNA also suggests that *A. isoaustralis* n. sp. is distinct from the type species *A. australis*.

**Key words:** *Aponotohymena*, morphogenesis, morphology, oxytrichid, phylogeny, SSU rDNA

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Research Article

## Sld5 Ensures Centrosomal Resistance to Congression Forces by Preserving Centriolar Satellites

Manpreet Kaur, Raksha Devi, Tanushree Ghosh, Md Muntaz Khan, Praveen Kumar, Priyanka, Ananya Kar, Aparna Sharma, Akhil Varshney, Vipin Kumar, and Sandeep Saxena

National Institute of Immunology, Aruna Asaf Ali Marg, New Delhi, India

### ABSTRACT

The migration of chromosomes during mitosis is mediated primarily by kinesins that bind to the chromosomes and move along the microtubules, exerting pulling and pushing forces on the centrosomes. We report that a DNA replication protein, Sld5, localizes to the centrosomes, resisting the microtubular pulling forces experienced during chromosome congression. In the absence of Sld5, centriolar satellites, which normally cluster around the centrosomes, are dissipated throughout the cytoplasm, resulting in the loss of their known function of recruiting the centrosomal protein, pericentrin. We observed that Sld5-deficient centrosomes lacking pericentrin were unable to endure the CENP-E- and Kid-mediated microtubular forces that converge on the centrosomes during chromosome congression, resulting in monocentriolar and acentriolar spindle poles. The minus-end-directed kinesin-14 motor protein, HSET, sustains the traction forces that mediate centrosomal fragmentation in Sld5-depleted cells. Thus, we report that a DNA replication protein has an as yet unknown function of ensuring spindle pole resistance to traction forces exerted during chromosome congression.

**KEYWORDS** GINS, kinesin CENP-E, multipolarity, centriolar satellites, chromosome congression, microtubule forces

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R.D. and T.G. contributed equally to this work.

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HAYATI Journal of Biosciences  
 Volume 24, Issue 4, October 2017, Pages 215-220



Original Research Article

## Diversity and Abundance of Ammonia-Oxidizing Bacteria and Archaea in a Freshwater Recirculating Aquaculture System

Cherits Devi Khangembam<sup>1</sup>, Jai Gopal Sharma<sup>2</sup>, Rina Chakrabarti<sup>1</sup>  [Show more](#) 

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## Abstract

The role of ammonia-oxidizing bacteria and archaea was evaluated using *amoA* gene in a freshwater recirculating system. Broken earthen pot pieces (BEP) were used as filter bed material. Five archaeal and four bacterial operational taxonomic units were retrieved from *amoA* genes. Shannon-Weiner and Simpson indices were higher in archaeal *amoA* sequence compared with the bacteria. Subtype diversity ratio and subtype diversity variance were 0.522 and 0.008, respectively, for archaea and 0.403 and 0.015, respectively, for bacteria. In archaea, 50% *amoA* sequences showed 99%–100% similarity with the known sequences of ammonia monooxygenase subunit A of uncultured archaeal clones and thaumararchaeote. In bacteria, 84% sequences showed 99% similarity with *amoA* sequences of different uncultured bacterial clone and Nitrosomonadaceae. Absolute quantification showed that the abundance of archaea was 12-fold higher compared with bacteria. In this recirculating system, ammonia-oxidizing archaea and bacteria played a major role; BEP supported the growth of these ammonia-oxidizing microorganisms.



## Study of effect of various temperatures on the abundance of ammonia oxidizing archaea and bacteria

CHERITA DEVI KHANGEMBAM<sup>1</sup>, SAMAR PAL SINGH<sup>2</sup>, RINA CHAKRABARTI<sup>3</sup> and JAIGOPAL SHARMA<sup>4</sup>

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Received: 7 July 2017; Accepted: 14 December 2017

### ABSTRACT

Temperature plays significant role in the oxidation of ammonia in filtration units of recirculating aquaculture system. The impact of temperature on the abundance of ammonia oxidizing archaea and bacteria, and the expression of ammonia oxidizing gene (*amoA*) at specific temperature was evaluated. The broken earthen pot pieces used as filter bed materials of recirculating system, showing the presence of microorganisms were introduced in glass containers (5 pieces/5l) filled with synthetic wastewater and exposed to four different temperatures of 10, 20, 30 and 40°C for 40 days. The ammonia oxidation rate was minimum at 10°C. In 20, 30 and 40°C treatments, 99% ammonia was reduced on day-18, 8 and 18, respectively compared to the initial day. Fresh ammonium chloride (2 mM) was added twice to maintain the ammonia concentration in all treatments, except 10°C one. Nitrite-N level was < 1 mg/l at 10°C. The level was highest on day-22 at 20° and 40°C and on day-12 at 30°C. The nitrification was 10 days delayed at 20°C and 40°C compared to 30°C treatment. Concentration of nitrate-N was lowest at 10°C. Highest concentration of nitrate-N was observed on day-40 at 20°C and 40°C and day-26 at 30°C. Highest copy number of bacterial *amoA* was recorded at 30°C ( $2.59 \times 10^7$ ) followed by 20°C ( $4.08 \times 10^6$ ), 40°C ( $1.45 \times 10^6$ ) and 10°C ( $5.664 \times 10^3$ ). Archaeal *amoA* was highest at 30°C ( $7.47 \times 10^3$ ) followed by 40°C ( $2.98 \times 10^2$ ) and 20°C (46.8) treatments. Hence it may be concluded that 30°C temperature was optimum for the efficient and faster oxidation of ammonia in the present recirculating system.

**Key words:** Ammonia, *amoA* gene, Archaea, Bacteria, Recirculating system, Temperature

In the global nitrogen cycle, microorganisms played significant role as the oxidation of ammonia, the key process for maintenance of nitrogen cycle depends on them. It determined the balance between oxidized and reduced forms of nitrogen in terrestrial and aquatic ecosystems. The oxidation of ammonia, the first step of nitrification was considered as the rate-limiting step because of slow growth rate of ammonia oxidizing bacteria and their response to changing environmental conditions (Wagner *et al.* 1995). Various studies showed the influence of temperature on the nitrification rate. It was influenced by environmental temperature and ammonium-N concentration (Hoilijoki *et al.* 2000). In environment, nitrification rate increased gradually from 10°C to 30°C (Stark 1996, Thamdrup and Fleischer 1998). The ammonia oxidation rate dropped as temperature decreased from 30°C to 10°C (Lei *et al.* 2012). The community structure of the microorganisms was also influenced by the environmental temperature. The diversity

found between ammonia oxidizing archaea (AOA)/ bacteria (AOB) and abundance of ammonia oxidizing genes (*amoA*) with ammonia oxidation rate depth profiles (Santoro *et al.* 2010, Newell *et al.* 2011). Abundance of ammonia oxidizing bacteria and environmental temperature both influenced the lag period and rate of ammonia oxidation (Lee *et al.* 2011). Each AOB lineages had specific temperature range that controlled the biogeographic distribution of individual AOB (Avrahami *et al.* 2011, Fierer 2009).

Like ammonia oxidizing bacteria, the activities of AOA are also influenced by temperature. The diversity of AOA decreased at low temperature (Urakawa 2008). Some AOA preferred elevated temperature (Tourna *et al.* 2008). The optimal growth of *Nitrososphaera viennensis* was found at 37°C and *Nitrosocaldus yellowstonii* grew up to 74°C (Tourna *et al.* 2011). The effect of temperature was reflected on the production of nitrous oxide in soil samples incubated for 5 days at different temperatures. Minimum and



Original Article | Open Access |

## Beyond the “Code”: A Guide to the Description and Documentation of Biodiversity in Ciliated Protists (Alveolata, Ciliophora)

Alan Warren , David J. Patterson, Micah Dunthorn, John C. Clamp, Undine E.M. Achilles-Day, Erna Aeschl, Saleh A. Al-Farraj, Saleh Al-Quraishy, Khaled Al-Rasheid, Martin Carr ... [See all authors](#)

First published: 06 January 2017 | <https://doi.org/10.1111/jeu.12391> | Citations: 79

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### Abstract

Recent advances in molecular technology have revolutionized research on all aspects of the biology of organisms, including ciliates, and created unprecedented opportunities for pursuing a more integrative approach to investigations of biodiversity. However, this goal is complicated by large gaps and inconsistencies that still exist in the foundation of basic information about biodiversity of ciliates. The present paper reviews issues relating to the taxonomy of ciliates and presents specific recommendations for best practice in the observation and documentation of their biodiversity. This effort stems from a workshop that explored ways to implement six Grand Challenges proposed by the International Research Coordination Network for Biodiversity of Ciliates (IRCN-BC). As part of its commitment to strengthening the knowledge base that supports research on biodiversity of ciliates, the IRCN-BC proposes to populate *The Ciliate Guide*, an online database, with biodiversity-related data and metadata to create a resource that will facilitate accurate taxonomic identifications and promote sharing of data.

# Assessment of heavy metal toxicity in four species of freshwater ciliates (Spirotrichea: Ciliophora) from Delhi, India

Jeeva Susan Abraham<sup>1</sup>, S. Sripoorna<sup>1</sup>, Ashish Choudhary<sup>1</sup>, Ravi Toteja<sup>1</sup>, Renu Gupta<sup>2</sup>, Seema Makhija<sup>1,\*</sup> and Alan Warren<sup>3</sup>

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*In vitro* laboratory experiments were conducted to determine the toxicity (per cent survival and LC<sub>50</sub>) of essential and non-essential heavy metals (cadmium, copper, nickel, lead and zinc) in four spirotrich ciliates: *Euplotes* sp., *Notohymena* sp., *Pseudourostyla* sp. and *Tetmemena* sp. isolated from three different freshwater ecosystems in the Delhi region, India. The toxicity of the heavy metals was found to vary among the different ciliates. Copper was most toxic (24 h-LC<sub>50</sub> value ranged between 0.125 and 0.74 mg/l) and zinc was least toxic (24 h LC<sub>50</sub> value ranged between 46.98 and 144.32 mg/l) to each of the ciliates. Of the four ciliates, *Notohymena* sp. had the highest tolerance limit to three heavy metals (Cu, Cd and Pb) out of the five tested. This study shows the high potentiality of using freshwater ciliates for monitoring the intensity and potency of ecological damage caused by heavy metals in aquatic ecosystems.

**Keywords:** Ciliates, freshwater, heavy metals, toxicity.

THERE is a global increase in the concentration of heavy metals in the environment mainly due to anthropogenic activities and India is no exception to this<sup>1</sup>. Although some heavy metals are essential micronutrients, all may be toxic if present in sufficiently high concentration in a bioavailable form, mainly as a result of metabolic interference and mutagenesis. The presence of heavy metals in aquatic environments is a major concern because of their threat to plant and animal life, thus disturbing the natural ecological balance<sup>2</sup>. Many freshwater ecosystems, including lakes, ponds, rivers and reservoirs are exposed to heavy metal contamination from a range of sources, primarily wastewater discharges from industry and households<sup>3,4</sup>. Most of the heavy metals have a long half-life and cannot be degraded, but may instead bio-accumulate throughout the food chain leading to physiological stress causing ecological disturbance<sup>5-7</sup>.

Toxicity of various heavy metals can be studied using ciliated protists<sup>8-10</sup>. These eukaryotic microorganisms are found in a variety of trophic niches, have generation time of 3–7 h and many are easy to culture *in vitro*<sup>11</sup>. Ciliates share a higher degree of functional and genetic similarities with humans than bacteria or yeast (microbial eukaryotic model organism)<sup>12-14</sup>. All these properties make them suitable candidates both for eco-toxicological studies and for monitoring water quality<sup>15-17</sup>.

In the present study, we assess the toxicity of essential (Cu and Zn) and non-essential (Cd, Ni and Pb) heavy metals on ciliated protists isolated from three different freshwater ecosystems (river, lake and pond) in the Delhi region, India. The diversity of free-living ciliates in the study sites was observed for a period of one year. The most frequently encountered ciliate species were from four genera, namely *Euplotes*, *Notohymena*, *Pseudourostyla* and *Tetmemena* (Figure 1) and all were easily cultured under laboratory conditions. Toxicity assays were carried out *in vitro* in order to determine the sensitivity and survival of *Euplotes* sp., *Notohymena* sp., *Pseudourostyla* sp. and *Tetmemena* sp. to different doses of heavy metals.

## Materials and methods

### Study area

Delhi is located in northern India. It is bordered by the states of Haryana to the north, west and south, and Uttar Pradesh (UP) to the east. Prominent features of the geography of Delhi include the floodplains of River Yamuna. In the present study three sites were selected in different ecological regions of Delhi.

*Site 1: Okhla Bird Sanctuary (28.5700°N, 77.3023°E):* This is a bird sanctuary at the Okhla Barrage over the

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Original Articles

## Estimating the parameter of selected uniform population under the squared log error loss function

K. R. Meena  Mohd. Arshad & Aditi Kar Gangopadhyay

Pages 1679-1692 | Received 15 Sep 2016; Accepted 25 Apr 2017; Accepted author version posted online: 09 May 2017; Published online: 27 Sep 2017

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### ABSTRACT

Let  $\pi_1, \dots, \pi_k$  be  $k$  ( $k \geq 2$ ) independent populations, where  $\pi_i$  denotes the uniform distribution over the interval  $(0, \theta_i)$  and  $\theta_i > 0$  ( $i = 1, \dots, k$ ) is an unknown scale parameter. The population associated with the largest scale parameter is called the best population. For selecting the best population, we use a selection rule based on the natural estimators of  $\theta_i$ ,  $i = 1, \dots, k$ , for the case of unequal sample sizes. Consider the problem of estimating the scale parameter  $\theta_i$  of the selected uniform population when sample sizes are unequal and the loss is measured by the squared log error (SLE) loss function. We derive the uniformly minimum risk unbiased (UMRU) estimator of  $\theta_i$  under the SLE loss function and two natural estimators of  $\theta_i$  are also studied. For  $k = 2$ , we derive a sufficient condition for inadmissibility of an estimator of  $\theta_i$ . Using these conditions, we conclude that the UMRU estimator and natural estimator are inadmissible. Finally, the risk functions of various competing estimators of  $\theta_i$  are compared through simulation.

**KEYWORDS:** inadmissibility natural estimators selection rule squared log error loss function UMRU estimator uniform distributions

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## Influence of copper and cadmium toxicity on antioxidant enzyme activity in freshwater ciliates

Ravi Toteja<sup>1</sup>, Seema Makhija<sup>1</sup>, S. Sripoorna<sup>1</sup>, Jeeva Susan Abraham<sup>1</sup> & Renu Gupta<sup>2</sup>

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Though metals are biologically important, increase in the threshold concentration of heavy metal in the environment may interfere with the metabolic activity of organisms. Heavy metal stress induces production of reactive oxygen species (ROS) viz. hydroxyl radical, superoxide radical or hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>). Various antioxidant enzymes such as superoxide dismutase, ascorbate peroxidase, catalase, glutathione peroxidase and peroxiredoxin of SOD-ascorbate-glutathione cycle get activated during such stress. These enzymes are involved in ROS detoxification, and thereby protect the cells from oxidative stress. In this study, we explored activity of the antioxidant enzyme, superoxide dismutase (SOD) in the presence of heavy metals i.e., Cu and Cd in three freshwater ciliates, *Tetmemena* sp., *Notohymena* sp. and *Euplotes* sp. Heavy metals negatively affected the population growth of chosen ciliates which was measured as 24 h-LC<sub>50</sub>. The 24 h-LC<sub>50</sub> doses of Cu and Cd, respectively were 0.14 and 2.44 mg/L for *Tetmemena* sp.; 0.74 and 5.06 mg/L for *Notohymena* sp.; and 0.17 and 2.24 mg/L for *Euplotes* sp. The levels of SOD were found to be significantly higher in the presence of Cu and Cd. Interestingly, exposure with Cu increased the SOD level at LC<sub>30</sub> and LC<sub>50</sub> doses, however, at higher concentration of Cu (i.e., LC<sub>70</sub> dose), SOD level decreased. The results suggest that SOD may be used as an effective enzymatic biomarker to evaluate the toxic effects of heavy metals in the ciliate species.

**Keywords:** *Euplotes* sp., Heavy metal stress, *Notohymena*, Oxidative stress, ROS, SOD, Spirotrich ciliates, *Tetmemena* sp.

Heavy metals increase reactive oxygen species (ROS) production and eventually induce oxidative stress in both aquatic and terrestrial organisms<sup>1-6</sup>. Heavy metals with redox activity (Fe, Cu) are directly involved in ROS production by Fenton/Haber-Weiss reaction or by autoxidation. Also, metals with non-redox activity (Cd, Zn, Hg) can produce ROS indirectly by blocking the cellular antioxidant defenses<sup>7,8</sup>. ROS (such as superoxide radicals, hydrogen peroxides and hydroxyl ions) are involved in various pathological processes including lipid peroxidation<sup>9,10</sup>. These radicals cause much of the tissue damage resulting from inflammation and can eventually induce cell death by apoptosis/necrosis<sup>10,11</sup>. Cells under oxidative stress show various dysfunctions due to significant changes caused by ROS on proteins, DNA and cellular lipids<sup>2,11</sup>. Various anti-oxidant enzymes (such as superoxide dismutase, ascorbate peroxidase, catalase glutathione peroxidase and peroxiredoxin) are known to be involved in ROS detoxification (Fig. 1) and in protecting the cells from oxidative stress<sup>7,12</sup>.

Superoxide dismutase (SOD), which gets activated in response to oxidative stress at first, plays a major role in catalyzing the dismutation of superoxide anion (O<sub>2</sub><sup>-</sup>) into O<sub>2</sub> and H<sub>2</sub>O<sub>2</sub><sup>13,14</sup>. SOD exists in several isoforms including cytosolic copper-zinc SOD (SOD-1), mitochondrial manganese SOD (SOD-2)<sup>15</sup> and extracellular/chloroplast iron SOD (SOD-3)<sup>14,16</sup>.

A major hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) detoxifying system in the cells is ascorbate-glutathione cycle, where ascorbate peroxidase (APx) plays a key role in catalyzing H<sub>2</sub>O<sub>2</sub> into H<sub>2</sub>O using ascorbate as a specific electron donor<sup>12</sup>. GSH is a tripeptide (L-γ-glutamyl-L-cysteinylglycine) synthesized in two consecutive steps catalyzed by γ-glutamyl-cysteine synthase and glutathione synthetase<sup>17</sup>. GSH also acts as substrate for glutathione peroxidase (GPx) to catalyze hydrogen peroxide<sup>7</sup>. Changes in these antioxidant enzymes including ASC-GSH cycle enzymes have been observed in various organisms exposed to different abiotic stress including heavy metals. Overexpression of any of these enzymes by a particular organism has shown higher resistance to the abiotic stress as compared to the organisms under-expressing these enzymes<sup>18,19</sup>. Studies on heavy metal induced oxidative stress and generation of ROS have

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## Cellular and molecular basis of heavy metal-induced stress in ciliates

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Globally, heavy metals are the major pollutants present in both terrestrial and aquatic ecosystems. Increase in their concentration due to various anthropogenic activities is a matter of concern. Higher concentration of these metals is known to be toxic due to their non-biodegradable nature. Eukaryotic microorganisms, ciliates can be used as cellular tools to assess and study the various mechanisms to overcome heavy metal toxicity. Here we discuss, at cellular level, the effect of heavy metal toxicity on growth rate, behavioural and morphological changes of ciliates. At the molecular level, changes in stress genes like *hsp70*, metallothionein and expression of various antioxidant enzymes (superoxide dismutase, glutathione peroxidase) adopted by ciliates have also been deliberated. It is also being argued that ciliates can be used as biosensor/cellular tools for detecting heavy metal pollution.

**Keywords:** Ciliates, heat shock protein, heavy metal stress, metallothionein, superoxide dismutase.

HEAVY metals are those metallic elements whose density is relatively higher than water<sup>1</sup>. Some of the essential heavy metals (such as cobalt, copper, chromium, iron, magnesium, manganese, molybdenum, nickel, selenium and zinc) act as important elements in the living systems, as most of them act as cofactors for the enzymes involved in various biochemical and physiological functions required for cellular metabolism and growth<sup>1-3</sup>. Higher concentrations of these metals are known to be toxic due to their non-biodegradable nature<sup>2,4</sup>. The other non-essential heavy metals (viz. aluminium, arsenic, cadmium, lead, mercury, nickel, platinum, titanium and uranium) show toxicity even at low concentrations<sup>1</sup>. Heavy metals cause detrimental effects on all living organisms<sup>5</sup>, leading to major ecological disturbances<sup>2</sup>.

The most effective method for detecting pollutants is the use of biological components known as biosensors or bioreceptors. In many reports, yeast, microalgae and protozoa (including ciliates) are used as eukaryotic biosensors to detect metals<sup>2</sup>. Since ciliates have widespread distribution and do not have a cell wall, they can react quickly to environmental stresses<sup>4-7</sup>. In addition, ciliates show a faster growth, can be cultured and maintained under laboratory conditions with ease<sup>8</sup>. These characteristics make them more suitable to be used as cellular tools in ecotoxicological studies<sup>8</sup>, and to study physiological and molecular processes involved in metal toxicity<sup>7,9,10</sup>.

In this article, the effect of heavy metal toxicity on ciliates along with the mechanisms involved in their defence against heavy metals have been discussed. Further, whether ciliates can be used as whole-cell biosensors/cellular tools to assess heavy metal pollution has also been explored.

### Effect of heavy metals on ciliates

#### Cell survivability

Several studies indicate that heavy metals have adverse effect on the growth rate of ciliates. It has also been shown that per cent survivability of ciliates decreases significantly with increasing heavy metal concentration<sup>5,11-17</sup>. Also, LC<sub>50</sub> values of various heavy metals, viz. cadmium, copper, chromium, lead, mercury and zinc on different ciliate species have been reported, and it has been found that Cd and Cu are more toxic to most of the ciliate species whereas Zn is least toxic<sup>13</sup>. In addition, it has also been reported that ciliates are highly sensitive to various heavy metals compared to other eukaryotic organisms<sup>4,7,10,14,16,18-21</sup>.

BIONOTES Vol. 21 (1) Mar., 2019

**SIGHTINGS OF *JAMIDES BOCHUS* (STOLL, [1782])  
AND *PROSOTAS NORA* (C. FELDER, 1860)  
(INSECTA: LEPIDOPTERA: LYCAENIDAE)  
FROM URBANIZED PARTS OF NEW DELHI, INDIA**

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The population of Delhi has increased seventy fold during the last century, with concurrent expansion of urban or concretized landscape (Anonymous, 1912; Anonymous, 2011). Presently, the urbanized portion of Delhi is dotted with numerous parks and gardens harbouring domesticated flora. An evident effect of urbanization of a geographical area is change in the species composition of plants and animals, and, in fact, urbanization introduces novel ecosystems (Lepczyk *et al.*, 2017; Donahue & Lambert, 2015). Insects such as butterflies, which require larval host plants for their survival and are sensitive to the effect of urbanization, can act as an indicator of biodiversity in urban settings (Clark *et al.*, 2007; Fontaine *et al.*, 2016; Dennis *et al.*, 2017). Also, butterflies are well documented and surveyed, they are relatively easy to identify and there is a wealth of information about their life histories.

The first partial list of butterflies of Delhi was prepared by Longstaff (1912), mentioning 21 species. An elaborate list of 62 butterflies was made by Jandu (1942, 1943) and Donahue (1967) listed 77 species of butterflies. The list was expanded to include 86 species by Larsen (2002). Recently, a checklist of 115 species of butterflies seen in Delhi was published by Biswas *et al.* (2017). The increase in the butterfly count over time, as evident from these lists, could be the effects of gradual changes in the pattern of floral diversity and habitat due to horticultural practices and urbanization. Alternatively, it may merely be the result of increased observation.

Here, we report the recent sightings of two species of butterflies, *Jamides bochus* (Dark Cerulean) and *Prosotas nora* (Common Lineblue) from the urbanized areas of Delhi. Both the species of butterflies have been reported to be sighted rarely in Delhi by earlier workers (Donahue, 1967; Larsen, 2002).

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Research Paper

## Floral contrivances and specialised pollination mechanism strongly influence mixed mating in *Wrightia tomentosa* (Apocynaceae)

C. Barman, V. K. Singh, S. Das, R. Tandon ✉

First published: 13 January 2018 | <https://doi.org/10.1111/plb.12690> | Citations: 6

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### Abstract

- Reproductive success of a plant species is largely influenced by the outcome of mating pattern in a population. It is believed that a significantly larger proportion of animal-pollinated plants have evolved a mixed-mating strategy, the extent of which may vary among species. It is thus pertinent to investigate the key contributors to mating success, especially to identify the reproductive constraints in depauperate populations of threatened plant species.
- We examined the contribution of floral architecture, pollination mechanism and breeding system on the extent of outcrossing rate in a near-threatened tree species, *Wrightia tomentosa*. The breeding system was ascertained from controlled pollination experiments. In order to determine outcrossing rate, 60 open-pollinated progeny were analysed using an AFLP markers.
- Although the trees are self-compatible, herkogamy and compartmentalisation of pollen and nectar in different chambers of the floral tube effectively prevent spontaneous autogamy. Pollination is achieved through specialised interaction with moths. Differential foraging behaviour of settling moths and hawkmoths leads to different proportions of geitonogamous and xenogamous pollen on the stigma. However, most open-pollinated progeny were the result of xenogamy (outcrossing rate,  $t_m = 0.68$ ).
- The study shows that floral contrivances and pollination system have a strong



## Research Article

# Relative contribution of reproductive attributes to the density-dependent effects on fruit-set

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**Abstract.** Reproductive success of a plant species can be affected by the distribution pattern of its conspecifics in a small population. Besides the low mate availability, the dynamics of breeding system and pollination mechanism may also contribute to low fruit-set in such populations. We examined the relative contribution of these reproductive attributes on fruit-set across the contrasting distribution pattern (denser vs. sparser plots) in two isolated natural populations of a near-threatened tree species, *Anogeissus sericea* var. *nummularia*. Although flowers in the species are of generalist type, the narrow stigmatic surface appears to impose a requirement for a specialist pollinator. Pollination in the tree species is mediated only by the flies. The trees exhibit partial selfing and suffer from strong inbreeding depression at the early life-history stages of the selfed progeny. We recorded significant difference between the denser and sparser plots in terms of inflorescence visits per tree, and the number of trees covered in a bout by the pollinators. Moreover, tree density showed a strong positive correlation with fruit-set. Besides the requirement of having proximity among the conspecifics to facilitate pollinator movement, pollen quality also seemed to be a crucial attribute in the reproductive success of the tree species. It is inferred that the mating pattern and fecundity of plants in small and isolated populations are significantly influenced by the extent of sexual incompatibility and magnitude of their dependence on pollinators.

**Keywords:** Inbreeding depression; myophily; partial self-compatibility; reproductive biology.

## Introduction

Plant communities in arid and semi-arid zones are usually small or isolated and their reproductive success is constrained by low mating opportunities (Aguilar and Sala 1999). This is largely because the interaction dynamics of certain reproductive attributes become confined due to the sparser distribution pattern of the conspecifics. Among these attributes, pollination mechanism and breeding system of biotically pollinated plant species are of significance (Silander 1978; Kunin 1992,

1997; Ghazoul et al. 1998). In a density-dependent landscape, the extent of pollinator dependence and sexual compatibility play a crucial role in defining the net outcome of mating success. Knowledge of interaction between these reproductive attributes is vital and is considered a prerequisite in attempts to recover threatened plant species (Metcalfe and Kunin 2006; Ruane et al. 2014).

Density-dependent effects on mating pattern can be ascertained from the contributors of pollination success

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## ARTICLE

## Occurrence of subdioecy and scarcity of gender-specific markers reveal an ongoing transition to dioecy in Himalayan seabuckthorn (*Hippophae rhamnoides* ssp. *turkestanica*)

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**Abstract**

Dioecy and the dynamics of its evolution are intensely investigated aspects of plant reproduction. Seabuckthorn (*Hippophae rhamnoides* ssp. *turkestanica*) is an alpine shrub growing wild in certain parts of western Himalaya. The previous studies have reported heteromorphic sex chromosomes in the species and yet marker-based studies indicate high similarity between the male and female genomes. Lack of information on sexual system in the species has further complicated the situation. A systematic study was thus undertaken to understand the sexual system in seabuckthorn and to discern the extent of similarity/dissimilarity between the male and female genomes by generating a large number of markers using amplified fragment length polymorphism and representational difference analysis. Floral biology and regular monitoring of species revealed the presence of polygamomonoecious (PGM) plants in most populations at a low percentage (~2–4%). PGM plants showed low pollen production and overall low fertility, suggesting a monoecy–paradioecy pathway at function. The results of the marker study demonstrated that there are limited differences between male and female genomes and these differences were not uniform across the populations in the Leh–Ladakh region, especially when the geographical distance increases. Results also suggest that a dynamic partitioning of genomes is operational between the two genders of seabuckthorn and differences are not homogenized across the populations. Both reproductive biology-based and DNA marker-based studies indicate that genders have separated recently. The present study proposes seabuckthorn as a promising model system to study evolution of dioecy and sex determination.

**Introduction**

Dioecy is widespread among the flowering plants. It is believed to have evolved independently from cosexuality on several occasions (Renner 2014). The evolutionary routes toward dioecy may include transitory stages, represented by some plants which bear bisexual flowers either along with staminate (andromonoecious), pistillate (gynomonoecious), or both the types (polygamomonoecious (PGM)), and exist along with fully evolved unisexual plants. Plant populations with such a gender configuration are termed subdioecious (Geber et al. 1999). Subdioecy is often maintained in a population until complete dioecy is established (Ross 1982; Barrett 2002), with a possibility of reversion to cosexuality (Charlesworth and Charlesworth 1979). Breakdown of established dioecy may also result in subdioecious condition (Ehlers and Bataillon 2007). Species harboring subdioecious condition can help in understanding the prevailing mechanism of gender determination and provide

These authors contributed equally: Yash Mangla, Kamal Das.

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## HETEROLEPTIC METAL(II) COMPLEXES OF CURCUMIN AND 2,2'-BIPYRIDINE: SYNTHESIS, CHARACTERIZATION, MOLECULAR MODELING AND PRELIMINARY ANTIMICROBIAL INVESTIGATION

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Three mononuclear metal complexes [(curcu)M(bpy)]Cl **1-3** of nickel<sup>II</sup> (**1**), copper<sup>II</sup> (**2**) and zinc<sup>II</sup> (**3**) derived from curcumin (curcu) and 2,2'-bipyridine (bpy) have been isolated and characterized by analytical and spectral methods, viz. elemental analyses, molar conductance, magnetic susceptibility measurements, mass spectrometry, IR, UV-visible spectrometry and molecular modeling studies. IR spectral frequencies exhibited curcumin and 2,2'-bipyridine both behave as bidentate ligand and coordinate to metal ion through the carbonyl oxygen and nitrogen atoms respectively. All the complexes showed molar conductance corresponding to 1:1 electrolytic nature. Ni<sup>II</sup> and Cu<sup>II</sup> complexes were confirmed possessing square planar geometry however Zn<sup>II</sup>, tetrahedral. Metal complexes along with curcumin and 2,2'-bipyridine were examined against the opportunistic pathogens. The results obtained indicate that metal complexes have reasonable antimicrobial potential.



### INTRODUCTION

Naturally occurring phenolic pigment, Curcumin; chemically, [1,7-bis(4-hydroxyl-3-methoxyphenyl)-1,6-heptadiene-3,5-dione] is a major component of the *Curcuma longa* Linn,<sup>1</sup> which is commonly used as a yellow coloring and flavoring agent in foods. Recent studies have shown that curcumin possesses a specific property of binding to metals and as a multipotent agent for combating to potent biological as well as pharmacological activities.<sup>2-8</sup> Thus, for the past decade curcumin as a ligand has been the subject of great interest in modern coordination chemistry.<sup>9-12</sup> Curcumin has a specific chemical motif, a bis- $\alpha,\beta$ -unsaturated- $\beta$ -diketone which exhibits keto-enol tautomerism (**Figure 1**). The virtue of coordination property of curcumin leads to tailoring a rational drug design including a number of metal complexes and

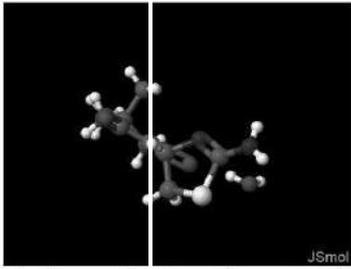
scavenge the active free-radicals which makes it a more potent bioactive agent viz. as antimicrobial agent, anticarcinogenic, antialzheimer, used in catalysis, radiodiagnostic and several other applications.<sup>13-17</sup> Research analysis postulates that the biological properties of curcumin are significantly enhanced upon coordination with metal ion.<sup>18-19</sup> On the other hand, heterocyclic compounds such as pyridine, phenanthroline, bipyridine, and their respective derivatives etc. have been shown extended biological activities when coordinated with metal ion.<sup>20-21</sup> Various enzymes, vitamins, proteins and other life regulating biomolecules, most of which consist of N- and/or O- containing heteroatoms which are the key of chelation with transition metal ions.

Thus, specific biological and pharmacological role of curcumin, bipyridine and various role of transition metal ions in daily life, could have made

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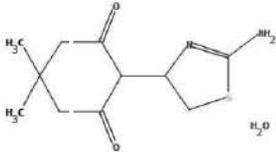
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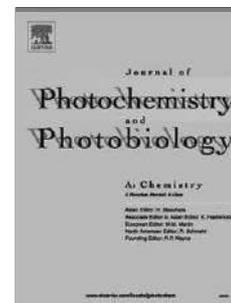
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# Protective effects of *Aporosa octandra* bark extract against D-galactose induced cognitive impairment and oxidative stress in mice

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## Abstract

*Aporosa octandra* (Buch.-Ham. ex D.Don) Vickery is a native species of India. Different parts of the plant are used for the medicinal purpose by the tribal peoples of south-eastern part of India. However, the biological properties of *A. octandra* have not been studied well. The extracts obtained from the bark of *A. octandra* were evaluated to determine their protective effect on cognitive impairment and oxidative stress in mice induced by D-galactose using the standard protocol. Different dosages of extract AOE-4 (100, 200, and 300 mg/kg, p.o.) were administered to mice, which were previously treated for six weeks with D-galactose (100 mg/kg s.c.). The D-galactose-induced mice showed significantly impaired cognitive behavior, i.e., oxidative defense, compared to the

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## Social centrality using network hierarchy and community structure

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### Abstract

Several centrality measures have been formulated to quantify the notion of ‘importance’ of actors in social networks. Current measures scrutinize either local or global connectivity of the nodes and have been found to be inadequate for social networks. Ignoring hierarchy and community structure, which are inherent in all human social networks, is the primary cause of this inadequacy. Positional hierarchy and embeddedness of an actor in the community are intuitively crucial determinants of his importance. The theory of social capital asserts that an actor’s importance is derived from his position in network hierarchy as well as from the potential to mobilize resources through intra-community (bonding) and inter-community (bridging) ties. Inspired by this idea, we propose a novel centrality measure social centrality (SC) for actors in social networks. Our measure accounts for—(1) an individual’s propensity to socialize, and (2) his connections within and outside the community. These two factors are suitably aggregated to produce social centrality score. Comparative analysis of SC measure with classical and recent centrality measures using large public networks shows that it consistently produces more realistic ranking of nodes. The inference is based on the available ground truth for each tested networks. Extensive analysis of rankings delivered by SC measure and mapping with known facts in well-studied networks justifies its effectiveness in diverse social networks. Scalability evaluation of SC measure justifies its efficacy for real-world large networks.

**Keywords** Centrality · Social capital · Hierarchy · Community · Strength of ties · k-Truss decomposition

### 1 Introduction

Centrality is widely-used for identifying important/powerful nodes in a network (Bloch et al. 2017; Landherr et al. 2010). Node centrality is based on the perception of

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**Bandwidth Efficient Broadcast Protocols in MANETs: A Review****C.K. Samal<sup>1</sup>, R. K. Choudhury<sup>2</sup>**<sup>1</sup>Computer Science, AND College, Delhi University, New Delhi, India<sup>2</sup>Computer Science, Kalinga University, New Raipur, India<sup>\*</sup>Corresponding Author: cksamal@gmail.com, Tel.: +91-93102-70787

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**Abstract**— Mobile ad hoc networks has been facing problems, when nodes are transmission in multi-hop nodes that time a contention and congestion due to node mobility, the network has unpredictable characteristics; its topology changes and signals strength fluctuates because of the broadcast nature of radio transmission. The broadcast operation is very important in MANETs and major challenges to reducing redundant, rebroadcast and broadcast latency problems. In this paper we comparative study of the DFCN and PEGSP algorithms for efficiently bandwidth utilize in multi-hop MANETs. Our validated simulation result shows that PEGSP algorithm is high reliability and high efficiency, channel's bandwidth is efficiently utilized in wide area networks context of low speed of mobile nodes. The DFCN protocol operates well in high density and low density networks, it well in high speed mobile nodes. Nodes are high reachability within transmission range of the network, this protocol is advantages for energy conservation in multi-hop mobile ad hoc network.

**Keywords**—Broadcast latency, Bandwidth, Reachability, Reliability and Efficiency.

**1. INTRODUCTION**

An ad hoc wireless network is a collection of wireless mobile nodes to form a temporary network without support of base stations and aid of any centralized administration. In such networks, each mobile node operates as a host or router [1]. When two nodes that is out of one another's transmission range, they want to communicate with each other, they need the support of the intermediate nodes for relaying the packets. Broadcast operation has the important role in mobile ad hoc wireless networks because of broadcasting nature of the radio transmission, when a sender transmits a packet, all neighbor nodes of network within the senders transmission range will be affected by this transmission. The benefit of this nature is that one packet can be received by all neighbor nodes; the disadvantage is that when node sending the packets it will interfere with the sending and receiving of other transmissions, in such situation two problem has occurred, one as hidden terminal and second as exposed terminal problems [2]. In broadcasting is a process of transmitting a packet so that each node in a network receives a copy of this packet. Blind flooding, where every node in the network forwards the packets exactly once. Devices are generally mobile which means that the topology of networks may change quickly in a high mobility environment, simple flooding ensures to achieve the full coverage of all the network; that is, the broadcast packet is guaranteed to be received by every node in the network, providing there is no packet collision caused by the MAC layer of the communication channel is error free during the broadcast

process [1]. The main focus of this paper, when high mobility of nodes communicated to each other in the network on that situation mobile nodes take a right decision where the packet to forward.

Section 1 contains introduction of Mobile ad hoc networks and broadcasting process in multi hop nodes. In Section 2 we have discussed the problem statements in ad hoc wireless sensor networks. Section 3 contains methodology of DFCN and PEGSP algorithms. Section 4 explains the simulation configuration setups and simulation result analysis with different metrics. Last section is conclusion, we compare the both protocols simulation results performance.

**2. PROBLEM STATEMENTS**

The main challenges in MANET are reliability, bandwidth, security, interference, battery power and routing protocols. Due to node mobility, the network has unpredictable characteristics; its topology changes, signal strength fluctuates with environment and time [3]. The communication routes break and new ones are formed dynamically. Broadcast algorithm is necessary in mobile ad hoc network for reliable communication. The problem can be characterized by causing a lot of contention, redundancy, rebroadcasts and collisions. First, when each node rebroadcasts a message it is highly likely that the neighboring nodes have already received the broadcast, which results in the flooding algorithm creating a large number of redundant messages. Second, since all nodes in the area are trying to rebroadcast the message at

## PAPER

# Structural and optical properties of electrochemically deposited ZnO nanorods by using graphene oxide and ITO as substrate material: a comparative study

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## PAPER

# Comparison of water purification properties of Graphene Oxide (GO) membranes with tuned interlayer spacings

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## PAPER

# Sonication effect on graphene oxide (GO) membranes for water purification applications

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## Synchronization of fractional order Rabinovich-Fabrikant systems using sliding mode control techniques

SANJAY KUMAR, CHAMAN SINGH, SADA NAND PRASAD,

CHANDRA SHEKHAR and RAJIV AGGARWAL

In this research article, we present the concepts of fractional-order dynamical systems and synchronization methodologies of fractional order chaotic dynamical systems using sliding mode control methodology of fractional order Rabinovich-Fabrikant systems. We have obtained that the lowest dimension of Rabinovich-Fabrikant system is 2.85 through utilization of the fractional calculus and computational simulation. Bifurcation diagrams and Lyapunov exponents of fractional order Rabinovich-Fabrikant system to justify the chaos in the systems. Synchronization of two identical fractional-order chaotic Rabinovich-Fabrikant systems are achieved using sliding mode control methodology.

**Key words:** fractional-order chaotic system, chaos synchronization, Rabinovich-Fabrikant system, Lyapunov exponents

### 1. Introduction

Chaos, an inevitable phenomenon is the part of nonlinear systems. It is highly sensitive to the initial conditions. This sensitivity is popularly known as the butterfly effect. Synchronization of more than two chaotic dynamical systems is one of most important applications of chaos. Last several decades, chaos synchronization has been become the research

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## Circular restricted three-body problem when both the primaries are heterogeneous spheroid of three layers and infinitesimal body varies its mass

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**Abstract.** The circular restricted three-body problem, where two primaries are taken as heterogeneous oblate spheroid with three layers of different densities and infinitesimal body varies its mass according to the Jeans law, has been studied. The system of equations of motion have been evaluated by using the Jeans law and hence the Jacobi integral has been determined. With the help of system of equations of motion, we have plotted the equilibrium points in different planes (in-plane and out-of planes), zero velocity curves, regions of possible motion, surfaces (zero-velocity surfaces with projections and Poincaré surfaces of section) and the basins of convergence with the variation of mass parameter. Finally, we have examined the stability of the equilibrium points with the help of Meshcherskii space–time inverse transformation of the above said model and revealed that all the equilibrium points are unstable.

**Keywords.** Heterogeneous spheroid—variable mass—regions of motion—zero-velocity surfaces—poincaré surfaces of section—basins of convergence.

### 1. Introduction

The restricted problem with many perturbations is an interesting problem in the celestial mechanics and space dynamics since many decades. Many researchers have studied the restricted problem of three-body with different perturbations as different shapes of the primaries, solar radiation pressure, P–R drag, variable mass, etc. Szebehely (1967) explained the dynamical behaviour of the bodies in his book ‘theory of orbits’. Sharma and Subba Rao (1975) numerically investigated the location of libration points for 19 systems of astronomical interest by taking the primaries as oblate bodies. Then they showed that the eccentricity and synodic period of these orbits are the function of oblateness. They also revealed that the orbits around libration points performed a different trend. Murray (1994) investigated the location and stability of the five equilibrium points in the planar circular restricted three-body problem under the effect of different drag forces. Khanna and Bhatnagar (1999) studied the existence and stability of libration points in the restricted three-body problem when the smaller

primary is a triaxial rigid body and the bigger one an oblate spheroid when the equatorial plane of both the bodies are coinciding with the plane of motion. They have found five equilibrium points in which two are triangular and three are collinear. They also observed that the collinear equilibrium points are unstable while triangular equilibrium points are stable and have long or short periodic elliptical orbits. Idrisi and Taqvi (2013) investigated the existence and stability of five equilibrium points which lie on the arc of the unit circle with centre at bigger primary. They observed that all the equilibrium points are unstable. Ansari (2017) studied the effect of albedo on the motion of infinitesimal body in circular restricted three-body problem when all the bodies vary their masses. Using Meshcherskii transformations, he evaluated the equations of motion by which he has drawn the locations of equilibrium points, periodic orbits, Poincaré surfaces of section and basins of attraction in four cases. He also examined the stability of equilibrium points and found that all the equilibrium points are unstable. Shalini & Abdullah (2016) and Shalini *et al.* (2017) investigated the existence, linear



## An EOQ Model for Deteriorating Items with Selling Price Dependent Exponential Demand for Time Varying Holding and Deterioration Costs

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### Abstract

Research investigation of the past few decades shown that the researchers developed economic order quantity (EOQ) model for perishable items under constant deterioration and constant demand. Though, in actual practice it is not true. This paper involved a representation of an inventory control model, in which perishable items has been taken with a price as well as an exponential dependent demand. The measured items in the model are deteriorating in nature based on time dependent deterioration rate. In the earlier studies the holding cost often treated as a constant, which is not suited to the most of the practical life situations. In real practical situation some kind of items treat holding cost is a function of time, which is increase as the time increases. In this paper, a model is developed which included the time dependent linear holding cost. We have achieved the estimated optimal solution under the given assumption according to the situation. A numerical example is presented to demonstrate the model and the sensitivity analysis of various parameters is approved out for the validation of the proposed method.

**Keywords:** Deteriorating items, price and time dependent demand, shortages and time varying holding cost, Lead time.

### 1. Introduction

In different business, Inventory shows a very crucial part in the manufacturing and service organization. For the stable running of the business, every company must carry some inventory. No organization claims that they are not keeping any inventory. Wilson [29], developed a one of the well-known Economic Order quantity model and in the connection of this model a lot of work has been done in the research area. Demand rate is assumed to be a constant in the classical inventory models. But in many everyday situation behavior of demand under different cases shows time, stock, and price dependent selling price has been the cause of demand increment and demand decrement in the inventory system. Sharma, A. et.al [22] [23] focused on the different demand rate for different time interval. Economical quantity lot size model, in which price-dependent demand under quantity and merchandise discounts developed by Burwell [2], which is followed by Mondal, et. al [12]. Mishra, V.K. et.al. [14] [15] and Acharya, M.S.D. [1], introduced an inventory model for perishable items, in which time dependency demand discussed. Roy, A., [21] and K. Geetha et.al. [10] introduced the model for decaying item in which Roy and Geetha focused on price dependent demand rate function. You [28] and Duari, N.K. [19] explained an inventory model in which the system includes the enriching items for price dependent demand. Last few decades have been the evidence the study of perishable items has gained enormous importance. In present time the wastage of any kind of natural or unnatural resources is considered as an unavoidable wickedness. Even most of the organizations are facing very tough competition and deterioration of resources

would shrink their profit margins considerably. Consequently, in most of the present models the items considered are deteriorating in nature and inventory cost compromises of the deterioration cost. Initially Ghare and Schrader were the first to use the concept of deterioration, they established an inventory model in which constant rate of deterioration has been focused. Ghare and Schrader [9], followed by Covert, and G. C. Philip [4] who formulated a model considering a variable rate of deterioration with two parameter Weibull distribution. Pal, S. [20] further extended the concept of a deteriorating item in his own views and explanation. Nahmais [17] provided the well-defined literature on the various problem of determining suitable ordering policies subject to continuous exponential decay. Singh, C and Singh, S.R [25][26] investigated the model in which exponential demand rate functions well as the weibull distribution of deterioration rate is used Many authors explained the Lead time related research. This topic has been the interest of many researchers. Lead time is recommended in deterministic as well as probabilistic cases. Assumed by Ben-day [3], Das [6], Foote [7], Magson [11], Naddor [18], Chung, and Ting, [5], Fujiwara [17]. Singh, S.R [27] touch the issue of lead time in his own research area and developed a supply chain model for inventory system though, in many practical situations lead time can be reduced at an added cost. By reducing the lead time, customer service and reaction to production schedule changes can be improved and reduction in safety stocks can be achieved. Singh, C. [24] developed an inventory control model and focused on problem of shortage in daily life situation.

In this paper, we extended the idea of M. Maragatham and R. Palani [16], an inventory model for deteriorating items with lead time price dependent demand and shortages.



# An Optimal Policy for Deterministic Model for Time Proportional Deteriorated Inventory with Different Demand Rate Pattern

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**Abstract**— In this paper, we have formulated an economic order quantity inventory model for a deteriorating item having a twofold deterministic demand rate. The Constant demand rate in the first part of the cycle and the exponential demand rate in the second part of the cycle has been taken. We also considered deterioration rate is time sensitive in nature and Shortages are not the part of this model. A complete solution procedure is provided to demonstrate the proposed model. Also, a numerical example and sensitivity analysis of various unknown parameters illustrated in this model.

**Keywords**—Constant and Time Dependent Exponential Demand Rate, Deteriorating Items, EOQ, Time Proportional Deterioration Rate.

## I. Introduction

In today's competitive world, Mostly business organizations trying to stress on inventory management and their problems, which occurred frequently. It is known that every business organization showing their interest to obtain economic order quantity (EOQ), through which minimized total average inventory cost can be achieved. During the last couple of decades, it has been observed that, many researches working in the direction to control and maintain the inventory in the better and efficient way. In real practical life situation, decay or deterioration of normal talk in now days. Vegetables, fruits, foods are some example of some items having deterioration in nature. As the time increases, deteriorating items keep losing their original value with regard the quantities and qualitative aspect. Therefore, Ignorance of deteriorating factors while analyzing the model leads to harmful results. So it is an unavoidable factor, which should be given attention during the optimization inventory problems Sharma, A. et.al [24] [25] suggested the inventory model in which different demand rate has been taken with a different time interval. Commercial based lot size model for price sensitive dependent demand.

Under quantity developed by Burwell [4], which is followed by Mondal, et. al [16]. Mishra, V.K. et.al, [17] [18] and Acharya, M.S.D. [1], Presented an inventory model for unpreserved items, in which time reliance demand discussed. Roy, A., [23] and K, Geetha et.al, [13] introduced the model for decomposing item in which Roy and Geetha proposed their views and developed a model on price reliant on demand rate function. You [30] explained an inventory model in which the system includes the enriching items for Time dependent demand. Shaikh, A. A. et.al, [28] focused on Non-instantaneous deterioration inventory model with price and stock dependent demand. Mondal, B. et.al, [16] introduced an inventory system of upgrading items for price dependent demand rate. Abad, P. L. [2] focused on pricing policies and lot-sizing under the circumstances of perishability and partial backordering. Avinadav, T. et.al, [3] presented an optimal inventory policy for a perishable item with demand function which is sensitive to price and time. Bhunia, A., Shaikh, A. [5] announced a deterministic model for deteriorating items with demonstrated an inventory level dependent demand rate. Bhunia, A. et.al, [6] considered a two warehouse deterministic model for deteriorating items, in which linear trend of time dependent demand has been taken. M., Ben-daya and R., Abdul. [7] Tried to develop the model for which lead time taken as a decision variable. Wilson R.H., [31] touched the issue related to scientific routine for stock control. Gilding, B. H. [12] discussed inventory model with Inflation and the optimal inventory replenishment schedule within a finite planning horizon.

6

## A production inventory model with selling price and stock sensitive demand under partial backlogging

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**Abstract:** In the proposed paper we develop an inventory model for instantaneous deteriorating items with multi variate function of demand rate. Generally, we observe that the demand for any product depends on so many factors, out of which the available stock and selling price are the main factors. So in this paper we have assumed that the demand rate is a function of stock and selling price. The production rate is taken as a function of demand rate. The shortages are allowed and it is assumed that the occurring shortages will be backlogged for which the backlogging rate is a function of waiting time. The numerical example and sensitivity exploration with respect to various parameters are also cited to illustrate the study.

**Keywords:** inventory; shortages and partial backlogging; multi variate demand rate; deterioration rate; production.

**Reference** to this paper should be made as follows: Arya, D.D. and Kumar, M. (2018) 'A production inventory model with selling price and stock sensitive demand under partial backlogging', *Int. J. Mathematics in Operational Research*, Vol. 12, No. 3, pp.350–363.

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Self Attested,  
Deo Datta Arya

## world view



Credit: Sarita Kumar

## Influence of open educational resources on educational practices in the Global South

Open educational resources enable the effective use and sharing of knowledge with those who have been denied an education due to economic or social circumstances. Sarita Kumar outlines how open educational resources can benefit education systems across the Global South by opening up an entire generation to new ideas, technologies and advancements.

Education is a fundamental factor in the growth and progress of any nation. It is one of the most powerful tools and an empowering right by which economically and socially marginalized individuals can develop and contribute to society. However, the global economic crisis, ever-widening inequalities and ongoing conflicts are creating greater need for social equality, economic justice and inclusive education. How can we meet these challenges, mitigate social injustice, inequality, marginalisation and exclusion to foster equity and bridge the learning divide to provide inclusive education?

Open educational resources (OERs) can go some way towards addressing these challenges. OERs rely on sharing of resources that inspire inquiry, equality and accessibility within the wider community. As defined by the William and Flora Hewlett Foundation, "OERs are teaching, learning and research materials in any medium—digital or otherwise—that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions" (<https://hewlett.org/strategy/open-educational-resources/>). Based on the '5 Rs' philosophy—retain, reuse, revise, remix and redistribute—OERs offer a radically novel approach to the effective use and sharing of knowledge. During the past decade, adoption of OER technology has led to blended learning and progressive changes in the methodology of knowledge dissemination. The steady migration of educational curricula from the '3 Rs' (reading, writing and arithmetic), rote-learning and 'blackboard and chalk'-based instruction to comprehensive learning supplemented with projects, online

discussion boards and hands-on teaching and learning has been a positive step towards improving the quality of education.

Despite policies at the global level, the Global South is facing a crisis in ensuring inclusive and equitable education.

Goal 4 of the United Nations Sustainable Development Agenda supports the right to education and aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" by 2030. Yet according to the UN, an estimated 265 million children, of whom 22% are of primary school age, are deprived of elementary education and basic literacy skills because of social, economic and cultural factors (<https://www.un.org/sustainabledevelopment/education/>). Despite policies at the global level, the Global South is facing a crisis in ensuring inclusive and equitable education. The ineffective empowerment of disadvantaged and neglected communities through self-paced learning environments and community-based vocational training has created a skill gap that adversely affects economic and social growth. Regardless of the large number of established universities and educational institutions and the rapid expansion of the knowledge-based community, countries such as India are unable to provide inclusive and equitable education to meet the needs of its continually increasing population due to insufficient resources, inadequate infrastructure and outdated teaching-learning strategies. Nevertheless, like many developed nations, India has

recognized the importance of OERs as one of the most innovative teaching-learning practices for optimizing the use of available resources to impart inclusive and quality education. Studies have shown that educators in India show a positive attitude toward OER and are motivated to create, use and adapt OER, despite a lack of understanding of copyright and licensing and a lack of institutional policy regarding OER.

The irony is that despite digital transformation across every level of education, OERs have not been widely adopted in India. The reasons for this could be lack of awareness, unwillingness to change and hesitation to share knowledge and resources. One major hurdle is the availability, or lack of, OER content in indigenous languages. According to the 2001 Census, India has 122 major languages and 1,599 other languages, with 22 national languages. Regardless of the incremental growth of OER, resources cannot be widely disseminated as they are predominantly in English and only about 10% of Indians speak English. A lack of adequate infrastructure, translators and training to create and repurpose OERs in local languages has resulted in a deeper divide between those who can benefit from OERs and those who cannot, depriving them of inclusive education. However, it is possible to access, use and adapt the vast reservoir of OER available worldwide by imparting basic skills and developing English competence in educators and learners. Linguistic localization of OER is key for comprehensive education in a multilingual country like India. It can only be achieved by engaging translation experts and by training local educators

DIMINISHED ACTIVITY OF LARVAL MIDGUT TRANSAMINASES AND PHOSPHATASES IN  
*HELICOVERPA ARMIGERA* HÜBNER (LEPIDOPTERA) INDUCED BY  
DIETARY STEM EXTRACTS OF *THEVETIA NERIFOLIA*

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**ABSTRACT.** *Helicoverpa armigera* Hübner (Noctuidae) is a common crop pest causing extensive loss of crop yields despite several efforts and diverse measures taken. As utilization of synthetic pesticides in the fields have caused ecological disturbances and lethal effects on humans and organisms; present studies explore *Thevetia nerifolia* (Apocynaceae), a widely used ornamental plant, against *H. armigera* as an alternate control measure. The study investigates the dietary effects of hexane and methanol extracts of *T. nerifolia* stems (HSE, MSE) on the activity of midgut enzymes of *H. armigera*, the alterations in which could hamper its growth and development. Different concentrations of the stem extracts, ranging from 0.001% to 0.02%, were incorporated in the diet of early IV instars of *H. armigera*. Effect of each extract was assessed by estimating the activity of four midgut enzymes; alanine aminotransaminase (ALT), aspartate aminotransaminase (AST), acid phosphatase (ACP) and alkaline phosphatase (ALP) of cotton boll worm. Investigations showed that dietary stem extracts resulted in significant and dose-dependent reduced activity of all the enzymes. The percent inhibition of the enzymatic activity was higher with dietary MSE of *T. nerifolia* as compared to the hexane stem extract. Also, the enzyme inhibition effects of extracts were more pronounced on phosphatases in comparison to transaminases. Larval feeding with *T. nerifolia* MSE diminished ALT activity by 26.98% to 49.79% and AST activity by 11.02% to 56.53%, whereas the ACP and ALP activity decreased by 44.65% to 87.61% and 21.97% to 85.97%, respectively. On the other hand, HSE inhibited ALT activity by 29.43% to 41.67% and AST activity by just 2.72% to 47.08%. However, a respective reduction of 14.58% to 78.44% and 32.73% to 78.07% was noticed in ACP and ALP activity with dietary HSE. The GC-MS analysis of the stem hexane and methanol extracts of *T. nerifolia* reveals the presence of 39 and 30 phyto-chemicals, respectively. Investigations showed the possible use of *T. nerifolia* extracts as a growth regulatory agent against *H. armigera*. Identification and isolation of bioactive compounds require further investigations.

**Additional key words:** *Helicoverpa armigera*; *Thevetia nerifolia*; transaminase; phosphatase; GC-MS.

*Helicoverpa armigera*, cotton bollworm, is a well-known polyphagous crop pest widely distributed in Asia, Africa, Australia, Europe and other countries. It attacks almost all agronomic crops from seedling to maturity stage leading to severe damages making them vulnerable to more infestations. Several measures have been attempted to control this devastating pest. Large scale application of chemical and microbial insecticides belonging to different groups has been tried for *Helicoverpa* management. Nevertheless, ecological imbalance, everlasting residual problems in food and drinking water, emergence of more aggressive pests, noxious effects on non-target organisms and the development of resistance in target organisms due to these measures have led to the exploration of novel strategies for *H. armigera* management. Efforts have been made for adopting integrated approach for *H. armigera* management using host-plant resistance techniques (Soleimannejad et al. 2010, Fathipour & Naseri 2011); biopesticides (Commercial formulations of *Bacillus thuringiensis*) (Liao et al. 2002); transgenic Bt crops (Shelton et al. 2002); biological control strategies (Abdi-Bastami et al. 2011); interference methods (Reddy & Manjunatha 2000); cultural

practices (Jallow et al. 2004) and selective insecticides (Rafiee-Dastjerdi et al. 2008).

Plants are known to be endowed with excellent potential to produce and possess anti-protective compounds shielding them from various infections and pest infestations. Owing to the non-detrimental effects of botanicals on the environment, various phyto-compounds have been explored by researchers in search of a safe replacement of chemical-based insecticides. The insect-toxic properties of crude plant extracts prepared from different parts of diverse plant species have been reported by a number of researchers (Mishra et al. 2015a, b; Sharma et al. 2016). Besides lethal effects, botanicals have been found to possess antifeedant properties as well as post-ingest adverse effects on the gut and other regions of insects (Mishra et al. 2015a, b). The mode of action of most of the plant allelochemicals at the enzymatic level is unknown, but a few of them appear to disturb the digestive process by targeting insect gut digestive enzymes (Duffey & Stout 1996, Nathan et al. 2005).

*Thevetia nerifolia* is an evergreen tropical shrub often grown as an ornamental plant in gardens and parks in temperate climates. Medicinal properties of

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RESEARCH ARTICLE

## Susceptibility Status of *Aedes aegypti* L. Against Different Classes of Insecticides in New Delhi, India to Formulate Mosquito Control Strategy in Fields

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Received: June 4, 2018

Revised: September 3, 2018

Accepted: September 7, 2018

**Abstract:**

**Background:**

Mosquito control is a major concern throughout the world because of rising cases of mosquito-borne diseases. The outbreak of Zika, Dengue and Chikungunya has caused grave situations raising urgent need to control *Aedes aegypti*. Moreover, extensive use of synthetic insecticides in mosquito control programs has resulted in high levels of insecticide resistance leading to the use of magnified concentrations, impacting human health and environment adversely. The knowledge about current status of the insecticide susceptibility against *Ae. aegypti* could help to devise mosquito control strategy.

**Objective:**

Present study evaluates the larvicidal potential of thirteen insecticides belonging to seven different classes; organochlorines, organophosphates, carbamates, pyrethroids, neonicotinoids, avermectins and secondary metabolites; against early fourth instars of *Ae. aegypti*.

**Materials and Methods:**

The insecticide susceptibility was evaluated as per WHO protocol. Fatality counts were made after 24h of exposure; and the  $LC_{50}$ ,  $LC_{90}$  and other statistical parameters were computed by probit-regression analysis.

**Results:**

The data reveals the maximum efficacy of pyrethroids and fenitrothion, with lethal values less than 0.001 ppm. Avermectins, organochlorines and carbamates were moderately toxic, while neonicotinoid posed appreciable toxicity. In contrast, berberine, a secondary plant metabolite was found inefficient. The larvicidal efficacy of tested insecticides against *Ae. aegypti* was found in the decreasing order of pyrethroids > organophosphates > avermectins > organochlorines > carbamates > neonicotinoids > secondary metabolites.

**Conclusion:**

Present investigations explore various toxicants as Dengue vector control agents in order to devise a suitable control strategy for mosquito control in fields.

**Keywords:** *Aedes aegypti*, Larvicidal, Insecticides, Resistance, Avermectins, Neonicotinoids.

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## RESEARCH ARTICLE

## Effects of *Achyranthes aspera* Extracts on the Survival and Midgut Histo-architecture of *Aedes aegypti* L. Early IV Instars

Aarti Sharma<sup>1</sup>, Sarita Kumar<sup>2,\*</sup> and Pushplata Tripathi<sup>1</sup><sup>1</sup>School of Sciences, Indira Gandhi National Open University, Maidan Garhi, New Delhi 110068, India<sup>2</sup>Department of Zoology, Acharya Narendra Dev College, University of Delhi, Kalka Ji, India

Received: May 3, 2018

Revised: August 13, 2018

Accepted: August 28, 2018

**Abstract:****Background:**

*Aedes aegypti* L.; one of the most important insect vectors in the world; transmits several diseases of concern; Zika, yellow fever, Chikungunya, dengue and dengue haemorrhagic fever. Despite multifarious problems on humans, non-targets and environment; caused by synthetic chemical insecticides; these are still the prime and preferred control measures against dengue vector. Alternative control strategies using eco-friendly and bio-degradable plant products are being explored.

**Objective:**

The present study investigates the toxic potential of the hexane extract of the leaf and stem of *Achyranthes aspera* against *Ae. aegypti*.

**Methods:**

The larvicidal potential of extracts was evaluated against dengue larvae as per WHO protocol. Subsequent concentration and time-dependent studies assessed their effects on the larval midgut histo-architecture using microtomy techniques.

**Results:**

Larvicidal bioassays with *A. aspera* extracts revealed their appreciable larvicidal potential. Hexane extract of the leaf resulted in respective LC<sub>50</sub>, LC<sub>90</sub> and LC<sub>99</sub> values of 67, 83 and 140 ppm while exposure to hexane extract of the stem showed respective values of 55, 68 and 115 ppm. Extract-exposed larvae at various lethal levels exhibited significant damage, shrinkage, distortion and vacuolization of gut tissues and peritrophic membrane. The disintegration of epithelial cells and cytoplasmic organelles evidenced stomach poison potential of the extracts. The extent of toxicity and damage was concentration and time-dependent; the stem extract imparted more deleterious effects as compared to the leaf extract.

**Conclusion:**

Present findings suggest the utilization of *A. aspera* as an alternate control strategy against *Ae. aegypti*; though further studies against non-targets are needed to ascertain its use in the fields.

**Keywords:** *Achyranthes aspera*, *Aedes aegypti*, Histological architecture, Larvicidal, Midgut, Stomach poison.

### 1. Introduction

*Aedes aegypti* L. is a worldwide disease vector, transmitting a number of diseases; dengue, Chikungunya, dengue hemorrhagic fever, yellow fever and Zika. The mosquito is prevalent in almost whole tropical and subtropical area

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## Growth regulatory and growth inhibitory effects of *Thevetia neriifolia* stem extracts on *Helicoverpa armigera* (Lepidoptera: Noctuidae)

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### ABSTRACT

*Helicoverpa armigera*, a serious global destructive pest of agricultural crops, is on continuous rise despite several control measures undertaken. The detrimental effects of these measures have created a dire need to explore alternate eco-safe strategies. The present study investigates the growth-regulatory and growth-arrest potential of hexane and methanol extracts of *Thevetia neriifolia* stems against *H. armigera*. Investigations revealed that larval feeding and rearing on the extract-containing diet did not result in appreciable larval mortality but delayed the larval growth and development. Both the extracts demonstrated dose-dependent effects exhibiting negative correlation between the weights gained by developmental stages and the extract concentrations. Feeding with extracts also resulted in formation of few larval-pupal and pupal-adult intermediates and significantly reduced percent adult emergence of *H. armigera*. Current study, however, revealed higher growth inhibitory potential of methanol extracts as compared with hexane extracts. The study attempts to provide an eco-friendly approach for *H. armigera* management.

### ARTICLE HISTORY

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### KEYWORDS

*Thevetia neriifolia*;  
*Helicoverpa armigera*;  
growth regulatory; growth  
inhibitory; larval-pupal  
intermediates; pupal-adult  
intermediates;  
adult emergence

### Introduction

*Helicoverpa armigera* is a well-known destructive pest of agricultural crops of serious concern at the global level. The pest has been reported to attack a large number of plant species belonging to more than 47 families (Fathipour and Naseri 2011). Although diverse measures have been attempted for the control of *H. armigera*, yet till date the major and most promising strategy considered is the repeated utilisation of chemical insecticides in the crop fields. However, since past many years, insecticides have been applied repeatedly in an unsystematic manner which

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*Sarita Kumar*



# Draft genome of *Streptomyces* sp. strain 130 and functional analysis of extracellular enzyme producing genes

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## Abstract

*Streptomyces* sp. strain 130 possesses multiple uncharacterized extracellular enzyme producing genes. Enzymes from these genes may fulfil the intense demand of stable and effective extracellular enzymes in various industries. Taxonomy of *Streptomyces* sp. strain 130 was validated by FAME analysis. Strain 130 was screened for the presence of chitinase producing genes of family 18 and 19 using SC1F/SC2R and F19F2/F19R primer sets respectively. Whole genome sequencing was done using Illumina Next Seq 500 system. In the analysis of draft genome of *Streptomyces* sp. strain 130, the genome size was found to be 7.1 Mb. Blastn and NCBI-conserved domain search tool were used to find similarity percentage with genes in existing database and enzyme family respectively. Ten chitinase, six xylanase and one cellulase producing genes were present in draft genome. Among the ten chitinase producing genes, two were belonging to GH19 family and other eight to GH18 family chitinase. Six out of ten chitinase producing genes were uncharacterized and one belonged to family GH18\_PF-ChiA (PF-ChiA is a chitinase found in the hyperthermophilic archaea, prokaryotes). In case of xylanase, four out of six (GH9, 43, 10 and 11 enzyme family) were not showing nucleotide based similarity with any characterized gene. The study of reported genome sequence will help us to identify gene sequence of characterized and uncharacterized extracellular enzyme producing genes. Cloning of each gene and enzyme activity assay of their products will reveal the activity and stability at different variables; and resulting products may have huge applications at industrial scale.

**Keywords** Draft genome sequence · *Streptomyces* · Extracellular enzyme · Uncharacterized genes · Enzyme family

## Introduction

*Streptomyces* genus of phylum actinobacteria is majorly known for production of commercial extracellular enzymes and antibiotics. Since late 1980s, extracellular enzymes from *Streptomyces* sp. are used for betterment of industrial products. Site directed modifications in enzyme producing genes have given the opportunity to enhance activity and stability of enzymes. On the other hand, whole genome sequencing has given the information of many novel enzymatic and antibiotics producing genes. Genome mining technique is currently in trend among the researchers to explore the uncharacterized genes. Extracellular chitinase, xylanase and cellulase have multiple industrial applications. Pan et al. [1], reported the role of chitinase as an antitumor, where lysis of

human breast cancer cell line MCF-7 was tested. Chitinase is mainly used as an antifungal and insecticidal agent [2]. In case of xylanase, it has widespread applications in food, textile, pulp and paper industries. Use of xylanase in food industry has increased in last two decades. The advantages of commercial use *Streptomyces* derived xylanases include their high level of extracellular activity, stability across a broad temperature (50–85 °C) and pH (pH 3–13) range [3]. Xylanases from *Streptomyces* have been characterized, cloned and expressed in *Pichia pastoris* and *Escherichia coli* to increase quality of industrial product [4, 5]. Moreover, xylanase and cellulase have given the futuristic corridor for an economical and environment-friendly biofuel production [6]. Muthusamy et al. [7], used *Streptomyces olivaceus* (MSU3) for bioethanol production from agro-residues by fermentation process. Genomic mining of *Streptomyces* sp. from diverse ecological habitats may open the opportunity for identification of novel antibiotic, antitumor agents and extracellular enzyme.

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Original article

**Soil ciliates of the Indian Delhi Region: Their community characteristics with emphasis on their ecological implications as sensitive bio-indicators for soil quality**

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ARTICLE INFO	ABSTRACT
<p><b>Article history:</b>            Received 20 February 2019            Revised 11 April 2019            Accepted 15 April 2019            Available online 17 April 2019</p> <p><b>Keywords:</b>            Ciliate diversity            Ecology            Physicochemical parameters            Soil ciliates            Soil quality</p>	<p>The present investigation aims to study the diversity of ciliates from different habitats in and around Delhi, India, and the correlation of this diversity with soil quality (agricultural lands (site 1 and 2), dump yards (site 3 and 4), sewage treatment plant (site 5), residential land (site 6), landfill (site 7) and barren land (site 8)). Various physicochemical parameters of the different soil samples were studied and analysed for soil texture, interstitial water, pH, conductivity, total organic carbon, total organic matter, total nitrogen and phosphorous content, using standard protocols. Seventeen ciliate taxa belonging to four classes, seven orders, ten families, and 17 genera were recorded, with the maximum number of species (eleven) belonging to the class Spirotrichea. Ciliate diversity was highest at sites 5 and 6 and lowest at sites 1 and 2. <i>Spathidium</i> sp. was the dominant species in the conditioned land (site 8), while the ciliate <i>Colpoda</i> sp. was present in all the sites examined, showing the highest population density in the sewage treatment plant site (site 5). Statistical analysis showed that ciliate diversity was positively correlated to physicochemical parameters such as interstitial water, total organic matter and organic carbon, total nitrogen and total phosphorous content. Analyses of spirotricha/colpodids (S/C) ratio and diversity indices implied that the habitat conditions of sites 1, 2, 3 and 8 are relatively unfavourable for soil ciliates to flourish; while sites 4, 5, 6 and 7 provided more favourable conditions. The ubiquity of ciliate distribution suggests their important role in the soil food webs and nutrient cycling, and their community structure and specific characteristics appear to be of major importance for soil formation. A full understanding of soil ciliate diversity and physicochemical parameters helps to inform best practice for improving soil quality as well as conservation practices for sustainable development and management of farms and cultivated lands. In conclusion, ciliate diversity serves as an important and sensitive bio-indicator for soil quality.</p> <p>© 2019 The Authors. Production and hosting by Elsevier B.V. on behalf of King Saud University. This is an open access article under the CC BY-NC-ND license (<a href="http://creativecommons.org/licenses/by-nc-nd/4.0/">http://creativecommons.org/licenses/by-nc-nd/4.0/</a>).</p>

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# Techniques and tools for species identification in ciliates: a review

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## Abstract

Ciliates are highly divergent unicellular eukaryotic organisms with numerous species and a highly specialized lifestyle. They inhabit all biotopes and play major roles in regulating microbial food webs as they prey on bacteria, protozoa and even on macroscopic animals. Nowadays, with the technological advancement and they have made progress towards identification for many ciliates. In the present review, we attempt to discuss the various methods for the identification of ciliates using different techniques for species identification. The different approaches involved in taxonomic identification of ciliates such as classical (using live-cell observations, staining techniques, etc.), molecular (involving various marker genes) and molecular (classification of eukaryotic organisms) methods have been explained. Molecular and biochemical approaches in species identification have also been discussed. A present-day taxonomy, it is important to use a 'total evidence' approach in identifying ciliates, relying on both classical and molecular information whenever possible. This integrative approach will help in the accurate identification with modern-day tools for comprehensive species description in future.

## INTRODUCTION

Ciliated protozoa (Ciliates) are a highly diverse class of eukaryotic micro-organisms that are morphologically very complex and highly differentiated taxa among single-celled organisms [1]. They exhibit high species diversity with over 4000 free-living ciliates described [2]. Ciliates have a number of distinctive structural and functional features, such as their extremely complex subcellular and organelle structures, structurally and functionally different macronuclear and micronuclear genomes, sexual reproduction by conjugation, whole genome duplications, patterns of cortical structure with semi-autonomous mechanisms of inheritance and morphogenesis, evidence of epigenetic mechanisms, broad array of ecological niches and lifestyles, and rapid evolutionary radiation at the species population level owing to their short generation times [3]. Their role is immense as they are part of the microbial loop, function as recyclers, remineralizers of organic material in terrestrial and aquatic systems, they prey upon the bacteria and smaller protozoa and maintain the ecosystem balance. These distinctive characteristics make them extremely useful models in studies of cell biology, molecular biology, genetics, ecology and

evolution [4, 5]. They have been used extensively as model systems for assessing heavy metal toxicity in freshwater ecosystems [6–9], to detect stress-induced morphological anomalies [10–12] and in the expression of genes such as hsp70, superoxide dismutase and metallothionein [13–15].

There are generally two major approaches used for identification of ciliates: the traditional method of live cell morphology, fixation, staining and morphometrics and, more recently, DNA-based methods. Nowadays, taxonomy is more focused on an integrative approach combining classical and molecular approaches. Ciliate taxonomy was traditionally done using microscope techniques involving observation of live or fixed cells with details of the ciliature or silver-line system. With improvements in optical microscopy and the wider application of silver impregnation methods, detailed descriptions of ciliature, oral apparatus, nuclear apparatus and ultrastructure have been done and various new species have been described in previous years [16–19]. In addition, due to advances in molecular taxonomy techniques, phylogenetic studies have become increasingly important in the last three decades [20–22]. The application of powerful and ultra-rapid nucleic acid

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Keywords: ciliates, classical, molecular, DNA based, identification, taxonomy, morphology, ecology, evolution.

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## ORIGINAL PAPER

Magnetization Reversal

# Modelling of Pinning-Depinning Reversal Mechanism in Ion-Irradiated Co/Al<sub>2</sub>O<sub>3</sub> Thin Films

Rajan Goyal, Rekha Gupta, Ambika Negi, Kandasami Asokan, Dinakar Kanjilal, Subhalakshmi Lamba, and Subramanian Annapoorni\*

Present study reports the pinning–depinning mechanism in Co embedded Al<sub>2</sub>O<sub>3</sub> matrix subjected to Ar<sup>+</sup> ion irradiations. Angular variation studies of the scaled coercivity are carried out and a comparison to existing theoretical models indicates that the dominant reversal mechanism is due to pinning. The origin of pinning is attributed to the displacement of Co atoms from their lattice sites, as a result of ion bombardment. The Monte Carlo simulations suggest that the observed magnetic behavior is well explained by pinning induced strain anisotropy in the system.

which may be due to the pinning effect of cobalt spins at the Au/Co interface.<sup>10)</sup> The dispersion of hcp Co NPs in an amorphous polymer matrix leads to lesser pinning sites resulting in a remarkable reduction in coercivity as compared to that of the polycrystalline pure Co films.<sup>11)</sup> Similar behavior was also reported in CoPt alloy consisting of disordered A1 and ordered L1<sub>0</sub> phases. The enhancement in coercivity with the increase in volume percentage of L1<sub>0</sub> phase was attributed to the presence of local defects such as anti-phase and grain boundaries acting as

## 1. Introduction

The magnetization reversal mechanism plays a crucial role in the usefulness of the magnetic materials in various technological applications namely memory devices. Out of several mechanism, pinning is seen to be dominant in defect based magnetic materials. Of the several magnetic NPs, hcp-Co has attracted attention due to its large uniaxial anisotropy ( $K_u \approx 0.53 \text{ MJ m}^{-3}$ ).<sup>1)</sup> The surface oxidation of Co NPs acting as a pinning layer and it result in modification of magnetization reversal mechanism. The mechanism, however, tends to vary with the processing conditions viz. thermal annealing, localized heating by radiation, thickness and composition of nanoparticles as well as on the dielectric matrix surrounding the NPs.<sup>2–3)</sup> Embedding metal nanoparticles (NPs) in a dielectric matrix such as Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, etc. is an effective way to prevent the oxidation.<sup>4–6)</sup> Embedded NPs found attractive applications in magnetic memory devices,<sup>7)</sup> biomedicine,<sup>8–9)</sup> etc. due to their size dependent structural, optical, and magnetic properties as compared to bulk. Wen et al. reported that the Au-core-Co-shell exhibits enhanced coercivity as compare to pure Co sample,

pinning centers.<sup>12)</sup> Akdogan et al also showed that the enhanced coercivity in SmCo<sub>5</sub> is probably due to domain wall pinning at grain boundaries and stacking fault.<sup>13)</sup> Furthermore, the domain wall pinning in ferromagnetic nanowires can be a potential technique for the fabrication of solid state memory devices. Polenciuc et al. have proposed the fabrication of exchange biased crossed ferromagnetic and antiferromagnetic nanowires to achieve the reproducible domain wall pinning of variable strength by changing the diameter of the antiferromagnetic nanowires.<sup>14)</sup>

In our earlier work, we have demonstrated the effect of thermal heat treatment on magnetic anisotropy and depinning field of Co NPs embedded in alumina matrix (Al<sub>2</sub>O<sub>3</sub>).<sup>15)</sup> The Monte Carlo simulation of hysteresis curves revealed that the conventional heat treatment results in uniform distribution of defects throughout the sample leading to a constant pinning field. However, no systematic study has been reported yet to analyze the effect of ion implantation/irradiation on magnetization reversal mechanism in Cobalt NPs embedded in the dielectric matrix. In the present communication, the Co NPs embedded in alumina matrix which remains non-reactive at high annealing temperatures are subjected to ion irradiation using 300 keV Ar<sup>+</sup> ion beam. The structural as well as magnetic analysis, supported by theoretical simulations, are carried out to examine the magnetization reversal mechanism in Co/Al<sub>2</sub>O<sub>3</sub> thin films when subjected to low energy ion (LEI) irradiation at different fluences.

## 2. Experimental Section

The films of Co embedded in Al<sub>2</sub>O<sub>3</sub> matrix were deposited on Si <111> single crystal substrate by RF magnetron sputtering. Aluminum (Al<sub>2</sub>O<sub>3</sub>) target of 99.9% purity with Co chips pasted on it in a symmetric fashion was used for depositing the films. The

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## Ferroelectric liquid crystal nanocomposites: recent development and future perspective

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### ABSTRACT

In recent years, dispersion of nanomaterials in liquid crystal media has attracted a great deal of attention for their applications in various fields and basic understanding. In this regard, nanocomposites of ferroelectric liquid crystals hold a great promise for technological advancement in displays, sensors, development of hybrid materials for optical applications and others. With the emphasis on the properties of ferroelectric liquid crystals, this paper presents a summarizing overview with critical comments on the progress made in last one decade in understanding the influence of nanoparticles on the ferroelectric liquid crystals. The dispersion of nanoparticles in liquid crystal (host material) significantly influences its properties, thereby making the dispersed material more promising for potential applications.

### ARTICLE HISTORY

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### KEYWORDS

Liquid crystals; ferroelectric liquid crystals; nanocomposites; memory effect

## 1. Introduction

Over the last few years, much interest has been shown to the study of ferroelectric liquid crystals (FLCs) dispersed with nanomaterials (nanoparticles (NPs), nanorods (NRs), quantum dots (QDs), etc.) of various shapes and sizes because these nanocomposites hold a great promise for the scientific advancement and technological breakthroughs in the applications of LC-based devices [1–18]. The FLCs based devices have been found to be more advantageous over the nematic liquid crystals (NLCs) based devices in terms of bistability, wide viewing angle and fast response. However, there are some issues associated with the NPs dispersed FLCs such as lack of perfect alignment, origin of some defects, domain formation at the interface of alignment layer and FLC molecules, etc. The purpose of the present article is to review very critically the promise and potential of ferroelectric nanocomposites and how the study of these composites is important from the points of view of basic understanding and applications?

Liquid crystals (LCs) are partially ordered, anisotropic fluids, which share the symmetry and properties that are usually associated with both anisotropic solids and isotropic liquids [19–25]. Their study belongs to the wider field of soft condensed matter physics, an area growing in importance because of new physics being discovered and the possibility of various technological

applications being developed. Impact of liquid crystalline materials on the modern science, technology, industry and medicine has been very profound. A remarkable development, in the history of LC devices, took place in the year 1980 when Clark and Lagerwall [26] patented a FLC display device based on the ferroelectric smectic C (Sm C\*) mesogen. In recent years, sufficient amount of work has been done to investigate the impact of the dispersion of non-mesogenic (dyes, polymers, nanomaterials (NMs), carbon nanotube (CNTs), etc.) materials on the properties of FLC host materials. It is not possible to present an overview of these works in a single review. Therefore, in this work, we intend to restrict our discussion on the work of recent decade or so and address the question how the dispersion of NPs in host, FLC matrix influences the properties of pristine material and the dispersed system becomes advantageous as compared to pure one? The present manuscript is organized as follows: A brief overview of LCs is given in section 2. Section 3 is devoted to the dispersion of NPs in LCs and the discussion on the applications and promise of FLC nanocomposite systems is given in section 5. The effect of nanoparticle dispersion on the various properties of host FLCs is discussed in section 4. In this section, the impact of dispersion of NPs on the properties of FLCs in terms of order and alignment of FLC molecules, phase transition behaviour, memory effects, hysteresis, electrical

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## Materials Research Express

### PAPER

# A novel method of electrochemically growing ZnO nanorods on graphene oxide as substrate for gas sensing applications

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## Abstract

The potential of electrochemically deposited ZnO nanorods using graphene oxide (GO) coated inter digital electrode (IDE) as substrate material for gas sensing applications has been reported. For this purpose, GO solution was synthesized via Hummer's method and coated over IDE of aluminium fabricated on the glass plate. Later ZnO nanorods were deposited on it using electrochemical method. For the structural, morphological and elemental analysis, as-grown nanorods were characterized by XRD, FESEM, EDX and Raman spectroscopy. The gas sensing properties of the sensor were analyzed using customized Gas Sensing Test Rig (GSTR). FESEM micrographs illustrated that ZnO nanorods with hexagonal geometry were deposited on GO homogeneously. In XRD spectra, an intense peak along (002) direction clearly indicate that nanorods possess c-axis orientation. In order to investigate the structural integration of the nanorods, Raman and EDX spectra were also recorded, and their results were found to be in consent with that of XRD analysis. Sensing results revealed that both ZnO

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# Polarization dependent charge control model for microwave performance assessment of AlGaN/GaN/AlGaN double heterostructure HEMTs

Nisha Chugh<sup>1</sup> · Monika Bhattacharya<sup>2</sup> · Manoj Kumar<sup>1</sup> · S. S. Deswal<sup>3</sup> · R. S. Gupta<sup>4</sup>

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## Abstract

An accurate polarization dependent charge control-based analytical model is proposed for microwave performance assessment of Al<sub>0.15</sub>Ga<sub>0.85</sub>N/GaN/Al<sub>0.15</sub>Ga<sub>0.85</sub>N double heterostructure high electron mobility transistors (DH-HEMTs) in terms of current, transconductance, gate capacitances and cutoff frequency. An analytical expression correlating the sheet carrier concentration in the two 2DEGs formed at the upper and lower heterointerfaces of a DH-HEMT is obtained. AlGaN/GaN/AlGaN DH-HEMTs are found to exhibit superior RF performance as compared to its single heterostructure counterpart in terms of higher drain current, improved transconductance, higher gate capacitance and higher unity-gain cutoff frequency. This improvement in the DH-HEMT is mainly attributed to the formation of two 2DEGs (at top and the bottom heterointerface) as compared to the single 2DEG in a SH-HEMT. The variation of drain current with drain voltage and with gate voltage of AlGaN/GaN SH-HEMTs and AlGaN/GaN/AlGaN DH-HEMTs is obtained analytically and found to agree reasonably well with that obtained using ATLAS 2D device simulation, thereby validating the proposed model.

**Keywords** AlGaN/GaN/AlGaN · Cutoff frequency · Double heterostructure · HEMT · Polarization

## 1 Introduction

GaN high electron mobility transistors (HEMTs) have demonstrated remarkable potential in millimeter-wave high-power applications as compared to GaAs HEMTs because of their large conduction band offsets and high two-dimensional electron gas (2DEG) sheet carrier density ( $n_s$ ) in the range of  $(2-6) \times 10^{13} \text{ cm}^{-2}$  [1,2]. In particular, AlGaN/GaN HEMTs have recently attracted much attention for use in future high-voltage, high-power and high-temperature microwave appli-

cations [2]. Enhancement-mode (E-mode) AlN/GaN/AlGaN HEMTs through several innovative device scaling technologies such as self-aligned gate (SAG) formation [3],  $n^+$ -GaN ohmic contact regrowth [4] and ultrathin barrier layer (AlN/InAlN/AlGaN/InGaN) [5,6] have demonstrated a high-current and power gain cutoff frequencies ( $f_t$  and  $f_{max}$ ) of 342 and 518 GHz by shortening the gate length to around 20 nm and the gate-source and gate-drain separation to 70 nm [7]. GaN HEMTs demonstrate the highest Johnson's figure of merit (JFoM) which is about five times higher than that obtained in InP-based HEMTs [8]. The AlGaN/GaN heterojunctions can be grown on semi-insulating GaN-on-sapphire substrates or SiC substrates although SiC is usually considered the material of choice.

Until now, the focus has been on GaN-based single heterostructure HEMTs (SH-HEMTs) with regard to high-frequency and high-power performance [8]. In an attempt to achieve better RF performance, the gate length is being continuously reduced. However, if the gate length is reduced beyond a certain limit, serious degradation in the performance is observed in terms of poor electron confinement in the channel, poor pinch-off characteristics and high output conductance.

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## PAPER

Room temperature SO<sub>2</sub> and H<sub>2</sub> gas sensing using hydrothermally grown GO–ZnO nanorod composite films

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Graphene based 2D materials with a surfeit of active sites and advantageously high surface to volume ratio are effectively linked to well established nanostructured semiconducting metal oxides for development of nanocomposites with enhanced gas sensing properties. Graphene Oxide (GO), a sister material of graphene, is therefore a natural choice for development of room temperature operated gas sensors. In the current investigation hydrothermally grown GO and ZnO nanorods composite (GO–ZnO–NR) is utilised for room temperature gas sensing of H<sub>2</sub> and SO<sub>2</sub> gases. Room temperature detection of H<sub>2</sub> and SO<sub>2</sub> at sub-100 ppm levels with linear variation in response for different concentrations is demonstrated. Morphological and structural analyses are conducted using Scanning electron microscopy, Raman spectroscopy and X-ray diffraction. GO–ZnO–NR composite sensor is seen to exhibit robust sensing response of 5.82 and 5.45 for 100 ppm each of H<sub>2</sub> and SO<sub>2</sub> gases respectively at room temperature. Further, the delayed response and recovery times exhibited by the sensor for SO<sub>2</sub> gas are recognized to be due to formation of strongly adhering SO<sub>3</sub> species.

**1. Introduction**

Worldwide researchers are actively engaged in developing gas sensors with low operating temperature (preferably room temperature) not only due to demands of the industry to minimize power consumption but also favourably integrate the same with Si micromachining technology [1]. Room/low operating temperatures of gas sensors proffer opportunities for use of flexible substrates which in turn are envisaged to help in the rapid development of wearable gas sensors [2]. Available literature reports over the last five decades indicate extensive investigation in the preferred use of semiconducting metal oxides (SnO<sub>2</sub>, ZnO, WO<sub>3</sub>, TiO<sub>2</sub> etc) with additives, dopants, bilayer/heterostructures, nanostructures/layers for gas sensing applications with selectivity [3, 4]. Semiconducting metal oxide based gas sensors are seen to exhibit enhanced sensitivity, partial selectivity to target gases, fast response speed and recovery based on two mechanisms of catalyst control proposed by Morrison [5]. The two mechanisms of catalyst control were described as a) Fermi level energy control mechanism and b) Spillover mechanism. In Fermi-level energy control mechanism, the sensing gas is seen to affect the catalyst that in turn varies the barrier height at the inter-granular boundaries after exchange of electrons while in the spillover mechanism the catalyst is seen to dissociate the gas molecule, and reactive atoms spill-over onto the underlying semiconductor surface and influence its conductivity. Chowdhuri *et al* have advantageously utilized both the mechanisms in conjunction to realise a trace-level H<sub>2</sub>S gas sensor with enhanced sensing and fast response speed [6]. Despite all the aforementioned advantages, semiconducting metal oxides have a major drawback in elevated temperature of operation. Further, their constraint in size reduction coupled with metal oxide grain growth leading to agglomeration during usage over extended periods of time has limited their commercial development.

## PAPER • OPEN ACCESS

# Room temperature SO<sub>2</sub> and H<sub>2</sub> gas sensing using hydrothermally grown GO–ZnO nanorod composite films

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# Extraction of admittance parameters of symmetrically doped AlGaN/GaN/AlGaN DH-HEMT for microwave frequency applications

Nisha Chugh<sup>1</sup> · Manoj Kumar<sup>1</sup> · Monika Bhattacharya<sup>2</sup> · R. S. Gupta<sup>3</sup>

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## Abstract

An analytical model for determining intrinsic short-circuit admittance (Y) parameters of AlGaN/GaN/AlGaN Double Heterostructure (DH) High Electron Mobility Transistor (HEMT) is presented. These Y parameters obtained in terms of the various small signal equivalent circuit parameters are in turn used to evaluate the enhanced microwave performance of the DH-HEMT in terms of various parameters including Unilateral Power Gain and maximum oscillation frequency. The cut-off frequency has been evaluated from short circuit current gain. The cut-off frequency ( $f_T$ ) and maximum oscillation frequency ( $f_{max}$ ) exhibited for DH-HEMT is 125 GHz and 215 GHz which is comparatively improved as obtained in Single Heterostructure (SH) HEMT ( $f_T = 105$  GHz and  $f_{max} = 165$  GHz). The analytical results obtained for DH and SH-HEMT; have been compared and found to match well with the ATLAS 2D device simulation results thus proving the validity of the model.

## 1 Introduction

Modern GaN based HEMTs are proving to be very attractive for high power and high frequency applications due to various beneficial and desirable properties exhibited by them such as high breakdown field, high carrier velocity and high switching speed. AlGaN/GaN HEMTs have undergone tremendous advancement over the past decade to provide improved reliability and power performance (Ghione et al. 2013; Fletcher and Nirmal 2017). Present

ultra-high frequency technologies such as wireless communications have clearly shown the need for high efficiency high power amplifiers (Qiu et al. 2013; Gustafsson et al. 2013). All the major desirable features such as high power, high efficiency, good linearity, manufacturing feasibility, low cost and small size which are today's market requirements are being fulfilled by GaN HEMTs (Wen et al. 2015; Brady et al. 2008; Prasad 2016). FOMs of particular interest include current gain cut-off frequency ( $f_T$ ), unilateral power gain ( $G_U$ ) and maximum frequency of oscillation ( $f_{max}$ ).

Recently, attention has shifted from SH-HEMTs to DH-HEMTs. Moving from SH-HEMT to DH-HEMT is advantageous in terms of larger 2DEG concentration, improved drain current and other RF performance parameters (Juncai et al. 2012; Ravikiran et al. 2015; Zhang et al. 2017). Authors in their previous work proposed a model based on charge control approach to analyze the high frequency performance of AlGaN/GaN/AlGaN DH-HEMT (Chugh et al. 2017; Chugh et al. 2017; Chugh et al. 2018; Chugh et al. 2019; Chugh et al. 2019). In comparison to SH-HEMT, DH-HEMT was observed to exhibit much better performance.

In present work, in order to further explore the potential of GaN based DH-HEMT, the previously proposed charge controlled analytical model is further extended to evaluate intrinsic short circuit admittance (Y) parameters of a

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# Transient setting of relativistic ponderomotive non-linearity and filamentation of ultra-short laser pulses in collisionless plasmas

## Research Article

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### Abstract

We study the setting up of relativistic ponderomotive non-linearity in an under-dense collisionless cold plasma. Using the fluid model, coupled system of equations of the laser beam and electron plasma oscillations has been derived. We present the numerical simulation for this coupled system of equations, when the coupling arises through relativistic ponderomotive non-linearity. The filamentation of the laser beam has been found to vary appreciably with perturbation wave number. The results show that with time, localized structures become more complex and the plasma oscillation frequency spectra have several harmonic peaks at terahertz frequencies when the electron plasma frequency is in terahertz range and laser frequency is around  $2.35 \times 10^{15}$  rad/s. We also present the semi-analytical model to capture the underlying physics.

## Introduction

The study of non-linear interaction of high-power laser with plasma is an area of very much importance. For laser–plasma-based applications, one needs an understanding of laser pulse energy absorption and its coupling with plasma species or electrostatic modes of plasmas (Chen and Sudan, 1993; Adak *et al.*, 2014; Sharma *et al.*, 2017). The laser imparts large quiver velocity to electrons that non-linearly couples with the collective modes of the plasma, giving rise to an ample of non-linear processes such as decay and modulational instability, stimulated Raman and Brillouin scattering, resonant absorption, self-focusing and filamentation of the laser pump (Ozaki *et al.*, 2007; Mulser and Bauer, 2010). Parametric instabilities have proven to be detrimental to the success of laser-induced fusion (Kaw *et al.*, 1973; Kruer, 1974; Liu and Tripathi, 1986; Umstadter, 2003).

Malka *et al.* (1997) and Modena *et al.* (1995) have studied the electron plasma wave for high-energy electron acceleration and have shown that the electron plasma wave-associated electric field can be very large in short distances. The transient evolutions of laser pump in plasma have been studied under ponderomotive non-linearity by Sharma *et al.* (2015). They have numerically solved the coupled system of equations comprising laser beam and ion acoustic wave (modified Zakharov system of equations). The ion acoustic spectra contain spatial harmonics which get modified with time and result in the laser beam localization.

Sprangle *et al.* (1990) have derived coupled non-linear equations for the vector potential of the radiation field and the electrostatic potential of the plasma by using the cold-fluid model along with “quasistatic” approximation. This approximate one-dimensional non-linear model describes the self-consistent interaction of intense laser pulse and plasma. Pukhov and Meyer-ter-Vehn (2002) have carried out 3D particle-in-cell simulations of the short laser pulse at relativistic intensity for the propagation in slightly under-dense plasma. Their work showed the occurrence of the mono-energetic beam of electron bunches (~300 MeV) from the 3D wave breaking of the laser wake field. Feit *et al.* (2001) have also studied the intense beam self-focusing in under-dense plasma and show that a laser beam can be self-channeled in plasma if laser intensity is high enough to produce electron cavitation.

Brandi *et al.* (1993) analyzed the self-focusing of the laser beam under quasi steady-state approximation and also derived the equations for laser beam and plasma oscillation dynamics under relativistic ponderomotive non-linearity. The present study analyzes the transient relativistic ponderomotive non-linearity when the quasi steady approximation is not taken into account using the computational method to solve the coupled equation of laser pump and electron plasma oscillations. The generation of density harmonics and their effects on the filamentation of laser beam have also been investigated. In addition to the computation method, a semi-analytic model has also been presented to describe the non-linear development of the laser beam.

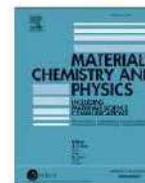
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# Synthesis of CdS nanoparticle by sol-gel method as low temperature NO<sub>2</sub> sensor

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## HIGHLIGHTS

- CdS thin film was prepared over interdigital electrodes (IDEs) by spin coating.
- The hexagonal shaped surface morphology is being reported first time.
- NO<sub>2</sub> Gas sensor work at low operating temperature has been studied.
- The sensing mechanism is administered by the porosity of the thin film.
- The sensor has sensor response  $\sim 1.73 \times 10^2$  towards to 20 ppm.

## GRAPHICAL ABSTRACT



## ARTICLE INFO

## Keywords:

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## ABSTRACT

In the present work, NO<sub>2</sub> gas sensor based on Cadmium sulfide (CdS) nanostructures were prepared by using the chemical route technique. CdS thin films of different thickness were prepared by spin coating technique with different speed (1000, 2000 and 3000 rpm). Prepared thin films were characterized by techniques, such as X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Fourier Transform infrared spectroscopy (FT-IR) and Ultraviolet-Visible spectroscopy (UV-Vis), which offered the information about the chemical structure and morphology of CdS thin film. Gas sensing measurements for detecting 20 ppm NO<sub>2</sub> gas were carried out on CdS thin film prepared on interdigital electrodes patterned on glass substrate and a maximum response of  $\sim 1.73 \times 10^2$  at 70 °C operating temperature was observed.

## 1. Introduction

Nitrogen dioxide (NO<sub>2</sub>) is among the major air pollutants that can cause serious problem related to health and environment. This leads towards the urgent development of gas-sensing materials which will be

able to detect NO<sub>2</sub> with quick response and recovery time at relatively low temperature. Semiconductors metal oxide-based gas sensor is commonly used nowadays, these are variation in electrical conductivity on interference with target gas particles. The semiconductor oxides film shown electrical resistance, such as Fe<sub>2</sub>O<sub>3</sub>, ZnO, TiO<sub>2</sub>, SrFe<sub>2</sub>O<sub>19</sub>, hBN

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## Optimizing Synthesis of *Citrus limetta* Peel Silver Nanocomposites Possessing Larvicidal Potential against Dengue Vector, *Aedes aegypti* L.

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**Abstract** *Aedes aegypti* L. is the major vector accountable for the spread of several diseases of medical importance. The control strategies primarily relying on chemical insecticides have caused negative impact on our environment and human health. Thus, current study employed *Citrus limetta* peel extracts (CLPE) against larvae of *Ae. aegypti*. Silver nanocomposites (AgNCs) from CLPE were synthesised and the process of synthesis was optimized by varying temperature; volume and concentration of silver nitrate solution; and the volume of catalyst. A conspicuous change in colour of the reaction mixture was noticed from pale yellow to dark brown. This indicated the synthesis of AgNCs which was traced by UV-Visible spectroscopy. The optimum synthesis of CLPE-AgNCs was obtained with the mixture of 4 mL AgNO<sub>3</sub> (3mM) and 3 mL CLPE. The larvicidal assay with these nanoparticles against *Ae. aegypti* resulted in LC<sub>50</sub> and LC<sub>90</sub> values of 26.82 µg/mL and 99.32 µg/mL after 24 h of exposure; which respectively decreased to 19.51 µg/mL and 71.99 µg/mL after 48 h of exposure. The results elucidate 1.3-fold higher larvicidal efficacy of nanoparticles with increased duration of larval exposure. We suggest that synthesis of AgNCs by utilizing peel extract of *C. limetta* is a cost-effective and eco-safe alternative to conventional insecticides; and can be utilized as the potent mosquito larvicide.

**Keywords** Green Synthesis, Silver Nanocomposites, *Citrus limetta*, Larvicidal, *Aedes aegypti*

### 1. Introduction

*Aedes aegypti*, the dreadful and global vector of fatal

diseases; like Yellow fever, Zika, Dengue fever and Chikungunya; has captivated attention of researchers, health organizations and vector control bodies. In the last few decades, the prevalence of *Aedes*-borne diseases; especially dengue; has augmented extensively at global level. According to World Health Organization, almost half of the world's population (3.9 billion) residing in 128 countries is prone to the dengue infection while more than 100 countries are endemic to dengue [1]. According to Union Health Ministry of India, the infections and fatalities caused by dengue virus are rising in India year by year raising serious concerns about the vector control.

It has been suggested that the rising dengue cases in India may be because of inappropriate vector control strategies, unplanned urbanization, variable environmental factors, host-pathogen interactions and immunological factors [2]. The radical shift of dengue from urban areas to rural areas is also considered one of the reasons for increase in incidences and severity of disease [3]. Though, Dengvaxia (R), a dengue vaccine, has been formulated and registered in several countries; it has not yet been approved by the Government of India and has recommended more clinical trials [4]. Because of lack of adequate medication and vaccines, the only measure to control the dengue is still based on the vector control.

Various measures have been attempted for *Aedes* control, yet major strategies still rely upon the use of chemical insecticides despite their harmful effects on the environment and human health. Therefore, researchers are nowadays exploring botanical extracts to formulate an eco-safe and effective remedy. Several botanicals, weeds and fruit wastes have been investigated as mosquito control agents and found effective [5-7]. The fruits, seeds, roots and leaves of the citrus plant have also been examined for their potential as mosquito control agents [8, 9]. The citrus



## Original Article

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One-pot synthesis of silver nanocomposites from *Achyranthes aspera*: An eco-friendly larvicide against *Aedes aegypti* L.Aarti Sharma<sup>1</sup>, Pushplata Tripathi<sup>1</sup>, Sarita Kumar<sup>2\*</sup><sup>1</sup>Department of Life Sciences (SOS), Indira Gandhi National Open University, Maidan Garhi, New Delhi 110068, India<sup>2</sup>Department of Zoology, Acharya Narendra Dev College, University of Delhi, Kalkaji, New Delhi 110019, India

## ABSTRACT

**Objective:** To formulate silver nanocomposites from *Achyranthes aspera* leaf extracts and evaluate its larvicidal activity against *Aedes aegypti*.

**Methods:** The silver nanocomposites were synthesized from *Achyranthes aspera* leaf extracts. The process was optimized and traced through UV-visible and photon correlation spectroscopy. The larvicidal potential of silver nanocomposites of *Achyranthes aspera* leaf extracts was assessed against the early fourth instars of *Aedes aegypti* and three non-target organisms. Furthermore, the most effective and eco-safe nanocomposite was characterized by different biophysical techniques including scanning electron microscopy (SEM), energy dispersive X-ray (EDX) spectroscopy, transmission electron microscopy (TEM), X-ray diffraction (XRD) and Fourier transform-infrared spectroscopy (FT-IR).

**Results:** The formulated silver nanocomposites exhibited efficient larvicidal efficacy against *Aedes aegypti*. Bioassay with silver nanocomposites formulated using different AgNO<sub>3</sub> concentrations (3, 4, and 5 mM) revealed respective LC<sub>50</sub> values of 37.570, 6.262 and 1.041 µg/mL; 5.819, 1.412 and 0.489 µg/mL; and 5.519, 1.302 and 0.267 µg/mL after 24, 48 and 72 h. The silver nanocomposites with 4 mM AgNO<sub>3</sub> were selected for characterization. SEM and TEM analysis revealed spherical, poly-dispersed structure with varied diameters of 1-25 nm. The XRD analysis established the crystalline and face-centred-cubic structure of silver nanocomposites with the maximum peak at a 2θ value of 37.42°. The EDX pattern showed the presence of Ag, O and C in the nanocomposites in their order of weight%. The FT-IR displayed visibly distinct peaks in different ranges demonstrating the intricacy of silver nanocomposites. In addition, the lethal concentrations of silver nanocomposites of *Achyranthes aspera* leaf extracts against *Aedes aegypti* larvae were non-toxic to non-target organisms including *Gambusia affinis*, *Daphnia magna* and *Moina macrocarpa*.

**Conclusions:** Silver nanocomposites synthesized with leaf

extract of *Achyranthes aspera* provide a cost-effective and eco-safe alternative to conventional insecticides, and can be utilized as a potent mosquito nano-larvicide.

**KEYWORDS:** *Achyranthes aspera*; *Aedes aegypti*; Larvicidal; Silver nanocomposites; SEM-TEM; EDX; XRD; FT-IR

## 1. Introduction

*Aedes aegypti* (*Ae. aegypti*)-borne diseases, such as dengue, Chikungunya and Zika, are on the rise at the global level since the last few years. These diseases have become a prime concern in urban and semi-urban regions of the tropical and sub-tropical areas of the world attracting the researchers' attention to explore novel strategies of vector control. The endemism of dengue in almost 125 countries has not only risked the health of around 40% of the world's population but has also costed the lives of a large number of the population[1]. An alarming 30x increase in dengue incidences since last 50 years has affected approximately 3.6 billion people across the globe; while three-quarters of the global incidences have occurred in Asian Pacific countries alone, which can be attributed to the weather conditions prevalent there.

In India, dengue fever is ubiquitous in almost every region and

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## Effect of dietary stress of emamectin benzoate on the fitness cost of American bollworm, *Helicoverpa armigera* (Hübner, 1808)

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### Abstract

Present study assessed the effect of Emamectin benzoate (EMB) on the survival, growth and nutrition efficiency of *Helicoverpa armigera*. Dietary EMB exhibited a significant systemic toxicity in *H. armigera* larvae resulting in LD<sub>50</sub> and LD<sub>90</sub> value of 0.092 µg/mL and 0.156 µg/mL, respectively. Feeding with 0.05–0.2 µg/mL EMB caused 10–100% larval mortality in a dose-dependent manner. Feeding the IV instars of *H. armigera* with 0.1–1.6 µg/mL EMB-incorporated diet deterred feeding significantly. Substantial deterrent effects of EMB with lower LD<sub>50</sub> values indicate the noteworthy systemic toxicity of EMB on the *H. armigera* larvae. Both choice and no-choice bioassay with dietary EMB showed a distinct preference of larvae towards control diet. Feeding the larvae with sublethal doses of 0.05–0.01 µg/mL EMB impaired ingestion and digestion, and induced considerable post-ingestive toxicity in larvae. Relative Consumption Rate (RCR) and the Relative Growth Rate (RGR) were recorded in the range of 1.653–3.985 and 0.385–0.978, respectively. The nutrition indices of larvae revealed reduction in Efficiency of Conversion of Ingested Food (ECI) by 10–24% and Efficiency of Conversion of Digested Food (ECD) by 2.0–52% and in Approximate Digestibility (AD) by 09–63%. The noticeable decrease in the food utilization, digestion and assimilation may have resulted in the observed reduced larval growth. The decreased metabolic efficiency in *H. armigera* larvae implicated that dietary EMB probably weakened the biochemical machinery of larval gut and reduced physiological fitness. The results suggest that use of EMB can be an effective tool in Integrated Pest Management program of *H. armigera*.

**Keywords** Emamectin benzoate · *Helicoverpa armigera* · Nutritional indices · Post-ingestive toxicity · Growth-inhibitory

### Introduction

*Helicoverpa armigera* (Lepidoptera: Noctuidae) is a recognized and devastating multiphagous pest; reported to affect ca. 181 wild and cultivated plant species across 45 families (Amer and El-Sayed 2014; Mironidis and Savopoulou-Soultani 2014). The pest is suggested to be closely associated with temperate broadleaf and mixed forests; deserts and xeric shrub lands; tropical and subtropical moist broadleaf forests;

Mediterranean scrub tropical and subtropical grasslands and savannas (Wasilun 2016). The extensive worldwide distribution of *H. armigera* may be attributed to its highly variable life-history traits; such as polyphagia, facultative diapause, high fecundity; as well as to its migratory potential and tolerance to insecticides. These traits enable the pest to endure unstable habitats and accustom to seasonal variations in diverse cropping systems (Naseri et al. 2009).

In Indian agricultural sector alone, the pest has caused annual damage worth USD 36 billion (Dhaliwal et al. 2015). Several synthetic pesticides have been employed to restrict *H. armigera* population costing annual expenditure of more than 1 billion USD (Ishtiaq et al. 2012; Carneiro et al. 2014). However, sustained use of insecticides in the fields has resulted in the development of high levels of resistance in *H. armigera* against pyrethroids, organophosphates, carbamates, organochlorines, spinosad, *Bacillus thuringiensis*-derived toxins, oxadiazines and diamides, etc.; resulting in frequent outbreaks in various parts of the world (Wang et al. 2009). In addition, frequent and random application of

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## Effects of $\beta$ -sitosterol on growth, development and midgut enzymes of *Helicoverpa armigera* Hübner

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**Abstract:** *Helicoverpa armigera* is a global agricultural pest of serious concern. Continued use of chemical insecticides as control measures has raised grave health and environment concerns, necessitating a search for botanicals as safe alternatives. The current study investigates the effects of  $\beta$ -sitosterol, a bioactive phytochemical in *Thevetia nerifolia*, on the growth and development, as well as on midgut enzymes of *H. armigera*. Dietary  $\beta$ -sitosterol produced dose-dependent systemic toxicity and growth inhibitory effects in *H. armigera*; the most significant effects were obtained with 10  $\mu$ g/mL dietary  $\beta$ -sitosterol. Higher prepupal and pupal mortality in comparison to larval mortality and a comparatively greater reduction in average weight gained by later instars point to cumulative effects of  $\beta$ -sitosterol. The delayed effects were ascertained by the 82.05%-57.89% reduction in adult emergence in comparison to 95.02% emergence in controls. Dose-dependent effects of  $\beta$ -sitosterol were observed as significantly decreased enzyme activities of alanine aminotransaminase (ALT), aspartate aminotransaminase (AST) and alkaline phosphatase (ALP) in the larval midgut. Suppression of enzyme activity was obtained in the order ALT>AST>ALP. Impaired activity of gut enzymes possibly lowered the energy reserves and affected nutrient transport through the gut epithelium, affecting the growth and development of *H. armigera*. Our study points to a promising use of  $\beta$ -sitosterol against *H. armigera*, although further examination and field studies are needed to ascertain its possible use in control programs.

**Keywords:** *Helicoverpa armigera*;  $\beta$ -sitosterol; alanine aminotransaminase; aspartate aminotransaminase; alkaline phosphatase

### INTRODUCTION

*Helicoverpa armigera* is a widely spread destructive pest of many important agricultural crops in Asia, Africa, Australia and Europe [1]. Commonly known as cotton bollworm, the pest feeds on a wide geographical range of host plants, possesses the ability to adapt to new ecosystem and causes great economic losses to cultivated crops [2]. In India alone, this highly polyphagous insect feeds on about 181 plant species spread across 68 botanical families [3]. So far, the major tool applied to keep this pest under check was spraying of crop fields with chemical insecticides. However, this has resulted in the persistent occurrence of residual insecticides in foodstuff and drinking water, raising grave health concerns. The adverse effects of insecticides in the environment has resulted in ecological imbalance, emergence of more aggressive and resistant pests and the elimination of valuable non-target organisms [4]. Several studies have reported the development of

resistance in *H. armigera* against almost every group of chemical insecticides [5-10]. All this has raised the necessity to explore and develop novel and eco-safe strategies for *H. armigera* control.

Plants contain a reservoir of endogenous secondary metabolites that provide them with defense against insects and increase their resistance to pest attack. Plant-herbivore interaction thus forms the basis of exploration of plants for pesticidal active natural products as alternates to synthetic counterparts [11]. Many phytochemicals like essential oils, flavonoids, alkaloids, glycosides, esters and fatty acids, are reported to possess anti-insect effects and can be used as alternatives to synthetic insecticides in different ways, such as repellents, feeding deterrents/antifeedants, toxicants, growth retardants, chemosterilants and attractants [12]. The identification of these chemical factors is crucial in determining the evolutionary and ecological processes of insect-plant interactions





## Exploitation of potential bioactive compounds from two soil derived actinomycetes, *Streptomyces* sp. strain 196 and RI.24

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### ABSTRACT

Due to emergence of drug resistant pathogens, nearly all available medicines are becoming ineffective against these life threatening pathogens so there is dire need for the discovery of compounds having unique modes of action. During our previous studies, actinomycetes designated as 196 and RI.24 were isolated, screened for bioactive compounds production and characterized using 16S rRNA gene sequencing. Colony 196 was identified as strain of *Streptomyces albolongus* (100% sequence similarity) and RI.24 as strain of *Streptomyces enissocaesilis* (100% sequence similarity). In current study, potential bioactive compounds produced by these strains were characterized. Cold extraction method was applied for taking out of bioactive compounds from actinomycetes. Minimum inhibitory concentration (MIC) determination of compounds from these strains showed activity nearly in the range of commercial antibiotics (strain 196 0.0075 mg/ml, RI.24 0.25 mg/ml and chloramphenicol 0.0075 mg/ml, ampicillin 0.025 mg/ml). Structural elucidation of these compounds was carried out using spectroscopic techniques of LC-MS/MS and <sup>1</sup>H NMR. Compounds K-252-C-Aglycone, indolocarbazole alkaloid, decoyinine, cycloheximide were detected from strain 196 whereas daunorubicin, hygromycin B, agecorynin F, indinavir-N-glucuronide and minocycline were identified from strain RI.24. Current study reports these compounds for the first time from strains of *Streptomyces albolongus* and *Streptomyces enissocaesilis*. Present investigation also suggests that strains 196 and RI.24 contain polyketide synthase-I (PKS-I) and non-ribosomal peptide synthetase (NRPS) gene clusters which are responsible for the production of bioactive compounds. The results of this study can be used by the scientific world or pharmaceutical industries for the development of new drugs/formulations by applying more advanced techniques.

### 1. Introduction

During mid-twentieth century discovery of penicillin and many other bioactive agents for treating contagious diseases has revolutionized the field of drug development. These inventions have led to the development of improved and effective antibiotics (Sharma et al., 2016). However, due to over the counter availability and overuse of antibiotics a large number of pathogens have developed resistance to the existing antibiotics. These pathogens were found to contain genes in their genome and plasmids which encode large number of resistant elements, greatly limiting therapeutic options against the bacteria (Wright, 2012). So, there is a dire need for invention and development of antibiotics that efficiently acts against deadly and life threatening pathogens. Microbes have long been considered as important reserves for isolation of useful molecules in the drug discovery paradigms

(Hussain et al., 2017). Actinomycetes have vigorous ability to biosynthesize the potent bioactive secondary metabolites with broad range of biological activities (Berdy, 2012; Hussain et al., 2017). A small portion of the existing ecosystems have methodically been explored for isolation of microbial diversity (Hussain et al., 2017). Although, myriad molecules have been extracted from actinomycetes but only few have been analyzed for diverse biological activities. There are only 1% actinomycetes that have been cultured till date, thus bio-prospection of actinomycetes from diverse habitats for production of biologically important metabolites becomes an essential aspect (Subramani and Aalbersberg, 2013).

Present investigation is focused on extraction, identification and characterization of potent bioactive compounds from two actinomycete strains, *Streptomyces* sp. strain 196 and RI.24 isolated from two distinct habitats. The study is also aimed at PCR detection of PKS (Polyketide

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# Potential applications of extracellular enzymes from *Streptomyces* spp. in various industries

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## Abstract

Extracellular enzymes produced from *Streptomyces* have the potential to replace toxic chemicals that are being used in various industries. The endorsement of this replacement has not received a better platform in developing countries. In this review, we have discussed the impact of chemicals and conventional practices on environmental health, and the role of extracellular enzymes to replace these practices. Burning of fossil fuels and agriculture residue is a global issue, but the production of biofuel using extracellular enzymes may be the single key to solve all these issues. We have discussed the replacement of hazardous chemicals with the use of xylanase, cellulase, and pectinase in food industries. In paper industries, delignification was done by the chemical treatment, but xylanase and laccase have the efficient potential to remove the lignin from pulp. In textile industries, the conventional method includes the chemicals which affect the nervous system and other organs. The use of xylanase, cellulase, and pectinase in different processes can give a safe and environment-friendly option to textile industries. Hazardous chemical pesticides can be replaced by the use of chitinase as an insecticide and fungicide in agricultural practices.

**Keywords** *Streptomyces* · Extracellular enzymes · Hazardous chemicals · Conventional practices · Waste management

## Introduction

*Streptomyces* spp. secrete various types of extracellular enzymes that have numerous applications in industry and agriculture practices (Fig. 1; Table 1). The advancement of molecular strategies in place of the traditional microbiological approach has improved the production of enzymes on a large scale (Adrio et al. 2014). Functional genomics, proteomics, and other genetic techniques such as metabolic engineering and combinatorial biosynthesis have contributed to developing effective and stable enzymes to improve metabolic processes (Fisher et al. 2014). Xylanase, chitinase, and cellulase are the major extracellular enzymes from *Streptomyces* spp. which play a huge role in various

industries (Talamantes et al. 2016). Consortia of these enzyme-producing actinomycetes also showed an effective role in biodegradation and waste management (Sarkar et al. 2011). Cellulase and xylanase from actinomycetes are well known for converting lignocellulosic plant biomass into biofuels (Talamantes et al. 2016). Limitation of fossil fuels and waste management are major concerns of the world; as a result, biofuel production from lignocellulose rich waste has given them hope to overcome both issues (Ahorsu et al. 2018). Apart from the management of biodegradable wastes, enzymes from *Streptomyces* spp. of actinomycetes were reported in the literature for degrading polythene and other non-biodegradable wastes, as well (Sangale et al. 2012). Various industries are showing dependency on extracellular enzymes as compared to their counter-part toxic chemicals (Singh et al. 2016a, b). In this study, we have tried to update the information of usages of extracellular enzymes in the place of chemicals. The review includes the comparison of the conventional approach of waste management with extracellular enzyme-based waste management; the impact of petroleum on environment health and extracellular enzymes in biofuel production; hazardous effects of chemicals used in food industries and extracellular enzymes as an efficient

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## Expression and molecular characterization of stress-responsive genes (*hsp70* and *Mn-sod*) and evaluation of antioxidant enzymes (CAT and GPx) in heavy metal exposed freshwater ciliate, *Tetmemena* sp.

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### Abstract

Response of heavy metals namely cadmium (Cd) and copper (Cu) on the expression of stress responsive genes in the fresh water ciliate, *Tetmemena* sp. (single cell eukaryote) was studied. Stress responsive genes include heat shock protein genes and genes involved in antioxidant defence system. Quantitative real time PCR (qRT-PCR) was employed to evaluate the effects of Cd and Cu on the expression of cytosolic *hsp70* and *Mn-sod* genes. Increase in the expression of these genes was observed after exposure with the heavy metals. The macronuclear cytosolic *hsp70* and *Mn-sod* (*SOD2*) genes were also sequenced and characterized using various bioinformatics tools. In antioxidant defence system, the superoxide dismutase (SOD) family is a first line antioxidant enzyme group involved in catalysing reactive oxygen species (ROS) to hydrogen peroxide and molecular oxygen. Influence of Cd and Cu on the activity of SOD has already been reported by our group. Therefore, the enzymatic activities of antioxidant enzymes, catalase (CAT) and glutathione peroxidase (GPx) were studied in the presence of Cd and Cu and there was significant increase in activity of these enzymes in concentration dependent manner. This study suggests that cytosolic *hsp70*, *Mn-sod* and the antioxidant enzymes such as CAT and GPx can be used as effective molecular biomarkers for heavy metal toxicity and *Tetmemena* sp. can be used as potential model for understanding the molecular response to heavy metal contamination in aquatic ecosystems.

**Keywords** Antioxidant enzymes · Biomarkers · Freshwater ciliate · Heavy metal stress · Stress genes · *Tetmemena* sp.

### Introduction

Environment is continuously being polluted with the addition of large number of heavy metals, chemicals and radiations which are dangerous for health of all kinds of living organisms including humans [1]. Heavy metals are found to be the major pollutants present in both terrestrial and aquatic ecosystems [2]. They are widely distributed on the earth's crust, and are present in the structure of various minerals which occur in the environment [3]. Metal pollution found in aquatic ecosystems is governed by diverse human

activities such as agricultural or industrial wastes, smelting and mining effluents [4, 5]. Amongst all the heavy metals Copper (Cu), Cadmium (Cd), Mercury (Hg), and Lead (Pb) are of major concerns because of their very high toxicological properties [6–8]. Released metals are considered to be very toxic because of their persistence and accumulation in the environment [5, 9]. Excessive concentrations of heavy metals have detrimental effects which affect the living organisms [5, 10]. Therefore, one key area of focus is the use of biomarkers to provide an early warning of environmental risk and its assessment. These biomarkers may be utilized as tools to understand the relationship between environmental changes and the health of various living organisms.

Heavy metals are known to enhance superoxide radical production, lipid peroxidation and accumulation of reactive oxygen species (ROS) in form of free radicals. The generated free radicals damage the cellular components such as DNA, protein and lipids [2, 11–16]. To protect the cell from cellular damage due to oxidative stress, heat shock proteins (HSPs) are highly activated [17, 18]. HSPs are involved in

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## SYMPOSIUM ARTICLE

**Symposium Report: International Symposium on Ciliate Biology, India Habitat Centre, New Delhi, India, 04–06 April 2018**

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Biodiversity; bio-indicators; ecotoxicology; IRCN-BC; ISOP; symbiosis.

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RESEARCH on ciliated protists has ramified in the Indian subcontinent in last few years. The first International Symposium on Ciliate Biology held at Sri Guru Tegh Bahadur Khalsa College, University of Delhi, on 06–07 February 2007 was a successful event (Lynn 2007). The second International Symposium on Ciliate Biology (ISCB) 2018 was held on 04–06 April 2018 at the India Habitat Centre, New Delhi, India. The symposium resulted from a synergy with the International Research Coordination Network for Biodiversity of Ciliates (IRCN-BC), an affiliate society of International Society of Protistologists (ISOP). The major

**ABSTRACT**

Ciliated protists have attracted wide interest among researchers from the Indian subcontinent in the last few years. An International Symposium on Ciliate Biology (ISCB) 2018 was held on 04–06 April 2018 at the India Habitat Centre, New Delhi, India. The symposium represented a synergy with International Research Coordination Network for Biodiversity of Ciliates (IRCN-BC), an affiliate society of International Society of Protistologists (ISOP). The symposium provided a platform for Indian and International delegates to exchange knowledge, present their latest research findings, and establish collaborations as well as creating a networking opportunity for undergraduate and postgraduate students. Nine foreign delegates from 5 countries and 300 Indian delegates actively participated in the event which included 22 oral and 57 poster presentations.

aim of the symposium was to provide a platform for ciliate biologists to exchange knowledge, present latest research findings, and establish collaborations as well as a networking opportunity for undergraduate and postgraduate students. Over 300 Indian and 9 International delegates from 5 countries participated in the event. The symposium comprised 22 oral and 57 poster presentations delivered by participants. Symposium proceedings are in the process of publication by Zoological Survey of India.

The symposium, convened by Dr Komal Kamra, co-convened by Dr Renu Gupta, Dr Seema Makhija, and Dr



## Original article

Description of a new species of *Tetmemena* (Ciliophora, Oxytrichidae) using classical and molecular markers

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Molecular markers

## ABSTRACT

*Tetmemena saprai* n. sp. was isolated from fresh-water samples collected from Okhla Bird Sanctuary, Delhi, India and described based on its morphology, morphogenesis and molecular markers, namely the small-subunit (SSU) rRNA gene and internal transcribed spacers (ITS1-5.8S-ITS2). The morphological features of *T. saprai* n. sp. are as follows: colourless; rigid body with no cortical granules; water expelling vesicle about 15 µm in size, located below the adoral zone of membranelles near the left body margin; body size about 125–140 × 50–60 µm in live and about 100 × 45 µm in protargol preparations, with body length : width ratio of around 2:1; undulating membranes in a *Stylonychia*-pattern; adoral zone about 44 µm in length with (on average) 45 adoral membranelles; 18 frontal-ventral-transverse cirri; one right and one left marginal row; six dorsal rows including two dorsomarginals, of which the fourth row is shortened anteriorly; three caudal cirri which are not equidistant; two macronuclear nodules; 2–4 micronuclei. A detailed morphogenetic study revealed the oral primordium to originate near the leftmost transverse cirrus, and the involvement of five parental cirri (three frontals and two ventrals) in the formation of streaks I–VI for the proter and opisthe. The genetic distance between *T. saprai* n. sp. and its congeners *T. pustulata* and *T. vorax* (S. vorax) varied from between 1% and 2% in the SSU rRNA gene and 1% and 6% in the ITS1-5.8S-ITS2 sequence. The secondary structures of the ITS1 and ITS2 RNA transcripts of four different species of genus *Tetmemena* (*T. saprai* n. sp., *T. pustulata*, *T. vorax* and *T. bifaria*) were also compared, revealing that the ITS1 region was more variable than ITS2. The morphological and morphogenetic characterisation, and phylogenetic analyses based on the molecular markers, confirm that the present species is a distinct species of the genus *Tetmemena* belonging to the subfamily *Stylonychinae*. This study also reveals that the macronuclear ITS region can be a suitable candidate for species identification.

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## 1. Introduction

In the late 1990s Berger divided the family Oxytrichidae into two subfamilies, Oxytrichinae and Stylonychinae, on the basis that the former had more "flexible" bodies and the latter more "rigid" ones (Berger, 1999; Berger and Foissner, 1997). Sequence analysis

of species from Oxytrichidae during the early years of the 21st century has confirmed this subdivision, albeit with relatively stronger support for the Stylonychinae subfamily than the Oxytrichinae (Bernhard et al., 2001; Hewitt et al., 2003; Schmidt et al., 2007). Analyses based on molecular data have also strongly supported the monophyly of the subfamily Stylonychinae (Bernhard et al., 2001; Chen et al., 2013; Foissner et al., 2004; Hu et al., 2011; Schmidt et al., 2007). The subfamily, Stylonychinae is characterised by the rigid body mentioned above, a lack of cortical granules and an adoral zone of membranelles that is usually more than 40% of the body length (Berger and Foissner, 1997) and also includes the so-called "18-cirri oxytrichids" (Berger, 1999).

The genus *Tetmemena*, first designated by Eigner (1999), is classified as a member of the subfamily Stylonychinae, family Oxytrichidae, suborder stichotrichida, order hypotrichia within

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## Research Article

# Synthesis, DFT studies, molecular docking, antimicrobial screening and UV fluorescence studies on ct-DNA for novel Schiff bases of 2-(1-aminobenzyl) benzimidazole

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## ABSTRACT

Novel Schiff bases (SBs) were synthesized by condensation of 2-(1-Amino benzyl) benzimidazole with heterocyclic and aromatic carbonyl compounds. The structural characterization was done using <sup>1</sup>H, <sup>13</sup>C NMR, FTIR and ES-MS spectroscopic techniques. The *in silico* pharmacokinetics showed that nearly all compounds obeyed Lipinski rule of 5 with low toxicity and metabolic stability. The global reactivity descriptors were calculated using DFT approach. The molecular docking result of SBs with ct-DNA suggested interaction *via* groove binding mode. The antibacterial activity was tested against *S. aureus* and *E. coli*, indicated significant inhibition than reference drug. The compound **4d** gave best results at 50 μg ml<sup>-1</sup> concentrations. UV/Vis and Fluorescence spectroscopy tools were used to evaluate ct-DNA binding ability of compounds **4a–e** through hypochromic shift. The steady state fluorescence predicted a moderate binding constant of  $1.12 \times 10^4$  for **4d**, indicative of non-intercalative mode.

## 1. Introduction

The extensive use of conventional antibiotics has led to resistance in micro-organisms. *E. coli*, *S. aureus* and *K. pneumonia* show resistance towards fluoroquinolone, methicillin, carbapenem respectively [1, 2]. Antimicrobial resistance (AMR) is of great concern making antimicrobial treatment become ineffective and infections persist. Therefore, it has become crucial to develop new molecules acting as non-resistant antimicrobial agents. Also, small molecules targeting bacterial DNA are the most widely studied due to their better efficacy as drugs. However, their binding modes may vary from either minor groove binding or intercalation depending on selectivity towards specific DNA sequence [3, 4].

Many natural occurring alkaloids such as ellipticine, cryptolepine and synthetic derivatives of benzimidazoles i.e. Hoechst-33258, have been earmarked as important DNA intercalators [5]. Whereas indole and benzimidazole diamidine derivatives have been found to possess DNA groove binding ability along with antimicrobial action. There *in vitro* and *in vivo* actions were superior to the clinically approved DNA groove binding drug, pentamidine [6]. Thiabendazole, a well-known anthelmintic, was proved to be a minor-groove binder of ct-DNA [7].

However, researchers are always keen in designing new Mannich and Schiff base derivatives, as they are easy to prepare, possess great

structural flexibility with DNA binding affinity. Schiff's Bases (SBs) of cinnamaldehyde, salicylaldehyde, 2-hydroxybenzaldehyde and 4-dimethylaminobenzaldehyde etc. have shown considerable antibacterial activity [8, 9, 10, 11]. The *in silico* and *in vitro* studies on indole based SBs have proved their antimicrobial potential [12, 13]. The SAR studies revealed that electron pair present on the nitrogen of the imine group is in sp<sup>2</sup> hybridized orbital and has been responsible for its DNA binding ability, leading to potential biological activities [14].

Owing to the above applicative importance of SBs and our constant endeavor to synthesize various biologically important heterocycles through SBs [15, 16, 17], we hereby report the synthesis of novel Schiff bases (SBs) as potential antimicrobial agents. One pot condensation reaction of heterocyclic amine with aryl/heteroaryl carbonyl compounds gave desired SBs. Benzimidazole was chosen as a heterocyclic amine due to its wide availability as a bioactive scaffold [2, 18] and diversified pharmaceutical applications [19, 20, 21, 22, 23, 24, 25, 26, 27, 28] with DNA minor groove binding capability [29].

Hence, novel Schiff Bases (SBs) have been prepared from the reaction of 2-(1-amino benzyl) benzimidazole with various aryl/heteroaryl carbonyl compounds. Further, computational studies including *in silico* DFT study to describe their chemical reactivity, toxicity screening (using PreAdmet Server) and molecular docking (using Autodock program 4.2)

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# Recent Trends in the Synthesis of Benzimidazoles From *o*-Phenylenediamine *via* Nanoparticles and Green Strategies Using Transition Metal Catalysts

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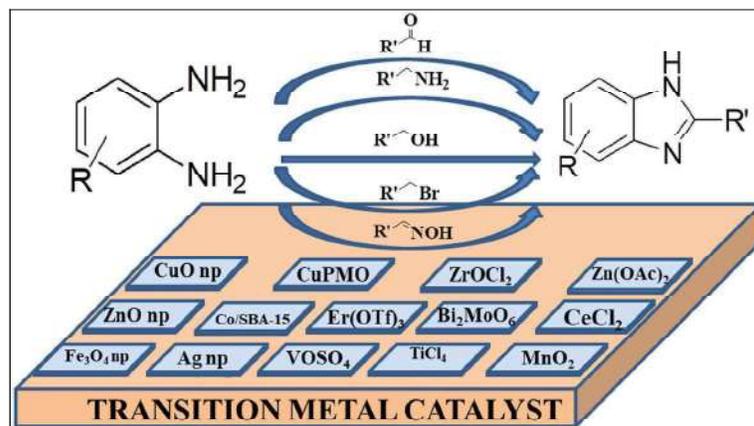
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Benzimidazole is a heterocyclic moiety of immense importance as it acts as a primary “biolinker” in diverse synthetic routes to obtain bioactive compounds. Substituted benzimidazoles are known to possess a varied range of pharmacological applications, namely, anti-cancer, anti-diabetic, anti-inflammatory, and antiviral like anti-HIV and anti-fungal. A number of reviews covering the important aspects of benzimidazoles such as pharmacological activities, SAR studies, and well-known methods of synthesis have appeared in the literature. However, green synthetic methods particularly using transition metal (TM) catalysts and their nanoparticles, although being more viable and extensively applied by researchers in the present scenario, have not been exclusively and expansively reviewed. Besides this, the vital precursors required for knitting the skeleton of benzimidazole are mainly *o*-aryldiamines. The conventional synthesis generally involved the condensation of these diamines with carbonyl/carboxylic acid derivatives either *via* high temperature heating or *via* adding strong acids, mostly resulting in poor yields or mixtures. However, recent trends are replacing these conditions by mild and green conditions through TM catalysts. Therefore, the current review emphasizes on the recent trends adopted in the synthesis of benzimidazoles using condensation reaction of *o*-phenylenediamines and various aldehydes/ester/amide/alcohols with TM in a catalytic role in nanoform and under environmentally benign green conditions.

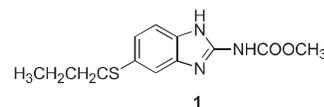
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## 1. INTRODUCTION

Benzimidazole nucleus finds a respectable space and interest among nitrogen heterocycles, whether for its applications or the number of synthetic methodologies employed for preparing it. The biological implication is because of the proximity with structure of purines, and applicative importance is ascertained by their abundance in majority of bioactive molecules. However, the existence of an enormous number of this motif, associated to these applications, has led to a spectrum of protocols for its synthesis in the last decade [1–6].

As far as the bioactivity is concerned, albendazole (**1**) and thiabendazole (**2**) are the best examples of common

commercial drugs comprising benzimidazole nucleus and possessing anthelmintic properties, whereas 2-heteroaryl/aryl substituted benzimidazoles (**3**) display antitumor activity against various cancer cell lines. Besides these, they possess a gamut of other pharmaceutical activities, as shown in Figure 1, giving more than a reason for chemists to go after their synthesis [7].





## Medicinal Chemistry &amp; Drug Discovery

## Spiro-Indole-Coumarin Hybrids: Synthesis, ADME, DFT, NBO Studies and In Silico Screening through Molecular Docking on DNA G-Quadruplex

Leena Khanna,<sup>[a, b]</sup> Sugandha Singhal,<sup>[b]</sup> Subhash C. Jain,<sup>[a]</sup> and Pankaj Khanna<sup>\*,[a, c]</sup>

New series of hybrids were synthesized by combination of 4-hydroxycoumarin with spiro[indol-indazole-thiazolidine]-diones and spiro[indol-pyrazole-thiazolidine]-diones, *via* hitherto unknown Schiff bases. The effects of substituents, such as -F, -Br and -CH<sub>3</sub>, on the crucial characteristics pertaining to the hybrids were investigated through computational studies. *In silico* or virtual screening through molecular docking studies on the library of 22 compounds, including reference compounds, precursors, non-hybrid and hybrid derivatives, was performed on DNA G-quadruplex of the human genome. All six freshly synthesized hybrids showed high binding energy as compared to non-hybrids as well as reference compounds. The presence of substituents at 5-position of indole enhanced the binding tendency of the ligand. ADME studies indicated good oral bioavailability and absorption of these compounds. Density

Functional Theory (DFT) calculations of hybrids were done at B3LYP/6-311G++(d,p) level of computation. Their HOMO and LUMO energy plots reflected the presence of high charge transfer and chemical potential. Natural bond order (NBO) calculations predicted hyperconjugative interactions. The Molecular Electrostatic Potential (MEP) surface plots showed possible electrophilic and nucleophilic attacking sites of the hybrids. Compound **10a** (5-fluoro-spiro[indol-indazole-thiazolidine]-dione-coumarin hybrid), on the basis of global reactivity descriptors, was filtered to be chemically most reactive with the highest binding energy of -8.23 kcal/mol with DNA G-quadruplex. The synthesized hybrid coumarin derivatives in correlation with theoretical docking studies validate that hybrid derivatives are more reactive compared to their non-hybrid counterparts.

## Introduction

Coumarins or 2*H*-chromen-2-ones constitute an important group of natural products and are known to possess varied activities *viz.* antibacterial, antiallergic, anti-inflammatory, antioxidant, anticoagulant. Among the various coumarins known, O-alkylated coumarins constitute an important group of naturally occurring compounds e.g., **1** (Figure 1) has been isolated from *Mutisia orbignyana*.<sup>[1]</sup>

The O-alkylated coumarins **2** (Figure 1), have shown antibacterial activity against *Bacillus subtilis* and *E. coli*.<sup>[2]</sup>

Also, the anticancer activity of coumarin derivatives has been well screened. 6-Brominated coumarin hydrazide-hydrazone derivatives (BCHHD) were found to be more effective against resistant Panc-1 cells than doxorubicin (DOX).<sup>[3]</sup> Whereas coumarin derivatives having 4,5-dihydropyrazole moiety exhibited as potential telomerase inhibition activity against human gastric cancer cell SGC-7901.<sup>[4]</sup>

Besides this, indole-2,3-diones when joined using alkyl bridges to different heterocyclic moieties have been known to act as SARS coronavirus 3CL protease inhibitors.<sup>[5]</sup> Bis-indoline derivatives having 2,6-disubstituted pyridine core or 1,10-disubstituted phenanthroline core showed high binding with G-quadruplexes as well as antitumor activity.<sup>[6]</sup>

Similarly, naturally occurring indole alkaloids, Spirotryprostatins A and B obtained from the fermentation broth of *Aspergillus fumigates*, inhibited the G2/M progression cell division in mammalian tsFT210 cells. While synthetically prepared dispiro[3*H*-indole-3,2'-pyrrolidine-3',3''-piperidine]-2(1*H*),4''-diones displayed effective antitumor activities against the cervical cancer cell line (HeLa) more than that of cisplatin.<sup>[7]</sup>

Fascinatingly, hybrid molecules are generally designed to target simultaneously two different sites with synergistic effects or acting as dual drugs.<sup>[8-10]</sup> Also, a single molecule carrying multiple pharmacophores acts as a hybrid multifunctional entity and is more useful as each pharmacophore displays diverse modes of action.

Therefore, considering the importance of coumarin and spiro-indoles, we thought of developing their hybrid molecules in anticipation of having better pharmacophoric features and biological profiles. Hence, in vogue of combining more numbers of bioactive moieties in a single molecular framework and continuing our interest in spiro-indoles,<sup>[11-16]</sup> we thought of synthesizing hybrids of spiro[indol-indazole/pyrazole-thiazolidine]-diones with coumarin.

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1.

## Biogenic Silver Nanoparticles: Evaluation of Their Biological and Catalytic Potential

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**Abstract** The biogenic tailoring of silver nanoparticles using plant extract is becoming an attractive approach in the current scenario. *Manilkara zapota* (MZ) is well known for its antibacterial, hepato-protective, anti-inflammatory, anti-tussive, anti-fungal, anti-tumour, and free radical scavenging potential. Its plants extract is a rich source of secondary metabolites. Nowadays, silver nanoparticles (AgNPs) have been advocated for a variety of biomedical applications. In present work, silver nanoparticles have

been synthesized using an aqueous extract of MZ, physicochemically characterized and finally evaluated for antimicrobial effects, catalytic reduction/degradation of organic dyes and cytotoxicity. The nanosized AgNPs (~ 84 nm) were found to possess prominent antibacterial potential against gram positive and gram negative pathogens (MIC 50 µg/ml) in comparison to native plant extract. Moreover, these particles were found to be non-toxic and efficient eradicators of environmental toxicants via rapid catalytic reduction of toxic chemicals and dyes. Altogether, these results suggest promising potential of these nanoparticles that can be used as multifunctional agents for future biomedical applications.

**Electronic supplementary material** The online version of this article (<https://doi.org/10.1007/s12088-020-00889-0>) contains supplementary material, which is available to authorized users.

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**Keywords** *Manilkara zapota* · Phytonanotechnology · Silver nanoparticles · Catalytic reduction · Antibacterial · Antibiofilm · Antioxidant activity

### Introduction

Recently, metal-based nanoparticles have been shown to possess promising potential in biomedical applications. The conversion of bulk material into nano-sized particles results in the exhibition of unique properties of matter owing to significantly increased surface area to volume ratio [1, 1 of mss]. Because of these unique properties, nanoparticles have been inculcated in the biosensor, nanocatalyst, antimicrobial, pharmaceutical, and environmental applications [2–6]. These properties have also made them active against various types of pathogens. Their mode of action has made it difficult for pathogens to develop resistance against them, which has resulted in the broadening of spectrum of antimicrobials. Further with the advent of nanobio-catalysts, which are produced by

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2.



## Ultrashort Peptide Self-Assembly: Front-Runners to Transport Drug and Gene Cargos

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The translational therapies to promote interaction between cell and signal come with stringent eligibility criteria. The chemically defined, hierarchically organized, and simpler yet blessed with robust intermolecular association, the peptides, are privileged to make the cut-off for sensing the cell-signal for biologics delivery and tissue engineering. The signature service and insoluble network formation of the peptide self-assemblies as hydrogels have drawn a spell of research activity among the scientists all around the globe in the past decades. The therapeutic peptide market players are anticipating promising growth opportunities due to the ample technological advancements in this field. The presence of the other organic moieties, enzyme substrates and well-established protecting groups like Fmoc and Boc etc., bring the best of both worlds. Since the large sequences of peptides severely limit the purification and their isolation, this article reviews the account of last 5 years' efforts on novel approaches for formulation and development of single molecule amino acids, ultra-short peptide self-assemblies (di- and tri- peptides only) and their derivatives as drug/gene carriers and tissue-engineering systems.

**Keywords:** amphiphilicity, peptide, self-assembly, drug delivery, tissue engineering

### INTRODUCTION

The global trend is growing toward precise medicines and diagnoses through multi-centered approaches of drug delivery technology. The poor systemic bioavailability, solubility, absorption, and stability of large sized materials pose major challenges in the area of drug delivery. Novel natural biomaterials which can qualify to be biodegradable, biocompatible, non-toxic, renewable, and readily available to deliver therapeutic agents to precise targeted sites in a controlled manner is one of the most sort after research-field. Presently, nanotechnology (Lombardo et al., 2020) has provided a solution by opening up of newer avenues in terms of developing advanced controlled drug delivery and release systems that have met with huge success (Webber et al., 2016; Webber and Langer, 2017; Patra et al., 2018). The customizable nanoparticles with the manipulation in size, surface characteristics and materials used enhance the efficacy of drug delivery in a paramount manner along with the advantage of safer treatment (Eskandari et al., 2017; Rizvi and Saleh, 2018). A relatively newer area to deliver drugs across biological barriers for improved site-specific absorption is also being explored (Kou et al., 2018) i.e., transporter-targeted nanoparticles. A specific application based self-assembled materials, injectable biomaterials, are also being investigated to improve the advancing practices in healthcare (Sahoo et al., 2018b).

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# Adsorption of Rhodamine 6G Dye on Binary System of Nanoarchitectonics Composite Magnetic Graphene Oxide Material

Drashya Gautam, Shyam Lal, and Sunita Hooda\*

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Magnetic Graphene Oxide nanocomposite prepared by the co-precipitation method based on concept of nanoarchitectonics. In co-precipitation method, Graphene oxide converts into Magnetic graphene oxide nanocomposite with uniform deposition of  $\text{Fe}_3\text{O}_4$  nano particles on the surface of Graphene oxide. Field Emission Scanning Electron Microscopy spectroscopy technique reveals the size ( $\sim 2.5$  nm) and uniformity of  $\text{Fe}_3\text{O}_4$  nano particles on Graphene oxide surface. The other properties characterized by Scanning electron microscopy, Raman spectroscopy, X-ray powder diffraction, X-ray photoelectron spectroscopy and vibrating-sample magnetometer. For Adsorption process, time, temperature, dose of adsorbent, initial concentration of dye solution and pH factors are optimize for Rhodamine 6G dye. Kinetic data expressed by Pseudo first order model and Pseudo second order model. Langmuir, Freundlich and Temkin isotherms used to evaluate the adsorption isotherm of Rhodamine 6G onto the surface of Magnetic graphene oxide nanocomposite and thermodynamic parameters tell us about the nature of reaction.

**Keywords:** Graphene Oxide, Adsorption, Rhodamine 6G, Kinetics, Thermodynamic Parameters, Isotherm.

## 1. INTRODUCTION

Environmental pollution is a serious threat because of its adverse effects on human health, plants, animals and exposed materials [1, 2]. A large number of industries introduced pollutant into the environment that has created water and land pollution. Dyeing industries are the main concern about the water pollution because dyes are used primarily in the production of consumer products, including paints, textiles, printing inks, paper, and plastics [3]. Since 3500 BC, Natural dyes are extracted from the vegetables, fruit and flowers used for colour fabric but in recent years natural dyes replaced through the chemical dyes [4, 5]. Now, ten thousand dyes are commercially available and 7 lakh tone dyes are produced annually [6]. Rhodamine 6G (R6G) dye, one of them and it is toxic, carcinogenic and explosive [7] in nature but fabric and plastic production use in huge amount for the coloring purpose [8]. 100% dyes are not used in coloring process for bind with material and approximately 10–50%

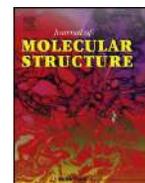
dyes are released into waste water [9]. Water discharge into rivers and ponds that is mix with ground water affects the human health as well as marine life. Many researchers work for the water purification by several ways like physical (adsorption, filtration, ion-exchange), chemical (oxidation, coagulation) and biological (microbial discoloration) methods [10]. But adsorption method is a more appropriate for the water purification because it is cost effective, environmental friendly, high efficient and easy to operate [11, 12]. Several inorganic and organic materials are used as adsorbent for R6G dye adsorption as shown in Table I. Graphene oxide already an adsorbent for other dyes because it is having a large surface area, excellent water dispersibility, huge oxides group and large composite diversity [18–20]. But according to the literature they remain in solution due to isolation problem [21]. According to physical and chemical property of  $\text{Fe}_3\text{O}_4$  and Graphene Oxide (GO),  $\text{Fe}_3\text{O}_4$  particle introduced on the surface of GO and its shows good separation property through external permanent magnet. In this work, Introduced Concept of

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Theoretical studies

## ABSTRACT

A novel curcumin based molecular probe **L1** was synthesized using 2-aminothiazole through covalent linkage. The structure of the probe **L1** was characterized by UV–Vis, Fluorescence, SEM, PXRD and other related spectroscopic techniques. The molecular probe **L1** was screened over assorted metal ion and selectivity was observed with  $\text{Cu}^{2+}$  and  $\text{Hg}^{2+}$  ion through the change of color in aqueous medium which was confirmed by UV or fluorescence signal and also supported by SEM and PXRD results. An unusual value of LOD with  $\text{Cu}^{2+}$  and  $\text{Hg}^{2+}$  ion was calculated to be 2.0  $\mu\text{M}$  and 1.2  $\mu\text{M}$ , respectively, which confirmed the selectivity of **L1**. The quenching in fluorescence spectrum was observed only with  $\text{Cu}^{2+}$  and  $\text{Hg}^{2+}$  ion, due to the loss of energy. The complex formation between **L1** and  $\text{Cu}^{2+}/\text{Hg}^{2+}$  ions were further studied by density functional theory using B3LYP/6–31(G) method to support the experimental results. Time-dependent-DFT studies were performed with LANL2DZ basis set to study the accurate complex mechanism which indicated a large HOMO-LUMO gap with  $\text{Hg}^{2+}$  ions.

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## 1. Introduction

Curcumin and its analogues are well-known for its biological activity in several diseases [1–3]. Curcumin based heterocyclic receptors are intensively studied and investigated because of the presence of N- or O- heteroatom in the center of above said molecular scaffold and along with its physical and chemical properties [4–6]. Over a class of natural products, curcumin is well-known and undoubtedly an important class of natural products along with diverse applications such as antimicrobial, antiviral and antioxidant activity [7–12]. After all, several applications of curcumin based molecular motif is being published, the quantification of guest and its specific recognition played an important role in the environment [13–17]. Various industrial discharges linearly increase the environmental detrimental effects due to release of toxic metal ion accessibility in environment [18–20]. Toxic and dreadful effects of metal ion provides the way to evaluate them at milli-

micro molar concentration [21,22]. As reported,  $\text{Cu}^{2+}$  ion is considered to be a fatal, dreadful and toxic heavy metal ion causing serious health issues, when present in excess or even beyond the tolerable limit [23,24].  $\text{Cu}^{2+}$  ion is well investigated to be a cause of liver damage and extensive dosage results in Indian and Non-Indian Childhood Cirrhosis [25–27]. As an outcome of excessive deposition of  $\text{Cu}^{2+}$  ion results in Wilson's disease [28–31]. Mercury ion, because of its intangible toxicity, is known to be a worldwide spread pollutant. It can accumulate by the living organism result in several chronic disorders viz. damaging of brain tissues [32]. Few of literature reports are available for sensing multiple-metal ion using a single molecule strategy [33–36]. Instantly, the detection of multiple metal ion, at the same time, through a single molecular probes are always in a need because it can attract two analytes together and will be able to distinguish among two with different supramolecular assembling [37]. Whilst, several fluorescent probes have been synthesized and evaluated towards the detection of  $\text{Cu}^{2+}$  and  $\text{Hg}^{2+}$  ion are reported [33,38–42].

In this work, we have designed, synthesized and characterized a simple, sensitive and selective molecular probe **L1** and evaluated the colorimetric as well as fluorometric response towards  $\text{Cu}^{2+}$  and  $\text{Hg}^{2+}$  ion in HEPES buffer (Scheme 1). As presented, **L1** have

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# Magnetic Graphene Oxide/Chitin Nanocomposites for Efficient Adsorption of Methylene Blue and Crystal Violet from Aqueous Solutions

Drashya Gautam and Sunita Hooda\*

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**ABSTRACT:** The present study is focused on the synthesis of prominent magnetic graphene oxide/chitin nanocomposites, which behaves as an adsorbent for organic dyes under visible light. The nanocomposites were characterized using physicochemical techniques such as X-ray diffraction, Fourier transform infrared spectroscopy, Raman spectroscopy, vibrating-sample magnetometer, scanning electron microscopy, and transmission electron microscopy. A band gap energy of 2.01 eV was evaluated from Tauc and Davis–Mott plots. Batch adsorption studies were performed on crystal violet and methylene blue dyes with varying parameters such as time, pH, concentration, dosage, and temperature, which resulted to excellent adsorption activities of 403.78 mg/g for crystal violet and 332.61 mg/g for methylene blue. The as-synthesized nanocomposite showed excellent recovery capability, retaining its adsorption efficiency even after nine cycles of regeneration. The adsorption equilibrium data fitted well into the pseudo-second-order model and Langmuir isotherm model, while the spontaneity and exothermic nature of the adsorption phenomenon are demonstrated by thermodynamic studies. A comparative adsorption study results to a selective adsorption of cationic dyes over anionic ones, which goes in conformity with the high negative value of zeta potential obtained at neutral pH.



## 1. INTRODUCTION

Despite investing enormous efforts over the years dedicated to the designing of various ranges of dye adsorbent moieties, an adequate result is still lacking. Meanwhile, in recent times, adsorption of dyes and different types of coloring agents attracted huge attention of researchers because of their unsustainable approach, which may affect the environment. Wastes from food, textile, calfskin, paper, rubber, plastic, cosmetic, and pharmaceutical industries contain a huge percentage of dyes or coloring agents, which are highly toxic.<sup>1–4</sup> Varieties of untreated coloring agents are discharged into water bodies that enter the food chain through ground water and menace human beings.<sup>5,6</sup> Substantially, most of the cationic dyes are difficult to degrade because of their aromatic structure and xenobiotic properties that are related to mutagenic and carcinogenic properties.<sup>7</sup>

Certainly, scientific research communities have developed numerous technologies such as biological processes, membrane processing, advanced oxidation processes, chemical and electrical techniques, coagulation, chemical precipitation, and adsorption for the removal of dyes from water effluents.<sup>8–13</sup> Adsorption in comparison to other techniques is a more efficient and non-destructive approach, owing to its low consumption of energy, simple design and operation, high efficiency, environmental friendliness, and cost-effective nature.<sup>14</sup> Assorted adsorbents have been developed for the

adsorption process like graphene oxide,<sup>15</sup> zeolites,<sup>16</sup> clay,<sup>11</sup> chitin,<sup>17</sup> agriculture waste,<sup>18</sup> and mGO/PVA CGs.<sup>19</sup> However, these materials face major difficulty in separation from the solution. To compensate these inadequacies, numerous attempts have been made to fabricate environmentally friendly materials that show selective adsorption of dyes and can easily be separated.

Consequently, a variety of new eco-friendly and cost-effective adsorbents have been designed that provide effortless strategy for the dye adsorption process. In this regard, chitin is one of the most abundant natural polymers, which can be sourced on the top scalp of Fungi, Fishes, Protozoa, Arthropods, and Nematodes.<sup>20,21</sup> It has long polymeric chains comprising huge numbers of hydroxyl and amine functional groups. It can be easily fabricated or modified for various applications due to the presence of various functional moieties on the chitin backbone. The physical and chemical properties of chitin can be modified or upgraded to increase the adsorption capacity by incorporating or doping the organic

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## Complexity Dynamics of Gumowski-Mira Map

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### Abstract

In the context of nonlinear dynamics, interesting dynamic behavior of Gumowski-Mira Map has been noted under various feasible circumstances. Evolutionary phenomena are discussed through the study of bifurcation analysis leading to period-doubling and chaos. The appearance of chaos in the method is identified by plotting Lyapunov characteristic exponents (LCE) and Topological Entropy within certain parameter range. Dynamic Lyapunov Indicator (DLI) has been procured for further identification of regular and chaotic motions of the Gumowski-Mira Map. The numerical results through the indicator DLI clearly demonstrate the behavior of our map. The correlation dimension has been calculated numerically for the dimension of the chaotic attractor.

**Keywords:** Bifurcation; Chaos indicators; Topological entropy; Correlation dimension

**MSC 2010 No.:** 37G15, 37D45

## CHAOS MEASURE IN AUTONOMOUS LPA MODEL

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June 20, 2020

**Abstract**

The discrete autonomous LPA model of dynamical systems investigated for regular and chaotic evolutions under different feasible conditions in the framework of nonlinear dynamics. Evolutionary phenomena discussed through bifurcation analysis leading to chaos. As part of chaos measure, numerical calculations performed to obtain Lyapunov characteristic exponents (LCE), Topological Entropy, correlation dimension etc. The results obtained by numerical calculations are demonstrated through various graphics. Chaotic evolutions discussed at critical set of parameters, which reveals very significant results. Correlation dimension, which provides dimensionality of an attractor (Strange/Chaotic), obtained numerically by the use of certain statistical method.

**Keywords:** Autonomous LPA model, Bifurcation, Lyapunov Characteristic Exponents, Topological Entropy, Correlation Dimension.

**1 Introduction**

Mathematical models expressing real phenomena are mostly nonlinear in nature. Their evolutionary dynamical behavior often shows properties like unpredictability and chaos attracting researchers obtaining interesting results [4; 5; 24]. The model on population dynamics and ecology are frequently used models and most considerable problems in dynamical systems. Investigators generally prefer to use difference equation while describing mathematical models in context of biological models. Numerous articles have appeared on such models after publication of articles by R. May [17; 18] with reasonable assumption of evolution processes of population in concerned. Such studies generate quite interesting results.

Many nonlinear systems exhibit chaos in some parameter space but in some cases within the system because of the interaction among different agents, complexity character also visible during evolution. Unpredictable motion is thus a mix phenomenon of chaos and complexity. Presence of complexity is responsible of coexistence of multiple attractors, bistability, intermittency, cascading effects, exhibit of hysteresis properties, and some more properties, [3; 6; 9; 26]. Chaotic evolution measured by positivity of Lyapunov exponents, (LCEs), whereas its negative value signifies the system is regular, [2; 8; 13]. Complexity measured by increase of topological entropy; more increase in topological entropy signifies the system is more complex, [7; 14; 15; 21; 22; 27].

Evolution in insects considered metamorphosis since big changes observed during their growth and development. Insect evolution passes through four clearly different stages: egg, larvae, pupae and adult. Class of such insects listed as butterflies, moths, beetles, flies, bees, wasps, and ants. Changing from one stage to another an insect has to molt its skin and each time it emerge larger and of different form until it reaches the adult stage, [10]. Some

# Supply Chain Model for Expiring Items Following Ramp-Type Demand With Stochastic Lead Time Under Crisp and Fuzzy Environment

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S.R. Singh, C.C.S. University, Meerut, India

## ABSTRACT

Supply chain models with deteriorating items, season pattern demand, expiration and uncertain lead time, though common in practice; had received little attention from researchers. In this article, the authors proposed a collaborative system with ramp type seasonal pattern demand rate for expiring items with supplier's random lead time under crisp and fuzzy environment considering the effect of inflation and time value of money. For the seasonal kind of items, demand rate follows the combination of increasing-steady-decreasing demand patterns. A supplier's lead time is a stochastic function of his managing cost; thus, the extra costs incurred on the retailer due to the uncertainty in lead time in terms of shortages costs and lost sales costs are owed by the supplier. Numerical examples are cited to illustrate the results and its significant features. Finally, to study the effect of change of parameters sensitivity analysis is presented and necessary observations are made.

## KEYWORDS

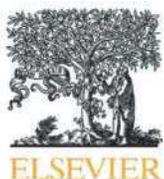
Expiring Items, Lead Time, Ramp-Type Demand, Supply Chain

## 1. INTRODUCTION

In the existing literature, most of the inventory/supply chain model was developed considering three types of demand rates: (i) constant demand rate; (ii) linearly positive/negative demand rate; and (iii) exponentially increasing/decreasing demand rate. However, demand for a commodity cannot increase/decrease continuously over time. It is observed that demand for seasonal products like fruits and the fashionable products over the entire time horizon is three folded. At the beginning of the season demand increases more rapidly, as the time passes, it becomes steady in the middle of the season and decreases more rapidly towards the end of the season and becomes asymptotic. The term "ramp type" is used to represent such kind of demand pattern. In the existing inventory and supply chain models, after the development of classical economic ordering quantity model by Wilson (1934) under the assumption of constant demand rate, researchers extensively studied several aspects of

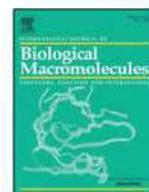
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## The anti-oxidant enzyme, Prdx6 might have *cis-acting* regulatory sequence(s)

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### ABSTRACT

Peroxiredoxin 6 (Prdx6) is a ubiquitously expressed 1-cysteine Peroxiredoxin found throughout all phyla. In mammals, under different physiological conditions, it has evolved from a peroxidase to a multifunctional enzyme. Among the mammalian Prdx6's, human and rat Prdx6's are the most extensively studied. Our study revealed that human and rat Prdx6's exhibit differences in their peroxidase activity. These two Prdx6's have only 8% difference in their primary sequence (with 19 amino acids) with no apparent modification at any of the key conserved residues. In the present communication, we have investigated the roles of thermodynamics, structure and internal flexibility of Prdx6 to account for the difference in their peroxidase activity. We discovered that these amino acid variations have led to structural alterations in human Prdx6 so that it shows enhanced intrinsic dynamics (or flexibility) than the rat protein. We could also identify the gain of intrinsic dynamics of the catalytic site in human Prdx6 due to relocation of an important active site residue (R132) to the loop region as the most plausible reason for high catalytic activity in the human protein as compared to rat variant. Since it is the thioredoxin fold that upholds the peroxidase function, certain structural alteration in the Prdx6 structure might help to regulate the efficiency of thioredoxin folds. Our results hint that Prdx6 might have a *cis-acting* regulatory sequence(s).

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### 1. Introduction

Peroxiredoxins (Prdx's) are ancestral thiol-dependent selenium- and heme-free peroxidases that are ubiquitously found in bacteria, archaea and eukarya [1,2]. Depending on the number of cysteine residues and their involvement in the peroxidatic catalytic mechanism, Prdx's are classified into six subfamilies referred to as typical 2-Cys Prx (Prdx1–4), atypical 2-Cys Prx (Prdx5), 1-Cys Prx (Prdx6), and 3 subfamilies present only in bacteria and other lower forms (AhpE, PrxQ, and Tpx) [2–4]. Peroxiredoxin 6 (Prdx6) is the sole mammalian member of the subfamily 1-Cys Prx, and shares similarity in most of its basic structural and functional properties with other subfamilies. For instance, Prdx6 like other Prdx's shows cytosolic peroxidase activity towards small peroxides such as H<sub>2</sub>O<sub>2</sub>, has a prominent thioredoxin fold, and involves the cysteine residue present at the base of alpha 2 helix as the active site [5,6]. Prdx6 also shows certain unique characteristics

that set it apart from other family members, including (i) usage of not two but only one cysteine residue for its peroxidase activity, (ii) glutathione as the physiological reductant in the catalytic cycle for regenerating the reduced active enzyme, in contrast to thioredoxin in other Prdx's [7]; (iii) existence as a stable protein within acidic compartments of cell; (iv) ability to bind and reduce phospholipid hydroperoxides at neutral pH; (v) hydrolyze the *sn*-2 fatty acyl bond of phospholipids at acidic pH, i.e., calcium independent phospholipase A2 activity (aiPLA2) [8]; and (vi) transfer a fatty acyl CoA into the *sn*-2 position of lysophosphatidylcholine (LPC), i.e., LPC acyl transferase (LPCAT) activity [9].

Prdx6 is one of the essential antioxidants employed by cell for efficient removal of reactive oxygen species or repair of oxidized metabolites, especially peroxidised phospholipid cell membrane [8]. However, peroxides are not always detrimental for cell, at nominal concentrations they also participate in various biological processes like cell signaling, phagocytosis, etc. [10–12]. Prdx6 via its flood-gate mechanistic peroxidase activity not just removes but helps in maintenance of physiological non-toxic concentration of peroxides as well. The catalytic efficiency of

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## Re-purposing of FDA-approved drugs to target MurB and MurE enzymes in *Mycobacterium tuberculosis*

Jyoti Rani, Yumnam Silla, Kasmika Boruah, Srinivasan Ramachandran & Urmi Bajpai

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# Screening of Antitubercular Compound Library Identifies Inhibitors of Mur Enzymes in *Mycobacterium tuberculosis*

SLAS Discovery  
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## Abstract

The rapid rise in the emergence of multidrug-resistant (MDR) and extensively drug-resistant (XDR) strains of *Mycobacterium tuberculosis* (Mtb) mandates the discovery of novel tuberculosis (TB) drugs. Mur enzymes, which are identified as essential proteins in Mtb and catalyze the cytoplasmic steps in the peptidoglycan biosynthetic pathway, are considered potential drug targets. However, none of the clinical drugs have yet been developed against these enzymes. Hence, the aim of this study was to identify novel inhibitors of Mur enzymes in *Mycobacterium tuberculosis*. We screened an antitubercular compound library of 684 compounds, using MurB and MurE enzymes of the Mtb Mur pathway as drug targets. For experimental validation, the top hits obtained on in silico screening were screened in vitro, using Mtb Mur enzyme-specific assays. In all, seven compounds were found to show greater than 50% inhibition, with the highest inhibition observed at 77%, and the IC<sub>50</sub> for these compounds was found to be in the range of 28–50 μM. Compound 5175112 showed the lowest IC<sub>50</sub> (28.69 ± 1.17 μM), and on the basis of (1) the binding affinity, (2) the stability of interaction noted on molecular dynamics simulation, and (3) an in vitro assay, MurE appeared to be its target enzyme. We believe that the overall strategy followed in this study and the results obtained are a good starting point for developing Mur enzyme-specific Mtb inhibitors.

## Keywords

*M. tuberculosis*, Mur enzymes, in silico screening, one-pot assay, molecular dynamics

## Introduction

The increase in the number of multidrug-resistant (MDR) and extensively drug-resistant (XDR) strains of *Mycobacterium tuberculosis* (Mtb) is a major cause of concern and highlights the need to discover new and more effective drugs. One-third of the world's population is infected with Mtb, and approximately 10.4 million people are affected with tuberculosis (TB).<sup>1</sup> Despite the availability of vaccines and effective drug therapy, Mtb continues to claim more lives than any other single infectious agent. Therefore, there is an urgent requirement to find and develop novel drug candidates against untapped target enzymes in the pathogen.

Currently available TB drugs inhibit enzymes of various metabolic pathways in Mtb.<sup>2</sup> Isoniazid and ethambutol inhibit the mycolic acid synthetic pathway and pyrazinamide inhibits the fatty acid synthetic pathway in Mtb. Expanding the information on enzymes that catalyze metabolic pathways that are essential for the survival of the bacterium but have not yet been explored in the drug discovery process has its advantages.<sup>3</sup> Peptidoglycan (PG) is the key

component of the cell wall, which is present outside the cytoplasmic membrane in almost all bacteria,<sup>4</sup> and so far, has not been targeted by the clinically approved TB drugs. PG's primary function is to preserve cell integrity by withstanding osmotic pressure; additionally, it also contributes

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## Journal Pre-proof

Characterization and genome analysis of B1 sub-cluster mycobacteriophage PDRPxv

Avni Sinha (Data curation)<ce:contributor-role>Writing- Original draft preparation) (Visualization) (Investigation) (Software) (Validation), Kandasamy Eniyan (Data curation)<ce:contributor-role>Writing - Original draft) (Visualization) (Investigation), Prasanth Manohar (Data curation)<ce:contributor-role>Writing - Original draft preparation) (Visualization) (Investigation), Nachimuthu Ramesh (Supervision), Urmi Bajpai (Conceptualization) (Methodology) (Software) (Supervision) (Software) (Validation)<ce:contributor-role>Writing- Reviewing and Editing)



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# Functional characterization of the endolysins derived from mycobacteriophage PDRPxv

Kandasamy Eniyan<sup>1</sup> · Avni Sinha<sup>1</sup> · Shazeb Ahmad<sup>1</sup> · Urmi Bajpai<sup>1</sup>

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## Abstract

Bacteriophage-derived endolysin enzymes play a critical role in disintegration of the host bacterial cell wall and hence have gained considerable attention as possible therapeutics for the treatment of drug-resistant infections. Endolysins can target both dividing and non-dividing cells and given the vital role peptidoglycan plays in bacterial survival, bacteria are less likely to modify it even if continuously exposed to lysins. Hence, probability of bacteria developing resistance to lysins appear bleak. Endolysins from mycobacteriophages offer great potential as alternative therapeutics for the drug-resistant TB. However, considering that a large number of mycobacteriophages have been discovered so far, the information on endolysins come from only a few mycobacteriophages. In this study, we report the structural and functional characterization of endolysins (LysinA and LysinB) encoded by mycobacteriophage PDRPxv which belongs to B1 sub cluster. On in silico analysis, we found LysinA to be a modular protein having peptidase domain at the N-terminal (104 aa), a central amidase domain (174 aa) and the peptidoglycan binding domain (62 aa) at the C-terminal. Additionally, 'H-X-H', which is a conserved motif and characteristic of peptidase domains, and the conserved residues His-His-Asp, which are characteristic of amidase domain were also observed. In LysinB enzyme, a single  $\alpha/\beta$  hydrolase domain having a catalytic triad (Ser-Asp-His) and G-X-S-X-G motif, which are characteristic of the serine esterase enzymes were predicted to be present. Both the enzymes were purified as recombinant proteins and their antimycobacterial activity against *M. smegmatis* was demonstrated through turbidimetric experiments and biochemical assay. Interesting observation in this study is the secretory nature of LysinA evident by its periplasmic expression in *E. coli*, which might explain the ability of PDRPxv to lyse the bacterial host in the absence of transmembrane Holin protein.

**Keywords** Endolysins · Esterase · Mycobacteriophage PDRPxv · Periplasmic expression

## Introduction

*Mycobacterium tuberculosis* is responsible for about 1.5 million deaths worldwide annually. It is also estimated that 2–3% of new cases and 12–17% of reinfection cases are multi-drug resistant (MDR) (World Health Organisation 2018). India has the highest rates of occurrence of tuberculosis and the second highest MDR TB burden in the world

(<https://www.tbfacts.org/tb-statistics-india/>). This highlights the need to devise new strategies to fight this deadly pathogen. Besides discovering and developing novel antibiotics, use of biologicals such as phages as well as their lytic enzymes (lysins), which are natural killers of bacteria are gaining attention. Phage-derived endolysins are promising because of their ability to act on cell walls even on exogenous application (Lai et al. 2015; Gerstmans et al. 2016; Love et al. 2018). Hence, their usage as potential alternative antibacterial agents and their synergistic effect with the existing antibiotics is being actively explored (Pastagia et al. 2013; Kim et al. 2018). Bacteriophages infecting Gram-positive bacteria require holin and endolysin (LysinA) to lyse the bacterial cell wall whereas phages that infect Gram-negative bacteria need to have additional proteins to disrupt the outer membrane (OM) as well (Gigante et al. 2017). This is achieved by proteins called Spanins, which mediate the

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## Journal Pre-proof

Polydopamine –aminoglycoside nanoconjugates: Synthesis, characterization, antimicrobial evaluation and cytocompatibility

Indu Singh, Ayushi Priyam, Diksha Jha, Gagan Dhawan, Hemant K. Gautam, P. Kumar



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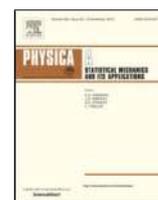
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## Identifying similar networks using structural hierarchy

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## ABSTRACT

Comparing structural similarities among complex networks is an important task in several scientific and social science applications. Existing techniques for quantifying network similarity range from network-centric methods that consider *global* network topology to node-centric methods that consider *local* node-level sub-structures.

In this paper, we address the research gap between computationally expensive network-centric approaches and myopic node-centric network comparison methods by introducing a novel approach to quantify network similarity based on hierarchical graph decomposition. The approach adequately captures both global and local topology and is motivated by the observation that networks from diverse domains such as physical, chemical, biological and social systems exhibit an inherent structural hierarchy that emerges from local dyadic and triadic interactions. The proposed algorithm, Network Similarity via graph Decomposition (NSD), extracts network signatures from hierarchical decomposition of networks and uses Canberra distance to quantify the similarity between signatures. We use two well-known graph decomposition methods to expose network hierarchy resulting in two variations of NSD. We find that our approach groups similar networks better than competing algorithms. Experimentation using 40 real-world networks, 15 massive networks, and 30 large synthetic networks establishes that the proposed methodology is effective, scalable, sensitive and applicable to wide variety of networks.

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## 1. Introduction

The premise that the behaviour and lives of social entities are impacted by their respective positions in the overall social structure has catalyzed research in the field of *Social Network Analysis*. Interestingly, the principles of social network analysis have also been applied successfully to networks of innate objects, giving a fillip to the multidisciplinary field of *Complex Networks*. Researchers in this field have not only generalized the theoretical underpinnings of social network analysis, but have also made significant advances that extend to diverse domains including social networks, telecommunication networks, power-grid networks, world wide web, biological networks, chemical networks, text graphs etc. [1–4].

Comparing complex systems by modelling them as networks<sup>1</sup> is an effective strategy for quantifying similarity (or dissimilarity) between their structures. Re-engineering a telecommunication network, planning a road network

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E-mail addresses: [rsaxena@db.du.ac.in](mailto:rsaxena@db.du.ac.in) (R. Saxena), [sharanjitkaur@andc.du.ac.in](mailto:sharanjitkaur@andc.du.ac.in) (S. Kaur), [vbnhatnagar@cs.du.ac.in](mailto:vbnhatnagar@cs.du.ac.in) (V. Bhatnagar).<sup>1</sup> We use terms network/graph, node/vertex, and edge/link interchangeably.

# The Impact Of Various Digitized Social Networking Media Through Text, Images And Videos On Language Usage

Sampurnananda Mishra, Chandra Kanta Samal, Navneet Yadav, Rama Kanta Choudhury

**Abstract:** The catalytic effect of social media on the diurnal course of people of the world has ushered in a new era of globalization. With the teeming multitudes of social media sites offering a universal user-friendly application in multifarious platforms has turned out to be a hunting ground for scholars and researchers from diverse fields. More so, their impact has been conspicuous among the language expounders and educators of today. The world has gone digital with the help of incredible tools of social media where people carry out global business and qualitative services. All the transactions, negotiations and deliberations happen through language conversation as a result of which language teaching and learning have become an indispensable part of social media. The language trainers introduce and execute various tools of social media which devises unique and novel ways of interaction transcending the local boundaries of the school. The notable social networking sites like Facebook, WhatsApp, Aadmodo Linkden, Me too etc equip educators to enhance their instructional skills. These widespread social networking sites offer a plentitude of openings for language educators to sharpen their digital, multi-literacy, linguistic and empirical skills. This paper probes into the theoretical bedrock of social networking in language learning and its effectiveness inside the classroom vis-a-vis the present pedagogy followed by different communities of the world. Further it intends to illuminate the fundamental issues and considerations while using social networking sites in a language classroom.

**Keywords:** Psycholinguistic approaches, Teeming multitudes, Multifarious platforms, Social networking, World wide web, IOT, Neural network.

## 1. INTRODUCTION

Information technology is playing a pivotal role in the use of technology in teaching and learning. Social networking has become the prime medium through which creation and transmission of information takes place. Social networking is in a state of flux and constant evolution. In order to facilitate learning and its quality, it has introduced and integrated new technologies like machine learning neural lays and neural network and IOT (Internert of things) to create a universal appeal among the world population irrespective of diversity of language and culture. There are a plethora of organized and unorganized tools which work together to enhance the quality of education. These tools facilitate, provide, engage and aid the process of teaching - learning. Social media can be compartmentalized into seven interconnected categories. (1) social networks (e.g., Facebook, LinkedIn); (2) bookmarking sites (e.g., Delicious, StumbleUpon); (3) social news (e.g., Digg, Reddit); (4) media sharing (e.g., Instagram, YouTube, Flickr); (5) microblogging (e.g., Twitter); and (6) blogging, particularly comments and forums (7) WhatsApps. These social networking sites became popular and are predominantly used in the recent years. The colossal sprawl of online exchange of information is a result of a incessant desire of the people to connect with their friends, siblings and acquaintances of late. We are a witness to the rising edifice of community building (global village), self expression and interaction. All these lure language educators to incorporate social media in them personal as well as professional life.

## 1.1 Approaches to Social Networks

Theories on latest technology refer to the development and exploration of tools aimed at examining the plausible advantages in the field they are to be used. The studies are often received with a pinch of salt as they lack proper theoretical and practical framework. But it is an undeniable fact that they initiate the educators to the L2 contexts. These studies also suggest that the new tools would bring about a revolution in the traditional mind set of the existing classrooms. As far as social networking is concerned these tools are employed for learning a language and other social purposes. Studies by Stevenson and Liu, Blyth, prove to be utilitarian for the educators of language and open up avenues for further research.

## 1.2 Psycholinguistic Approaches

Psycholinguistic approaches to language learning aims at the significance of social interaction and getting noticed. There is a progressive development in language where there is a one-to-one communication. It is during this that the linguistic interaction is measured in the input-exchange-output model. At the level of input, direct information of the language is provided. It may be, to some extent, beyond the comprehension of the learner. The learner may understand it but may not be able to comprehend the pattern of the language. The understandable inputs are most likely to be noticed and expressed by the learner. As the interaction continues the learner tries to arrive at a compromise in the understanding due to a number of factors. It may be due to the insufficient knowledge on the part the learner. A breakdown of communication can also lead to negotiations in meaning for the learner. The learner goes through a series of comprehension checks and strategies and finally arrives at the output. The entire process would aim at producing a language through various social networking tools connecting learners to raise the input, negotiate and enhance the output.

## 2. INTEGRATION OF SOCIAL NETWORKING TOOLS IN THE CLASSROOM CONTEXT

With the above observation, the incorporation of social media for the language learning class is imminent. Various

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## Analysis of $\text{Al}_{0.15}\text{Ga}_{0.85}\text{N}/\text{GaN}/\text{Al}_{0.15}\text{Ga}_{0.85}\text{N}$ DH-HEMT for RF and Microwave Frequency Applications

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**Abstract**—A charge control based analytical model is followed to study the impact of donor-layer doping and gate-length on microwave frequency performance of AlGa<sub>0.15</sub>N/GaN/AlGa<sub>0.15</sub>N double heterostructure high electron mobility transistor (DH-HEMT). DH-HEMT is observed to be more sensitive to gate-length and doping variation as compared to single heterostructure high electron mobility transistor (SH-HEMT). The effect of gate-length and doping on various performance parameters, i.e., transconductance, drain conductance, cut-off frequency and maximum oscillation frequency has been analysed. The results so obtained are compared with simulation results and are found to be in good agreement.

**Keywords:** doping, double heterostructure, gate-length, maximum oscillation frequency, output conductance, transit time

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### 1. INTRODUCTION

High breakdown field and high electron velocity are the major requisites for microwave frequency applications. In the recent years, AlGa<sub>0.15</sub>N/GaN HEMTs have emerged as the most suitable choice for use in future high voltage; high-power and high temperature microwave applications owing to their wide band-gap energy, high peak and saturation electron drift velocity and large breakdown voltage [1–3]. GaN devices are fulfilling these mentioned attributes which are the main requirements for today's wireless communication technology [4–6].

Till date, attention has remained on gallium nitride based SH-HEMTs. In order to achieve improved RF performance, gate-length is being continuously reduced. However, reducing the gate-length beyond a certain limit, degrades the device performance in terms of substandard pinch-off characteristics and indigent electron confinement. One feasible approach to achieve further improvement in the device performance in terms of higher sheet-carrier concentration, better electron confinement, higher transconductance and higher cut-off frequency is to use double-hetero-junction (DH) HEMT [7–12]. In a DH-HEMT, due

to the presence of two AlGa<sub>0.15</sub>N/GaN heterointerfaces (top heterointerface and bottom heterointerface), two 2DEGs are formed on the top and bottom sides of the GaN channel layer which result in higher carrier density, almost twice that of conventional SH-HEMT. Luo et al. [13] proposed the improved state of the art performance of GaN HEMTs in terms of breakdown voltage with reduced gate-length and Zhang et al. [14] proposed the high temperature performance of AlGa<sub>0.15</sub>N/GaN/InGa<sub>0.15</sub>N/GaN DH-HEMTs. Khan et al. [15] reported that reducing donor layer thickness or higher level of doping in the donor layer, the double quantum well HEMT (DH-HEMT) structure shows better high frequency (GHz) performance than single quantum well HEMT (SH-HEMT) structure.

Authors in their previous work proposed a charge control model to access the dc and microwave performance of GaN DH-HEMT as compared to SH-HEMT [16, 17]. DH-HEMT was observed to exhibit significantly much better performance in comparison to SH-HEMT in terms of higher sheet carrier concentration, higher drain-current and improved transconductance. It was also shown that due to higher (more negative) threshold voltage in DH-HEMT as com-



## Estimating Parameter of the Selected Uniform Population Under the Generalized Stein Loss Function

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### Abstract

This paper deals with the problem of estimating scale parameter of the selected uniform population when sample sizes are unequal. The loss has been measured by the generalized Stein loss (GSL) function. The uniformly minimum risk unbiased (UMRU) estimator is derived, and the natural estimators are also constructed under the GSL function. One of the natural estimators is proved to be the generalized Bayes estimator with respect to a noninformative prior. For  $k = 2$ , we obtained a sufficient condition for an inadmissibility result and demonstrate that the natural estimator and UMRU estimator are inadmissible. A simulation investigation is also carried out for the performance of the risk functions of various competing estimators. Finally, this article represents a conclusion of our study.

**Keywords:** Generalized Stein loss (GSL) function; Uniform distributions; Inadmissibility; UMRU estimator; Natural estimators; Selection rule; Entropy loss function

**MSC 2010 No.:** 62E10, 62M90, 60G70, 60E05, 62E10, 62E15

# Reliable Path Finding Technique for Mobile Robot

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**Abstract** - Path planning techniques of mobile robot (Automated Vehicle) is discussed in this paper. Though different researchers had proposed different path planning strategies, each plan has its own advantages and disadvantages. The goal of the research work is to develop an algorithm to find out an optimal path from source to destination along with the obstacles. The path planning algorithm not only minimizes the risk of collision but also reduces the planning time and creates a reliable path to reach the desired destination avoiding obstacles. The proposed algorithm is implemented to get the reliable path and compared with that of the existing algorithm to find the optimized path. The new approach is able to minimize the risk of collisions and travelling time with the help of different parameters and simulation software. It is proved through experimental results that the performance of the proposed algorithm is improves considerably and works efficiently when the shape and size of the image changes. It also turns closely at the corners of the obstacles and also reduces the number of steps without affecting the steps and corners. Time and space complexity analysis for this algorithm is experimentally tested and implemented.

**Keywords:** NFT, Path planning, Time Complexity, Space Complexity, DDA Optimization, Adj\*.

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## 1. INTRODUCTION

Path planning of a mobile robot is to determine a collision-free path from a starting point to a goal point optimizing a performance criterion such as distance, time or energy (distance being the most commonly adopted criterion). Based on the availability of information about environment, there are two categories of path planning algorithms, namely off-line and on-line. Path planning of robots in environments where complete information about static obstacles and trajectory of moving obstacles are known in advance is known as off-line or global path planning. When complete information about environment is not available in advance, mobile robot gets information through sensors and plans its path as it moves through the environment. This is known as on-line or local path planning. Essentially on-line path planning begins its initial path off-line but switches to on-line mode when it discovers new changes in obstacle scenario commonly used classic algorithms and

evolutionary approaches of path planning of mobile robots are discussed. Review shows that optimization algorithms are computationally more efficient and hence are increasingly used in tandem with classic approaches [5].

The path planning algorithm contains various methods with different optimization techniques for optimization. The path planning algorithm developed for various platforms depends on the condition whether it is static or dynamic. Mobile robots are expected to work in many places such as factories, offices and so on. Nowadays, autonomous mobile robots are used in the environment where human beings are working together with robots. Since there are many stationary/moving obstacles in these environments, autonomous mobile robots should plan their own path to avoid not only stationary obstacles but also moving ones such as human workers and other robots. There are various methods available for path planning in the field of robotics, but planning or finding a path which is collision free, shortest and optimal is recent



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## Android-based application for shading analysis and assessment of actual solar energy potential

Garg, Amit, Sharma, Prince, Verma, Vivek, Kaur, Tarunpreet

Amit Garg, Prince Sharma, Vivek Verma, Tarunpreet Kaur, "Android-based application for shading analysis and assessment of actual solar energy potential," Proc. SPIE 11496, New Concepts in Solar and Thermal Radiation Conversion III, 114960G (20 August 2020); doi: 10.1117/12.2570966

**SPIE.**

Event: SPIE Optical Engineering + Applications, 2020, Online Only

# Android based Application for Shading Analysis and Assessment of Actual Solar Energy Potential

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## ABSTRACT

The excessive utilisation of conventional energy sources has highlighted a complicated energy crisis due to high dependency and depletion of non-renewable resources; along with the inefficiency to cope up with the pressing requirements of the economy. Shifting to alternative, replenishable forms of energy and developing technology for the same, will fulfil the current energy needs and complement the national security. Solar energy can be productively exercised to meet the current energy requirements. Shading analysis is one of the most critical steps essential to any successful installation of a solar energy system. In photovoltaics, it is important to analyze shading caused by surrounding objects and/or vegetation. In special cases like analysis or design of BIPV systems, the exact analysis of shadow-voltaic systems (overhangs, vertical shading fins, awnings, etc.) is also very important. Detection of shading is important in photovoltaics installations and shall be eliminated or minimized as much as possible. Even small obstacles in any colonial set-up like chimneys, telephone poles, etc. shouldn't be neglected. To minimize the influence of photovoltaic array shading (if shading cannot be avoided), we hereby present first of its own kind smartphone application backed with Deep learning algorithms, designed to calculate effective solar insolation, perform shading analysis, check the efficacy of the site and list the related requirements for the installation of photovoltaic systems.

**Keywords:** Solar Insolation/irradiance, Image Segmentation, Shading Analysis, Android Application

## 1. INTRODUCTION

The excessive utilisation of conventional energy sources has highlighted a complicated energy crisis due to high dependency and depletion of non-renewable resources; along with the inefficiency to cope up with the pressing requirements of the economy. Shifting to alternative, replenishable forms of energy and developing technology for the same, will fulfil the current energy needs and promise a cleaner world. Solar energy can be productively exercised to meet the current energy requirements. To ensure maximum output of the installed photovoltaic system, all the parameters involved - solar irradiance, proper solar exposure, tilt angle and orientation of the panels should be taken care of. In the urban setting, buildings, trees and skyscrapers hinder the solar input received by the panels and thus, reduce their efficacy. A proper shading analysis should be carried out to determine whether a chosen solar site receives enough energy to fulfil current energy requirements and whether the PV systems give financial advantage to the users to get rid of the hefty bills they used to pay for using the conventional energy sources. Recent technological advancements, related costs to the installation of the solar standalone systems has been considerably reduced. Advanced technologies and novel software systems are successfully carrying out the solar insolation checks, handling the installation and minimising the initial cost of PV system installation. But, shading continues to be an inevitable problem. To thoroughly assess the financial

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## Some fun pedagogical techniques to teach optics to students of all ages

Garg, Amit, Sharma, Prince, Prajapat, Prahlad, Saxena, Anurag, Pandey, Pushkar, et al.

Amit Garg, Prince Sharma, Prahlad Prajapat, Anurag Saxena, Pushkar Pandey, Aman Tyagi, Yash Varshney, Aditi Sharma, "Some fun pedagogical techniques to teach optics to students of all ages," Proc. SPIE 11480, Optics Education and Outreach VI, 114800R (21 August 2020); doi: 10.1117/12.2570964

**SPIE.**

Event: SPIE Optical Engineering + Applications, 2020, Online Only

## Some Fun Pedagogical Techniques to Teach Optics to Students of All Ages

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### ABSTRACT

During the COVID-19 pandemic, educational institutions have adopted digital technologies as a medium to share the knowledge and to connect with the students. The idea of learning and teaching has taken a huge turn and needs to be customized and made innovative since the technological era has stepped in. Although the educational information and knowledge are easily available over the internet, the fruitful gains of meaningful knowledge assimilation can only be achieved under the supervision of teachers/mentors. Taking this ideology forward, this paper presents pedagogical techniques to virtually connect with students leading to successful inculcation of the theoretical knowledge with practical wisdom unto the student's mind. The pedagogical idea was exercised with school students studying from 6<sup>th</sup> to 12<sup>th</sup> grade. Initially, a teacher-student connect was established. Then, the students were pro-actively made to understand topics through self-apprehended practicals at home, keeping up with the age-old conventional environment so as to gradually ease them in the virtual technology. Practical and tasks that were carried out throughout the pedagogy played a major part in the development of mind with curiosity, questioning and constructivism, emphasizing on the weak points and strengthening their concepts in optics.

**Keywords:** Pedagogy, K-12, Virtual Learning, Optics Learning, COVID-19

### 1. INTRODUCTION

Blending and bending the ways of functioning in accordance with the circumstances, is the only route to evolution. With so many things to learn, numerous theories, and a shedload of concepts to go through every day, relying just on brain memory is a tedious and lackluster way of learning. Engaging students' minds, learning through your eyes and ears, firsthand experiencing the bookish concepts is a progressive approach towards studying. Where swatting enhances knowledge, insight enriches wisdom, then the practical knowledge is permanently impressed giving you a deep understanding of the notion. With the basics covered, the mind can relate and connect with the phenomena of the world with ease. Interestingly, it brings out the eager and keen nature in you to learn about an engrossing and compelling scientific occurrence in the surroundings. Acquiring knowledge through reading, from the teacher's monolog to visual perception, experiences in life or discussion in the classroom seamlessly pass the knowledge. We have tried to blend the lines of theoretical and practical knowledge, limiting the students to lab experiences and experimentation because students need to know how things work in real life in order to increase their creativity, improve their understanding, comprehension, and finally grasp the concept. This is exactly what learning through tasks ensures. Students actively participated in new intriguing activities before they were taught new topics. After gaining theoretical knowledge, topic wise tasks let them put

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## Optimisation of dielectric spacer layer thickness in Ag nanospheres/ITO/c-Si structure for plasmonic solar cells using FDTD simulation

Manju Rani, Jyoti Kashyap, Udaibir Singh & Avinashi Kapoor

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## Optimisation of dielectric spacer layer thickness in Ag nanospheres/ITO/c-Si structure for plasmonic solar cells using FDTD simulation

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### ABSTRACT

The thickness of dielectric spacer layer (DSL) plays an important role in performance of plasmonic solar cells. In this work, effect of thickness variation of ITO (indium tin oxide) DSL in silver (Ag) nanospheres/ITO/crystalline silicon(c-Si) structure on forward and backward scattering efficiencies has been investigated. Simulations were carried out using the open-source software MEEP via FDTD method for Ag nanospheres of sizes 50nm, 80nm and 100nm. Maximum forward scattering was observed with 80nm thickness of ITO DSL for all sizes of Ag nanospheres. Transmittance at ITO/c-Si interface and spatial distribution of electric field have been investigated for optimised thickness of ITO DSL. In visible to near infra-red region, maximum transmittance was exhibited by 100nm Ag nanosphere. Enhanced electric field has been observed with increasing size of nanosphere. This study provides us an optimum value of ITO DSL thickness in Ag nanospheres/ITO/c-Si structure to fabricate a photovoltaic device with upgraded efficiency.

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Solar cell; plasmonics; silver nanospheres; FDTD; forward scattering; backward scattering; transmittance; dielectric spacer layer (DSL); electric field

### Introduction

In plasmonic solar cells, the dielectric spacer layer between the metal nanoparticles and the substrate plays a significant role in enhancing the light trapping in the active layer [1]. The coupling of surface plasmons with the substrate is strongly sensitive to the nature of dielectric spacer layer and its thickness. The surface of c-Si (bandgap  $\approx 1.12$  eV at 300 K) allows the energy states in the forbidden band gap as it represents the disturbance of crystal lattice up to a great extent due to non-saturated bonds. This accounts for the recombination of charge carriers and reduces the photocurrent generation. Consequently, efficiency of the solar cell also reduces [2]. When nanoparticles are placed on the top of dielectric/semiconductor interface, their polarisability and hence surface plasmon resonance wavelength gets modified. Along with, the intensity of the electric field driving the surface plasmon resonance and angular spectrum of the scattered light also observe changes [3]. Nanoparticles scatter the incident photons in all possible directions. The photons scattered in forward direction support the absorption enhancement in the active layer of solar cell [4]. The size, shape, material of the nanoparticles and the local dielectric medium significantly affect the coupling and scattering efficiency [5–7]. With the increasing size of the nanoparticle, total scattering cross section increases. It has been observed that scattering component in forward direction also gets

enhanced with size [8]. Catchpole et al. have shown that as the spacing between nanoparticles and substrate increases, the effective scattering cross section also increases [9,10]. Recently, effect of metal nanoparticles embedded within the active layer of solar cells on their efficiency has been shown by M.A. Alkhalayfeh et al. [11,12].

When electromagnetic radiation is incident on the nanoparticles/dielectric/semiconductor structure, surface plasmon waves are excited which propagate along the interface of nanoparticles and the dielectric. For metal nanoparticles, the dielectric constant  $\epsilon_r$  is of complex nature and shows significant variation with frequency of the incident radiation. This dielectric function has been explained by Drude model as [13]

$$\epsilon_r = 1 - \frac{\omega_p^2}{\omega^2 - i\gamma(\omega)\omega} \quad (1)$$

Where  $\omega_p$  is the plasma frequency and  $\gamma$  is the damping frequency.

The surface plasmons have a short effective range up to an order of tens of nanometres. This suggests that the spacing between the nanoparticles and the semiconductor substrate plays a significant role. Previously, S. Pillai et al. and Xu Rui et al. have studied the effect of the thickness of the dielectric thickness on the various efficiency parameters [2,14,15]. In the present work, effect of ITO DSL in Ag nanospheres/ITO/c-Si structure on forward and backward scattering has



# Applicability of Field Plate in Double Channel GaN HEMT for Radio-Frequency and Power-Electronic Applications

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## Abstract

In the present communication, for the first time, applicability of Field Plate (FP) for Double Channel (DC) AlGaN/GaNHEMT is demonstrated. Impact of design space parameters such as field plate length ( $L_{FP}$ ) and Silicon Nitride thickness ( $t_{SiN}$ ) on breakdown voltage of DC HEMT is investigated and benchmarked with Single Channel (SC) HEMT. The investigation is carried out using ATLAS Technological Computer Aided Design (TCAD) Simulation tool, which is an efficient method in terms of time and cost to analyze and understand DC HEMT prior to the fabrication. The simulation shows new findings that breakdown voltage of DC device exhibited a large deviation with that of SC device. The breakdown voltage deviation is well corroborated through electric field, impact ionization and off-state leakage analysis. The electric field analysis has shown optimal value of  $L_{FP}$  and  $t_{SiN}$  for DC HEMT. It is also observed that  $t_{SiN}$  for DC-HEMT should be lower than that of SC-HEMT. In this paper, the off-state leakage, electron-depletion and impact ionization are the first-hand observations for benchmarking DC device with SC device. Furthermore, it is found that DC device yield higher cut-off frequency and device linearity than that of SC device, which is highly desirable for Radio-Frequency (RF) and linear amplifiers. Thus, the observation presented in this paper assist device technologist to enhance the performance of DC device further and foundries to optimize the FP for DC device.

**Keywords** AlGaN/GaN · HEMT · Breakdown voltage · Double channel · Field plate

## 1 Introduction

In radio frequency (RF) and power electronic application, GaN based HEMTs have received great attention in last few decades. It is due to wide band gap and higher electron velocity of GaN material [1–4]. Wide band gap and higher electron velocity makes GaN device suitable for high voltage and high frequency applications. Apart from material properties,

tremendous technological advancements in GaN-HEMTs have been done in the last decade. Some of them include incorporating Field Plate (FP), Double Channel, Back Barrier (BB), P-GaN gate, gate-length reduction and recessed gate. FP and BB techniques are used to enhance the breakdown voltage. The BB terminology is also used to mitigate the short channel effects (SCEs) [5–8]. Gate-length reduction is being used to enhance the cut-off frequency ( $f_T$ ) [9–12]. Among these techniques, Double Channel is an outstanding method for power electronic applications due to its higher drive current power gain capabilities and high cut-off frequency [3]. However, Double channel is one of the most recent techniques and several performance metrics have not been analyzed yet. Apart from this, studies which have not been done yet in DC device are: (i) physics behind breakdown mechanism, (ii) benchmarking of DC device linearity with SC device, (iii) comparison of cut-off frequency in DC device with that of SC device, (iv) double channel E-Mode HEMT and (v) linking of second channel with impact ionization and off-state leakage current. In precise, applicability/influence of FP and its design space parameters on breakdown voltage for DC device has not been demonstrated yet even though FP is a

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## Research Article

# Gamma Rays Induced Modification in Ultrahigh Molecular Weight Polyethylene (UHMWPE)

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Modifications taking place in ultrahigh molecular weight polyethylene (UHMWPE) films due to gamma ray radiation-induced and investigated in correlation with the applied doses. Films were irradiated in a vacuum at room temperature by a 1.25 MeV  $Co^{60}$  source with doses ranging from 0 to 300 kGy. The optical, chemical, structural, and surface morphological properties of the irradiated and unirradiated UHMWPE films were investigated by UV-Visible, FTIR, XRD, and SEM, respectively. The band gap  $E_g$  decreases with increasing radiation dose and coloration effects have been seen at higher doses. FTIR spectra show an oscillatory behavior in the transmittance intensities without affecting in their peak positions. Number of small absorption peaks can be seen clearly which may be due to the cross-linking of the polymeric chain. No significant change in crystalline peak has been found in the X-ray diffraction pattern indicating the structural stability of the polymer. The morphology of the smooth topography of the polymer samples to change rougher one polymeric sample shows the formation of microvoids on the surface of the polymeric materials with the increase of the doses from 0 to 300 kGy.

## 1. Introduction

UHMWPE (ultrahigh molecular weight polyethylene) is a polymer commonly known as high modulus polyethylene.

macromolecules of polyethylene form an orthorhombic unit cell which is characterized by the following constraints;  $a = 7.40 \text{ \AA}$ ,  $b = 4.93 \text{ \AA}$ , and  $c = 2.534 \text{ \AA}$ . The polymeric chains in polyethylene crystals are arranged parallel to one another.

## Trace Detection of Nerve Agent Simulant in the Fuel Vapour Environment using Metal Oxide/Surface Acoustic Wave E-Nose

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### ABSTRACT

Nerve agents are often used at the military warfront, where diesel is a very common interferant. In the present work, a group of surface acoustic wave (SAW) sensors, called E-Nose with dissimilar sensing layers is developed for the recognition of the mixture of diesel and dimethyl methylphosphonate (DMMP) vapors. The exposure of DMMP and diesel vapors is kept at ppb and ppm levels respectively. Varied response patterns of DMMP and diesel vapors were obtained by SAW E-nose. Principal component analysis (PCA) has been used to extract features from the response curves of SAW sensors. Artificial Neural Network pattern recognition has been implemented to identify the precise detection of DMMP vapors in the binary mixture of DMMP and diesel. The effect of pre-processing (using PCA) the raw data before feeding it to artificial neural network is also studied.

**Keywords:** E-nose; Metal oxide; Sensor

### 1. INTRODUCTION

Today chemical attack is one of the biggest threats for us. Nerve agents (Sarin, Soman) are the deadliest and widely used class of chemical warfare agents, employed several times during a war<sup>1</sup>. Sensors employed for their detection must take care of the interferants also. Since the accuracy level required in the detection of warfare agents is very high, special technologies are required to minimize the possibility of false alarms. Nerve agents are mostly used at warfronts, where diesel is the major source of interferant. Diesel is used in tanks, trucks, generators, starting compressors for jet engines<sup>2</sup>. Therefore, sensor systems

deposition, lack of long-term stability, metal oxide sensing layers have also been tried<sup>3-10</sup>.

The use of a single sensor is generally not sufficient to detect a particular vapour in a mixture. Hence an E-nose (an array of sensors) is essentially required. The sensing data of E-nose along with suitable pattern recognition technique (PCA, ANN etc.) allows correct recognition of target vapours<sup>11</sup>. In literature, SAW E-nose has been employed for the recognition of various target vapours<sup>12-15</sup>. Joo<sup>11</sup>, *et al.* fabricated an array of polymer-coated SAW sensors for the recognition of simulant vapours but individual vapours were tested and the neural

# Superficial Synthesis of CdS Quantum Dots for an Efficient Perovskite-Sensitized Solar Cell

Rakesh K. Sonker,\* Rajkamal Shastri, and Rahul Johari

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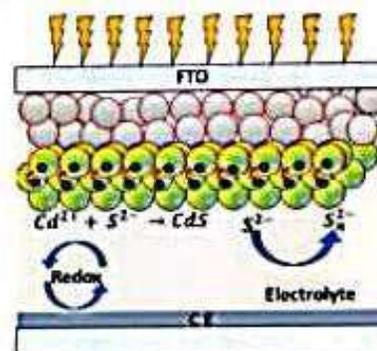
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**ABSTRACT:** In this paper, a thorough investigation of cadmium sulfide nanoparticle characteristics has been studied as a result of the wide attention and enormous application in a solar cell. Perovskite-sensitized solar cells (PSSCs) are a favorably effectual and sanitary hybrid, organic–inorganic solar cell device. The simple way uses synthesized cost-effective CdS quantum dots (QDs) via the sol–gel approach and also investigates their structural, electronic, and vibrational properties of CdS nanoparticles with the density functional theory method in B3LYP. Moreover, we use high-resolution transmission electron microscopy (HRTEM) techniques to confirm our calculations and acquire good agreement to the structural analysis of CdS QD formation. The maximum grain diameter is obtained from a HRTEM image, at  $\sim 4$  nm. The particle size analyzer that obtained  $\sim 4$  nm of CdS QD nanoparticles was determine via a dynamic light scattering study. The results demonstrated that the fabricated CdS QD-based dye-sensitized solar cell and PSSC represented a maximum power conversion efficiency ( $\eta$ ) of 0.5 and 1.8% at 1 sun condition. This efficiency was improved by approximately 72%, associated with that of the reference cell.



## 1. INTRODUCTION

As a result of the energy crisis, human health, and environmental pollution, renewable solar energy is considered the most favorable substitute for traditional fossil fuels,

durability gap of a wearable solar cell. The excellent photoactive materials must be able to produce mechanical bending, stretching stress, and high-power alteration efficiency. A world record efficiency has been attained by current

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## Materials Science &amp; Engineering B

journal homepage: [www.elsevier.com/locate/mseb](http://www.elsevier.com/locate/mseb)Green synthesis of TiO<sub>2</sub> nanosheet by chemical method for the removal of Rhodamin B from industrial wasteRakesh K. Sonker<sup>a,b,\*</sup>, Gaurav Hitkari<sup>c</sup>, S.R. Sabhajeet<sup>d</sup>, S. Sikarwar<sup>d</sup>, Rahul<sup>e</sup>, Sandhya Singh<sup>e</sup><sup>a</sup> Department of Physics and Astrophysics, University of Delhi, Delhi 110007, India<sup>b</sup> Department of Physics, Acharya Narendra Dev College, University of Delhi, Delhi 110019, India<sup>c</sup> Department of Applied Chemistry, Babasaheb Bhimrao Ambedkar University, Lucknow, U.P. 226025, India<sup>d</sup> Department of Physics, Babasaheb Bhimrao Ambedkar University, Lucknow, U.P. 226025, India<sup>e</sup> Department of Applied Sciences and Humanities, Jamia Millia Islamia, New Delhi 110025, India

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## ABSTRACT

In this research article, the photocatalytic decolourization of rhodamin B by the newly green synthesized TiO<sub>2</sub> nanostructure material has been investigated to consider as effective catalyst for the decontamination of wastewater. The crystal structure and particle size measurement of green synthesized TiO<sub>2</sub> was appraised by X ray diffraction (XRD). The morphological, structure and particle size distribution was study by SEM and TEM. The optical properties of these materials were investigated by using UV-visible and photoluminescence spectra. The photocatalytic behaviour of synthesized TiO<sub>2</sub> nanostructure was study the photo degradation sample over the rhodamin B dye illustrate water pollutant under UV light irradiation. Photoluminescence spectra confirmed the enhancement of photogenerated e<sup>-</sup> - h<sup>+</sup> pair recombination of electron in valance and conduction band. The simultaneous photocatalytic efficiency and kinetic study was considered in the presence of UV light and measured as 58% and it follow first order kinetics with rate constant 0.0196 min<sup>-1</sup>.

## 1. Introduction

The immense development of industries in worldwide has enormously enhanced the production, propagation and accumulation of waste byproducts [1]. It can reduce the water impurities defined as benzene, numerous dyes and compound combinations of water pollutant in industrial and domestic waste system [2]. According to the

diseases like irritation of skin, eyes and respiratory system and also toxic to the reproductive and nervous systems [7]. Therefore, it is obligatory to degrade RhB pollutants from wastewater before releasing into waterbodies and environment to care for both environment and human beings.

Biological process is generally relevant in dealing of factual wastewater purification [8,9]. However, traditional biological techniques

## Review Article

## An overview of factors affecting dengue transmission in Asian region and its predictive models

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## Abstract

Among various mosquito-borne diseases, dengue is one of the most prevalent and quickly spreading diseases primarily transmitted by *Aedes aegypti* and *Aedes albopictus*. This review discusses the dengue epidemics in Asian countries with a focus on India and recognizes various climatic, socio-economic and demographic factors and their complex interaction, involved in dengue expansion. The impact of climatic factors, such as temperature, moisture and precipitation has been elucidated on the mosquito breeding and disease outbreaks; demonstrating a linear correlation of ambient temperature and humidity with dengue transmission, in contrast with the uncertain association of rainfall. Multifarious empirical models have been developed for estimating the climatic effects on dengue and are used as a baseline to assess the impact on future infections. However, the spatio-temporal distribution of dengue cases can only be predicted best using dynamic modelling based on a blend of long-term climatic data, vector ecology, and multiple etiological parameters. The human economic profile, migration and the behavioural pattern towards the epidemic have also impacted dengue transmission. Moreover, the impoverished countries are facing higher risks due to the lack of resources for proper medical care and mosquito management measures. Thus, advanced and confirmatory vector control interventions, increased awareness of *Aedes*-borne diseases, and adequate decision and policies may play a key role to prepare and combat the disease incidences across varied geographic range. Moreover, the increasing support for the research and development along with regular monitoring, can help recognize the current and predict the future distributions of *Aedes* and DENV better.

**Keywords:** *Aedes*, Climate change, Dengue, Predicting models, Socio-economic factors

## INTRODUCTION

Dengue, an *Aedes*-borne disease, is one of the most prevalent mosquito-borne diseases nowadays. Since the past few decades, the dengue incidence throughout the world has increased at a large scale despite fruitful intercession efforts, enhanced sanitation practices and developments in medical care. Ironically, apart from frequent outbreaks in the dengue-endemic areas, the emergence of disease in unexposed regions has resulted in an increased count of fatalities. As per reports of the World Health Organization (WHO, 2019a), South-East Asia and WHO regions of the Americas are considered major hotspots recording substantial dengue cases. The Organization has listed 129 countries; primarily Asian and American countries; which are endemic to the risk of dengue and distress

nearly 3.97 billion people (Brady et al., 2012; Bhatt et al., 2013; WHO, 2020a). With roughly 50% world's population at risk of dengue and 100-400 million annual infections; the disease is on the rampant increase. The rise in dengue incidences can be attributed to multifaceted reasons, but the prospective driving force behind spreading disease worldwide could be rapid globalization, mass mobility, unplanned urbanization, and environmental changes (Bhatt et al., 2013). The climatic changes in multiple regions of the world, facilitating mosquito breeding and increased global travel patterns transmitting novel dengue virus serotypes to new topographical areas; have been contributing majority in its global expansion. All these possible grounds have been supported by the lack of effective medication and non-availability of a successful vac-

COMPARATIVE LARVICIDAL EFFICACY  
OF  $\alpha$ -CYPERMETHRIN ALONE AND  
 $\alpha$ -CYPERMETHRIN/*CITRUS SINENSIS*  
PEEL EXTRACT BINARY MIXTURES  
AGAINST *Aedes Aegypti* L.

DEVINA AGGARWAL, ROOPA RANI SAMAL, SARITA KUMAR\*

*Aedes aegypti* is a widely spread disease vector of great concern throughout the world. With continuous rise in cases of Zika, dengue and Chikungunya worldwide, control of *Ae. aegypti* has become a prime concern. The present study investigated the larvicidal effects of individual and various combinations of *Citrus sinensis* hexane peel extract and a synthetic pyrethroid, alpha-cypermethrin against *Ae. aegypti*. Larvicidal bioassays were performed using WHO protocol with minor modifications. The investigated compounds were found effective individually as well in binary mixtures indicating the efficient synergism. Hexane extract of *Citrus sinensis* peels assayed against *Aedes aegypti* larvae resulted in  $LC_{50}$  of 46.53 ppm after exposure for 24 h, while alpha-cypermethrin treatment resulted in  $LC_{50}$  value of 0.0063 ppm. The binary mixtures of both the compounds in 1:1, 1:5 and 1:10 ratios also showed significant larvicidal potential. The 1:1 mixture was found most effective with co-toxicity coefficient and synergistic factor as 23.456 and 3.865, respectively, for the  $LC_{50}$  at 24h. The binary mixtures showed synergism as well as additive effects in all the ratios tested except 1:5 ratio for  $LC_{50}$  at 48h which showed inconsequential antagonistic effect. Results showed decreased synergistic effects with increase in the citrus extract proportion in the binary mixtures. We suggest that phytoextract/cypermethrin mixtures can be more operative than insecticide/phytoextract alone, and can be used as a good ecofriendly approach in vector control programs. Such mixtures could reduce the costs, reduce insecticide dose, and regulate insecticide resistance as part of integrated vector management.

*Keywords:* *Citrus sinensis*, *Aedes aegypti*, synergism, additive, antagonism, binary mixtures.

### INTRODUCTION

Mosquito-borne diseases are the major cause of concern worldwide, especially in tropical countries. Different mosquito vectors, *Aedes*, *Culex* and *Anopheles* transmit a range of disease pathogens causing dengue, Chikungunya, malaria, filariasis and Zika, etc. Though, different species of mosquitoes are playing havoc at global level, yet since last decade, outbreak of *Aedes*-borne diseases has taken a

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## Reduced physiological and reproductive fitness induced by *Nerium oleander* leaf extracts in the cotton bollworm, *Helicoverpa armigera* (Lepidoptera: Noctuidae)

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## ABSTRACT

*Helicoverpa armigera* is one of the most devastating, cosmopolitan, polyphagous and multivoltine pests of agricultural crops. The growing side-effects of synthetic insecticides used to control agricultural pests, have amplified demand for the relatively safe and biodegradable compounds which offer benefits over synthetic chemical insecticides. Hence, the current study investigates the effects of *Nerium oleander* methanol leaf extracts on the physiological and reproductive fitness of *H. armigera*. Addition of the range of extract concentration; 0.5%–10.0% in the larval diet induced an appreciable and dose-dependent effect on the developmental parameters of *H. armigera*. The extract, though resulted in moderate larval and pupal mortality, caused significant growth regulatory effects. A prolonged larval duration, formation of larval-pupal intermediates and significant reduction in the average larval weight gain by 26.5%–63.4% and pupal weight by 23.9%–63.4% was recorded. The 74.0%–54.9% reduction in the oviposition duration in the emerged adults, and diminished fecundity and egg hatch in the corresponding range of 0.78–0.62 and 0.89–0.62 demonstrated negative impact of the extract on the adult reproductive fitness. The adverse impact of *N. oleander* methanol leaf extracts on the growth and development of *H. armigera* leading to the reproductive disadvantage in adults can be beneficial in the field management; though its use can only be ascertained after identification of bioactive constituents and elucidating their mode of action.

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## 1. Introduction

*Helicoverpa armigera*, Family Noctuidae, is one of the most distressing, cosmopolitan, polyphagous and multivoltine pests of agricultural crops [1]. Despite various intercessions, approximately 17.5% to 73.5% yield losses in chickpea have been reported in India due to the attack of *H. armigera* [2]. Like wise, in safflower plants, the economic injury level of *H. armigera* has been recorded as just 0.53 larvae/plant [3]. Several eco-safe control interventions; such as cultural control measures [4], biological control methods [5] and use of transgenic crops [6], etc, have been attempted as a part of Integrated Pest Management Program to keep this pest below the economic threshold level. However, the management of *H. armigera* is still based primarily on the use of synthetic insecticides.

Continued and unplanned application of chemical-based interventions in the fields has induced resistance in *H. armigera* to several insecticides, such as carbamates, organochlorines organophosphates, pyrethroids and even microbial insecticides, leading to increased losses

of economically important crops and augmented adverse effects on the environment [7–9]. Consequent to adaptability of *H. armigera*, utilization of higher amounts and concentration of toxicants has risen toxic residues in food and drinking water, and created ecological imbalance due to elimination of beneficial organisms. The ever-increasing side-effects of synthetic insecticides has amplified demand for the relatively safe and biodegradable compounds which are less disruptive to the environment [10]. Plant-based pesticides are reported to be much safer compared to the chemical insecticides as they do not impact non-target organisms, plant growth and seed viability adversely. Being broad-spectrum, relatively specific in their mode of action, biodegradable, easy to process and use, and imposing low residues in soil fauna, flora, water and food crops; they pose much less risk to the animals and the environment [11].

*Nerium oleander*, family Apocynaceae, commonly named “Raner” is an evergreen ornamental plant, often used outdoors along roadsides and, in landscapes and parks. It is about four meters high, primarily shrub, with 10–20 cm long leaves. All parts of the plant have been documented in folklore as therapeutic in various ailments; including skin allergies, eczema, ringworm infections, cancer, malaria, epileptic fits and even gastrointestinal disturbances [12]. Use of leaves and bark as heart tonic, antibacterial and diuretic has also been recommended

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## Influence of lufenuron on the nutrient content and detoxification enzyme expression in *Aedes aegypti* L. (Diptera: Culicidae)

Kungreiliu Panmei<sup>1</sup> · Roopa Rani Samal<sup>1</sup> · P. Lanbilu<sup>1</sup> · Sarita Kumar<sup>1</sup> Received: 18 August 2020 / Accepted: 10 February 2021  
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### Abstract

*Aedes aegypti* is of utmost public health concern transmitting various diseases of human health concern. Employment of chemical-based control interventions has induced immunity in mosquitoes, harmed environment, and adversely affected human health and non-targets diverting the research focus on alternate measures. Current study investigates the efficacy of an Insect Growth Regulator, lufenuron, against early fourth instars of *Ae. aegypti*. The larvae exposed to lufenuron for 24 h were assessed for the effects on the development and adult emergence. The impact of sub-lethal and median-lethal dose of lufenuron was determined on the nutrients and detoxification enzymes of *Ae. aegypti*. The larvae exposed to lufenuron showed reduced adult emergence exhibiting the respective  $IE_{50}$  and  $IE_{90}$  as 0.13  $\mu\text{g/L}$  and 0.96  $\mu\text{g/L}$ . Larval treatment with  $IE_{50}$  and  $IE_{90}$  lufenuron reduced the carbohydrate and lipid content in *Ae. aegypti*. However, the protein levels in the larvae decreased only on exposure to  $IE_{50}$  lufenuron while increased with  $IE_{90}$  lufenuron. Besides,  $IE_{50}$  and  $IE_{90}$  lufenuron treatment elevated  $\alpha$ -esterases (1.05-fold; 1.15-fold);  $\beta$ -esterases (1.29-fold; 1.62-fold), and Glutathione-S-transferases (1.19-fold; 3.1-fold) expression in the *Ae. aegypti* larvae. The % acetylcholinesterase inhibition also reduced by 3.75-fold and 2.07-fold, correspondingly, while the cytochrome P450 monooxygenase expression rose (1.15-fold) only with  $IE_{90}$  dosage of lufenuron. It is suggested that lufenuron stress probably amplified the catabolism of nutrients and expression of metabolic detoxifying enzymes in *Ae. aegypti* larvae in order to meet higher energy requirements and counteract the adverse effects of lufenuron. This is the first ever report unravelling the effect of lufenuron on the biochemical parameters of *Ae. aegypti* larvae.

**Keywords** *Aedes aegypti* · Detoxifying enzymes · Insect growth regulators · Lufenuron · Metabolism · Nutrients

### Introduction

The dengue fever mosquito, *Aedes aegypti* prevalent worldwide, particularly in the tropical and subtropical regions, transmits several viral diseases; such as dengue, dengue haemorrhagic fever, chikungunya, yellow fever and Zika, and thus, poses major health concern among human beings

(Benelli and Mehlhorn 2016). Among these diseases, dengue is the most prevalent ailment with cases reported in more than 100 countries. The South East Asia, United States of America and the Western Pacific countries are the most seriously impacted regions; Asia accounting for approximately 70% of the global disease burden (World Health Organisation 2020). In India, the Directorate of National Vector Borne Disease Control Programme (NVBDCP) has recorded a total of 1,01,192 dengue cases and 172 deaths during the year 2018; while 1,57,315 cases and 166 fatalities in the year 2019 (NVBDCP 2020). Ironically, these numbers do not reflect the actual number of dengue cases due to the occurrence of numerous asymptomatic, mild and even self-managed cases (Waggoner et al. 2016).

For a long time, various attempts have been made to minimize mosquito population density, at both larval and adult stage, yet, larvicidal measures are regarded as the ideal methods due to their localized mobility and confinement to small aquatic habitats (Killen et al. 2002). Despite

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## Cuticular thickening associated with insecticide resistance in dengue vector, *Aedes aegypti* L.

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### Abstract

*Aedes aegypti* is a globally spread disease vector of supreme concern, primarily controlled by chemical insecticides. Current study investigates the comparative rate of acetamiprid and deltamethrin resistance development in *Ae. aegypti* larvae and possible correlation between resistance and cuticular thickening. The larvae were selected with  $LC_{50}$  level of the respective insecticide for 10 successive generations and the level of resistance induced was estimated. The larvae of parent (PS), acetamiprid-selected (ACSF-10) and deltamethrin-selected (DLSF-10) strains were sectioned through first abdominal segment to elucidate the variation in cuticular thickness. The PS larvae of *Ae. aegypti* were 229.26-fold higher susceptible to deltamethrin as compared to acetamiprid, exhibiting corresponding  $LC_{50}$  values of 0.00082 mg/L and 0.18799 mg/L. Larval selections induced 9.91-fold and 19.74-fold resistance to deltamethrin and acetamiprid, respectively; indicating multifactorial and heterozygous pattern. Cuticular analysis of the larval sections demonstrated a significantly thicker cuticle in selected strains, the mean thickness in PS, ACSF-10 and DLSF-10 was  $2.891 \pm 0.243$ ,  $4.288 \pm 0.508$  and  $5.695 \pm 0.437$   $\mu$ m, respectively revealing 1.48-fold and 1.97-fold thicker cuticle in the ACSF-10 and DLSF-10 strains, respectively in comparison to PS strain. The increased cuticular thickness possibly inhibited the insecticide penetration in selected larvae resulting in the resistance development. This is the first such report which demonstrates the association between acetamiprid/deltamethrin resistance in *Ae. aegypti* larvae with the cuticular thickness.

**Key-words** Acetamiprid · *Aedes aegypti* · Cuticular thickness · Deltamethrin · Resistance

### Introduction

*Aedes aegypti* L. is an extensively spread disease vector of utmost concern throughout the world. It is not only a biting nuisance but is also a dreadful vector transmitting viruses causing yellow fever, dengue fever, Chikungunya and Zika. Since last few decades, *Aedes*-borne diseases are on the rise causing varying degree of health hazards in different parts of the world; especially in tropical and sub-tropical regions of the world, where dengue has emerged as a principal health concern (Bhatt et al. 2013). The number of cases has risen alarm-

ingly despite under-reporting and misrecognition of genuine incidences. WHO (World Health Organization) has reported occurrence of almost 390 million global dengue infections/year out of which 96 million infections are projected with variable clinical manifestations (Bhatt et al. 2013). Another study approximated that 3900 million people residing in 128 countries face peril of dengue infection (Brady et al. 2012). In India itself, a total of 136,422 cases of dengue with 132 fatalities were reported till 30th November, 2019 with highest cases (15,232) reported from the Karnataka State (NVBDCP 2020a). Moreover, a total of 65,217 suspected cases of Chikungunya, with 9477 confirmed cases, reported in India in 2019 have raised serious concerns (NVBDCP 2020b).

Since, till date, no specific treatment and vaccines for most of the *Aedes*-borne diseases have been successfully formulated; vector management and personal protection by adopting different interventions; such as prevention of larval breeding, adequate drainage of stagnant water, proper disposal of potential breeding sites, use of mosquito nets, application of various

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## Research Article

## Physiological and reproductive fitness cost in *Aedes aegypti* on exposure to toxic xenobiotics in New Delhi, India

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## Abstract

*Aedes aegypti*, is a well-known vector of dengue, Chikungunya and Zika at the global level. Primary use of pyrethroids as control interventions has caused the development of a considerable level of immunity in *Ae. aegypti*. The current study assessed the efficacy of a pyrethroid,  $\alpha$ -cypermethrin on the survival and various life parameters of *Ae. aegypti*. The larvicidal studies with  $\alpha$ -cypermethrin revealed the respective LC<sub>50</sub> and LC<sub>90</sub> values as 0.26526 mg/L and 0.60211 mg/L. The impact of LC<sub>50</sub> level was assessed on the growth and life attributes; such as gonotrophic cycle, egg development, hatchability, development and survival of immature stages, adult longevity, reproduction rate and generation time; of fourth instar of susceptible (S) and  $\alpha$ -cypermethrin-exposed population (E). The exposed population showed diminished fitness as compared to the susceptible population. The individual female fecundity in susceptible population was recorded as 79.6 with 51.6% hatchability rate as compared to the 28 eggs/female and 25% hatchability in the exposed population. The mean egg hatch time in S strain increased by 2-fold in E strain. The proportion of immature survival observed in S strain was 0.83 for fourth instar to pupa (P/I), 0.94 for pupa to adult (A/P) and an overall 0.83 for fourth larva to adult (A/I), which respectively reduced to 0.32, 0.86 and 0.27 in E strain of *Ae. aegypti*. Likewise, the net reproductive rate, birth rate and death rate were significantly ( $p < 0.05$ ) higher in S than in E strain. This study demonstrates the negative impact of  $\alpha$ -cypermethrin on the physiological and reproductive fitness of *Ae. aegypti*.

**Keywords:** *Aedes*,  $\alpha$ -cypermethrin, Larvicidal bioassay, Life table, Pyrethroids

## INTRODUCTION

*Aedes aegypti* is the predominant disease vector responsible for the transmission of several diseases of human concern. The continuous increase in these diseases has made the management of *Ae. aegypti* indispensable to improve the quality of the environment and public health (Benelli et al., 2016). Due to lack of successful medication and vaccine against these diseases, prime mitigation approach is the disruption of disease transmission either by killing different developmental stages of a mosquito or by preventing adult bites using chemical or natural repellents (Achee et al., 2019).

In India, Ministry of Family and Health Welfare recorded

99,913 cases of dengue and 220 fatalities in 2015, which rose to 1,57,315 cases and 166 deaths in 2019 (NVBDCP, 2020a). In addition, the outbreak of Chikungunya across India registered 81,914 cases in 2010, highest since last fifteen years (NVBDCP, 2020b). These diseases are distributed in almost all the Indian states and Union Territories; majorly in the Gujarat, Maharashtra, Rajasthan, Karnataka, Kerala, Tamil Nadu, Telangana, Uttarakhand and Uttar Pradesh (NVBDCP, 2020a).

Chemical-based interventions are being practised since decades for mosquito management. Several organochlorines, organophosphates and carbamates have been formulated and utilized for field and domestic use. Nevertheless, rapid resistance development in mosqui-



# Protection of surplus food from fungal spoilage using *Streptomyces* spp.: a green approach

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## Abstract

Consortia of *Streptomyces* spp. (colonies 169, 194, 165 and 130) used in this study are an efficient producer of secondary metabolites like chitinases and antifungal compounds, which may help in the protection of surplus food from spoilage. Qualitative screening for chitinase production and taxonomy of these colonies were undertaken in our previous studies. In the current study, GC–MS analysis of extract produced from the consortia of *Streptomyces* strains was done for the identification of antifungal compounds. Treatment of surplus food with activated consortia of *Streptomyces* spp. has protected powdered food for a month, whereas fresh food (unpowdered) was preserved for two days. A control sample of surplus food (untreated) was kept to check the contamination, which resulted in the growth of three fungi (FP-1, FG-1, and FB-1). Taxonomic characterization of fungi and identification of toxic compounds produced from them were done by ITS amplification and GC–MS analysis, respectively. The study shows that the secondary metabolites from *Streptomyces* spp. have the potential to protect the food from mycotoxin contamination. Based on literature reports, this is for the first time that bioactive compounds and chitinases produced from *Streptomyces* are being used for the protection and management of surplus food.

**Keywords** *Streptomyces* · Secondary metabolites · Food protection · Food-spoiling fungus · Mycotoxins

## Introduction

Wastage of food is a critical and global issue, which is not getting a proper solution. About one-third of the annual gross production of food is being wasted because of improper management, unawareness and many other factors (Ghosh et al. 2016). Wastage of food, on one side, leads to scarcity of limited food resources and while on another side, it affects the environment and human health. According to the “Hunger map 2019” of the “World Food Program” published on 1st August 2019, more than one in nine of the world population is starving due to lack of food (World hunger map (World food program(2019)Hunger map.<https://www.wfp.org/publications/2019-hunger-map> 2019). Contamination

of food and feedstock with pathogenic fungus is a major disadvantageous and global problem. The research community has given lots of effort to minimize food and feed product contamination. However, the protection of surplus food is still untouched, and it is a single key to a hygienic environment and food security. Due to lack of proper waste management system in developing countries, the wanderer animals consume food wastes which are thrown on roads and municipal-allotted sites. Consumption of contaminated food with life-threatening toxins secreted from fungi affects the human and other animal's health (Zain 2011). Digestive, allergic, neuropsychiatric, immunological, carcinogenic, and many other intense medical effects have been reported due to mycotoxins (Omotayo et al. 2019). Direct consumption of mycotoxins is not the only route to affect human health, but many toxins have been tracked to enter the food chain and showed multiple adverse effects at each trophic level in the food chain (Bryden 2007). Fungal contamination is very rapid, it can contaminate “surplus food” within a few hours of disposal. After fungal contamination, food becomes worthless and a serious threat to the environment and human health. Even with the availability of waste dumping sites, disposed waste in current practices takes too much time to

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# Draft genome and secondary metabolite biosynthetic gene clusters of *Streptomyces* sp. strain 196

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## Abstract

Emergence of MDR 'superbugs' inflamed a severe sense of urgency amongst scientists aiming at the discovery of novel potential drug molecules. Bacteria of the genus *Streptomyces* are really worth investigating for their immense potential to produce natural compounds of pharmaceutical importance. In the present study, the genome of *Streptomyces* sp. strain 196 was sequenced, studied and secondary metabolite biosynthetic gene clusters (smBGCs) were detected. FAME analysis was used for taxonomic validation of strain 196. Genome of strain 196 was sequenced using the Illumina NextSeq system which has resulted in a draft genome of 7.4 Mb. Rapid annotation using subsystem technology (RAST) results revealed the presence of 6682 CDS, 64 tRNA genes and 7 rRNA genes. Comparative studies revealed that strain 196 have 93.5% nucleotide and 96% protein level similarities with *Streptomyces rhizosphaericola* 1AS2c. Genome mining using antiSMASH predicted the presence of BGCs responsible for diverse bioactive compound production. The detected gene clusters were two PKS-III, one PKS-I, five NRPS, two hybrid PKS-I/NRPS, one thiopeptide/LAP, and one bacteriocin types. Furthermore, many other types BGCs such as three ectoine, two siderophore, one arylpolyene, two butyrolactone, one lassopeptide, one lanthipeptide and one melanin were also found. The results of this study provides information about genome and BGCs of strain 196, this information is valuable for researchers who are interested in isolation of bioactive compounds and working on heterologous expression of cryptic BGCs for novel bioactive compounds production.

**Keywords** Draft genome · *Streptomyces* · Bioactive compounds · Biosynthetic gene clusters · AntiSMASH · PKS and NRPS

## Introduction

Antimicrobial resistance has resulted in a global health crisis where both common and deadly infections becoming incurable [1]. The rise in these incidences and reduction in drug discovery is greatly limiting the therapeutic options. Natural products from microbes have the potential for the

development of new remedial options. Natural products from actinomycetes are considered as excellent reserves of bioactive compounds and lead molecules [2]. Upto the mid-1990s, more than 50% of drugs were obtained from natural products [3, 4]. After that, the use of these products decreased due to the labor-intensive and time-consuming process of isolation and characterization of new natural products from crude extracts. However, >40% of drugs under development in recent times are obtained from these natural products and their analogs [4, 5]. These natural products are considered as very important for drug discovery due to their structural diversity [6]. So, there is a need to discover new approaches, which can replace the conventional labor-intensive and time-consuming process of isolation and characterization of novel natural products from crude extracts.

The genus *Streptomyces* in the actinomycetes is considered as the most prolific source of bioactive secondary metabolites [7]. These compounds show antibiotic, anti-cancer, antifungal, immunosuppressive and antiparasitic

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# Proactive role of *Streptomyces* spp. in plant growth stimulation and management of chemical pesticides and fertilizers

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## Abstract

In current agriculture practices, various chemical stimulants are being used to enhance crop productivity. However, these chemical fertilizers and pesticides show a deadly impact on the environment, food chain, and human health. The researchers are looking for the biological replacement of these chemical fertilizers and pesticides. Nevertheless, still, no strong bio-alternative has replaced the use of such chemicals. Bacteria belonging to the genus *Streptomyces* are well-known producers of secondary metabolites, which can be potentially utilized to replace chemical fertilizers and pesticides. Metabolites from *Streptomyces* can degrade the chemical pesticides, help in the recoupage of essential minerals (e.g., iron, phosphate, nitrogen) and regulation of plant hormone's action. Extracellular enzymes like cellulase and xylanase enhance the soil texture by hydrolysing the lignocellulosic material, and chitinase acts as a biocontrol agent against the fungus and insects. It has been reported in earlier studies that *Streptomyces* spp. produce various plant growth-promoting compounds, which can stimulate the plant's growth and productivity. *Streptomyces* is the largest producer of antimicrobial compounds, which may act as a biocontrol agent for various plant diseases caused by bacteria and fungi. This review has discussed the direct and indirect impact of chemical pesticides and fertilizers used in current agriculture practices and their possible replacement using *Streptomyces* spp.

**Keywords** *Streptomyces* · Plant growth stimulation · Biofertilizers · Biopesticides · Agriculture practices

## Introduction

The surge in the human population leads to enhance conflict and competition for resources. Survival in the developed countries is flourishing with the quality of life, but people in developing countries are still looking for essential resources like food, clothes, and home for survival. The surge in population growth directly affects the food supply chain and food stock, affecting the global hunger index (GHI). The high demand for food urges the need for an increase in the production rate of agricultural products (Islam and Karim

2019). Farmers are encouraged to use chemical fertilizers and pesticides on a large scale to enhance crop productivity (Joshi et al. 2019). The development of new chemical products tried to maintain the balance between the demand and the fulfilment of resources. Syncing of technologies to conventional agriculture practices also played an important role. Nevertheless, with time, these chemical fertilizers and pesticides started to affect human health and the environment (Amaraneni et al. 2018). Higher use of inorganic fertilizers for a longer duration affected the soil fertility and caused nitrogen leaching, disruption of soil microbiota, and soil acidification, and many more impact has been reported in the literature (Lin et al. 2019). The use of these chemical fertilizers and pesticides surged in the last few decades (Liu et al. 2015). Many reports claimed that pesticides directly or indirectly enter and accumulate in the food chain (Lushchak et al. 2018). The best example is DDT (dichloro-diphenyl-trichloroethane), which directly affected biodiversity by promoting the extinction of many bird species (Bienkowski 2014). According to the studies, pesticides were found in many food items like milk, grains, vegetables, fruits, and

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## Exploring Small Heat Shock Proteins (sHSPs) for Targeting Drug Resistance in *Candida albicans* and other Pathogenic Fungi

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### Abstract

Fungal infections have predominantly increased worldwide that leads to morbidity and mortality in severe cases. Invasive candidiasis and other pathogenic fungal infections are a major problem in immunocompromised individuals and post-operative patients. Increasing resistance to existing antifungal drugs calls for the identification of novel antifungal drug targets for chemotherapeutic interventions. This demand for identification and characterization of novel drug targets leads to the development of effective antifungal therapy against drug resistant fungi. Heat shock proteins (HSPs) are important for various biological processes like protein folding, posttranslational modifications, transcription, translation, and protein aggregation. HSPs are involved in maintaining homeostasis of the cell. A subgroup of HSPs is small heat shock proteins (sHSPs), which functions as cellular chaperones. They are having a significant role in the many cellular functions like development, cytoskeletal organization, apoptosis, membrane lipid polymorphism, differentiation, autophagy, in infection recognition and are major players in various stresses like osmotic stress, pH stress, etc. Studies have shown that fungal cells express increased levels of sHSPs upon antifungal drug induced stress responses. Here we review the important role of small heat shock proteins (sHSPs) in fungal diseases and their potential as antifungal targets.

**Keywords:** *Candida albicans*, Drug resistance, Small heat shock proteins, Antifungals

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## Indicators for assessment of soil quality: a mini-review

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**Abstract** Soil quality is the competence of soil to perform necessary functions that are able to maintain animal and plant productivity of the soil. Soil consists of various physical, chemical, and biological parameters, and all these parameters are involved in the critical functioning of soil. There is a need for continuous assessment of soil quality as soil is a complex and dynamic constituent of Earth's biosphere that is continuously changing by natural and anthropogenic disturbances. Any perturbations in the soil cause disturbances in the physical (soil texture, bulk density, etc.), chemical (pH, salinity, organic carbon, etc.), and biological (microbes and enzymes) parameters. These physical, chemical, and biological parameters can serve as indicators for soil quality assessment. However, soil quality assessment cannot be possible by evaluating only one parameter out of physical, chemical, or biological. So, there is an emergent need to establish a minimum dataset (MDS) which shall include physical, chemical, and biological parameters to assess the quality of the given soil. This review attempts to describe various physical, chemical, and biological parameters,

combinations of which can be used in the establishment of MDS.

**Keywords** Agro-ecological · Biological indicators · Chemical indicators · Multiomics approach · Physical indicators · Soil enzymes

### Introduction

Soil quality is defined as the capacity of soil to fulfill ecological functions and provide ecosystem services to maintain biological productivity and environmental quality and enhance the plant and animal health (Joinel et al. 2017; Bunemann et al. 2018). Resistance and quick recovery to perturbations (natural or manmade) is a characteristic of healthy soil (Schaeffer et al. 2016). The more accurate and better soil assessment can be provided by the integration of various factors such as physical, chemical, biological, and enzymatic activity (Liao et al. 2014). These factors should be used in combination as indicators of soil quality assessment (Liao et al. 2014). Natural disturbances and agricultural practices such as tillage, irrigation, burning, and application of pesticides and fertilizers cause an imbalance in physical and chemical parameters such as soil texture, soil moisture, pH, and organic matter (Vallejo et al. 2012). Organic matter also serves as an important indicator for determining soil fertility and soil health (Anikwe 2006; Obalum et al. 2017).

Soil constitutes a major component of the terrestrial environment and holds various living forms including

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## Characterization of *Euplotes lynni* nov. spec., *E. indica* nov. spec. and description of *E. aediculatus* and *E. woodruffi* (Ciliophora, Euplotidae) using an integrative approach

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### Abstract

Four species belonging to the genus *Euplotes* have been investigated, namely: *E. lynni* nov. spec., *E. indica* nov. spec., *E. aediculatus*, and *E. woodruffi*. All populations are from India and were investigated using morphological and molecular markers. The phylogenetic relationships were inferred from small subunit ribosomal rRNA gene (SSU rRNA), internal transcribed spacer (ITS) region, and mitochondrial cytochrome c oxidase subunit I (COI) gene. Predicted secondary structure models for two new species using the hypervariable region of the SSU rRNA gene and ITS2 region support the distinctness of both species. Morphological characters were subjected to principal component analysis (PCA) and genetic variations were studied in-depth to analyze the relatedness of the two new species with their congeners. An integrative approach combining morphological features, molecular analysis, and ecological characteristics was carried out to understand the phylogenetic position of the reported species within the different clades of the genus *Euplotes*.

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**Keywords:** COI gene; India; ITS region; Morphology; Phylogeny; SSU rRNA gene

### Introduction

The genus *Euplotes* Ehrenberg, 1830 is present in almost all habitats and is represented by many recognized species (over 70 species) (Berger 2001; Borror 1968; Curds 1975; Di Giuseppe et al. 2011, 2013, 2015; Shao et al. 2010; Wilbert and Song 2008). Various species of *Euplotes* have been used,

inter alia, as model systems for studying stress responses (Chen et al. 2014; Pischedda et al. 2018; Ricci et al. 2017), pheromones structure and activity, and high-multiple mating types (Beale 1990; Dini and Luporini 1979; Valbonesi et al. 1992; Vallesi et al. 1995, 2014). Pheromones were first identified 70 years ago in *Euplotes patella* (Müller 1773) Ehrenberg, 1838 (Kimball 1942), and later on, were isolated and characterized in *E. raikovi* Agamaliev, 1966, *E. octocarinatus* Carter, 1972, *E. nobilii* Valbonesi and Luporini, 1990, *E. woodruffi* Gaw, 1939 and *E. crassus* Kahl, 1932 (Luporini et al. 2015). It was found that ciliate pheromones function secondarily in a paracrine manner (non-self) for mating, as primarily it functions in an autocrine manner (self) for self-mitotic growth hence promoting cell viabil-

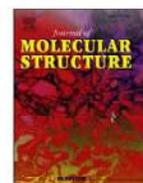
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# Ibuprofen-based chemosensor for efficient binding and sensing of $\text{Cu}^{2+}$ ion in aqueous medium

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## ABSTRACT

An ibuprofen based molecular receptor **R1** (N-[2-[(2-Hydroxy-benzylidene)-amino]-ethyl]-2-(4-isobutyl-phenyl)-propionamide) was developed for the detection of  $\text{Cu}^{2+}$  ion in aqueous medium by absorbance and fluorescence techniques. Binding constants ( $4.89\text{--}5.67 \times 10^3 \text{ M}^{-1}$ ) and detection limits ( $1.71\text{--}2.12 \mu\text{M}$ ) showed significant sensing ability. SEM and PXRD techniques were employed to establish the complex formation between **R1** and  $\text{Cu}^{2+}$  ion and also showed promising behaviour of nanomaterial. The competitive binding experiments showed the selectivity of  $\text{Cu}^{2+}$  ion in presence of other metal ions in aqueous medium. The reversibility studies for chemosensor **R1** was investigated and EDTA used as restoring agent. The strong chelation through  $\text{--N}$  and  $\text{--O}$  atoms of receptor **R1** enhance the change in color triggered selectively by  $\text{Cu}^{2+}$  ion and detected by colorimetric methods. The theoretical calculations were employed in order to confirm the experimental observations in the molecular frames.

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## 1. Introduction

Ibuprofen based molecular probes have significant role in biological and chemical aspect due to the presence of reactive site inside their structural motif [1–4]. Ibuprofen based Schiff's base chemosensor investigated intensively due to their unique physical and chemical properties [5,6]. In the past years, design and development of chromogenic and fluorogenic chemosensor that are beneficial for the detection of several metal ions viz.  $\text{Hg}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Cd}^{2+}$  and  $\text{Cu}^{2+}$  biologically or environmentally, has become a growing field of research [7]. Copper ion is one of the *d*-series metal ions which is present in the body and play most important role in functioning of several biological processes [8–10]. Excessive accumulation of copper in body results in the several disorders [11]. Copper ion acts as a co-factor in electron transportation, used as a catalyst in C–C coupling and in ring transformation reactions etc. [12–17]. Copper based enzymes push several biological processes, its accumulation in the body is favourable due to its toxicity, which results in Alzheimer's, Wilson's, Menke's Disease and Indian-Non Indian childhood cirrhosis [18]. United States Environmental

Protection Agency has set a maximum tolerable limit of copper ions present in the drinking water to  $20 \mu\text{M}$  [18,19]. Thus, method for the selective and sensitive detection of  $\text{Cu}^{2+}$  ion even, in trace level, in environment have been developed [20]. This require sophisticated instrumentation for the detection purpose but, a simple and reliable method for the detection of  $\text{Cu}^{2+}$  ion with high sensitivity, visible color change and reversible nature always creates attention of material chemists [21,22]. For on-site applications, there is always a quick need to develop chemosensor for  $\text{Cu}^{2+}$  ion that could be easily synthesized, easily detected without any sophisticated instrumentation. Therefore, colorimetric sensor played a crucial role with naked eye evaluation [23].

In addition, several colorimetric and fluorometric chemosensor for  $\text{Cu}^{2+}$  ion have already been published in the literature [24–26].  $\text{Cu}^{2+}$  ion is known for its fluorescence quenching property because of its paramagnetic nature, several molecular probes have already been reported [27]. To the best of our knowledge, Ibuprofen based Schiff's base probe not more reported yet. Schiff's bases are those heterocyclic compounds which contains C=N functionality, are highly reactive and applicable in the fields of metal ion sensing due to high reactivity towards chelate formation with different metal ions [28–30]. In this report, receptor **R1** was developed for the detection of  $\text{Cu}^{2+}$  ion intensively by absorbance and fluorescence techniques. Binding parameters, competitive binding studies,

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# Fabrication of a Gold-Supported NiAlTi-Layered Double Hydroxide Nanocatalyst for Organic Transformations

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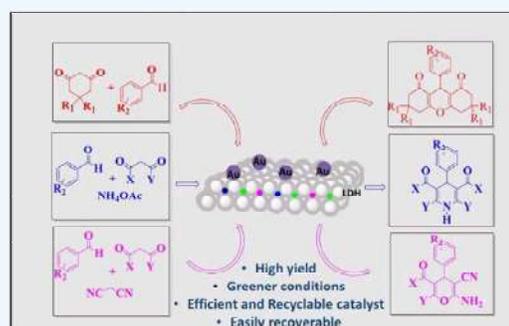


Article Recommendations



Supporting Information

**ABSTRACT:** This work is mainly focused on the synthesis of an efficient and reusable heterogeneous Au/NiAlTi layered double hydroxide (LDH) nanocatalyst and its applications in the preparation of biologically important xanthene, 1,4-dihydropyridine, polyhydroquinoline, and 4*H*-pyran derivatives. NiAlTi LDH was designed hydrothermally and then gold was supported over the surface of LDH by using ion-exchange and NaBH<sub>4</sub> reduction methods. The synthesized nanocatalyst was physicochemically characterized by X-ray diffractometry, Fourier-transform infrared spectroscopy, thermogravimetric analysis, scanning electron microscopy, and transmission electron microscopy (TEM). The TEM images confirmed the support of gold nanoparticles over the surface of LDH with a size distribution of 7–9 nm. The well-characterized nanocatalyst was tested for the synthesis of biologically important xanthene, 1,4-dihydropyridine, polyhydroquinoline, and 4*H*-pyran derivatives. The advantages obtained were excellent yields in a lesser reaction time. Stability and reusability were also accessed; the catalyst was stable even after five cycles. High catalytic efficiency, easy fabrication, and recycling ability of Au/NiAlTi LDH make it a potential catalyst for the synthesis of xanthene, 1,4-dihydropyridine, polyhydroquinoline, and 4*H*-pyran derivatives.



## 1. INTRODUCTION

Xanthene, 1,4-dihydropyridine, polyhydroquinoline, and 4*H*-pyran derivatives are famous structural architectures found in many synthetic drugs, biologically active natural products, and essential units for chemical intermediates.<sup>1</sup> Therefore, many methods have been reported for their catalytic synthesis with different advantages. Still, each of them offers various limitations such as hazardous and long catalyst preparation, harsh conditions, extended workup, and toxic and expensive solvents and reagents. Therefore, the fabrication of novel heterogeneous catalysts for such catalytic synthesis to replace toxic, polluting, and conventional catalysts has attracted the attention of many researchers because of their easy recovery, selectivity, reusability, enhanced reactivity, and convenient product isolation.<sup>2</sup>

Nanocatalysts have gained ample attention for various such transformations but suffer from disadvantages such as reusability and recovery. Therefore, designing heterogeneous nanocatalysts could be a better alternative as they can be separated easily by centrifugation or filtration methods and reused after catalyst washing.<sup>3</sup> Layered double hydroxides (LDHs), also named hydrotalcite-like compounds, are a branch of clay minerals having positively charged octahedral-type brucite-like sheets intercalated with anionic charges and H<sub>2</sub>O molecules.<sup>4,5</sup> Because of their properties of high surface

area and anion-exchange capacities, LDHs have emerged as eco-friendly materials in the fields of catalysis, drug carriers, adsorption, anion exchange, and precursors for magnetic materials.<sup>4–9</sup> As LDHs can be synthesized by economic and simple routes, they have gained considerable attraction in the field of catalytic synthesis of organic compounds.

To date, many metal nanoparticles and metal ions such as copper, cobalt, ruthenium, and palladium have been used catalytically for various reactions such as oxidation of alcohols and so forth. For the last few decades, gold catalysts have attracted attention because of their higher catalytic properties.<sup>10</sup> One of the essential applications of Au nanoparticles in organic synthesis is alcohol oxidation.<sup>11</sup> Nanocomposites fabricated by supporting Au on a support system (LDHs) could generate an active catalyst for various organic transformations with a greater efficiency.

Herein, we have fabricated a new nanocomposite material by supporting gold nanoparticles over hydrothermally generated

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# Natural Polysaccharide Based Graphene Oxide Nanocomposites for Removal of Dyes from Wastewater: A Review

Laishram Saya, Drashya Gautam, Vipin Malik, W. Rameshwor Singh, and Sunita Hooda\*



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**ABSTRACT:** This article discusses the potential applications of natural polysaccharide-based graphene oxide nanomaterials in the field of wastewater remediation through the removal of organic and synthetic dyes. Being highly toxic, carcinogenic, and nonbiodegradable, dyes disposed from textile, paper, and printing industries etc. pose a serious threat to various life forms on earth. Recently, there has been an increased interest in the amalgamation of biopolymers, such as polysaccharides, with the high adsorption efficiency of graphene oxide. Polysaccharides, apart from being nontoxic, low cost, and eco-friendly, possess a variety of functional groups enabling them to be easily tuned for the desired applications. When grafted with GO nanosheets, they give rise to unique nanomaterials possessing diverse applications, especially in the eradication of harmful contaminants from wastewater. This review is an attempt to give consolidated and detailed information on different aspects of the adsorption behavior of various potentially low-cost polysaccharide-based GO nanoadsorbents toward lethal dyes. The characterization techniques used, adsorption isotherms, kinetics, thermodynamic behavior, recyclability, and swelling properties as well as the adsorption mechanism have been outlined in this article. The whole anthology of literature reports excellent dye removal efficiency with significant regeneration performance making these nanoadsorbents promising candidates for practical applications. In view of all aspects, this review recommends the use of such sustainable adsorbents with a further search toward obtaining the polysaccharides from natural wastes.



## 1. INTRODUCTION

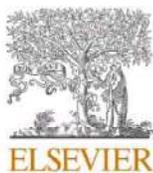
Water is one of the most essential substances for all forms of life on earth and has always been a boon-like resource for human civilization since ancient times. However, in the 21st century, with the rapid development of industry, water pollution and the lack of reliable access to clean and pure water have become major challenges that the human race is facing worldwide. According to WHO (2012), some 780 million people cannot get access to clean and potable water.<sup>1</sup> Overcoming this global challenge has become a most basic humanitarian goal, attracting much research attention recently.

Of the various contaminants in wastewater, synthetic dyes are the ones which are released in huge quantities annually. Dyes are colored organic compounds composed of complex aromatic rings basically comprising two main components, namely, the color imparting part called the chromophores (e.g., NR<sub>2</sub>, NH<sub>2</sub>, NHR, OH, and COOH) and the auxochromes (e.g., NO, NO<sub>2</sub>, and N<sub>2</sub>). The chromophore is the basic part of all types of dyes such as acidic, basic, vat, azo, reactive, and disperse dyes.<sup>2</sup> Molecular structures of some common cationic and anionic dyes are shown in Figure 1. Dyes have numerous applications in various industries that include food, paper, plastic, carpet, cosmetic, printing, and textile industries. The

industrial dyeing and printing process produces over  $7 \times 10^5$  tons and nearly 10,000 variety of dyes and pigments,<sup>3</sup> and more than 10,000 tons of dyes are consumed globally, per annum of which approximately 10–15% are discharged along with the effluents into various water bodies.<sup>4,5</sup> These dyes are practically nondegradable<sup>6</sup> and cannot be degraded even in the sludge treatment plants.<sup>7</sup> They exhibit a very high solubility in water which makes them difficult to be removed by conventional methods.<sup>8</sup> The presence of even a minute amount of some of the dyes in water (maybe <1 ppm) is highly visible and proves quite harmful.<sup>9</sup> Moreover, textile dyes are potentially genotoxic and carcinogenic,<sup>10–13</sup> consequently causing degradation of the environment and various deadly diseases in animals and humans.<sup>14–18</sup> These dyes also compromise the intrinsic quality of aquatic bodies by

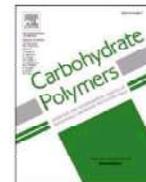
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Review



## Guar gum based nanocomposites: Role in water purification through efficient removal of dyes and metal ions

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## ABSTRACT

Researchers nowadays are relentlessly on a race exploring sustainable materials and techniques for the sequestration of toxic dyes and metal ions from water bodies. Biopolymers such as guar gum, owing to its high abundance, low cost and non-toxicity, are potential candidates in this field. Plenty of hydroxyl groups in the polymer backbone enable guar gum to be functionalised or grafted in a versatile manner proving itself as an excellent starting substance for fabricating upgraded materials meant for diverse applications. This review offers a comprehensive coverage of the role of guar gum-based nanocomposites in removal of dyes and heavy metal ions from waste water through adsorption and photo-catalytic degradation. Isotherm and kinetics models, fabrication routes, characterisation techniques, swelling properties and reusability as well as adsorption and degradation mechanisms are outlined. A detailed analysis with convincing results suggests a good future perspective of implementation of these materials in real-time wastewater treatment technology.

### 1. Introduction

Deterioration of water quality due to the rapid pace of urbanisation and industrialisation on a large scale has led to scarcity of clean water which has eventually become a matter of worldwide concern. Research communities over the years have been paying extensive attention on the eradication or in the least, reduction of organic and inorganic pollutants from waste water especially from industrial effluents. (Barakat, 2011; Tchounwou, Yedjou, Patlolla, & Sutton., 2012). Dyes and metal ions which are the major components of effluents from industries such as textile, paper, leather, cosmetics and plastic, prove to be the most harmful and toxic of all the contaminants (Ahmad & Mirza, 2017; Janaki et al., 2012; Torrades & García-Montaña, 2014; Zaman et al., 2020). Aquatic species are the most affected lot as dyes block the sunlight from getting transmitted to water (Singh, Kumar, Kim, & Rawat, 2019). Dyes are released in huge quantities annually from various sources leading to extreme values of COD (>150 ppm), TOC (2900 mg L<sup>-1</sup>), and BOD (>80 mg L<sup>-1</sup>) thereby deteriorating aesthetic values in various water bodies (Geng, Zhang, Zhou, & Lei, 2018; Larbi, Doll, & Amlouk, 2019). Hence,

dyes prove to be toxic for all aquatic life forms which gets transferred through the food chain and on the worst side, may be correlated to mutagenic and carcinogenic effects leading to severe damage to human beings such as dysfunction of various organ systems including kidneys, liver, brain, etc. (Dinçer, Güneş, Karakaya, & Güneş, 2007; Kadirvelu et al., 2003; Shen et al., 2009). Even a minute concentration of organic dye (1 × 10<sup>-3</sup> mg L<sup>-1</sup>) can prove highly toxic to humans and other animals. (Benedek, Sebestyén, & Bartók, 2018; Robinson, Chandran, & Nigam, 2002). Apart from dyes, there is a growing concern over contamination of water bodies by metal ions especially heavy metals released from industries including fertilizer and pesticide industries, tanneries, mining and refineries (Abbas et al., 2016; Chen, Zheng, Zhou, & Kang, 2019). Heavy metals such as arsenic, lead, cadmium, nickel, mercury, chromium, cobalt, zinc and selenium are usually present in trace amounts in water bodies, however most of them are associated with high toxic effects even at very low concentrations (Ahmad et al., 2020; Yin, Wang, Lv, & Chen, 2018). Various health hazards caused by these metal ions are listed out in Table S. Increasing accumulation of trace amounts of these heavy metals is making water scarily unfit for

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# Recent Advances in a Polydopamine-Mediated Antimicrobial Adhesion System

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The drug resistance developed by bacteria during antibiotic treatment has been a call to action for researchers and scientists across the globe, as bacteria and fungi develop ever increasing resistance to current drugs. Innovative antimicrobial/antibacterial materials and coatings to combat such infections have become a priority, as many infections are caused by indwelling implants (e.g., catheters) as well as improving postsurgical function and outcomes. Pathogenic microorganisms that can exist either in planktonic form or as biofilms in water-carrying pipelines are one of the sources responsible for causing water-borne infections. To combat this, researchers have developed nanotextured surfaces with bactericidal properties mirroring the topographical features of some natural antibacterial materials. Protein-based adhesives, secreted by marine mussels, contain a catecholic amino acid, 3,4-dihydroxyphenylalanine (DOPA), which, in the presence of lysine amino acid, empowers with the ability to anchor them to various surfaces in both wet and saline habitats. Inspired by these features, a novel coating material derived from a catechol derivative, dopamine, known as polydopamine (PDA), has been designed and developed with the ability to adhere to almost all kinds of substrates. Looking at the immense potential of PDA, this review article offers an overview of the recent growth in the field of PDA and its derivatives, especially focusing the promising applications as antibacterial nanocoatings and discussing various antimicrobial mechanisms including reactive oxygen species-mediated antimicrobial properties.

**Keywords:** biofilm, polymerization, ROS, polydopamine, antimicrobial, surface coating

## INTRODUCTION

A considerable number of catecholic residues similar to those found in the mussel foot proteins (mytilus foot proteins, MFP-3 and 5) and melanin have attracted the attention of researchers around the globe. A plethora of articles/reviews has been presented on the structure, reaction mechanism, and biomedical and biotechnological applications of materials containing these functionalities (Solano, 2014, 2017; Ahn, 2017; Ball, 2017; Forooshani and Lee, 2017; Maier and Butler, 2017; Rahimnejad and Zhong, 2017; Moulay, 2018; Park et al., 2019). Polydopamine (PDA) is one such material and is an extremely interesting polymer, ennobled with unique features – such as adherence to all types of surfaces even under water, a characteristic attributed to the catechol moieties in its monomeric building blocks. The polymer, reaped by dopamine oxidation, contains

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ORIGINAL PAPER



## Antimicrobial, radical scavenging, and dye degradation potential of nontoxic biogenic silver nanoparticles using *Cassia fistula* pods

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### Abstract

Synthesis of metallic nanoparticles via green approach holds great potential in diverse fields of biotechnology and medicine with special mention to silver nanoparticles (AgNPs) which undoubtedly display antimicrobial, radical scavenging, and dye degradation properties. Currently, there is a need to explore more cost-effective and efficient methods to synthesize AgNPs. In this study, we have synthesized biogenic AgNPs using an aqueous extract of a flowering plant of the legume family, Fabaceae, subfamily Caesalpinioideae, *Cassia fistula*, which is also well known for its medicinal values. Spectroscopically and physicochemically characterized AgNPs were evaluated for their cytocompatibility, antimicrobial effects, antioxidant and catalytic activity to establish their potential for various biomedical applications. DLS studies revealed their size ~237 nm with the surface charge of ~ -30 mV. The results of the zone of inhibition and MIC assays showed the superiority of the activity of these particles over the pod extract. Catalytic reduction of toxic p-nitrophenol to benign p-aminophenol as well as degradation of hazardous industrial dyes (methyl orange and methylene blue) advocated their potential as environmental toxicant eradicators. Besides, these biogenic AgNPs displayed profound antibiofilm effects in static microtiter plates. Altogether, the results of various bioassays using these biogenic nanoparticles demonstrate their immense potential as antimicrobial, antioxidant, and antibiofilm agents.

**Keywords** *Cassia fistula* (amaltas) · Silver nanoparticles · Antimicrobial · Antioxidant · Catalytic reduction · Antibiofilm effect

### Introduction

Presently, the use of conventional physical and chemical methods for the synthesis of metallic or metallic oxide nanoparticles (NPs) has reached the bare minimum as these methods are hazardous for living organisms and the surrounding environment (Das et al. 2017). The green synthesis with its tremendous potential is being counted as a better approach, especially, for some metallic nanoparticles, viz., gold, silver, selenium, iron. Green synthesis has reasonable merits over other physical and chemical methods, such as eco-friendly,

inexpensive, less reaction time consuming with well-defined surface morphology, effective and efficient to uplift the scope of biomedical nanotechnology. In the current scenario, green chemistry is known as an intellectual approach with the inculcation of diverse ecological members such as bacteria (Baltazar-Encarnacion et al. 2019; Samuel et al. 2020), fungi (Li et al. 2012), yeast (Niknejad et al. 2015), algae (Ravichandran et al. 2018) and plants containing active constituents, such as flavonoids, terpenes, enzymes, polysaccharides, phytochemicals, and phenolic compounds (Dlugosz et al. 2020; Ghadi et al. 2018; Kumar et al. 2019; Marslin et al. 2018). These biological entities that act as reducing as well as capping agents can transform metal ions into respective metallic forms. For decades, several plants have been used as traditional medicines for treating numerous diseases and pathological conditions (Lopes et al. 2020). Currently, plants or its exudates, such as leaves, fruit, bark, etc., containing bioreductive substances, are being inculcated for the synthesis of nanoparticles. Besides owning antimicrobial, anticancer, anti-inflammatory, and antidiabetic properties,

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3.

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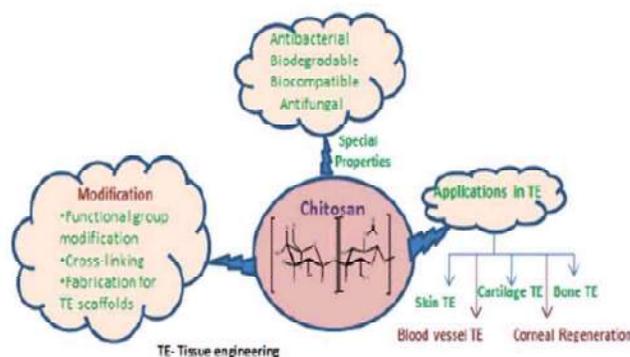


### Applications of Chitosan in Tissue Engineering

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#### GRAPHICAL ABSTRACT



#### Abstract

Tissue engineering in alliance with regenerative medicine provides new strategies to improve or repair different types of biological tissues. The main requirement of tissue engineering is 2D or 3D polymeric scaffolds to provide cell attachment, proliferation and cell differentiation to the damaged tissue. In recent times, the interest to synthesize scaffolds using natural polymers is thriving. Among these polymers, chitosan-based materials have gained more attention in tissue engineering because of their unique inherent biological properties such as biocompatibility, biodegradability and also cost effectiveness. The weaknesses of chitosan due to its low mechanical strength and poor water solubility have significantly affected the spectrum of its applications in biological engineering, however, it has been shown to overcome these concerns either through conjugation with other polymers or by synthesizing modified derivatives. The present review mainly focuses on the different properties of chitosan and its applicability in tissue engineering in combination with other polymers with an outlook into future applications.

**Keywords:** Chitosan; Hydrogel; Tissue engineering; Biodegradable, Biocompatible

#### 1. Introduction

Over the last few decades, tissue engineering has gained significant attention as a strategic partner of regenerative medicine in therapeutics. The vast role of tissue engineering involves maintaining, restoring, regenerating or to improve the functioning of defective/lost tissues by using biomaterials' self-sufficiency or in combination of other adjuvants.<sup>1</sup> This may involve creation of the biological substitutes to induce tissue engineering that, in turn, works as scaffolds to reestablish or regenerate the damaged

tissue.<sup>2</sup> Hence, tissue engineering can rally around the isolated cells or cell substitutes and facilitate cell attachment, proliferation and differentiation by corroborating extra cellular matrix (ECM) synthesis. This task usually involves implanting cells into some form of supporting structural device called scaffold. Scaffolding is a temporary (3D/2D) structure specially designed to promote the cell-adhesion, cell-biomaterial interactions and extracellular matrix deposits (ECMD) for sufficient transport of gases, nutrients, and regulatory factors for cell survival with minimal inflammation.<sup>3,4</sup> 2D and 3D polymeric scaffolds enjoy

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### Mannosylated and mannan-modified nanovectors targeting Resident Tissue Macrophages (RTM) for efficient pharmacotherapy

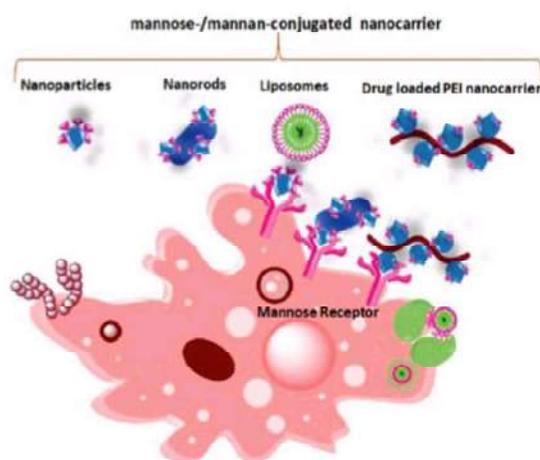
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#### Graphical Abstract



#### Abstract

Nanovectors advocate extensive scientific advancement for feeding safe and efficient pharmaceutical delivery systems. Embraced as both organic and inorganic vectors, these nanovectors can be designed and engineered with various layers of complexity to achieve therapeutic targeting and ensuring effective pharmacotherapy for disease management. A substantial challenge that the most therapeutic agents face is an inability to penetrate effectively to the target site. Chemical methods offer a solution to allow safe, controlled release and specific delivery of therapeutic molecules to the target tissue. Chemical targeting of vectors to diseased tissues or macrophages can utilize molecular recognition units for decorating the surface of particles or molecular units responsive to diseased microenvironments or remote stimuli. This review aims to provide insights into the sophisticated chemical vectors designing and characterization that can be used as carriers for implication in nanotechnology. Further, desired characteristic properties of nanovectors essential for therapeutic delivery have been stressed in the communication. Additionally, the current trends and novel concepts for mannose receptor macrophage-specific drug or gene or antigen targeting that use conjugation or encapsulation pathways for binding targeting moieties have been addressed.

**Keywords:** Nanovectors; macrophages; mannose receptors; drug delivery; mannose; galactomannan.

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<https://doi.org/10.1080/07391102.2021.1904004>

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REVIEW ARTICLE

**A review targeting the infection by CHIKV using computational and experimental approaches**

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Communicated by Rameswamy N. Sarma

**ABSTRACT**  
 The rise of normal body temperature of 98.6°F beyond 100.4°F in humans indicates fever due to some illness or infection. Viral infections caused by different viruses are one of the major causes of fever. One of such viruses is Chikungunya virus (CHIKV) is known to cause Chikungunya fever (CHIKF) which is transmitted to humans through the mosquitoes, which actually become the primary source of transmission of the virus. The genomic structure of the CHIKV consists of the two open reading frames (ORFs). The first one is a 5' end ORF and it encodes the nonstructural protein (nsP1-nsP4). The second is a 3' end ORF and it encodes the structural proteins, which is consisted of capsid, envelope (E), accessory peptides, E3 and a.k. IIB gene, there is no effective vaccine or medicine available for early detection of the CHIKV infection and appropriate diagnosis to cure the patients from the infection. NSP3 of CHIKV is the prime target of the researchers as it is responsible for the catalytic activity. This review has updates of literature on CHIKV; pathogenesis of CHIKV; inhibition of CHIKV using theoretical and experimental approaches.

**ARTICLE HISTORY**  
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**KEYWORDS**  
 CHIKV; duckling; MD; simulations; inhibition

**1. Fever**  
 Gastroenteritis infections may be due to the Nova virus, Zika virus (Silva et al., 2019), Chikungunya virus (Silva et al., 2019), Haman virus, Dengue virus (Silva et al., 2019), Hepatitis C virus (Silva et al., 2019), Poliovirus (Silva et al., 2019),

The rise of normal body temperature of 98.6°F beyond 100.4°F in humans indicates fever due to some illness or infection. The temperature of humans is normally measured through mouth.

Page 17 of 31

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Original article

## Self-nitrogen doped carbons aerogel derived from waste cigarette butts (cellulose acetate) for the adsorption of BPA: Kinetics and adsorption mechanisms

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### ABSTRACT

The fabrication of highly porous functionalized carbon materials is the demand of current scenario for the removal of toxic pollutants from aqueous solution. Therefore, waste cigarette butts that consist of cellulose acetate and other nitrogen rich compounds, such as nicotine and harmine have been used for the fabrication of N-doped carbon aerogel (NDC) via hydrothermal and carbonization process. As-fabricated NDC was characterized via, elemental analysis, FTIR, Raman, TGA, XRD, BET, SEM and XPS and used for the adsorption of bisphenol –A (BPA). The outcomes of adsorption essay and its kinetics support that the adsorption of BPA over NDC was carried out via pseudo-second-order kinetic model and via Langmuir model isotherm. The values for  $\Delta G$  and  $\Delta H$  were found negative and positive respectively, and support that the adsorption process is spontaneous and endothermic. The nature of adsorbent as well as in-situ and post characterization of the adsorbent support the adsorption mechanism, and the conclusions support that the hydrogen bonding, electrostatic as well as the  $\pi$ - $\pi$  interactions were employed between the BPA and NDC during adsorption. In addition, the regeneration of the NDC was efficiently achieved and BPA removal efficiency remained high (92.47%) after seven cycles.

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### 1. Introduction

Water pollution has always been a serious worldwide problem and it has concerned the attention of researchers all over the world. Several industries including fabric, printing and tissue, paints, plastics and leather, etc. use different type of organic dyes, heavy metals and organic phenols and expose to the environment. Among these pollutants, bisphenol-A (BPA), which is used for the manufacture of several polymers and plastics and noticed as an endocrine disruptor compounds (EDCs) has several health issue including cancer, hormonal imbalance, abnormal reproductive

and developmental behavior (Sophia and Lima, 2018; Wang et al., 2019a, 2019b). Due to these health issues, it is essential to eliminate BPA from wastewaters, prior to discharge into the environment. Several methods such as biodegradation, filtration, fenton chemical oxidation, photocatalytic degradation and adsorption have been employed for the management of BPA in contaminated water and other pollutants with variable success (Shokry et al., 2019; Soliman et al., 2019; Zhang et al., 2019). Among these methods, adsorption stands as one of the best available techniques due to its easy operation, cost-effective, feasibility, time and energy saving (Xiaoying et al., 2009). Hence, many adsorbents, such as metal oxides, graphite carbon/CNTs, bio-adsorbents, clay and polymers have been used for the adsorption of BPA from waste water. Among these adsorbent, carbon based adsorbents such as carbon nanotubes, activated carbon, and graphene have been extensively used for the removal pollutants from aqueous solution due to their high surface area and due to their excellent mechanical properties. Although, these pure carbonaceous materials are very stable but have two drawbacks, firstly the high costs and regeneration and secondly, poor adsorption capacity due to

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# Synthesis, comparative *in vitro* antibacterial, antioxidant and UV fluorescence studies of bis indole Schiff bases and molecular docking with ct-DNA and SARS-CoV-2 M<sup>PRO</sup>

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## Abstract

In this study, synthesis of 15 novel bis indole-based Schiff bases (SBs) **4a–4o** was conducted by condensation of 2-(1-aminobenzyl)benzimidazole with symmetrical bis-isatins linked via five alkyl chains ( $n = 2–6$ ). These were subjected to ADME (absorption, distribution, metabolism and excretion), physicochemical properties, molecular docking, *in vitro* antibacterial and antioxidant studies. The *in silico* studies indicated lower toxicity with metabolic stability for nearly all the derivatives proving reliability as drug candidates. The comparative antibacterial study against *Staphylococcus aureus* and *Escherichia coli*, also showed a superior inhibition than reference drug and their mono counterparts. The increase in linker alkyl chain length and variation of substituents in indole, further predicted increased inhibition, with maximum value for compound **4o** at 50  $\mu\text{g/ml}$ . The *in vitro* calf thymus DNA (ct-DNA) binding ability of compounds **4c**, **4f**, **4i**, **4l**, **4m**, **4n**, and **4o** was evaluated via ultraviolet-visible and fluorescence spectroscopy techniques. A hyperchromic effect was observed with no apparent wavelength shift which predicted for the groove binding mode. A moderate binding constant for **4o**, in fluorescence results, confirms groove binding. The molecular docking of **4o** with ct-DNA (PDBID:1BNA) and SARS-CoV-2 M<sup>PRO</sup> (3CL protease, PDBID:6LU7) prove its efficacy as potential DNA binder and antiviral agent.

## KEYWORDS

antibacterial, bis-Schiff bases (SBs), groove binding, molecular docking, SARS-CoV-2 M<sup>PRO</sup>, UV-fluorescence

## 1 | INTRODUCTION

Antimicrobial resistance is a serious global issue that leads to resistance of microbes like bacteria to the available antibacterial agents. Owing to various infectious diseases, like tuberculosis or staphylococcal infection, etc. resistance has become untreatable using existing drugs.<sup>[1,2]</sup> Hence, to overpower these, there is an urgent need to develop new effective antibiotics having better modes of action.

The heterocyclic world is fortunate to have an indole moiety, which is not only a significant structural motif embodied in many

natural products but also an active component of pharmaceuticals.<sup>[3,4]</sup>

The indole nucleus has time and again been proved to have a variety of biological applications such as antibacterial, antitumor, anticonvulsant and antihypertensive activity.<sup>[5–8]</sup> However, bis-indole compounds have shown high antibacterial activities against many antibiotic resistant strains.<sup>[9]</sup>

Similarly, isatin (1*H*-indole-2,3-dione) moiety has been well known for its pharmacological action, as evident from its diverse biological applications namely antimicrobial, anticancer, antifungal, anti-inflammatory and anticonvulsant activities.<sup>[10]</sup> Its bis-Schiff bases

## ■ Biological Chemistry & Chemical Biology

# Multitarget Diallyl Disulfides (DADS) against A $\beta$ Aggregation: Screening through Molecular Docking with A $\beta_{42}$ & Zn<sup>II</sup>-A $\beta_{16}$ , ADME, DFT & Synthetic Strategy

Sugandha Singhal,<sup>[a]</sup> Pankaj Khanna,<sup>[b]</sup> Neeti Misra,<sup>[b]</sup> and Leena Khanna<sup>\*[a]</sup>

The A $\beta_{42}$  amyloid aggregation and its stabilization by coordination metals like Zn<sup>II</sup> through chelation, are the major pathological causes behind the occurrence of Alzheimer's disease (AD). Natural compounds like curcumin and chrysin have depicted A $\beta_{42}$  aggregation inhibition, metal chelation and antioxidant properties. Likewise garlic derived diallyl disulfide (DADS) has shown metal chelation, acetylcholinesterase (AChE) inhibition and antioxidant properties. In the present study a library of **thirty four** unnatural symmetrical DADS derivatives with aliphatic, aryl and new heteroaryl spacer groups, has been designed on the basis of electron releasing/withdrawing substituents and N/O heteroatom. The library was screened

using various theoretical tools for their molecular properties and bioactivity with different receptors, to filter **eleven** potentially active derivatives. Further, Molecular docking study with A $\beta_{42}$  (PDB ID: 1IYT) and Zn<sup>II</sup>-A $\beta_{16}$  (PDB ID: 1ZE9) displayed significant binding of heteroaryl DADS derivatives with highest binding energies and zinc binding ability. DFT calculations helped to predict their binding ability with free Zn<sup>II</sup> ion through disulfide linkage. MEP studies specified their reactive sites of binding. Finally, a synthetic protocol using less toxic reagents has been designed for their synthesis and an in vitro antioxidant activity has been evaluated.

## Introduction

Aging of a person is linked to different changes in the biological and physiological system of the body. It may lead to the development of age-related neurodegenerative disease like Alzheimer (AD). Besides gene polymorphism, one of the major causes of AD is mutation in one of the important genes, the amyloid precursor protein (APP) that results in increased generation of  $\beta$  amyloid peptide. The self-assembled aggregation of A $\beta$  amyloid leads to development of amyloid plaques which play a crucial role in AD.<sup>[1,2]</sup> The presence of soluble monomeric A $\beta$  form in healthy individuals reveals the etiology of AD towards the formation of A $\beta$  aggregates.<sup>[2,3]</sup> The transmembrane APP is sliced by  $\beta$  and  $\gamma$  secretases to produce A $\beta$ . The two most abundant A $\beta$  species produced in brain are A $\beta_{40}$  and A $\beta_{42}$  with soluble fraction ratio of 1.9. A $\beta_{42}$  is more toxic with a higher tendency to aggregate and initiate A $\beta$  aggregation. Hence, the inhibition of A $\beta_{42}$  aggregation is majorly studied over A $\beta_{40}$  towards possible potential therapeutics of AD.<sup>[4,5]</sup> Metal induced aggregation and degeneration of neurons are also some of the major causes of AD. This is verified by a multifold increase in level of metal ions in plaques of AD patients.<sup>[2]</sup> However, metal chelators are able to reverse this

process. Likewise, acetylcholine is a critical neurotransmitter in brain, whose deficiency due to non-generation or increased acetylcholinesterase (AChE) activity, causes loss of memory. The use of AChE inhibitors which can enhance acetylcholine levels is another strategy to improve cognitive functioning in AD.<sup>[6]</sup>

Although till date it is impossible to completely treat AD, yet many unnatural and natural compounds with multifaceted biological activity are investigated continuously to prevent or minimize its effects. The natural products like phenolic compounds including flavonoids, anthraquinones, alkaloids such as indoles, pyridines, and porphyrins, terpenes and steroids have shown effective anti-aggregation towards A $\beta$  amyloid by binding to the metal ions as well as well-defined brain permeability.<sup>[7]</sup> The efficacy of semi-purified extract of *Withania somnifera*'s (ashwagandha) roots, mainly comprising of withanolides and withanosides, has been established in effecting plaque pathology by reducing accumulation of A $\beta$ -amyloid and oligomers in the brains of transgenic mice with Alzheimer's disease.<sup>[8,9]</sup> Various other natural products such as curcumin,<sup>[10,11]</sup> chrysin,<sup>[12]</sup> ginkgo biloba,<sup>[13]</sup> congo red (CR),<sup>[14]</sup> thioflavin S, and revestrol have also been investigated for their A $\beta$  amyloid aggregation inhibition, metal chelation and antioxidant properties.<sup>[15]</sup> It was observed that Congo red (CR), chrysin (CG) and curcumin, which are the major A $\beta$  aggregation inhibitors, bear a similar chemical structure. They contain two aromatic groups that are separated by a linker chain of appropriate length with some functional groups. The two terminal aromatic rings are capable of binding with A $\beta$  protein residues while the linker enables its binding to specific subregions.

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## Screening of compound library identifies novel inhibitors against the MurA enzyme of *Escherichia coli*

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### Abstract

Bacterial cell has always been an attractive target for anti-infective drug discovery. MurA (UDP-N-acetylglucosamine enolpyruvyl transferase) enzyme of *Escherichia coli* (*E.coli*) is crucial for peptidoglycan biosynthetic pathway, as it is involved in the early stages of bacterial cell wall biosynthesis. In the present study we aim to identify novel chemical structures targeting the MurA enzyme. For screening purpose, we used *in silico* approach (pharmacophore based strategy) for 52,026 library compounds (Chembridge, Chemdiv and in house synthetics) which resulted in identification of 50 compounds. These compounds were screened *in vitro* against MurA enzyme and release of inorganic phosphate (Pi) was estimated. Two compounds (IN00152 and IN00156) were found to inhibit MurA enzyme > 70% in primary screening and IC<sub>50</sub> of 14.03 to 32.30 μM respectively. These two hits were further evaluated for their mode of inhibition studies and whole-cell activity where we observed 2–4 folds increase in activity in presence of Permeabilizer EDTA (Ethylenediaminetetraacetic acid). Combination studies were also performed with known antibiotics in presence of EDTA. Hits are reported for the first time against this target and our report also support the use of OM permeabilizer in combination with antibacterial compounds to address the permeability and efficacy issue. These lead hits can be further optimized for drug discovery.

### Key points

- Emerging Gram negative resistant strains is a matter of concern.
- Need for new screening strategies to cope with drying up antibiotics pipeline.
- Outer membrane permeabilizers could be useful to improve potency of molecules to reach its target.

**Keywords** *Escherichia coli* · MurA · Peptidoglycan · Molecular docking · Drug discovery

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Article

# Design and Synthesis of Various 5'-Deoxy-5'-(4-Substituted-1,2,3-Triazol-1-yl)-Uridine Analogues as Inhibitors of *Mycobacterium tuberculosis* Mur Ligases

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**Abstract:** The synthesis of hitherto unknown 5'-deoxy-5'-(4-substituted-1,2,3-triazol-1-yl)-uridine and its evaluation, through an one-pot screening assay, against MurA-F enzymes involved in *Mycobacterium tuberculosis* (Mtb), are described. Starting from UDP-*N*-acetylmuramic acid (UDP-MurNAc), the natural substrate involved in the peptidoglycan biosynthesis, our strategy was to substitute the diphosphate group of UDP-MurNAc by a 1,2,3-triazolo spacer under copper-catalyzed azide-alkyne cycloaddition conditions. The structure-activity relationship was discussed and among the 23 novel compounds developed, *N*-acetylglucosamine analogues **11c** and **11e** emerged as the best inhibitors against the Mtb MurA-F enzymes reconstruction pathway with an inhibitory effect of 56% and 50%, respectively, at 100  $\mu$ M. Both compounds are selective inhibitors of Mtb MurE, the molecular docking and molecular dynamic simulation suggesting that **11c** and **11e** are occupying the active site of Mtb MurE ligase.

**Keywords:** Mur ligase; nucleoside analogues; copper-catalyzed azide-alkyne cycloaddition; antibacterial agents; molecular modelling

## 1. Introduction

*Mycobacterium tuberculosis* (Mtb) disease is one of the top 10 causes of death worldwide and has developed multi-drug resistance [1]. The viability of Mtb is directly linked to its remarkable cell wall structure and especially the peptidoglycan layer. Mur ligases enable the development of cell walls through cytoplasmic and periplasmic biosynthesis [2,3]. Thus, cell wall biosynthesis and especially Mur ligases appear to be a relevant target for new antibiotics [4,5] especially since bacteria have developed different alarming resistance against antibiotics drugs [6–8]. Of interest, the amide ligases MurC, MurD, MurE and MurF share the same catalytic function with similar amino acid regions and preserve comparable structural properties that must be exploited for the design of multi-inhibition molecules, which can reduce the incidence of bacterial resistance [3,5,9]. As part of our drug discovery program,

## NEEM FLOWERS (*AZADIRACHTA INDICA*) AS AN ABUNDANT SOURCE OF NECTAR FOR BUTTERFLIES IN AN URBAN LANDSCAPE IN DELHI, INDIA

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*Reviewer: Peter Smetacek*

### Abstract

Most butterflies feed on floral nectar. The ability of butterflies to access nectar deep within a flower depends on the length of their proboscis. Adequate nutrition is known to maintain the reproductive potential of butterflies. In an urban context, lacking adequate parks and gardens, there is always a need of flowers that can provide nectar to butterflies. In this situation, avenue trees, bearing flowers with nectar accessible to a wide range of butterflies, could help maintain a reasonably diverse butterfly population. The Neem tree, *Azadirachta indica*, is planted along roads and in parks in urban areas of Delhi. Its small flowers were found to attract several species of butterflies belonging to all five major families present in Delhi. It is suggested that trees such as *Azadirachta indica* and other nectar trees, if planted as avenue trees, may help in the conservation of butterflies in an urban landscape.

**Key words:** Flowering tree, Food plant, Butterfly, Urban Landscape

### Introduction

Butterflies are liquid-feeding insects; they acquire food by sucking through their long tubular proboscis (Krenn, 2010). Adult butterflies can be broadly categorised into two feeding guilds: nectar feeding (feeding on floral nectar) and non-nectar feeding (acquiring nutrition from decaying fruit, sap, honey dew, etc.). The feeding habits are associated with certain modifications in the microstructure of the proboscis, particularly at the tip (Krenn *et al.*, 2001, Molleman *et al.*, 2005; Krenn, 2010; Lehnert, *et al.*, 2016). A vast majority of butterflies feed on floral nectar (Krenn, 2010). The profitability of feeding on floral nectar depends in part on the depth of the corolla-tube (or the depth at which nectar is seated in flowers); the amount of nectar, proboscis length and wing load (Corbet, 2000; Tiple *et al.*, 2009). The shorter proboscis of small butterflies limits them from using flowers with deep seated nectar (May, 1992). Butterflies with a longer proboscis

however, can harvest nectar from a broad range of flowers, including flowers with short as well as those with long corolla tubes (May, 1992; Corbet, 2000; Kunte, 2007; Sultana *et al.*, 2017). Nutrition is known to maintain high fecundity in female butterflies and increase their body weight and fat storage (Hill *et al.*, 1989; O'Brien *et al.*, 2004; Mevi-Schutz *et al.*, 2005; Geister *et al.*, 2008; Karlsson *et al.*, 2009). Butterflies obtain nectar from a range of flowers. The role of tree flowers as a source of nectar has not been appreciated by many researchers. Tree flowers however, can be an important source of nectar for butterflies living in or close to forested as well as urban landscapes. Here, I present an account of butterfly species which can benefit from feeding on the flowers of *Azadirachta indica* (A. Juss; Family: Meliaceae) commonly known as 'Neem tree'. The tree commonly grows in urban and rural areas in most parts of India and a few researchers have indicated

## A COMPREHENSIVE CHECKLIST OF BUTTERFLIES SEEN IN CORBETT TIGER RESERVE, UTTARAKHAND, INDIA

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*Reviewer: Peter Smetacek*

### Abstract

Corbett Tiger Reserve (CTR) conserves a wealth of flora and fauna and is a known destination for ecotourism in Northern India. Besides mammals and birds, for which CTR is known to many, frequent visits to CTR and its vicinity for watching butterflies are also on the rise in recent times. In this respect, an account of species of butterflies in the CTR and its vicinity would be useful not only for butterfly ecotourism but also for conservational, educational and scientific purposes. By virtue of photographic documentation of species of butterflies in CTR for over a decade, we provide here a list of butterflies seen in various tourist zones of CTR and its immediate vicinity. We recorded 94 genera and 130 species belonging to six families. On the basis of our records and work by others in CTR, a comprehensive checklist of 143 species of butterflies has been compiled.

### Introduction

Corbett Tiger Reserve (CTR) is one of the key biodiversity areas in the foothills of Himalaya in Northern India. Established as a wildlife sanctuary with a total area of few hundred square kilometres in 1934, it was upgraded to a National Park in 1936 (Khanna *et al.*, 2008). Presently, the CTR has a well-protected expanse of 1288.31 km<sup>2</sup> (NTCA, 2009). The spread of CTR encompasses a variety of habitats that support diverse flora and fauna (Pant, 1986, Editor-Director, 2008, Khan *et al.*, 2008). Besides conserving wilderness, the location and approachability of CTR; and plentiful wildlife attracts lakhs of tourists every year (Badola *et al.*, 2010; Gusain, 2015). The recreational value of CTR generates livelihood for the local community (Badola *et al.* 2010; Kumar *et al.*, 2019).

Today, butterfly watching is one of the favourite recreational activities for many, and the trend is gradually on the rise. This makes

butterflies important from the perspective of ecotourism; defined here as “low impact nature tourism which contributes to the maintenance of species and habitats either directly through a contribution to conservation and/or indirectly by providing revenue to the local community sufficient for local people to value, and therefore protect, their wildlife heritage area as a source of income” (Fennel, 2015; Kurnianto *et al.*, 2016; Singh *et al.*, 2016). The diverse and pristine habitat of CTR is expected to be rich in the diversity of butterflies. However, literature on butterfly diversity in and around CTR is sparse. Only two reports provide an account of species of butterflies found in CTR (Kumar, 2008; Arya *et al.*, 2020). The number of species of butterflies mentioned in these reports are 36 (Kumar, 2008), and 56 (Arya *et al.*, 2020). The present communication reports 130 species of butterflies based on the observations made

## OVIPOSITION BY *JAMIDES BOCHUS* (STOLL, [1782]) (INSECTA: LEPIDOPTERA: LYCAENIDAE) IN NEW DELHI, INDIA

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Several individuals of the Dark Cerulean (*Jamides bochus*) were sighted 3-4 times daily between 30. viii.2020 to 20.ix.2020, fluttering over the crown of *Millettia pinnata* (L.) Panigrahi (Fabaceae). On two occasions, more than two individuals were sighted at a time. On 22.ix.2020, a female *J. bochus* was observed laying eggs on nascent buds and leaves of *M. pinnata*, in the Rohini area of New Delhi. It was observed for 5 minutes from a distance of 2.5-3 m and the events were photographed (Figures 1). The butterfly returned twice to the same spot to lay eggs after fluttering for about 1 minute in the vicinity of the twig, where it had laid the first batch of eggs.

*M. pinnata* is a medium sized tree planted commonly alongside many roads in Delhi.

Sightings of *Jamides bochus* in Delhi are rare. However, during the past few years it has been sighted several times. It was so far not known to breed in Delhi (Chaudhary *et. al.*, 2019, Dr. Surya Prakash, *pers. comm.*). The present observation provides supporting evidence towards the assertion by Chaudhary & Kumar (2019) that the records of the *J. bochus* in Delhi are of a breeding population rather than of migrants.

### Reference

Chaudhary, R. & V. Kumar. 2019. Sightings of *Jamides bochus* (Stoll, [1782]) and *Prosotas nora* (C. Felder, 1860) (insecta: Lepidoptera: Lycaenidae) from urbanized parts of New Delhi. *Bionotes* 21 (1): 3-4.



Fig.1 & 2: Oviposition by *Jamides bochus* on nascent buds and leaf of *Millettia pinnata* in Delhi.

## **SHELTER BUILDING BEHAVIOUR OF *HASORA CHROMUS* (CRAMER, 1780) LARVAE (INSECTA: LEPIDOPTERA: HESPERIIDAE)**

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### **Abstract**

Larvae of many lepidopterans, including those belonging to the family HesperIIDae, construct leaf shelters. It has been indicated that these shelters confer protection to larvae from predators and harsh environmental conditions. The repertoire of shelter architectures constructed by given genera or species of HesperIIDae is fairly predictable. Thus, shelter building behaviour can also be important from the perspective of evolution. The present study provides an insight into shelter building behaviour of larvae of Common Banded Awl, *Hasora chromus* (Cramer), including various designs of shelter that larvae can make, and the role of shelters protection from predators. *H. chromus* larvae were found to construct at least four broad architectural types of shelters by folding and tying leaves. The shelters function as a barrier for arthropod predators (including wasps and spiders), and also effective in protecting larvae from avian predators too.

**Keywords:** Common Banded Awl, *Hasora chromus*, HesperIIDae, Larva, Ecobiology, Shelter-building, Predation, Protection.

### **Introduction**

Larvae of lepidopterans have devised several ways to protect themselves from predators as well as environmental conditions such as solar heat, dislodgement due to shaking or wind blow (Greeney et al., 2015). Their protective strategies include chemical, physiological, morphological, and behavioural defences association with other organisms and avoiding encounters with predators by constructing shelters (Greeney et al., 2015). The latter strategy, *i.e.* shelter making, is widely utilized by larvae of HesperIIDae (Greeney et al., 2003). The larvae of this butterfly family construct shelters with a diverse array of architecture through precisely executed actions, including cutting, rolling, folding and tying a portion or whole of a leaf or several leaves together (Greeney et al., 2003, 2015; Greeney 2009). Within HesperIIDae, the range of shelter architecture made by larvae of a

species is largely predictable, and this may be important from the point of view of phylogeny of this group of butterflies (Greeney et al., 2003, 2010; Greeney 2009). However, studies on shelter building behaviour, architectural details of shelter and its protective values (protection from predators and harsh environment) for larvae have not received much attention, particularly for Indian hesperids. In the present communication, these aforementioned aspects have been reported for Common Banded Awl (*Hasora chromus* Cramer, 1780), a common hesperid butterfly found in most parts of India. *Hasora chromus* lays eggs singly or in groups of 2-3 eggs on nascent leaves of its host plant. There are five larval instars, live in self-constructed leaf shelters (Jenkinson, 2010; Devika Rani et al., 2020). In this observational study, the shelter building behaviour of *H. chromus* was



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# Structural basis of peroxidase catalytic cycle of human Prdx6

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Peroxiredoxin 6 (Prdx6) is a ubiquitously expressed antioxidant non-selenium glutathione peroxidase that is known to play a major role in various physiological and pathological processes. It belongs to the family of peroxidases (referred to as Peroxiredoxins, Prdx's) that work independently of any prosthetic groups or co-factors, and instead utilize a peroxidatic thiol residue for peroxide reduction. Mammalian Prdx's are classified according to the number of Cys implicated in their catalytic activity by the formation of either inter-molecular (typical 2-Cys, Prdx1–4) or intra-molecular (atypical 2-Cys, Prdx5) disulfide bond, or non-covalent interactions (1-Cys, Prdx6). The typical and atypical 2-Prdx's have been identified to show decamer/dimer and monomer/dimer transition, respectively, upon oxidation of their peroxidatic cysteine. However, the alterations in the oligomeric status of Prdx6 as a function of peroxidatic thiol's redox state are still ambiguous. While the crystal structure of recombinant human Prdx6 is resolved as a dimer, the solution structures are reported to have both monomers and dimers. In the present study, we have employed several spectroscopic and electrophoretic probes to discern the impact of change in the redox status of peroxidatic cysteine on conformation and oligomeric status of Prdx6. Our study indicates Prdx6's peroxidase activity to be a redox-based conformation driven process which essentially involves monomer–dimer transition.

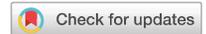
Peroxiredoxin6 (Prdx6) belongs to a family of antioxidant enzymes called peroxiredoxins which rescue cells from oxidative stress by hydrolysing peroxides and peroxidised macromolecules<sup>1</sup>. They have been reported to be involved in various pathological conditions like neurodegeneration, diabetes, acute and chronic lung injury, cancer, etc<sup>1–5</sup>. Prdx family includes six isoforms in mammals, five in *Sachharomyces cerevisiae* and *Drosophila melanogaster*, up to 10 in plants with several specific ones located in the chloroplasts. These Prdx's have been classified on the basis of multiple characteristics, including: (i) Enzymatic mechanism and cysteine involved in catalytic cycle (the most commonly used): this classification gave rise to qualification “typical 2-cys” (human Prdx 1–4), “atypical 2-Cys” (human Prdx5) and “1-Cys” (human Prdx6) Prdx categories; (ii) Sequence diversity and the position of the conserved cysteine: this system classified Prdx in six distinct types called A, B, C, D, E, and F. In mammals, only three of these types (A, B, and D) are present. Type A Prdx include typical 2-cys Prdx, homologous to human Prdx2. Type-B Prdx's include 1-Cys Prdx's homologous to human Prdx6, while, type-D Prdx's includes homologous proteins to human Prdx5.

While typical Prdx (Prdx1–4) and atypical 2-Cys Prdx (Prdx5) have been identified to show decamer/dimer and monomer/dimer transition, respectively, upon oxidation of their peroxidatic cysteine<sup>8,9,33,35</sup>, the impact of redox modulation on 1-Cys Prdx structure is yet not clear. It is to be noted here that with the exception of Prdx6 all mammalian Prdx's have 2-cysteine residues (peroxidatic, C<sub>P</sub> and resolving, C<sub>R</sub>) that forms inter-molecular disulphide bond and are responsible for preferential homo-dimeric arrangement in oxidised state. For detailed review on structural biochemistry of Prdx family refer Sharapov et al. 2014 and Wood et al. 2004.

Prdx6's peroxidase activity is mainly derived from a catalytically active C<sub>P</sub>-Cys 47 residue, located at the N-terminal part of the helix  $\alpha_2$  of  $\beta\alpha\beta$  motif within thioredoxin fold<sup>6</sup>. The redox status of this peroxidatic cysteine regulates switching on/off of Prdx6's peroxidase activity such that the enzyme with reduced Cys is active, oxidised Cys is reversibly inactive and hyperoxidised Cys is irreversibly inactive<sup>6</sup>. Redox cycling of Prdx6 to propel its peroxidase catalysis is believed to comprise of three steps—(i) self-oxidation and concurrent reduction of the peroxide substrate, (ii) glutathionylation of oxidised Prdx6 after hetero-dimerizing with pi-form of glutathione-S-transferase ( $\pi$ GST), and (iii) regeneration of catalytically active reduced Prdx6 and release of oxidised glutathione<sup>7</sup>. However, our knowledge regarding Prdx6 structure in these different redox states (especially the physiologically active structure) is very limited.

Despite progress in the study of other Prdx's, limited data are available in the literature about the structural differences and quaternary structures between the oxidised and reduced forms of Prdx6 and hence the structural basis of redox regulation has not been completely explored. To date, there has been no systematic effort

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OPEN

# pH induced conformational alteration in human peroxiredoxin 6 might be responsible for its resistance against lysosomal pH or high temperature

Rimpy Kaur Chowhan<sup>1</sup>, Sunaina Hotumalani<sup>1</sup>, Hamidur Rahaman<sup>2</sup> & Laishram Rajendrakumar Singh<sup>1</sup>✉

**Peroxiredoxin 6 (Prdx6), the ubiquitously expressed enzyme belonging to the family of peroxidases, namely, peroxiredoxins, exhibits a unique feature of functional compartmentalization within cells. Whereas, the enzyme localized in cytosol shows glutathione peroxidase activity, its lysosomal counterpart performs calcium independent phospholipase A2 (aiPLA<sub>2</sub>) activity. Like any true moonlighting protein, these two activities of Prdx6 are mutually exclusive of each other as a function of the pH of the cellular compartments. Differential substrate preference at different pH (i.e. peroxidised phospholipids at neutral pH and reduced phospholipids at acidic pH) is considered to be the reason for this behavior. To gain insight into the pH-induced structural–functional interplay we have systematically evaluated conformational variations, thermodynamic stability of the protein and quaternary state of the conformers at both pH 7.0 and 4.0. Our findings suggest that change in pH allows alterations in native states of Prdx6 at pH 7.0 and 4.0 such that the changes make the protein resistant to thermal denaturation at low pH.**

Peroxiredoxins (Prdx) are a group of six types of antioxidant enzymes, namely Prdx1–6, that work by reducing cellular peroxide content. This peroxidase activity is mediated by a reduced cysteine residue (also referred to as peroxidatic Cys) that donates its electron to neutralize peroxide and then recycle back into its native form with the help of reductants like thioredoxin (Prdx1–5) and glutathione (Prdx6). Exceptionally, Prdx6 is the only member of this family with additional moonlighting activity of calcium independent phospholipase A2 (aiPLA<sub>2</sub>), and lysophosphatidylcholine acyl transferase (LPCAT) activity. The aiPLA<sub>2</sub> and LPCAT activity is possible because of the presence of lipase motif (GDSWG) that allows Prdx6 to bind with phospholipids<sup>1,2</sup>. Like any true moonlighting proteins, the two active sites for peroxidase (H39, C47, R132) and aiPLA<sub>2</sub> (H26, S32, W33, D140) in Prdx6 are functionally independent of each other such that the deletion of one does not affect the catalytic efficiency of other<sup>3,4</sup>.

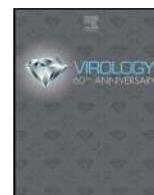
Mammalian Prdx6 is primarily a cytosolic protein (where peroxidase activity is maximal) and is translocated to the acidic organelles like lysosomes and lamellar bodies<sup>1,5</sup> (for its aiPLA<sub>2</sub> activity) with the help of 14-3-3ε chaperone<sup>1,6,7</sup>. This post-translational process requires direct interaction between the specific peptide sequence (amino acids 31–40) on Prdx6 and the chaperone protein, 14-3-3ε<sup>1,6,7</sup>. This pH specificity has been attributed to the differential substrate preference at different pH as Prdx6 at acidic pH has binding affinity for reduced phospholipids and for peroxidised phospholipids at cytosolic pH<sup>8</sup>. This is compatible with the biological role of Prdx6 in lipid metabolism (in lysosome) and antioxidation (in cytosol). To date much effort have been made toward understanding the pH-dependent enzymatic behaviors<sup>1,8–10</sup>. However, the structural alterations responsible for this pH dependent functional behaviour of Prdx6 have yet not been thoroughly explored. Therefore, structure–function relation of this enzyme is not known. In the present study to comprehend the structure–function dynamics of Prdx6, we have investigated the pH-induced conformational variations in human Prdx6 (hPrdx6). We observed that low pH brings conformational changes to switch to high order oligomer and the oligomer formation is the rationale for resistance of hPrdx6 at lysosomal pH and high temperature.

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## Experimental validation of influenza A virus matrix protein (M1) interaction with host cellular alpha enolase and pyruvate kinase

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### ABSTRACT

Influenza A virus, a respiratory pathogen manipulates various host cellular processes to establish a successful infection in a host. We had reported earlier the interaction of influenza A virus nucleoprotein with host glycolytic enzymes; alpha enolase and pyruvate kinase in A549 cells. Matrix protein (M1), another multifunctional protein encoded by genome segment 7 forms the inner layer of the virion and interacts with the ribonucleoprotein complex. Nucleoprotein and matrix protein, major structural components of the virion together contribute to the stability of the capsid. Thus, we have investigated the interaction of viral matrix protein with host glycolytic enzymes; alpha enolase and pyruvate kinase. Results had demonstrated differential expression of these two glycolytic enzymes in response to matrix protein and their interaction with matrix protein by *in vitro* binding, co-immunoprecipitation and co-localization studies. Our results confirmed that viral matrix protein interacts with host glycolytic enzymes in association with viral nucleoprotein.

### 1. Introduction

Viruses, not encoding for metabolic machinery manipulate several host cellular metabolic processes to ensure the optimal conditions for their replication, spread and infection. Altered cellular metabolic processes may provide increased pool of nucleotides and amino acids for replication and enhanced expression of viral proteins over host cellular proteins. Influenza A virus, a respiratory pathogen remains as a major public health threat worldwide. It is an enveloped virus and its genome comprises of eight negative sense RNA segments. It continuously develops remarkable strategies to evade the host defense mechanisms and to manipulate the host cellular metabolic processes (van der Sandt et al., 2012; Fernandez-Sesma et al., 2006) to establish infection in the host. During infection, influenza viral proteins interact with cellular proteins to redirect the host machinery to facilitate its replication and the production of progeny particles.

We previously reported differential expression of alpha enolase and pyruvate kinase (PKM) in A549 cells expressing recombinant influenza A virus nucleoprotein (NP) by proteome analysis and the interaction of viral NP with the above two glycolytic proteins (Kumar et al., 2017). Interestingly, these two host glycolytic proteins were reported to be packaged into mature influenza A virion by a proteomic approach (Shaw et al., 2008). This report together with our study indicates the

possible role of these two proteins in influenza A virus life cycle. NP encoded by viral segment 5 is a structural protein that encapsidates negative sense RNA segments and three RNA dependent RNA polymerase subunits (PA, PB1 and PB2) forms a ribonucleoprotein (RNP) complex (Portela and Digard, 2002). It interacts with plethora of cellular proteins and plays multiple roles in virus replication. Matrix protein (M1), a 27 kDa protein encoded by segment 7 of influenza A virus is another abundant protein plays an essential structural and functional role in virus life cycle (Rossman and Lamb, 2011). It is the major component of the virion, lies underneath the lipid envelope in the form of dimer and provides rigidity to the virion. M1 interacts with both viral RNA and NP to facilitate the formation of RNP complexes (Bui et al., 2000; Noton et al., 2007). Its interaction with RNP forms a bridge between capsid proteins and surface proteins through protein-lipid and protein-protein interaction (Boulo et al., 2007). M1 protein has N terminal, Linker, Middle and C terminal domains. M1 mediates protein-protein interaction with NP through its N-terminal domain, and with viral RNA through a basic RNA-binding motif present in the middle domain (Noton et al., 2007).

Following entry in to the host cell, disruption of M1-RNP interaction is indispensable for uncoating of virion to release RNP complexes and their transport to nucleus for replication (Martin and Heleniust, 1991). M1 during replication moves in and out of nucleus through nuclear

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<sup>1</sup> Authors contributed equally.

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## Diabetes: Perspective and challenges in modern era

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### Abstract

Prevalence of diabetes is increasing rapidly due to change in lifestyle and modernization. Other than genetic and lifestyle factors, research has been concentrated in recognizing the effect of in utero conditions and mechanisms of epigenetics in developing diabetes. It emphasizes the need of discovering new methods of prevention focusing on child and maternal health. The Diabetes prevalence is more in developing nations than developed nations. In modern era with the globalization diabetes is a major reason of medical care expenditure and mortality and it is one of the biggest health challenges of current and future time frame. Improved living and economic conditions can decrease the type 2 diabetes prevalence. It is an impelling logic for supporting the type 2 diabetes prevention and control efforts.



## Vertical Motion of the Variable Infinitesimal Mass In the Circular Sitnikov Problem

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### Abstract

The circular case of Sitnikov problem is studied here when the infinitesimal body varies its mass according to Jeans law and it is moving along the  $z$ -axis which is perpendicular to the orbital plane of the two equal spherical primaries. The two primaries are moving in  $xy$ -plane on the same circular path. These two primaries are imposing the Newtonian forces on the third variable mass body but not influenced by it. Stability of equilibrium points is examined followed by the derived equations of motion. The time-series solutions of the equation of motion are performed by using the Lindstedt-Poincaré method which is used to remove the secular term. We have numerically performed the time-series which shows that variation parameters have great impact on it.

**Keywords:** Circular Sitnikov problem; Variable mass; Meshcherskii transformation; Lindstedt-Poincaré method

**MSC 2010 No.:** 70F15, 70K42, 70F07

# Generalized Elliptic Restricted Four-Body Problem with Variable Mass

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**Abstract**—The elliptic case of restricted four-body problem with variable mass of infinitesimal body is studied here. The three primary bodies which are placed at the vertices of an equilateral triangle and moving in the elliptical orbits around their common center of mass. Out of these primaries we have considered that one massive body is having radiating effect and other two bodies are oblate in shapes. The fourth body which have infinitesimal mass, are varying its mass according to Jeans law. We derive the equations of motion of the infinitesimal body under the generalized sense in the elliptic restricted four-body problem by using the Meshcherskii-space time transformations. Further we numerically study about the equilibrium points, Poincaré surfaces of section, regions of possible motion and basins of the attracting domain by considering the variation of parameters used. Further more we examine the stability of these equilibrium points and found them unstable.

**DOI:** 10.1134/S1063773720040015

**Keywords:** *elliptical orbit, variable mass, oblate, regions of motion, attracting domain.*

## 1. INTRODUCTION

In the present age to write a research article is a serious problem because of the plagiarism. We have to be straight forward towards our aim and goal for the research. Here our field is celestial mechanics and dynamical astronomy which lies in the field of applied mathematics and is branch of mechanics. This study is related to the celestial bodies and behaviour of their motions. During last decades, researchers focused on the study of motion of a small body (in general satellite) under the influence of two, three or four massive bodies but small body is not influencing them. Accordingly they have considered their configurations while these bodies are moving either in circular or elliptical orbits with many other perturbations.

Some of them are as follows: By supposing the bigger primary as oblate spheroid, Sharma and SubbaRao (1976) studied the stationary solutions and their characteristic exponents in the circular restricted 3-body problem. Kalvouridis (1997) investigated the equilibrium points and permissible regions of motion of the minor bodies under the effect of radiated oblate primaries. Douskos (2010) revealed the basins of attraction in the generalized Hill's problem.

Baltagiannis et al. (2011) studied the stability of the equilibrium points of the infinitesimal body

which is moving under the influence of the three primaries. These primaries are situated at the vertices of an equilateral triangle, moving in circular orbits around their common center of mass to which they consider as origin. Further they have studied the zero-velocity surfaces and corresponding equipotential curves. They also found that collinear equilibrium points does not exist when all three-masses are not equal. Furthermore they have illustrated the basins of attraction for the present dynamical model. Kumari and Kushvah (2013, 2014) have illustrated the equilibrium points, their stability, zero-velocity curves as well as the basins of attraction in the restricted four-body problem under the effect of solar drag and oblateness.

Singh and Vincent (2016) studied the motion of infinitesimal body in the generalized restricted three-body problem. Generalized in the sense that both the primaries are radiating, oblate bodies, together with the effect of the gravitational potential from the belt and they found seven equilibrium points instead of five equilibrium points in the classical restricted three-body problem. They also found that collinear points are always unstable while triangular points are stable for some interval of mass ratio. Zotos (2017) performed the basins of attraction in the planar equilateral restricted four-body problem.

Abouelmagd and Ansari (2019) studied numerically the bicircular Sun perturbed Earth-Moon-satellite system and illustrated the equilibrium points,

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# THE MOTION PROPERTIES OF THE VARIABLE MASS PLANETOID IN THE ELLIPTICAL SITNIKOV PROBLEM

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## Abstract

The aim of the study is to investigate the effect of variation parameters due to variable mass of the planetoid in the elliptical Sitnikov problem. Where both primaries are moving in elliptical orbits and imposing the gravitational forces on the third infinitesimal body which varies its mass according to Jeans law and it does not affect the motion of the primaries. Planetoid is moving along perpendicular line ( $z$ -axis) to the orbital plane of the primaries. We derive the equation of motion of the planetoid followed by the hamiltonian of the system. Then we solve the equation of motion of the Hill's type equation. And again the time-series solution to the equation with nonlinear force is determined using first the Courant and Snyder transformation followed by the Lindstedt–Poincaré perturbation method which is used to remove the secular term and then an application of Courant and Snyder transformation is used. We have numerically performed the time-series which shows that variation parameters have great impact on it. We also compare our results with the existing results and found significant role of the variation parameters used.

**Keywords:** Elliptical Sitnikov problem, Variable mass, Jeans law, Courant and Snyder transformation.

## 1 Introduction

Sitnikov configuration is an interesting problem which starts over decades by K. A. Sitnikov in 1960. This configuration of restricted problem has primaries which are moving either in elliptic or circular path in the same plane while third body is moving on the vertical straight line of the plane of the motion of the primaries. These configurations are studied with different shapes of the bodies (as point mass, spherical shape, oblateness, triaxial body, heterogeneous body, homogeneous body etc.), variable mass, mobile coordinates, viscous force, Stroke force, Poynting-Robertson drag, resonance, coriolis and centrifugal forces, modified Newtonian potential etc. Many scientists have studied these problems some of them are as follows:

Jeans [1928] explained about variable mass in his book. Singh [1984, 2008, 2011] studied the effect of oblateness and variable parameters in the frame of circular restricted three-body problem. Perdios *et al.* [1988, 2007, 2008, 2012] studied the restricted three- body problem in the Sitnikov configuration where they discussed the periodic motion, the stability and self resonant bifurcations. Faruque [2003] used a Lindstedt-Poincare perturbation method and Courant-Snyder transformation to evaluate the solution and compared with existing solution where he found satisfactory agreement. Kalantonis *et al.* [2008] studied the problem with Sitnikov configuration by supposing the radiated oblate-primaries. Zhang *et al.* [2012] investigated the effect of variable mass of the infinitesimal body in the frame of circular restricted three-body problem.

Shahbaz *et al.* [2015] studied the series solution of the problem in the elliptic Sitnikov configuration when there are  $N + 1$  bodies by following Giacaglia [1967]. Ansari *et al.* [2017, 2018, 2019] have studied restricted three-body

## PERTURBED SIX-BODY CONFIGURATION WITH VARIABLE MASS

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*Abstract.* Six-body configuration is investigated with the effects of oblateness, variable mass as well as Coriolis and centrifugal forces, where four equal bodies are placed at the vertices of a square and fifth body is placed at the center of the circle on which the previous four bodies are moving. All five bodies are considered as oblate in shapes where first four bodies have same oblateness while fifth body has different oblateness. There is the sixth smallest body which varies its mass according to Jeans law. The system is also affected with small perturbations in the Coriolis and centrifugal forces. By considering these effects and using the Jeans law as well as Meshcherskii space time transformations, the system of equations of motion for the smallest body is determined. The Jacobian integral and mean motion are also admitted from this system. Further the equilibrium points, motion for forbidden regions and attracting regions are illustrated under the effects of above said parameters. Here twelve equilibrium points are exists out of which four equilibrium points are collinear, four points are on the perpendicular axis and rest four points are in four quadrants separately. Finally, the stability of these equilibrium points are examined by using Meshcherskii space time inverse transformations and found them unstable.

*Key words:* Perturbed six-body configuration – Coriolis and centrifugal forces – Oblateness – Attracting regions.

### 1. INTRODUCTION

The restricted problem is the most considerable problem in the Celestial Mechanics and Space Dynamics due to its theoretical and practical importance. This restricted problem may have three, four, five or N-body and was studied investigate by many researchers. In the restricted three-body problem authors have considered many types of configurations one of them is the classical restricted three-body configuration where two bodies are placed at the same straight line and moving either in the circular orbits or in the elliptical orbits while the third infinitesimal body is moving under the influence of these two bodies which are known as primaries. Szebehely (1967) investigated the problem taken into account only to the gravitational forces and identified five libration points in the classical case out of which three are collinear and two are non-collinear. The collinear libration points are unstable for  $0 \leq \mu \leq 1/2$

**ORIGINAL ARTICLE**

## EPQ MODEL WITH GREEN PRODUCTION, PRODUCT STEWARD SHIP AND SELLING PRICE DEPENDENT DEMAND

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**Abstract:** There are number of confrontations faced by the producers to manufacture a product environmental friendly. These challenges can be related to the product design, manufacturing process and the waste diffusion after reprocess. To solve these issues, a production model is proposed for green production. Shortage is not permissible in the whole time cycle. To promote the model, demand and selling price are correlated. Cost of Product stewardship and green production cost is calculated for the model made it more suitable. It is analyzed that if the products are recycled then it will become more costly than a fresh product. The objective of this paper is to reduce total cost of recycled object with the help of green production and product stewardship. Agriculture is one of the most suitable example for this model. The aim of this research paper is achieved and it is proved with the help of sensitivity analysis. An optimal solution is derived for proposed model and to epitomize the analytic result of convexity behavior of the function and sensitivity analysis of some specific parameters is done in the paper. A theorem is also annexed in the paper to derive the condition for the convexity of total cost function.

**Key words:** Production model, Green production, Product stewardship, Selling price, Dependent demand.

### Cite this article

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### 1. Introduction

Product stewardship is mainly centralized on environmental aspects of a product, including the systems of manufacturing, distribution, utilization and end-of-life management. Its important aim is to minimize the total environmental impact of product life cycle. Normally, product stewardship considers several environmental impacts; some of them are associated with the use of raw materials, energy, water and auxiliaries, while others are associated with the emissions of waste from the product life cycle. Product stewardship is a influential driver for the reduction of salvage toxicity and volume. By addressing the responsibility for commodity life cycle management on the producer, these operations ensure that life cycle impacts of any commodity or package are considered

at the initial stages of product design. Product stewardship programs provide facility for producers to redesign different products and packaging to be low toxic, lighter and less bulky, as well as much more recyclable. Reducing material toxicity and booming recycling result in powerful environmental, energy reduction and economic benefits. The target of product stewardship is environment, health, and safety protection features of any product. Green production is an example of agriculture production. In farming all the by-products of a crop are utilized and recycled for the utilization. Initially, Weinberg (1999) introduced a way of environmental awareness, product stewardship to attempt limited impact of products on environment. Peck Jerilynn and John (2006) developed a practical approach of product stewardship for moss harvest due



## RESEARCH ARTICLE



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## Green design and product stewardship approach for two-warehouse inventory model

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### Abstract

**Background/Objectives:** To trim down the recycling cost of any manufactured goods with the help of green design and product stewardship. **Methods/Statistical analysis:** For the planned EPQ (economic production quantity model) model, all costs are calculated to find total cost and this total cost is optimized with the help of the Hessian matrix. Sensitivity analysis is also carried w.r.t. different parameters, to illustrate the impact of these parameters on the proposed model. The convexity of the total cost function is also checked with the help of mathematical software Mathematica 9.0. **Findings:** Major finding of the proposed model are as follows: (i) Increase in the number of recycles results in the reduction of the total cost. (ii) Product stewardship parameter has a negative effect on total cost as the PS increases from 1 to 4 units, total cost decreases from 5926.00 to 5918.96 units (see [Table 9](#)) (similar findings can be written for numeric example 1 after correcting it). (iii) Green design costs have a positive effect on total cost, as the green design cost increases from 3 to 6 units, total cost also increases from 5918.49 to 5920.37 units (see [Table 10](#)). (iv) increase in the number of recycles results in the reduction of the total cost, as the number of recycles increases from 20 to 50 units total cost decreases from 5922.87 to 5919.12 units (see [Table 11](#)). **Novelty/Applications:** The Study of the effects of recycling by this green design and product stewardship approach makes the proposed model distinctive from the existing methods. The proposed model applies to eco-friendly manufacturing items with green design and product stewardship.

**Keywords:** Green design; product stewardship; production model; own warehouse (OW); rented warehouse (RW); shortage; deterioration

### 1 Introduction

In the current inventory modeling, green design and product stewardship are quite emerging issues. To resolve environmental stumbling blocks, inventory modeling can play a significant role in terms of green design and product stewardship. Manufacturer designs products considering it to be a profitable task, but most



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Dear Professor Ansari,

Based on the reviewers' comments, I am pleased to inform you that your manuscript, titled as above, has been accepted for publication in AAM journal. Please review the entire manuscript once more to be sure there is no error and it complies with the AAM Guides for Authors, regarding text formatting. Then, submit your final version within 30 days from the date of this letter, electronically.

Thank you again for submitting your manuscripts to AAM. I look forward to receiving more manuscripts from you and your colleagues.

With warmest regards,

A. M. Haghighi, Ph. D.



# Properties of Motion of the Infinitesimal Variable Mass Body in the Well Known Circular Restricted Three-Body Problem with Newtonian and Yukawa Potential

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**Abstract:** The effects of Newtonian and Yukawa gravitational potentials are studied on the circular restricted three-body system under the assumption that infinitesimal body varies its mass according to Jeans law. The equations of motion are determined under these perturbations. The numerical studies are conducted where locations of equilibrium points, regions of motion, trajectories with Poincaré surfaces of section and the basins of attraction have been investigated by well known software Mathematica. Moreover, the stability of the locations of equilibrium points are determined and it was found that all these points are unstable.

**Keywords:** Attracting domain, Newtonian potential, Variable mass, Trajectories, Yukawa potential.

## 1 Introduction

The classical circular restricted three-body problem is the most intriguing problem in celestial mechanics and dynamic astronomy. The restricted three-body problem describes the movement of a third body in the combined gravity field of two primary bodies with an infinitesimal mass (serving as the particle testing), according to [1]. Several practical applications exist in this subject ranging from theory of molecular physics, chaos, planetary physics and galactic dynamics.

In the last decade, the classical three-body problem has changed considerably to explain the motion existence of mass-free measuring particles in the solar system, considering more dynamic parameters. Particularly, several additional forces have increased the effective potential of the classical restricted three-body problem.

In the conventional version of the restricted three body problem, the two primaries are spherical and homogeneous. However, some celestial bodies (e.g. Saturn and Jupiter) in our solar system also have an oblate shape. The parameter of oblateness has been added to achieve a more accurate definition of the motion of the test particle. Numerous articles, such as: [2], [3], [4], [5],

[6], [7], [8], [9], have explored the effect of oblateness on the character of motion.

The restricted three-body problem explains how the two finite masses (i.e. primaries) move in circular orbits around their center of mass due to their reciprocal attraction and infinitesimal mass body that does not affect the motion of primaries. It was first conceived because of the nearly circular orbits of the planets around the sun, the tiny masses of the asteroids as well as planetary satellites relative to the masses of those planets were considered. The restricted problem is also addressed in other configurations as three-body problem (with special configurations as copenhagen problem, Robe's problem), four-body problem, five-body problem and six-body problem by many researchers, including [10], [11], [12], [13], [14], [15] etc. The infinitesimal body has been seen to experience a position of rest at a certain point in the motion plane at some particular points in case of zero velocity and zero acceleration. These points are known as balance points (stationary points) and are five in classical case. Three of these points are called hill balance points because they lie on the  $x$ -axis and on the line that connects the primaries. These three points are referenced respectively by  $L_1, L_2$  and  $L_3$ . The hillside balance points

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*to be amended*



## On Estimating Scale Parameter of the Selected Pareto Population under the Generalized Stein Loss Function

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### ABSTRACT

The problem of estimation after selection can be seen in numerous statistical applications. Let  $X_{i1}, \dots, X_{in}$  be a random sample drawn from the population  $\Pi_i, i = 1, \dots, k$ , where  $\Pi_i$  follows Pareto distribution with an unknown scale parameter  $\theta_i$  and common known shape parameter  $\beta$ . This article is concerned with the problem of estimating  $\theta_L$  (or  $\theta_S$ ), the scale parameter of the selected Pareto population under the generalized Stein loss function. The uniformly minimum risk unbiased (UMRU) estimators of  $\theta_L$  and  $\theta_S$ , scale parameters of the largest and the smallest population respectively, are determined. For  $k=2$ , we have obtained a sufficient condition of minimaxity of  $\theta_S$  and showed that the generalized Bayes estimator of  $\theta_S$  is a minimax estimator for  $k=2$ . Also, a class of linear admissible estimators of the form  $dX_{(2)}(dX_{(1)})$  of  $\theta_L$  and  $\theta_S$  is found, and a sufficient condition for inadmissibility is provided. Further, we demonstrate that the UMRU estimator of  $\theta_S$  is inadmissible. A comparison between the proposed estimators is conducted using MATLAB software and a real data set is analyzed for illustrative purposes. Finally, conclusions and discussion are reported.

### KEY WORDS AND PHRASES

Generalized Bayes estimators; generalized Stein loss (GSL) function; inadmissibility; minimaxity; Pareto distributions; UMRU estimator

## 1. Introduction

The Pareto distribution was initially presented by Pareto (1964) as a model to describe the income of individuals in literature. Thereafter, this distribution has found wide-spread applications in various fields of studies such as agricultural, industrial, and economic investigations. Johnson et al. (1994) have recognized that this distribution can be used to adequately model quantities such as distributions of individual incomes, city population sizes, geophysical, stock price fluctuations, etc. For a detailed review of literature on estimating parameters of Pareto populations, one may refer to Malik (1970), Kern (1983), Asrabadi (1990), Amin (2008), Dixit and Nooghabi (2010, 2011), Scollnik (2013), and the references therein.

The problem of estimating parameters after selection has been extensively studied in the statistical literature and widely discussed in many real-life applications, such as industrial, agricultural, economic, and medical experiments. The concrete applications

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# Alternative Treatment Strategies for Secondary Bacterial and Fungal Infections Associated with COVID-19

Ritam Das, Komal Kotra, Pulkit Singh, Belinda Loh, Sebastian Lechtin & Urmil Bajpai *Infectious Diseases and Therapy* 11, 53–78 (2022) | [Cite this article](#)3073 Accesses | 2 Citations | 11 Altmetric | [Metrics](#) A [Correction](#) to this article was published on 25 January 2022 This article has been [updated](#)

## Abstract

Antimicrobials are essential for combating infectious diseases. However, an increase in resistance to them is a major cause of concern. The empirical use of drugs in managing COVID-19 and the associated secondary infections have further exacerbated the problem of antimicrobial resistance. Hence, the situation mandates exploring and developing efficient

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## Adverse events and breakthrough infections associated with COVID-19 vaccination in the Indian population

Geetika Arora, Jyoti Taneja, Priya Bhardwaj, Shorya Goyal, Kumar Naidu, Sunita, K. Yadav, Daman Saluja✉, Sunita Jetly✉

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G. Arora and J. Taneja are equal contributors.

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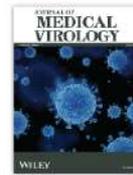
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### Abstract

Vaccines against COVID-19 provide immunity to deter severe morbidities associated with the infection. However, it does not prevent infection altogether in all exposed individuals. Furthermore, emerging variants of SARS-CoV-2 impose a threat concerning the



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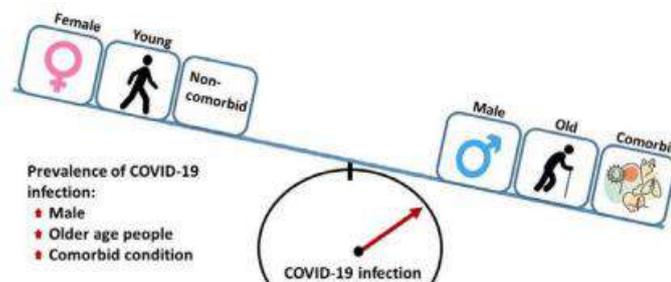
## Association of Gender, Age, and Comorbidities with COVID-19 infection in India

Sunita Kumari Yadav,<sup>1</sup> Priya Bhardwaj,<sup>2</sup> Praveen Gupta,<sup>3</sup> Daman Saluja,<sup>4</sup> Sunita Jetly,<sup>5</sup> Jyoti Taneja<sup>1\*</sup>

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### ABSTRACT



Due to a lack of data on various parameters with COVID-19 in the Indian population, this study was carried out to understand the relation among gender, age and comorbidities in Indian population. The data was collected using a questionnaire-based survey form that included questions on

# Hesitancy and Acceptance of COVID-19 Vaccination Amidst the Second Wave of Pandemic in India: A General Population Study

Sunita Jetly, PhD<sup>1\*</sup>, Priya Bhardwaj, PhD<sup>2\*</sup>,  
Geetika Arora, MSc<sup>3</sup>, Daman Saluja, PhD<sup>4</sup>,  
Sunita K. Yadav, PhD<sup>5</sup>, Kumar P. Naidu, MSc<sup>6</sup>,  
and Jyoti Taneja, PhD<sup>5</sup> 

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## Introduction

Currently, with Delta, Omicron, and other variants on a rampage across the world, it is imperative to get vaccinated in time to curtail the burden of COVID-19 pandemic. The SARS-CoV-2 pandemic was devastating in India, infecting more than 34 million people and 4 million mortality as on December 22, 2021.<sup>1</sup> India is the second densest country with a population of more than 1.3 billion posing a challenge for COVID-19 vaccination.<sup>2</sup> In order to accelerate the pace of vaccination, the Government of India adopted an aggressive “Covid-19 Vaccine Communication Strategy” with the key elements being advocacy, capacity building, media, and social media engagement, social mobilization, community engagement, and adverse events following immunization (AEFI) crisis communication.<sup>3</sup> The pace of vaccination has tremendously increased from 1.26% in June 2021 to 41.2% (both doses) on December 21, 2021.<sup>4</sup> However, despite India

## Results

### *Demographic Profile of Respondents*

A total of 2051 Indians participated in the online and offline surveys with a higher representation of respondents aged 18 to 40 years (70.9%), 41 to 60 years (23.8%), and 61 years and above (5.3%). Gender was found to be almost equally distributed among respondents. About 37.7% were academicians followed by professional and managerial occupations (32.3%) and frontline workers (15.7%). Of note, about 37.1% of the study participants had experienced COVID-19.

### *Basic Characteristics of Vaccine Hesitancy (VH) and Vaccine Acceptance (VA) Group*

Among participants, 146 (7.2%) were hesitant, and a higher number of participants, 1880 (92.8%) accepted the COVID-



# Bioreducible polyethylenimine core–shell nanostructures as efficient and non-toxic gene and drug delivery vectors

H. Jena<sup>a, b</sup>, Z. Ahmadi<sup>b, c</sup>, P. Kumar<sup>b</sup>  , G. Dhawan<sup>a, d</sup>  

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## Abstract

Low molecular weight branched polyethylenimine (LMW bPEIs 1.8 kDa) have received considerable attention for the fabrication of nucleic acid carriers due to their biocompatible and non-toxic nature. However, due to the inadequate nucleic acid complexation ability and transportation across the cell membrane, these show poor transfection efficacy, limiting their clinical applications. Therefore, to overcome these challenges, in this study, we have grafted bPEI 1.8 kDa with a disulfide bond containing hydrophobic moiety, 3-(2-pyridyldithio) propionic acid (PDPA), via amide linkages through EDC/NHS-mediated coupling to obtain N-[3-(2-pyridyldithio)] propionoyl polyethylenimine (PDPP) conjugates. The best formulation for nucleic acid transfection was evaluated after preparing a series of

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## Exploring the role of framework mutations in enabling breadth of a cross-reactive antibody (CR3022) against the SARS-CoV-2 RBD and its variants of concern

Samvedna Saini , Manuamruti Agarwal , Amartya Pradhan , Savitha Pareek, Ashish K Singh, Gagan Dhawan  ... [show all](#)

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### Abstract

Cross-reactive and broadly neutralizing antibodies against surface proteins of diverse strains of rapidly evolving viral pathogens like SARS-CoV-2 can prevent infection and therefore are crucial for the development of effective universal vaccines. While antibodies typically incorporate mutations in their complementarity determining regions during affinity maturation, mutations in the framework regions have been reported as

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## Synthesis and Characterization of Nanoselenium: A Step-by-Step Guide for Undergraduate Students

Gagan Dhawan\*, Indu Singh, Uma Dhawan\*, and Pradeep Kumar\*

Cite this: *J. Chem. Educ.* 2021, 98, 9, 2982–2989

Publication Date: August 20, 2021

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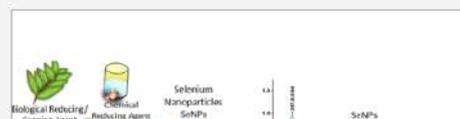
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SUBJECTS: Metal nanoparticles, Nanoparticles, Selenium, &lt;

### Abstract

Nanoparticle synthesis is an important area of nanotechnology and has been performed by undergraduate students from various universities across the globe. Due to the availability of massive data on the synthesis of a wide variety of metallic nanoparticles, including silver, gold, selenium, zinc,





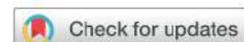
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Pharmaceutical Nanotechnology

## Self-Assembled Biodegradable Core-Shell Nanocomposites of Amphiphilic Retinoic Acid-LMW bPEI Conjugates Exhibit Enhanced Transgene Expression in Hepatocellular Carcinoma Cells With Inherent Anticancer Properties



Zeba Ahmadi<sup>a,b</sup>, Harekrushna Jena<sup>a,c</sup>, Mahak Singh<sup>d</sup>, Gagan Dhawan<sup>c</sup>, Pradeep Kumar<sup>a,b,\*</sup>

<sup>a</sup> Nucleic Acids Research Laboratory, CSIR-Institute of Genomics and Integrative Biology, Mall Road, Delhi-110007, India

<sup>b</sup> Academy of Scientific and Innovation Research (ASIR), Chaziabad- 201002, India

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<sup>d</sup> Department of Chemistry, Ramjas College (University of Delhi), University Enclave, Delhi-110007, India



Review

# Fluorine-containing pharmaceuticals approved by the FDA in 2020: Synthesis and biological activity

Yingjie Yu <sup>a</sup>, Aiyao Liu <sup>a</sup>, Gagan Dhawan <sup>b</sup>  , Haibo Mei <sup>a</sup>, Wei Zhang <sup>c</sup>  , Kunisuke Izawa <sup>d</sup>, Vadim A. Soloshonok <sup>a, f</sup>  , Jianlin Han <sup>a</sup>  

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## Abstract

Thirteen new fluorine-containing drugs, which have been granted approval by the US Food and Drug Administration (FDA) in 2020, are profiled in this review. Therapeutic areas of these new fluorinated pharmaceuticals include medicines and diagnostic agents for Cushing's disease, neurofibromatosis, migraine, Alzheimer's disease, myelodysplastic syndromes, hereditary angioedema attacks, and various cancers. Molecules of these approved drugs feature aromatic fluorine (Ar-F) (11 compounds), aromatic Ar-CF<sub>3</sub> (1), aliphatic CHF (1) and CF<sub>2</sub> (1) groups. For each compound, we provide a spectrum of biological activity, medicinal chemistry

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Author(s): Anju Kumari, Rimpay Kaur Chowhan, Pushpa Kekchingtabam, Sharifun Shehnaaj, Hamidur Rahaman, Mohd Saquib Ansari and Laishram Rajendrakumar Singh\*  
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**Abstract**  
The moonlighting protein, Prdx-6, exhibits peroxidase activity, phospholipase activity, and lysophosphatidylcholine acyltransferase (LPCAT) activity. Although it is ubiquitous in expression, its level is prominently high in the lung. Prdx-6 has been known to be an important enzyme for the maintenance of normal lung physiology including antioxidant defense, lung surfactant homeostasis, and cell signaling. Studies

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## Signaling mechanisms and biochemical pathways regulating pollen-stigma interaction, seed development and seedling growth in sunflower under salt stress

Review

Satish C. Bhatta , Mansi Gogna, Prachi Jain, Neha Singh, Soumya Mukherjee & Geetika Kaira

Article: 1958129 | Received: 25 Jun 2021 | Accepted: 15 Jul 2021 | Published online: 25 Aug 2021

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**ABSTRACT**

Sunflower (*Helianthus annuus* L.) is one of the major oilseed crops cultivated world over for its high-quality oil rich in linoleic acid. It also has established applications in pharmaceutical and biotechnological industries, mainly through recombinant production of unique oil body (OB) membrane proteins-oleosins, which are used for producing a wide variety of vaccines, food products, cosmetics and nutraceuticals. The present

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ABSTRACT

Introduction

Biomolecules

Published: 08 March 2021

## Unraveling the AM fungal community for understanding its ecosystem resilience to changed climate in agroecosystems

Dipanti Chourasiya, Manju M. Gupta, Sumit Sahnji, Fritz Oehl, Richa Agnihotri, Reena Buade, Hemant S. Maheshwari, Anil Prakash & Mahaveer P. Sharma 

*Symbiosis* **84**, 295–310 (2021) | [Cite this article](#)

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### Abstract

The changing global climate affects the agroecosystem making it challenging to achieve the world's sustainable development goals. Among the facets of belowground microbial communities, the arbuscular mycorrhizal fungi (AMF) hold an important place. They represent the most common symbiont phylum colonizing more than 80% of the plant families and are likely to be affected by global climate change. These fungi facilitate plant's mineral acquisition, improving growth and protecting them from biotic and abiotic stresses. The elevated carbon dioxide (eCO<sub>2</sub>) level, temperature, increased nitrogen and phosphorus deposition influences the plant phenology and AMF functioning through changes in diversity and community composition of AMF. The interaction effects of soil management practices due to climate change affect the system productivity and perturb mineral cycling. Understanding

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## **Al<sub>2</sub>O<sub>3</sub>/CuI/PANI nanocomposite catalyzed green synthesis of biologically active 2-substituted benzimidazole derivatives**

*Sahil Kohli,<sup>1</sup> Garima Rathee,<sup>1</sup> Sunita Hooda<sup>2,b\*</sup> and Ramesh Chandra<sup>1,a\*</sup>*

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(b) Dr. Sunita Hooda, Department of Chemistry, Acharya Narendra Dev College, University of Delhi, Delhi-110019, India. E-mail: hooda\_sunita@hotmail.com.



## Multifunctional activity of graphene oxide-based nanoformulation against the disease vector, *Aedes aegypti*

PDF

Published Dec 16, 2021

DOI <https://doi.org/10.31018/jans.v13i4.3018>**Devaj Gupta**

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**Sarita Kumar**

Department of Zoology, Acharya Narendra Dev College, University of Delhi, Kalkaji, New Delhi-110019, India

### Abstract

*Aedes aegypti* management is a global concern due to the absence of medication and effective vaccines. The

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Review Paper | Published: 06 January 2022

## Review on adsorptive removal of metal ions and dyes from wastewater using tamarind-based bio-composites

Vipin Malik, Laishram Saya, Drashya Gautam, Shallu Sachdeva, Neelu Dheer, Dinesh Kumar Arya, Geetu Gambhir & Sunita Hooda 

*Polymer Bulletin* 79, 9267–9302 (2022) | [Cite this article](#)

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### Abstract

Large-scale industrialization and urbanization have led to such an alarming level of water contamination throughout the world that wastewater management has become one of the major global challenges attracting much research attention in recent times. Various techniques have been adopted for the treatment of polluted water among which adsorption has been preferred on a larger scale by virtue of its ease and cost-effective nature. This review highlights the efficiency of tamarind-based nanocomposites as potential adsorbents for a varying range of harmful organic and inorganic water pollutants including metal ions, fluoride ions and numerous kinds of dyes. A comprehensive analysis of fabrication routes, adsorption isotherms, kinetic and thermodynamic modeling as well as the adsorption mechanism and recyclability of these adsorbents is being presented in this work. In addition, various factors affecting the adsorption behavior such as pH, amount of adsorbent, concentration of ion/dye

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Science of The Total Environment  
Volume 813, 20 March 2022, 152529

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Review

## A comprehensive review on recent advances toward sequestration of levofloxacin antibiotic from wastewater

Lalshram Saye<sup>a, b, c</sup>, Vipin Malik<sup>b</sup>, Drashya Gautam<sup>a</sup>, Geetu Gambhir<sup>b</sup>, Balendra<sup>a</sup>, W. Ramaswori Singh<sup>a</sup>, Sunita Hooda<sup>b</sup>

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5. Recyclability and reusability aspects of nanomaterials
6. Conclusions
7. Knowledge gaps and future perspectives

Abbreviations

Credit authorship contribution statement

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### A Novel Terpolymer Membrane-Based Electrode Sensor for Selective Determination of Cd(II) Ions

Geetu Gambhir<sup>1,✉</sup>, Drashya Gautam<sup>1,✉</sup>, Laishram Saya<sup>1,2,3</sup>, Amit Kumar<sup>1</sup>, Subodh Kumar<sup>1</sup>, Aarushi Singh<sup>4</sup>, Snigdha Singh<sup>4</sup>, Ramesh Chandra<sup>4,\*</sup> and Sunita Hooda<sup>1,\*</sup>

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<sup>2</sup>Department of Chemistry, Sri Venkateswara College (University of Delhi), Dhaura Kuan, New Delhi-110021, India

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<sup>4</sup>Drug Discovery and Development Laboratory, Department of Chemistry, University of Delhi, Delhi-110007, India

\*Corresponding authors: acbrdu@hotmail.com; sunitahooda@andc.du.ac.in

#### Abstract

A new polymeric membrane sensor for Cd(II) ion based on methyl acrylate-acrylonitrile-methyl methacrylate terpolymer as membrane carrier has been synthesized *via* atom transfer radical polymerization (ATRP) method at 60 °C. Preliminary investigation with the membrane exhibited promising selectivity for Cd(II) ion with a slope of 32.02 mV/decade and the same could be estimated in the concentration range of  $1 \times 10^{-6} - 1 \times 10^{-1}$  M in the working pH range of 4-6 for up to 90 days. The potentials generated across the membrane were reproducible and the response time was less than one minute. The electrode works well even in a partially non-aqueous media. The effect of surfactant and detergent on the working of Cd(II) selective electrode was also studied. A decrease in potential was observed in the presence of appreciable amount of surfactant and detergent. Addition of plasticisers was found to greatly improve the performance of membrane, best results being obtained with the membrane ratio (NaTPB:TP:TBP::1:100:06), exhibiting a working concentration range of  $1 \times 10^{-6} - 1 \times 10^{-1}$  mol L<sup>-1</sup> with a short response time of 10 s. The proposed sensor shows significantly good selectivity toward Cd(II) ion in comparison with some alkali, alkaline earth, transition and heavy metal ions. It was successfully employed as an indicator electrode in potentiometric titration of cadmium(II) ions against EDTA solution.

#### Keywords

## A new polysaccharide-based ion-exchange resin for industrial wastewater treatment

Savita Bargujar<sup>1†</sup> (ORCID ID: 0000-0001-5392-597X), Geetu Gambhir<sup>2†\*</sup> (0000-0002-8995-9714), Madhu Bala Raigar<sup>1†\*</sup> (0000-0001-3711-5907), Sunita Hooda<sup>2†</sup> (0000-0001-8002-400X), Dinesh Kumar Arya<sup>2†</sup> (0000-0002-9716-0136), Mamta Bhatia<sup>3†</sup> (0000-0002-4176-4942)

DOI: [dx.doi.org/10.14314/polimery.2022.5.4](https://doi.org/10.14314/polimery.2022.5.4)

**Abstract:** A new ion-exchange resin was obtained by incorporating a tripropylamine group into a tamarind polysaccharide resin (TTA). The TTA resin was characterized by FTIR, elemental analysis, and other physicochemical properties. The influence of pH, treatment time and resin concentration on the adsorption of metal ions from industrial wastewater was investigated. It was found that the obtained TTA resin effectively removes heavy metal ions in the following order:  $\text{Fe}^{2+} > \text{Cu}^{2+} > \text{Zn}^{2+} > \text{Cd}^{2+} > \text{Pb}^{2+}$ .

**Keywords:** industrial wastewater, tamarind, tripropylamine, ion-exchange resin, adsorption, flocculants.

### Nowa żywica jonowymienna na bazie polisacharydów do oczyszczania ścieków przemysłowych

**Streszczenie:** Nową żywicę jonowymienną otrzymano poprzez wbudowanie grupy tripropyloaminowej do żywicy polisacharydowej tamaryndowca (TTA). Żywicę TTA scharakteryzowano za pomocą FTIR, analizy elementarnej i innych właściwości fizykochemicznych. Zbadano wpływ pH, czasu obróbki i stężenia żywicy na adsorpcję jonów metali ze ścieków przemysłowych. Stwierdzono, że żywica TTA skutecznie usuwa jony metali ciężkich w następującej kolejności:  $\text{Fe}^{2+} > \text{Cu}^{2+} > \text{Zn}^{2+} > \text{Cd}^{2+} > \text{Pb}^{2+}$ .

**Słowa kluczowe:** ścieki przemysłowe, tamaryndowiec, tripropyloamina, żywica jonowymienna, adsorpcja, flokulanty.

In India ground water is used for domestic as well as agricultural purposes. Heavy metals ions such as iron, cobalt, cadmium, lead, mercury, chromium, selenium, arsenic, copper and zinc are invariably present in ground-water. These metal ions are considered to be toxins when they enter inside the body exceeding the prescribed limit, wherein they start causing illness [1–3]. Some of the heavy metal ions such as iron, cobalt, cadmium, lead, mercury, chromium, selenium and arsenic were found in industrial effluent of Okhla industrial area phase-II of Delhi NCR Region, India and because of this the groundwater of nearby areas is also contaminated [4]. Heavy metal ions isolated from the industrial effluents like  $\text{Fe}^{2+}$ ,  $\text{Cu}^{2+}$ ,

$\text{Zn}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Pb}^{2+}$  have extensive applications in electronic appliances such as LED, Mobile phones, and other devices due to their chemical, electrical, optical and magnetic values [5]. Growing demand for reduction of metal ions in water has enhanced the strive for development of feasible ways to remove harmful metal ions from industrial contaminated water. Environmentally friendly adsorbents have been investigated for preferential adsorption of metal ions in multivariant [6]. The main techniques for the recovery of these heavy metal ions from the industrial effluents involve co-precipitation [7], ion exchange [8], solvent extraction [9], membrane separation methods [10] and adsorption [11]. Out of these techniques, ion exchange technique has found wide application because of low operation cost, less generation of pollutants and high recovery rate [12, 13].

Nowadays, ion exchange resins, with the performance based on ion exchange technique find many applications in waste water treatment for the removal of heavy metal ions as they have greater selectivity and higher exchange properties [14]. For effective removal of trace heavy metal ions from the waste water of metal processing industry, a selective polymeric precipitant is widely used [15]. Polymeric ion exchange resin e.g. Tamarind based resin

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**Assessment of Groundwater Quality for Drinking and Irrigation Use in Gurugram Block of Gurugram District, Haryana, India**

Vijay Laxmi<sup>1</sup>, Jakir Hussain<sup>2,\*</sup>, Ikbal Husain<sup>3</sup> and Geetu Gambhir<sup>4,\*</sup>

<sup>1</sup>Department of Science and Technology, Mewar University, Gangrar, Chittorgarh-312901, India

<sup>2</sup>Upper Yamuna River Board, Ministry of Jal Shakti, R.K. Puram, New Delhi-110066, India

<sup>3</sup>Public Health Engineering Department, Bhilwara-311001, India

<sup>4</sup>Department of Chemistry, Acharya Narendra Dev College, University of Delhi, Govindpuri, Kalkaji, New Delhi-110019, India

\*Corresponding authors: E-mail: drjakirhussain@gmail.com; geetugambhir@andc.du.ac.in

**Abstract**

Groundwater is a vital and reliable source of water in all climates worldwide. In this work, a total of 26 groundwater samples were collected from the Gurugram Block of Gurugram District (a cosmopolitan city situated proximately to capital of India) analyzed for electrical conductivity, pH, hardness, dissolved solids (TDS), Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, Cl<sup>-</sup> and alkalinity as HCO<sub>3</sub><sup>-</sup>, CO<sub>3</sub><sup>2-</sup>. Based on the analytical results, the sodium adsorption ratio, sodium percentage, residual sodium carbonate, chloro-alkaline index, base exchange index, meteoric genesis index, permeability index, magnesium hazard and Kelly index were calculated. The most abundant cations were Na<sup>+</sup> and Ca<sup>2+</sup>, which accounted for 43% and 36% of total cations, respectively. Based on median value, the cations are in the following order: Na<sup>+</sup> > Ca<sup>2+</sup> > Mg<sup>2+</sup> > K<sup>+</sup>. There are no dangers in any of the 22 villages (85%). They have fluoride levels which are less than the maximum desirable limit of 1.0 mg/L established by IS: 10500, 2012. There were 15 villages (58%) with nitrate concentrations less than the limit (45 mg/L) and 11 villages (42%) with nitrate concentrations greater than the limit. The conductivity of groundwater samples was dominated by the ions EC-TDS (r = 1.0), EC-Na (r = 0.93) and EC-HCO<sub>3</sub> (r = 0.84). The natural origin of the ions was revealed by the Na-Cl correlation coefficient (r = 0.82). TDS and Na correlated positively (r = 0.93). Wilcox classified that 4% of the ground water samples as excellent to good, 19% as good to permissible, more than 19% as doubtful to unsuitable and 58% as unsuitable for irrigation. According to the US salinity diagram, % of the samples fall into the C3-S1 water class, indicating water with a high salinity hazard and a low sodium hazard.

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Leena Khanna , Mansi, Shilpa Yadav, Neeti Misra & Pankaj Khanna   
Pages 2862-2923 | Received 29 May 2021, Published online 30 Jul 2021

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### Abstract

Bis(indolyl) methane (BIM) derivatives have shown numerous biological properties which has influenced the scientific fraternity to explore the length and breadth of their synthesis. Mostly, the procedure involves a catalytic electrophilic substitution reaction of indoles with various aldehydes and ketones. However, many variations have been applied from time to time to promote this reaction under green conditions. The use of water as a solvent in organic synthesis, has gained much attention due to economic and eco-friendly reasons. It has also been observed that the reactions under aqueous conditions have shown high reactivities and chemo-selectivity, which are not found in organic media. "In water synthesis" of BIMs has gained

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Research Article

## A DFT Study on Diels-Alder Reaction of Dibenzazepine and 2,5-Dimethylfuran Using Different Solvents and Temperature Conditions

Shilpa Yadav, Neeti Mishra, Pankaj Khanna, Manoj, Kriti Batra & Leena Khanna

Received 30 Nov 2021; Accepted 17 Mar 2022; Published online 23 Mar 2022

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### Abstract

The Diels-Alder reaction involves cycloaddition of dienes and dienophiles to form a six-membered ring. The reaction involves the formation of adduct which can have two possible configurations, viz, endo and exo. For a vast majority of the Diels-Alder reactions, endo is the major adduct. This first ever study focuses on the Diels-Alder reaction between dibenzazepine and 2,5-dimethylfuran depicted by the computational method using Gaussian 16 software at different basis set levels. The formation of adduct is studied under different temperatures in the gas phase and aqueous medium. The kinetically favored endo adduct is preferred at low temperatures as compared to exo adduct. The adduct gets dehydrated further to give tribenzazepine as the final product. The applicability of the reaction is also proved experimentally in absence or presence of aqueous medium. The final product is characterized and its experimental and

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Volume 264, 5 January 2022, 120279

Chromone functionalized pyridine chemosensor  
for cupric ions detectionParul Bhalla <sup>a</sup>, Nisha Tomer <sup>a</sup>, Pooja Bhagat <sup>b</sup>, Rajesh Malhotra <sup>a</sup>

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## Highlights

- Chromone functionalized pyridine chemosensor was synthesized.
- CD can selectively detect cupric ions with limit of detection  $1.2 \times 10^{-6}$  M.
- The binding stoichiometry obtained as 1:2 for CD: Cu<sup>2+</sup> complex from Job's plot.



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Volume 427, 1 May 2022, 113823



# Chromone derived effective probe for the detection of metal ion ( $\text{Cu}^{2+}$ ) and chemical explosive (p-nitrotoluene)

Nisha Tomer <sup>a</sup>, Apurva Goel <sup>a</sup>, Parul Bhalla <sup>a</sup>, Pooja Bhagat <sup>b</sup>, Rajesh Malhotra <sup>a</sup>

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## Highlights

- New Schiff base 1,3-bis(((4-oxo-4H-chromen-3-yl)methylidene]amino})urea (**CCH**) has been synthesized and characterized.
- Probe **CCH** showed a visual colorimetric response from colorless to yellow for  $\text{Cu}^{2+}$  ions, exceptionally.
- Synthesized Schiff base **CCH** efficiently detect pNT with negligible interference of other nitroaromatics taken for study.



## WET CHEMICAL GROWTH OF ONE DIMENSIONAL ZnO FILM

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### ABSTRACT

The present work focuses on the growth of ZnO films vertically on indium tin oxide substrate using a wet chemical method. The morphological and structural study of the prepared films confirmed the formation of one-dimensional growth with a polycrystalline single-phase hexagonal wurtzite structure. The computed texture coefficient indicates the c-axis growth of the film. The optical spectra study exhibited a strong and sharp characteristics absorption band. The numerical derivative method and the Tauc plot method for the different transition values have been used to compare energy bandgap calculations.

**Keywords:** ZnO Film, SEM, XRD, Rietveld Refinement, UV-Visible Spectroscopy, Tauc Plot Method

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### INTRODUCTION

In the recent era, metal oxide nanostructures showcase many applications in every field that exists, mainly biosensors, solar cells, photocatalysis, bio-imaging, UV-light emitters, piezoelectric transducers, chemical sensors.<sup>1</sup> There are many metal oxide nanostructures existing in nature, out of which ZnO is the most promising nanostructures (nanomaterial) due to its wide bandgap, thermal stability, high electron mobility, conductance variability, etc.<sup>2</sup> According to the literature, these ZnO nanostructures can be subdivided into various categories such as nanodots, nanoflowers, nanowires, nanopores, nanotubes, nanorings, nanorods, etc.<sup>1</sup> Among these, nanorods and nanowires are being extensively used for practical applications, such as nanowires are used for field-effect transistor (FET) devices, nanogenerators, and nanorods are used for heterojunction devices such as varistors, four-probe electrode systems, sensing applications, etc.<sup>3-6</sup> In addition to these applications, ZnO nanorods in the form of films are being used in FET, dye-sensitized solar cells (DSSCs), light emitters, light detectors, biosensors, gas sensors, etc.<sup>7-8</sup> Various methods are reported in the literature for synthesizing these nanorods, such as electrochemical deposition technique, hydrothermal method, sputter chemical deposition, etc.<sup>9-10</sup> However, certain criteria need to be met to use these methods, mainly high reactant concentration, and high reaction temperature. On similar grounds, these processes are complex and expensive. Therefore, the more accessible approach to synthesize ZnO nanorods is by using the wet chemical method due to its easy processing and cost effectiveness.<sup>11-12</sup>

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## An *In Silico* investigation for acyclovir and its derivatives to fight the COVID-19: Molecular docking, DFT calculations, ADME and td-Molecular dynamics simulations

Madhur Babu Singh <sup>a,b</sup>, Pallavi Jain <sup>b</sup>, Jaya Tomar <sup>a</sup>, Vinod Kumar <sup>c</sup>, Indra Bahadur <sup>d</sup>, Dinesh Kumar Arya <sup>e</sup>, Prashant Singh <sup>a</sup>

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### Abstract

In the present work, we have designed three molecules, acyclovir (A), ganciclovir (G) and derivative of hydroxymethyl derivative of ganciclovir (CH<sub>2</sub>OH of G, that is D) and investigated their biological potential against the Mpro of nCoV via *in silico* studies. Further, density functional theory (DFT) calculations of A, G and D were performed using Gaussian 16 on applying B3LYP under default condition to collect



## II-VI core/shell quantum dots and doping with transition metal ions as a means of tuning the magnetoelectronic properties of CdS/ZnS core/shell QDs: A DFT study

Pragati Malik, Rakhi Thareja, Jyoti Singh, Rita Kakkar  

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### Highlights

- Coating of a shell over the bare quantum dots alters their properties.
- Investigation of the structural, electronic and magnetic properties of doped CdS/ZnS core/shell QDs.
- Introduction of magnetism in core/shell QDs on doping with transition metal ions.
- Doping with transition metal ions alters several magnetoelectronic

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## A DFT Study of Interaction of (CdSe)<sub>3</sub> Quantum Dots with Nucleobases

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Pragati Malik, Rita Kakkar

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## Abstract

Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) play important roles in the storage of genetic information and protein biosynthesis. Nucleobases, which are nitrogenous bases, are the functional units of these nucleic acids. It is very important to detect changes in the sequence of DNA/RNA, as any mutations in them may cause harm to the organism. Our aim is to verify the use of (CdSe)<sub>3</sub> Quantum Dots (QDs), owing to their distinctive optical and electronic properties, for sensing changes in DNA/RNA. Hence, in this work, we have focused on studying the interaction between (CdSe)<sub>3</sub> QDs and the five nucleobases (adenine, guanine, cytosine, thymine and uracil) at various probable sites by means of density functional calculations. Several structural, electronic and optical properties, and charge transfer on interaction between the two, have been discussed. The present band gap and charge transfer calculations indicate that binding of (CdSe)<sub>3</sub> to guanine is strongest and is weakest with uracil. The vibrational spectral analysis indicates that the intensities of the peaks due to (CdSe)<sub>3</sub> enhance on interacting with the nucleobase, and a blue shift is observed in all the interactions. The presence of both the frontier orbitals (HOMO and LUMO) on the QD indicates that (CdSe)<sub>3</sub> acts as a guardian of DNA and prevents it from damage. Hence, our studies direct that CdSe QDs can be successfully employed as sensors for these nucleobases.

## Keywords

Nucleobase, purine, pyrimidine, quantum dots, sensing, HOMO, LUMO



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## Size-dependent structural and electronic properties of stoichiometric II–VI quantum dots and gas sensing ability of CdSe quantum dots: a DFT study

Jyoti Singh, Rakhi Thareja, Pragati Malik & Rita Kakkar *Journal of Nanoparticle Research* 24, Article number: 33 (2022) | [Cite this article](#)220 Accesses | [Metrics](#)

### Abstract

The structural, electronic, and quantum confinement effects observed in II–VI quantum dots have been described using density functional theory. Various properties like binding energy, Fermi energy, charge distribution, and band gap of various clusters have been determined as a function of cluster size in order to find out the most stable of all the clusters considered. The binding energies are found to be a function of the cluster size but converge to a maximum. Cadmium is observed to possess a larger tendency to form clusters with higher coordination numbers compared to zinc and mercury. In mercury sulfide (HgS)<sub>n</sub>, the clusters with  $n = 6$  and 13 get dissociated into two graphene-like parallel layers. The adsorptions of single gas molecules on the (CdSe)<sub>13</sub> quantum dots are exothermic, indicating that most of the gas molecules adsorb spontaneously on the CdSe quantum dots. Among the various gases, O<sub>2</sub> and NO<sub>2</sub> are the gas molecules that get most strongly chemisorbed. The CdSe quantum dot acts as an electron donor when it interacts with the oxidizing gases, O<sub>2</sub>, CO, NO<sub>2</sub>, and SO<sub>2</sub> gases. The

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## Full Length Article

## Precisely engineered type II ZnO-CuS based heterostructure: A visible light driven photocatalyst for efficient mineralization of organic dyes

Bhawna Kaushik<sup>a</sup>, Sneha Yadav<sup>a</sup>, Pooja Rana<sup>a</sup>, Pooja Rana<sup>a</sup>, Kanika Solanki<sup>a</sup>, Deepti Rawat<sup>b</sup>, R.K. Sharma<sup>a,\*</sup>

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## ARTICLE INFO

**Keywords:**  
Visible light  
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Core-shell architectures

## ABSTRACT

Herein, type-II band alignment of magnetic ZnO/CuS has been achieved by assembling p-type CuS nanoparticles on n-type ZnO heterostructures to accomplish the photocatalytic degradation of two colored cationic dyes, namely, methylene blue (MB) and toluidine blue (TB). The material exhibited excellent photocatalytic efficiency towards MB and TB with 93% and 87.5% degradation in just 16 and 18 min respectively. The efficacy of doped photocatalyst (PSZCS) was found to be 6 times higher than the undoped material (Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>@ZnO; PSZ) whereas pristine CuS degraded only 50% of the dye sample under identical conditions. Therefore, the dramatic enhancement of the photocatalytic degradation performance could be attributed to the synergistic effect created by doping CuS over magnetic ZnO nanocomposites which extended the photoresponse of ZnO by driving the entire degradation process under visible light irradiation and also reducing the charge recombination rate. The plausible mechanistic pathway and identification of degradation products was discussed in detail on the basis of scavenger studies as well as GC-MS analysis. Furthermore, the designed catalyst could be recycled and reused up to 5 runs without any significant decrease in its photocatalytic activity. The reported procedure exhibited multiple advances as it proceeded by utilizing renewable household LEDs as power source at room temperature without the use of any additional oxidant under neutral pH conditions thus, paving a strong path towards sustainable, green and responsible chemistry.

## 1. Introduction

Photocatalytic degradation has surfaced as a burgeoning technique contributing immensely towards environmental remediation via the use of renewable, clean and abundant solar energy [1]. As a green and sustainable approach, it has found numerous applications in the arena of treatment of perilous and toxic effluents such as dyes, pesticides, pharmaceutical by-products, industrial waste etc. A wide range of photo-responsive materials like metal oxides, metal nitrides and oxy-nitrides, alkali metal base, metal sulfides and carbon-based components have been employed for carrying out the degradation of harmful organic pollutants into environmentally benign products [2–6]. Amongst them, metal oxide and sulfide based semiconductors have occupied a central place in the field of environmental reformation owing to their wide band gap due to deep 2p oxygen orbital in their valence band [7,8]. The process is set off by the generation of electrons when light with wavelength lesser than or equal to the band gap of the semiconductor is

illuminated in turn separating the charge carriers (electrons and holes). Semiconductors with wide band gap such as TiO<sub>2</sub> and ZnO have invariably proved their worth as dynamic photocatalysts [9–11]. ZnO specifically with a band gap of 3.37 eV has the potential of detoxifying water owing to its prominent reaction and mineralization rates, lower toxicity, economic nature, higher number of active sites and the fact that it can be moulded to obtain various morphologies [12]. Unfortunately, it works best in the UV region, which constitutes less than 5% of the solar energy thus conspicuously confining its photocatalytic utility. Another factor limiting its photocatalytic efficiency is the rapid charge recombination. Therefore, it is indispensable to shift the optical absorption band of ZnO towards the visible range and simultaneously circumvent the issue of charge recombination [13]. One of the simplest yet appealing pathway to overcome this roadblock is by doping such single-component semiconductor with another narrow band gap semiconductor which can synergistically bring the band gap in visible region and ensure prolonged separation of charge carriers [14]. Copious

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## Ingeniously designed Silica nanostructures as an exceptional support: Opportunities, potential challenges and future prospects for viable degradation of pesticides

Rakesh Kumar Sharma<sup>a,\*</sup>, Bhawna Kaushik<sup>a</sup>, Sneha Yadav<sup>a</sup>, Pooja Rana<sup>a</sup>, Pooja Rana<sup>a</sup>, Kanika Solanki<sup>a</sup>, Deepti Rawat<sup>b</sup>

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### ARTICLE INFO

**Keywords:**  
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### ABSTRACT

Despite significant advancements in modern agricultural practices, efficient handling of pesticides is a must as they are continuously defiling our terrestrial as well as aquatic life. During the last couple of decades, substantial efforts by various research groups have been devoted to find innovative solutions to remove pesticides from our environment in a greener way. In this regard, functionalized silica nanoparticles (NPs) have gained considerable attention of scientific community due to their notable properties such as amenable design, large surface area as well as fine-tunable and uniform pore structures which make them an ideal material for pesticides removal. The present review aims to proffer current scientific progress attained by silica-based nanostructures as an excellent material for effective removal of noxious agrochemicals. Further, a brief discussion on the synthetic strategies as well as intrinsic benefits associated with different morphologies of silica have also been highlighted in this article. It also summarizes the recent reports on silica assisted degradation of pesticides via enzymatic, chemical as well as advanced oxidation protocols. Additionally, it presents a critical analysis of different support materials for decontamination of our ecosystem. The review concludes with potential challenges, their possible solutions along with key knowledge gaps and future research directions for successful deployment of silica supported materials in degradation of pesticides at commercial scale.

### 1. Introduction

For many decades, population spurt has been a topic of deliberation and preoccupation calling for an immediate action to intensify the global agricultural production to ensure food security. According to the "World Population Prospects 2019", a United Nations (UN) report, world population is further expected to reach 9.7 billion by 2050 (DESA, 2019). Thus, the ever-expanding number of inhabitants stresses on the requirement to boost the crop production without increasing farmland footprint. To enhance crop productivity and make agriculture profitable in face of rising valuation, use of pesticides, herbicides and fertilizers have proliferated exponentially. Pesticides refer to a group of chemical compounds used to kill undesirable organisms in farmlands and have been playing a pivotal role in agronomics since the dawn of agricultural revolution (Rani et al., 2020). According to their usage, pesticides can be classified broadly in four categories namely, herbicides, insecticides,

fungicides and rodenticides. Synthetic organic pesticides generally contain carbamates, organophosphates, coumarins, organochlorines, organonitrogens, pyrethroids along with arsenic and mercury derivatives (Rani et al., 2017).

Nevertheless, with the rapid development and proliferation of chemical industries, their indiscriminate and sporadic use has led to 200,000 human deaths annually along with the contamination of natural resources (Mew et al., 2017). Most of the chemical pesticides are retained within the body of organism because of their lipophilicity and exhibit detrimental effects on human health due to their carcinogenic nature and ability to damage central nervous system (Sabarwal et al., 2018). Starting from flora to fauna, pesticides owing to their longer half-lives not only extensively accumulate but also remain persistent in water and soil, thereby posing serious threat to the environment (Fernández-Pérez et al., 2011; Liu et al., 2016a). Another major limitation associated with the use of conventional pesticides is that their

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## Magnetically separable type-II semiconductor based ZnO/MoO<sub>3</sub> photocatalyst: a proficient system for heteroarenes arylation and rhodamine B degradation under visible light†

Bhawna Kaushik,<sup>a</sup> Pooja Rana,<sup>a</sup> Deepti Rawat,<sup>b</sup> Kanika Solanki,<sup>a</sup> Sneha Yadav,<sup>a</sup> Pooja Rana<sup>a</sup> and R. K. Sharma<sup>a</sup> 

Herein, a new strategy is used to systematically tailor the band arrangement in a ZnO-based heterostructure to realize its bifunctionality towards the synthesis of heteroarylated products and degradation of Rhodamine B under visible light. A Type-II band alignment transition is carried out via introducing MoO<sub>3</sub> rods which subsequently enhance its light-harvesting properties, prolonged charge separation and abundant active sites. The designed heterostructure displayed broad functional group compatibility for both electron-donating and electron-withdrawing group substituted substrates with good product yield. Comparably, their visible light driven heteroarylation process is significantly enhanced to more than 4 times that of pristine ZnO and is superior to most photocatalysts reported previously. ZnO/MoO<sub>3</sub> also displayed remarkable degradation ability of 96.8% towards RhB into innocuous products under neutral conditions without utilizing any oxidant. More impressively, the developed catalyst demonstrated long-term stability and excellent reusability up to five runs without any significant change in efficiency. Hence, this work not only for the first time exhibits the untapped potential of using a highly active, economically efficient and magnetically separable ZnO/MoO<sub>3</sub> core-shell heterostructure to substitute for expensive metals in photocatalysis but also presents a new opening for synthesising hybrid materials with excellent performance in environmental remediation.

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### Introduction

In the era of rapid industrialisation and growing pollution concerns, utilization of a renewable and green strategy for organic transformations is indispensable. Visible light photocatalysis constitutes a right step in paving a way towards a sustainable economy. Traditional organic synthetic protocols are accompanied by certain drawbacks, such as harsh reaction conditions (high temperature and pressure, use of toxic solvents) as well as energy-intensive processes.<sup>1,2</sup> Interestingly, photocatalytic systems have the potential to synthesise various industrially important compounds with high efficiency along with good atom economy, lower energy consumption and innocuous solvents using an environmentally benign, non-conventional source of energy.<sup>3–12</sup> Additionally, a photo-assisted system has the

tendency to alter the thermodynamic equilibrium of the reaction and facilitate the transformation at room temperature, thus averting the generation of undesirable products due to elevated temperatures. Therefore, the fusion of renewable light energy and transition metal assisted organic transformations represents an effective building block in developing useful synthetic protocols.<sup>1,3</sup>

The formation of a C–C bond represents an important class of core structural constituents of biomedical significance in the agrochemical and pharmaceutical industries, peptide mimetics, dyes etc.<sup>14</sup> In particular, heteroarylation of arenes exemplifies an important class of reaction as it opens up avenues to various heterobiaryl motifs with applications in technological fields since they possess fascinating biological and optical properties.<sup>15–18</sup> Until now, scientists have utilized various renowned reactions such as Suzuki, Stille, and Kumada coupling for synthesising the important class of biaryl compounds. However, these protocols come with many drawbacks, such as the employment of expensive and tediously separable homogeneous catalysts along with noxious organic halides such as organic bromides and less reactive organic chlorides.<sup>19–22</sup> In order to make the process commercially beneficial, activation of these reagents *via* attaching various

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† Electronic supplementary information (ESI) available. See DOI: <https://doi.org/10.1039/d2nj00906d>



## Surface engineered Iridium-based magnetic photocatalyst paving a path towards visible light driven C-H arylation and cyanation reaction

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### ABSTRACT

The report presents the fabrication and application of a highly versatile, magnetic and robust iridium based photoredox nanocatalyst. Herein, Ir(ppy)<sub>3</sub> based photocatalyst sites have been chemically engineered over the magnetic nanoparticles to encompass the captivating features of homogeneous iridium photocatalyst with the magnetically recyclable core. A household photoreactor was designed and fabricated to achieve highly selective visible light driven oxidative C-H arylation and C-H cyanation under sustainable and ambient reaction conditions utilizing the Ir@PyBz@ASMNPs photoredox nanocatalyst. The environment friendly Ir@PyBz@ASMNPs shows excellent photocatalytic activity, broad substrate adaptability and outstanding recyclability compared to the analogous homogeneous catalysts. Indeed, the Ir@PyBz@ASMNPs possess some key features including high surface area, high iridium metal loading and excellent stability. This work is expected to enlighten and provide new insights in the rational design of high performance and recoverable photoredox nanocatalyst through surface engineering strategy.

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### 1. Introduction

Photoredox catalysis has gained colossal attention for engineering environmentally sustainable processes due to its ability to exploit inexpensive, clean and endless renewable solar energy to engage single electron transfer (SET) for synthetic manipulation or catalytic activation of organic molecules [1]. Over the past few years, numerous research groups have widely employed the power of light for various applications such as photocatalysis, photodegradation, singlet oxygen generation, water splitting, reduction of carbon dioxide, etc. [2–5]. In fact, several transition metals based homogeneous catalysts (such as ruthenium, iridium and copper polypyridyl complexes) and organic moieties (like eosin Y, rose bengal etc.) have garnered particular appreciation in the field of photocatalysis [3,6–9]. These photocatalysts possess various attention grabbing properties such as energy efficiency, stability, absorbance in visible range, long-lived photoexcited states, versatile nature and readily tunable photophysical properties by modification of the ligand scaffold [6]. Unlike the thermal

and UV light catalyzed reactions, the visible light catalyzed reactions reduce the possibility of side reactions due to lack of visible light absorbance by organic compounds [9,10].

Over the years, the chemistry of tris-cyclometalated coordinatively saturated, 18-electron d<sup>6</sup> complexes of iridium, such as Ir(ppy)<sub>3</sub>, has been the focus of great attention due to the ease of synthesis and diversification, stability at room temperature, and excellent photoredox properties [11,12]. Additionally, the iridium complexes unveil a wide variety of applications in the field of solar cells, light-emitting diodes (LEDs), sensing, biology and as initiators in free radical polymerization [12]. Despite these above-mentioned advantages, progress must be made toward ease of separation, recyclability, stability, and environmental neutrality of these photoredox catalysts in order to move the field toward practical utility in academia and industry [13,14]. Consequently, the development of a heterogeneously immobilized photosensitizer system that maintains photoredox capability upon immobilization is a significant step toward this goal. Henceforth, coordination chemistry delivers a new pathway for engineering heterogeneous supports through immobilizing photocatalytically active sites having high activity and selectivity. To date, a limited number of covalently or physically immobilized photoredox catalyst over cores (such as graphene, TiO<sub>2</sub>, silica, polymer, ZnO, NPs etc.) have been

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## PAPER



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## An Earth-abundant cobalt based photocatalyst: visible light induced direct (het)arene C–H arylation and CO<sub>2</sub> capture†

Pooja Rana,<sup>a</sup> Bhawna Kaushik,<sup>a</sup> Rashmi Gaur,<sup>a</sup> Sriparna Dutta,<sup>a</sup> Sneha Yadav,<sup>a</sup> Pooja Rana,<sup>a</sup> Kanika Solanki,<sup>a</sup> Bhavya Arora,<sup>a</sup> Ankush V. Biradar,<sup>b,c</sup> Manoj B. Gawande<sup>b,c</sup> and R. K. Sharma<sup>b,d</sup>\*

In this work, we have reported a noble metal free heterogeneous photocatalyst to carry out direct (het)arene C–H arylation and solvent-free CO<sub>2</sub> capture via single-electron transfer processes at room temperature and under pressure. The catalytic system comprises a cobalt(II) complex grafted over the silica coated magnetic support for the efficient recovery of the photocatalytic moiety without hampering its light-harvesting capability. The novel Earth-abundant cobalt(II) based photocatalyst possesses various fascinating properties such as high surface area to volume ratios, large pore volume, crystalline behaviour, high metal loading, excellent stability and reusability. The general efficacy of the highly abundant and low-cost cobalt based heterogeneous nanocatalyst was checked for the selective conversion of arylidiazonium salts into synthetically and pharmaceutically significant biaryl motifs under ambient conditions upon irradiation with visible light. The highly efficient photocatalytic conversion of carbon dioxide (CO<sub>2</sub>) to a value-added chemical was accomplished under mild reaction conditions with high selectivity, showing the added benefit of operational simplicity.

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### Introduction

Visible light mediated photocatalysis, owing to its notable capacity to harvest light energy and convert it into chemical energy, has acquired tremendous significance in the research community showing promising applications in diverse fields such as water splitting, solar energy storage, photovoltaics, pollutant degradation and organic transformations.<sup>1–4</sup> Generally, an efficient photosensitizer is required for harvesting free, clean, abundant, non-hazardous and environment friendly visible light energy that can meet the current and future energy demands.<sup>5,6</sup> To date, many highly active and stable Ru<sup>II</sup>, Re<sup>I</sup>, Os<sup>III</sup> and Ir<sup>III</sup> based d<sup>6</sup> complexes have been widely recognized and extensively exploited in photoredox reactions due to their prominent properties such as (i) strong absor-

bance in the visible light region, (ii) long-lived electronically excited states, (iii) ease of attaining highly oxidised and reduced species either in the ground or excited state in contrast to organic moieties, and (iv) highly reversible electrochemical nature and photostability of the photoactivated, oxidized and reduced species.<sup>7,8</sup> Along with the above mentioned captivating properties, photoredox catalysis has clear benefits for sustainability as it adheres to the key principles of Green Chemistry including atom economy, design for energy efficiency, catalysis and use of renewable feedstock.<sup>9</sup> In addition, the fascinating properties of photons aid in delivering sufficient energy to achieve the desired reactivity without using high temperatures or harsh conditions, contrary to thermally induced reactions.<sup>9</sup> Despite the appealing properties of photocatalysts enabling bond formation processes, unfortunately the low abundance, toxicity and exorbitant cost associated with them, limit their practical utility.<sup>10</sup> Recently, scientists have shown keen interest in eliminating the use of precious and toxic metals in photoactive coordination complexes by employing more Earth abundant elements for the development of sustainable photocatalysts.<sup>11</sup> Thus, various synthetic and material chemists are reorienting their efforts toward the employment of base metal photocatalysts as clean, energy efficient and versatile materials to process visible light driven organic transformations and CO<sub>2</sub> capture.<sup>12</sup> Nevertheless,

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## Magnetic Boron Nitride Nanosheets Decorated with Cobalt Nanoparticles as Catalyst for the Synthesis of 3,4-Dihydropyrimidin-2(1H)-ones/thiones

Pooja Rana, Ranjana Dixit, Shivani Sharma, Sriparna Dutta, Sneha Yadav, Bhavya Arora, Bhawna Kaushik, Pooja Rana, and Rakesh K. Sharma\*

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**ABSTRACT:** Atomically thin two-dimensional boron nitride nanosheets have spawned futuristic advancements in the arena of nanocatalysis research through their intriguing capability to act as exceptional support matrices. Motivated by their phenomenal attributes, we have fabricated a magnetic boron nitride nanosheet-based cobalt catalytic system wherein boron nitride nanosheets are initially integrated with magnetic  $\text{Fe}_3\text{O}_4$  nanoparticles (NPs), and the resulting nanostructure is further surface-engineered with cobalt NPs to yield an *h*-BN/ $\text{Fe}_3\text{O}_4$ /Co hybrid. For gaining an insight into their structural and morphological features, reliable spectroscopic and microscopic characterization techniques including TEM, SEM, XRD, FT-IR, VSM, ED-XRF, XPS, BET, TGA, and AAS were employed. The developed nanohybrid material was then utilized to provide ready access to a library of highly bioactive 3,4-dihydropyrimidin-2(1H)-ones/thiones under ambient conditions. A plausible mechanistic route for furnishing 3,4-dihydropyrimidin-2(1H)-ones catalyzed by *h*-BN/ $\text{Fe}_3\text{O}_4$ /Co has also been delineated. Ambient reaction conditions, solvent-free conditions, high product yield, and excellent thermal and mechanical stability of the catalyst along with facile magnetic retrievability and efficient recyclability are some of the phenomenal characteristics of this methodology. The present protocol besides exhibiting a wider functional group tolerance and a high turnover number was devoid of any additive, thus making it superior to literature precedents reported to date. In consideration of the striking catalytic activity of the *h*-BN/ $\text{Fe}_3\text{O}_4$ /Co nanomaterial, it can be anticipated that the present catalyst can not only possess a stupendous potential to expedite substantial manufacturing of other industrially demanding organic motifs but may also unlock insights for designing next-generation 2D catalytic materials.

**KEYWORDS:** nanocomposites, heterocyclic motifs, heterogeneous catalytic system, catalytic efficacy, recoverability, recyclability

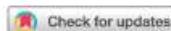
### 1. INTRODUCTION

Nanostructured materials have emerged at the forefront of catalysis science research as they play a significant role in the furtherance of the key goals of green chemistry.<sup>1</sup> In recent years, astonishing advancements have been witnessed in the rational design and fabrication of well-defined, highly active, and selective nanocatalysts.<sup>2</sup> The prospects of tuning the catalytic properties of nanomaterials by controlling the structural aspects of nanoparticles and manipulating the interaction between catalytically active species and its support matrix have aided in the engineering of new types of hybrid multifunctional materials that can be deployed for diverse industrially significant organic transformations.<sup>3–7</sup> Indeed, the

prominence of nanocatalysts having precisely controlled surface morphology can be realized from the Green Chemistry Presidential Challenge Awards that have been conferred for innovations pertaining to the development of promising nanocatalysts. Among a plethora of support materials utilized

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## Unlocking the catalytic potency of a magnetic responsive $\text{CoFe}_2\text{O}_4/\text{Ni-BTC}$ MOF composite for the sustainable synthesis of tri- and tetra-substituted imidazoles†

Sneha Yadav,<sup>a</sup> Ranjana Dixit,<sup>a</sup> Shivani Sharma,<sup>a</sup> Sriparna Dutta,<sup>a</sup> Bhavya Arora,<sup>a</sup> Pooja Rana,<sup>a</sup> Bhawna Kaushik,<sup>a</sup> Pooja Rana,<sup>a</sup> Alok Adholey,<sup>a</sup> Manoj B. Gawande<sup>c</sup> and Rakesh K. Sharma<sup>b,d\*</sup>

With the advancements in materials engineering, unprecedented newer materials based on magnetic MOFs have emerged as one of the promising candidates in the strategic field of catalysis. Within this perspective, the present report unveils the fabrication of an intricately designed magnetic  $\text{CoFe}_2\text{O}_4/\text{Ni-BTC}$  based MOF composite via a one-pot solvothermal approach. The synthesized composite was comprehensively characterized using various analytical tools such as FTIR, XRD, XPS, VSM, TGA, EDS, ED-XRF and AAS. Advanced microscopic tools like SEM and TEM provided deep insights into the structural aspects of the synthesized material. The catalytic performance of the hybrid composite was further explored in one-pot multicomponent reactions to obtain a combinatorial library of biologically and pharmacologically significant 2,4,5-trisubstituted (up to 98% yield) and 1,2,4,5-tetrasubstituted (up to 97% yield) imidazoles in good to excellent yields under solvent free conditions. Wider functional group tolerance, excellent turnover numbers, high atom economy, ambient reaction conditions, magnetic retrievability and good recyclability are some of the striking attributes of this protocol. We envisage that the present methodology employing magnetic MOFs as catalytic reactors is highly desirable for designing cleaner and greener processes in modern organic chemistry.

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### Introduction

Since the groundbreaking research by Yaghi, Robson and Kitagawa on functional polymers, metal organic frameworks (MOFs) have found a niche in modern materials science.<sup>1–5</sup> The significant progress in MOFs can be attributed to their structural versatility driven by coordination chemistry that allows designing hierarchically advanced multifunctional architectures with novel topologies and superior properties.<sup>6–8</sup> The additional enthusiasm for these materials in academia and industries arises because of their exceptionally good thermal and chemical stabilities, structural robustness, tunable pore size, incredibly high surface area and record breaking porosity.<sup>9–11</sup> Besides, the extraordinary periodic network of metal

nodes and inorganic functional linkers in MOFs allows the incorporation of diverse functionalities within the framework for targeted applications.<sup>12,13</sup> These outstanding and remarkable features of MOFs play a crucial role in diverse fields including gas storage and separation, heterogeneous catalysis, proton conduction, sensing, luminescence, drug delivery and water remediation.<sup>14–21</sup> Moreover, the phenomenal and prodigious skeleton of MOFs renders spatially separated unsaturated metal centers and functional linkers which further obstruct catalyst deactivation and deterioration, thereby enhancing the overall catalytic efficiency.<sup>19–21</sup> Furthermore, to expedite the separation process, the idea of magnetic retrievability has been successfully utilized by decorating the surface of MOFs with inverse spinel magnetic nanoparticles.<sup>22–31</sup> Stimulated by these advancements, tremendous efforts of the research community are oriented towards finding neoteric magnetic MOF catalyzed routes for several unexplored transformations that generate countless heterocyclic motifs of fundamental interest. Amongst the numerous heterocycles, imidazoles are privileged structural moieties present in several biologically active molecules and natural products. Additional soaring interest stems from the bioactive nature presented by these moieties that renders them appealing in pharmaceutical and drug development fields, ligand chemistry and materials

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† Electronic supplementary information (ESI) available. See DOI: 10.1039/d1qm00904d



OPEN **Enhanced catalysis through structurally modified hybrid 2-D boron nitride nanosheets comprising of complexed 2-hydroxy-4-methoxybenzophenone motif**

Pooja Rana<sup>1</sup>, Ranjana Dixit<sup>1</sup>, Shivani Sharma<sup>1</sup>, Sriparna Dutta<sup>1</sup>, Sneha Yadav<sup>1</sup>, Aditi Sharma<sup>1</sup>, Bhawna Kaushik<sup>1</sup>, Pooja Rana<sup>1</sup>, Alok Adholeya<sup>2,3</sup> & Rakesh K. Sharma<sup>2,3</sup>

Tuning the structural architecture of the pristine two dimensional hexagonal boron nitride (*h*-BN) nanosheets through rational surface engineering have proven advantageous in the fabrication of competent catalytic materials. Inspired by the performance of *h*-BN based nanomaterials in expediting key organic transformations, we channeled our research efforts towards engineering the inherent surface properties of the exclusively stacked *h*-BN nanosheets through the incorporation of a novel competent copper complex of a bidentate chelating ligand 2-hydroxy-4-methoxybenzophenone (BP). Delightfully, this hybrid nanomaterial worked exceptionally well in boosting the [3 + 2] cycloaddition reaction of azide and nitriles, providing a facile access to a diverse variety of highly bioactive tetrazole motifs. A deep insight into the morphology of the covalently crafted *h*-BN signified the structural integrity of the exfoliated *h*-BN@OH nanosheets that exhibited lamellar like structures possessing smooth edges and flat surface. This interesting morphology could also be envisioned to augment the catalysis by allowing the desired surface area for the reactants and thus tailoring their activity. The work paves the way towards rational design of *h*-BN based nanomaterials and adjusting their catalytic potential by the use of suitable complexes for promoting sustainable catalysis, especially in view of the fact that till date only a very few *h*-BN nanosheets based catalysts have been devised.

Two-dimensional hexagonal boron nitride nanosheets based architectures with long-range ordered atomic arrangements have recently stimulated the exponential growth in the arena of materials chemistry. Indeed, it is the exclusive stacked structure of BN nanosheets due to electronegativity difference between B and N atom which imparts several fascinating features such as excellent mechanical strength, outstanding thermal and chemical stability, low dielectric constant, oxidative resistance, nanometre size, large surface area to volume ratio and high complex loading<sup>1-3</sup>. Considering such intrinsic characteristics, research on structurally flexible *h*-BN based nanomaterials has been flourishing across the globe in myriad of diverse fields including sensing, electronics, sensors, hydrogen storage, gas separation, etc<sup>4-8</sup>. Very recently, these exotic materials have significantly garnered the attention of scientific community as a promising candidate to design new generation catalytic materials for cascade reactions due to their unique atomic structure. Notably, atomically thin *h*-BN nanosheets have received tremendous recognition as a solid matrix amongst various nanostructured materials to develop surface engineered catalysts as they are capable of dissipating considerable amount of heat in exothermic organic reactions<sup>9,10</sup>. Besides, they not only prevent catalyst deactivation by driving off the moisture owing to hydrophobic surface but also prevent the issue of silicates or aluminates formation often encountered

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## Unravelling the catalytic potential of a magnetic CoFe<sub>2</sub>O<sub>4</sub>/Cu–ABDC MOF composite in the sustainable synthesis of 2*H*-indazole motifs†

Sneha Yadav, Ranjana Dixit, Shivani Sharma, Sripama Dutta, Bhavya Arora, Pooja Rana, Bhawna Kaushik, Kanika Solanki and Rakesh K. Sharma<sup>†</sup>\*

Incessant advancements made in catalytic processes during the past few decades prompted researchers to design prodigious sustainable materials that lie within the domain of green synthesis. From this perspective, metal organic frameworks (MOFs) with abundant chemical functionalities and ultra-high chemical as well as structural tunability have emerged as the most prolific heterogeneous catalysts in synthetic organic chemistry. Herein, we report the fabrication of a magnetic CoFe<sub>2</sub>O<sub>4</sub>/Cu–ABDC (ABDC = 2-aminoterephthalate) hybrid composite via a one-pot solvothermal strategy whose catalytic efficiency has been investigated in a three-component coupling reaction to obtain biologically active and pharmacologically significant 2*H*-indazole scaffolds (up to 96% yield). By integrating magnetic inverse spinel cobalt ferrite nanoparticles with the functional properties of the MOF, two most important parameters, *i.e.* environmental compatibility and recyclability, have been well established on a single platform. Aided by the advanced microscopic, spectroscopic and property characterization tools, the morphological as well as structural information of the developed hybrid composite has been deduced well. The aim of this study is to design a sustainably viable process that would provide highly demanding pharmacophores, *i.e.* 2*H*-indazoles, in surprisingly high yields from comparatively cheap benchmark substrates – “substituted anilines, 2-bromobenzaldehydes and sodium azide”. Furthermore, our protocol has successfully accomplished the remarkable task of replacing toxic volatile organic solvents with eco-friendly solvents such as water. A broad substrate scope, high atom economy, ambient and greener reaction conditions devoid of any ligands, additives or activators, a lower reaction time and temperature, a high turnover frequency and magnetic retrievability are some of the salient features of this methodology which render it highly promising in industry and academia. Besides, the present study is the first report employing a magnetic MOF as a heterogeneous catalyst for the preparation of 2*H*-indazole moieties.

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### Introduction

The advent of metal organic frameworks (MOFs) as porous coordination polymers comprising a systematic array of metal ions linked with organic linkers has completely metamorphosed the landscape of materials chemistry across the globe through their notable attributes. Quite appreciably, the chemistry as well as synthesis of these transformative materials (MOFs) is not only expanding at an impressive pace but has rather garnered worldwide attention. Indeed, striking progress made in this field during the last two decades is apparent from

the exponential rise in the number of publications appearing each year in the literature.<sup>1,2</sup> Their intriguing or unique properties such as high chemical and thermal stability, an extremely high surface area, numerous topologies, an unprecedented degree of chemical tunability and record breaking porosity have provided a great impetus to researchers.<sup>3–5</sup> Owing to their magnificent features, these multimodal architectures are finding tantalizing applications in the fields of catalysis, medicinal chemistry, optics, sensing, magnetism, conductivity, gas storage and separation.<sup>6–9</sup> Besides, the virtually infinite choice of spaces or high degree of structural tunability in MOFs provides viable opportunities to tune their activity as per requirement.<sup>10–12</sup> Therefore, by judiciously selecting an appropriate metal ion and an organic linker possessing chemical functionalities, it is possible to rationally design MOF architectures for specific applications.<sup>13,14</sup> In fact, certain MOF materials possess coordinatively unsaturated or exposed metal sites which play a

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Review

## Functionalized MCM-41: Versatile Catalysts for Organic Transformations

 Dr. Sharda Pasricha , Dr. Pragya Gahlot, Dr. Kavita Mittal, Devansh Rai, Nishita Avasthi, Harsimar Kaur, Shruti Rai

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### Graphical Abstract

The scope of seven surface functionalized MCM-41 catalysts in organic transformations discussed. Functionalized MCM-41 are innovative and need based catalyst systems for reactions like Sonogashira, Suzuki, Heck, Aldol, Knoevenagel, Friedel Craft reaction and Pechmann condensation etc. Several other reactions like oxidation, reduction, dehydration, esterification, trans-esterification, epoxidation as well as C-S, C-N, C-O and S-S coupling reactions also possible with MCM-41 based catalysts. Multicomponent synthesis of bioactive heterocycles is reported. Major challenges and future prospects of functionalized MCM-41 catalysts are discussed.


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# Identifying Central Nodes in Directed and Weighted Networks

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**Abstract**—An issue of critical interest in complex network analysis is the identification of key players or important nodes. Centrality measures quantify the notion of importance and hence provide a mechanism to rank nodes within a network. Several centrality measures have been proposed for un-weighted, un-directed networks but applying or modifying them for networks in which edges are weighted and directed is challenging. Existing centrality measures for weighted, directed networks are by and large domain-specific. Depending upon the application, these measures prefer either the incoming or the outgoing links of a node to measure its importance. In this paper, we introduce a new centrality measure, *Affinity Centrality*, that leverages both weighted in-degrees as well as out-degrees of a node's local neighborhood. A tuning parameter permits the user to give preference to a node's neighbors in either incoming or outgoing direction. To evaluate the effectiveness of the proposed measure, we use three types of real-world networks - migration, trade, and animal social networks. Experimental results on these weighted, directed networks demonstrate that our centrality measure can rank nodes in consonance to the ground truth much better than the other established measures.

**Keywords**—Centrality; weighted network; directed network; migration network; world input output trade network; community structure

## I. INTRODUCTION

Data analysts from diverse domains represent relationships or ties between entities using graph-based network models. The semantic meaning of nodes and ties is, however, domain-specific; in social networks where nodes represent individuals, ties might represent friendship or face-to-face communication [17], [2] whereas, in web networks, ties signify the existence of hyperlinks between web pages [16]. In most real-world networks, ties are characterized by their strength as well as direction. For instance, in world trade networks, where links between nations represent the exchange of commodities, tie strength is the cash flow and its direction indicates either import or export [6]. When both the strength and direction of ties are available, modeling data as *weighted, directed network* can be more elucidative and revelatory.

Network models are generally deployed to explain or predict the behavior of entities [11]. One key requirement in these applications is to determine the 'most important' or 'central' node in a network. A centrality measure quantifies this notion of node importance and provides a means to rank nodes based on their importance. Central nodes are useful in varied applications such as predicting most cited authors [22], determining influential spreaders for product advertisement in

online social networks [12], [25], detecting influential criminals [9], performing resilience analysis of power grid networks [13], locating key areas of activity in the urban infrastructure of a city [1], and traffic sampling for intrusion detection [28].

Several centrality measures have been formulated to quantify the notion of central nodes in un-weighted/ weighted, un-directed networks and are surveyed in [7], [3], [4], [5]. However, quantification of node centrality is more challenging in complex weighted and directed networks due to the dynamic effect of weighted reciprocal links on its computation. Very few measures exist for such networks, and the area remains under-explored.

### A. The Problem and Motivation

PageRank (PR) proposed by Brin and Page to rank web pages is a popular and effective centrality measure [20], and there exist variations and extensions of PR for weighted, directed networks [27], [30]. These measures quantify the importance of a web page by iterative counting of the number and quality of its incoming links. The underlying assumption is that more important web pages have more *incoming* links from other central web pages. The problem is that this assumption, though correct for web pages, may not be valid for other domains. For example, in the migration networks, a state's importance in the network is affected not only by the incoming migrant population but also by the outgoing migrants from that state.

A pair of centrality measures that consider both incoming and outgoing links are computed through the Hyperlink-Induced Topic Search (HITS) algorithm for web pages. However, this method delivers two metrics - hub score and authority score [14]. A good hub page has *outgoing* links to many good authorities; a good authority page has *incoming* links from many good hub pages. Similarly, the recently proposed Bi-directional h-index also presents two measures,  $h_{in}$ -index and  $h_{out}$ -index that give preference to incoming and outgoing links, respectively [29].

This raises a critical question regarding the importance of *incoming* versus *outgoing* links when computing the relative importance of a node. We conjecture that, in some domains, incoming links have more impact than outgoing links, whereas, in others, it is vice versa. This trade-off offers the opportunity to define a novel measure that can tune the relative importance between incoming and outgoing ties.

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## Perception of youth on Digital India

Sunita Narang, Monica Singhania, Surinder Kaur and Shalu Mahajan

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### Abstract

Digital India is seen as the engine for transition of India into an empowered nation. In this direction, several pro-people initiatives like MyGov, Digilocker, e-basta, and e-hospital are being implemented. Through a self-structured survey questionnaire, the study evaluates awareness about, implementation and utilisation of various e-services offered under the Digital India Program among Delhi University students. It examines the extent to which the services are being utilised and main barriers/challenges restricting its utilisation. The data has been analysed using ANOVA. The study reveals a high level of

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## Coupling Fear and Contagion for Modeling Epidemic Dynamics

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Kirti Jain ; Vasudha Bhatnagar ; Sadanand Prasad; Sharanjit Kaur [All Authors](#)

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### Abstract

#### Document Sections

- I. Introduction
- II. Archetypal Model of Fear
- III. Individual-Based Fear Model
- IV. Differential Equation-Based

### Abstract:

The emotion of fear related to an infectious disease not only influences an individual's behavior but also transmits to social contacts. Therefore, modeling human behavior is a precursor to reliable estimates of epidemic size and duration. In this paper, we present an abstract model of fear, which is realized using an Individual-based Fear Model (IBFM). In this model, fear is coupled with contagion to study the influence of human behavior on epidemic dynamics. Since fear is an inherent characteristic of an individual that determines susceptibility to infection, the model discerns between individuals by maintaining a fear-index. Variations in innate fear levels in populations with cultural differences are also accommodated. Since the fear level of individuals is affected by the changing size of the epidemic, IBFM provides a mechanism to update fear in the population realistically. The mechanism gives rise to multiple epidemic waves observed in real-world epidemics. We compare the epidemic

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## Intensity quantification of public opinion and emotion analysis on climate change

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### Abstract

Human-related activities are primarily accountable for climate change resulting in natural disasters. Therefore, it has become essential to analyze and evaluate public awareness of climate change globally. With the prevalence of social networks like Twitter, sentiment classification has been recognized as a powerful tool to determine public opinion and concern on such ecological issues. Therefore, this study proposes a framework to classify the tweets containing public opinion towards climate change using Bi-directional Long Short-Term Memory (Bi-LSTM) Networks. The proposed framework quantified the intensity of the public opinion classified by the Bi-LSTM model to measure the strength of the public concern towards climate change and validated it using three case studies: Earth Day, Delhi Air Pollution, and Australian Bushfires. The intensity values of the public sentiments concerning these events were obtained as 98.50%, 96.57%, and 98.33%, respectively. The proposed work was further augmented with a lexicon-based emotion analyzer to categorize the emotions associated with the tweets into positive, negative, neutral, and mixed to substantiate the results. This framework can be utilized before enforcing the policy decisions on the general public in any domain.

### Keywords

Bi-LSTM networks, Sentiment analysis, Global warming, Social networks, Climate change.

# A smart learning assistance tool for inclusive education

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**Abstract.** The government has established special schools to cater to the needs of children with disabilities but they are often segregated rather than receiving equitable opportunities. Artificial Intelligence has opened new ways to promote special education with advanced learning tools. These tools enable to adapt to a typical classroom set up for all the students with or without disabilities. To ensure social equity and the same classroom experience, a coherent solution is envisioned for inclusive education. This paper aims to propose a cost-effective and integrated Smart Learning Assistance (SLA) tool for Inclusive Education using Deep Learning and Computer Vision techniques. It comprises speech to text and sign language conversion for hearing impaired students, sign language to text conversion for speech impaired students, and Braille to text for communicating with visually impaired students. The tool assists differently-abled students to make use of various teaching-learning opportunities conferred to them and ensures convenient two-way communication with the instructor and peers in the classroom thus makes learning easier.

Keywords: Inclusive classroom, image processing, computer vision, deep learning, artificial intelligence

## 1. Introduction

The education system plays a very crucial role in the overall growth and development of a country. India, one of the fastest developing countries globally, took cognizance of the situation and underwent many reforms in strengthening its education system. It is believed that education is not a privilege but a right of everyone. The students with disabilities may wish to contribute to the development of the country, but they generally do not get equitable opportunities. An analytical report published by *enabled.in* mentioned that 2.21% (2.68 Cr) of the total population (121 crores) has disabilities, out of which 19%

have a visual impairment and 19% have a hearing impairment, and another 8% have multiple disabilities [1]. The Indian government has implemented several policies for the last two decades concerning educational reforms for the disabled. One of these policies is “Sarva Shiksha Abhiyan” (SSA), aiming at free education for disabled children of 6–14 years of age. Free inclusive education is an integral part of SSA to provide “*education to all*”. Inclusive education is a learning environment where children with and without disabilities study in the same classroom [2]. The purpose of inclusive education is to make classrooms impartial to all students regardless of any disparity. Inclusive education is a birthright for every child and not a privilege. The *Individuals with Disabilities Education Act* (IDEA) clearly states that all children with disabilities should be edu-

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Home > AIP Conference Proceedings > Volume 2369, Issue 1 > 10.1063/5.0060996

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No Access • Published Online: 13 September 2021

## Varying sonication conditions to tailor surface morphology of GO thin films for enhanced gas sensing performance

AIP Conference Proceedings **2369**, 020109 (2021); <https://doi.org/10.1063/5.0060996>

Vishal Dhingra<sup>1,3</sup>, Shani Kumar<sup>1,3</sup>, Arijit Chowdhuri<sup>2</sup>, and Amit Garg<sup>1,4</sup>

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### ABSTRACT

Efficient and enhanced gas sensing especially at room temperature is the demand for contemporary industrial applications. This has been made possible due to a paradigm shift

## Behaviour of motion of infinitesimal variable mass oblate body in the generalized perturbed circular restricted three-body problem

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**Abstract.** The main goal of the present study is to reveal the behaviour of motion of the infinitesimal body in case of circular restricted three-body problem where all the participating bodies have oblate shapes and both primaries have the effect of solar radiation pressure. The third infinitesimal body is varying its mass according to Jeans law. We also consider that the system is affected by the small perturbations in Coriolis and centrifugal forces. We evaluate the equations of motion of the infinitesimal oblate body under the generalized sense in the perturbed circular restricted three-body problem by using the Meshcherskii-space time transformations to preserve the dimensions of the position as well as time, and then determine the Jacobi-integral. Further we numerically illustrated the equilibrium points, Poincaré surfaces of section, regions of possible and forbidden motion and then basins of the attracting domain by supposing the effects of all the parameters used. Further more, we examine the stability of these

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\*. Corresponding author

## Outline

Abstract

Keywords

1. Introduction

2. Data and methodology

3. Results and discussion

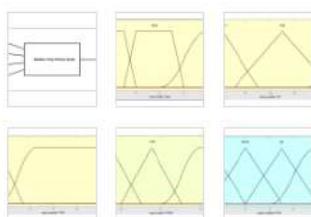
4. Conclusion

Declaration of Competing Interest

References

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## Figures (10)

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## Study and prediction of prostate cancer using fuzzy inference system

 Rashul Boodh <sup>a</sup>, Deo Datta Aarya <sup>b</sup>, Mamta Dahiya <sup>c</sup>, Rakesh Rathee <sup>d</sup>, Sarita Rathee <sup>e</sup>, Ajay Kumar <sup>f</sup>    
 , Sarika Jain <sup>g</sup>, Yogendra Kumar Rajoria <sup>h</sup>
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### Abstract

The essential driver of passing among men on the planet is prostate disease. In the chief stage, for early identification of the prostate disease by applying Fuzzy Inference System (FIS) has been depicted in this study. The age of the patient, Prostate Volume (PV), % Free PSA (FPSA) and Prostate Specific Antigen (PSA) are utilized as input parameters in FIS for computing the risk factor of the prostate

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## Outline

Abstract

Keywords

1. Introduction

2. Assumptions and notations

3. Mathematical model

4. Numerical example

5. Observations

6. Conclusion

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Declaration of Competing Interest

References

## Figures (1)



## Tables (7)

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Volume 56, Part 1, 2022, Pages 245-251



## Selling price, time dependent demand and variable holding cost inventory model with two storage facilities

Deo Datta Aarya <sup>a</sup>, Yogendra Kumar Rajoria <sup>b</sup>, Neha Gupta <sup>c</sup>, Yashpal Singh Raghav <sup>d</sup>, Rakesh Rathee <sup>e</sup>,  
Rahul Boadh <sup>b</sup>, Ajay Kumar <sup>f</sup>

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### Abstract

Customer service stock-out rates, as well as the company's business sales and marketing productivity, are controlled by the storage facility (warehouse). In this study, a two- storage production inventory model with demand dependent on price



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## Optimal ordering policy for deteriorating items with stock dependent demand, partial backlogging and trade credit period

Sachin Kumar Verma, Mohd. Rizwanullah and Chaman Singh

Published Online: September 6, 2021 · pp 95-120 · <https://doi.org/10.1504/IJLSM.2021.117709>

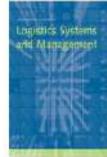
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### Abstract

In this paper, policies of optimal ordering has been focussed on economic order quantity (EOQ) model, where we considered deteriorated as well as non-instantaneous nature items. In this inventory model, we are also assuming there is a stock-dependent demand and constant holding cost. Occurrence of shortage during the complete process of the system, taking into consideration with partial backlogging where deterioration of items follows the Weibull distribution. In the present study, it is considered that the supplier's proposed lucrative trade credit offers to the retailers to buy more to generate more

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Published Online: September 06, 2021

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Research Article: 2022 Vol: 25 Issue: 2

## Two ware-houses fuzzy inventory model for deteriorating items with ramp type demand and shortages

**Garima Sethi, Research Scholar, SRM Institute of Science and Technology, Delhi-NCR Campus**

**Ajay Singh Yadav, SRM Institute of Science and Technology, Delhi-NCR Campus**

**Chaman Singh, Acharya Narendra Dev College**

**Citation Information:** Sethi, G., Yadav, A. S., & Singh, C. (2022). Two ware-houses fuzzy inventory model for deteriorating items with ramp type demand and shortages. *Journal of Management Information and Decision Sciences*, 25(2), 1-22.

### Abstract

In this paper we developed a fuzzy inventory model for single spoilage two-parameter weibull-distribution degradation rate, ramp type demand, and partial backordering at a constant rate. In the current market scenario, an increase in the cost of the inverter affecting the total cost of inventory costs due to inflation can increase at any time of the order length. The increase in the cost of the components of the inventory cannot be pre-determined due to the uncertainty of the market situation. Therefore, we have considered the interval based fuzzy concept to handle the uncertainty condition. Ordering cost, the cost of holding in both ware-houses is considered a triangular fuzzy number.



## Smart materials for cardiovascular devices

Mamta Bhatia <sup>a</sup>, Snigdha Bhatia <sup>b</sup>, Siddhartha <sup>a</sup>  [Show more](#) [+ Add to Mendeley](#)  [Share](#)  [Cite](#)<https://doi.org/10.1016/j.matpr.2021.12.591>[Get rights and content](#)

### Abstract

Shape memory alloys belong to the category of Smart materials which are gaining popularity and have great potential for various medical applications. The property of undergoing deformation and retaining the original shape after removal of external stimuli makes these materials most suitable for their use in designing implants. This paper focuses on use of Ferromagnetic Shape Memory Alloys (FSMA) and magnetostrictive materials for designing cardiovascular devices, which can be most suitable for pediatric heart patients. These materials change their shape in response to a magnetic field. Materials with unique crystal structure are being reviewed for stent designs and coronary applications. This work demonstrates how stents made of FSMA can be magnetically activated and finds their applications in peripheral and coronary heart diseases, thus replacing the current stent technology.

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# ENERGY STORAGE

SPECIAL ISSUE ARTICLE

## Studies on energy storage properties of BFO/WO<sub>3</sub> bilayer thin film capacitor

Shiva Lamichhane, Savita Sharma, Monika Tomar, Arijit Chowdhuri First published: 05 April 2022 | <https://doi.org/10.1002/est2.342>**Funding information:** Department of Science and Technology, New Delhi, India[Read the full text >](#)[PDF](#) [TOOLS](#) [SHARE](#)

### Abstract

Present work reports the growth of BFO/WO<sub>3</sub> bilayer thin film structures over Silicon, corning and ITO coated glass substrates. BFO layer in BFO/WO<sub>3</sub> bilayer structure was deposited using Pulsed Laser deposition (PLD) technique at optimized laser energy (200 mJ) while WO<sub>3</sub> nanostructured layer was deposited using rf-magnetron sputtering technique at varying glancing angle from 65° to 80°. For the realization of MBM (metal-bilayer-metal) device, top Gold (Au) electrodes have been deposited using thermal evaporation technique. The BFO/WO<sub>3</sub> bilayer structure fabricated at 70° glancing angle exhibited the saturation ( $P_s$ ) and remnant ( $P_r$ ) polarization as 45.45  $\mu\text{C}/\text{cm}^2$  and 21.52  $\mu\text{C}/\text{cm}^2$  respectively, which are appreciably higher than the earlier reports for pure BFO thin films. Enhanced energy storage characteristics were obtained in Au/BFO/WO<sub>3</sub>/ITO structure fabricated at 70° glancing angle with charge-discharge efficiency (63%) and

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## Double quantum ionization cross-sections for more general exponential cosine screened coulomb potential

Rachna Joshi 

Pages 414-423 | Received 28 Mar 2022, Accepted 27 May 2022, Published online: 23 Jun 2022

[Download citation](#) <https://doi.org/10.1080/00387010.2022.2088559> [Check for updates](#)

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### Abstract

Double-quantum ionization cross-sections for hydrogen atom have been calculated for the more

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Regular Article – Atomic Physics | [Published: 24 February 2022](#)

# Micrometre double-quantum ionization of Rydberg hydrogen using linearly and circularly polarized light

[Rachna Joshi](#) 

[The European Physical Journal D](#) **76**, Article number: 37 (2022) | [Cite this article](#)

135 Accesses | 1 Citations | [Metrics](#)

## Abstract

Double-quantum ionization for Rydberg hydrogen is studied. The variation of ionization rates with wavelength is shown for linearly polarized (LP) and circularly polarized (CP) radiations. For performing the infinite summations over the intermediate states, pseudostate summation technique (PST) is used which is fast and efficient. Presently, the numerical values of two-quantum and three-quantum ionization rates from ground state and metastable  $2s$  state only are available in the literature. The present work reports the calculations for the double-quantum ionization rates from higher excited levels of hydrogen. Numerical data is also presented for comparison with future experiments.

**Spectroscopy Letters** ›  
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Research Article

# High harmonic generation spectra for lithium embedded in plasma environment

Rachna Joshi

Pages 112-116 | Received 08 Jan 2022, Accepted 19 Feb 2022, Published online 07 Mar 2022

[Download citation](#) <https://doi.org/10.1080/00387010.2022.2046104>
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In this article

[Abstract](#)
[Introduction](#)
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[Conclusion](#)

## Abstract

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Effect of plasma on High harmonic generation of Lithium is investigated. Variation of the strength of different harmonics with respect to changes in Debye length is shown. The unperturbed energy eigenvalues and wavefunctions are calculated using the pseudostate summation technique while for the time evolution of wavefunctions the symplectic method is applied. Results for the numerical simulation of High harmonic generation spectra for plasma embedded Lithium are reported.

**Q** Keywords: [Debye plasma](#) [high harmonic generation](#) [lithium atom](#) [pseudostate summation technique](#) [symplectic method](#)

**Q** SUBJECT CLASSIFICATION CODES: [32.80.Wr](#)

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Regular Article – Atomic Physics | [Published: 26 May 2022](#)

# A numerical evaluation of Shannon entropy for modified Hulthen potential

[Seema Dabas](#) & [Rachna Joshi](#) 

[The European Physical Journal D](#) **76**, Article number: 95 (2022) | [Cite this article](#)

112 [Accesses](#) | [Metrics](#)

## Abstract

We calculate Shannon entropy for Modified Hulthen potential (MHP). Dependence of Shannon entropy on various parameters of the potential is investigated. For solving Schrodinger equation, i.e., for calculation of the wavefunctions, Numerov method has been employed which is fast and efficient. Numerical simulation is performed for the purpose. Novel data for Shannon entropy is presented for a wide range of the parameters of MHP.



# Favourable tuning of optical absorbance, bandgap and surface roughness of ZnO thin films by C ion implantation at the critical angle

Rajesh V. Hariwal<sup>a</sup>  , Hitendra K. Malik<sup>b</sup>, Ambika Negi<sup>c</sup>, K. Asokan<sup>a</sup>

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## Highlights

- Low energy ion implantation with exquisite control of angle allows to manipulate the applications of thin films.

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## Materials Letters

Volume 308, Part B, 1 February 2022, 131200



# Unravelling impacts of C ion implantations at polar angles in the physical properties of ZnO nanostructured thin films

Rajesh V. Hariwal<sup>a</sup>, Hitendra K. Malik<sup>b</sup>, Ambika Negi<sup>c</sup>, K. Asokan<sup>a, d</sup>[Show more](#)[+ Add to Mendeley](#) [Share](#) [Cite](#)<https://doi.org/10.1016/j.matlet.2021.131200>[Get rights and content](#)

## Abstract

The physical properties of nanostructured ZnO thin films have been modified by a pragmatic approach of varying polar angles during low energy ion implantation.

[Home](#) > [Physics of Plasmas](#) > [Volume 29, Issue 4](#) > [10.1063/5.0085724](#) No Access • Submitted: 19 January 2022 • Accepted: 31 March 2022 • Published Online: 19 April 2022

# Spatiotemporal nonlinear evolution of the laser pulse and turbulence generation in laser produced plasmas

Physics of Plasmas **29**, 042114 (2022); <https://doi.org/10.1063/5.0085724>

 [Indraj Singh<sup>1,a\)</sup>](#), [P. K. Gupta<sup>2</sup>](#), [R. Uma<sup>1</sup>](#), and [R. P. Sharma<sup>1</sup>](#)

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## TOPICS

- Analytical chemistry
- Laboratory procedures

## ABSTRACT

This study presents a model to understand the behavior of the turbulence generated in the



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Physica B: Condensed Matter

Volume 632, 1 May 2022, 413762



# Effect of Ag doping on structural, morphological and optical properties of CdO nanostructured thin films

Z.R. Khan <sup>a</sup> , Abdullah S. Alshammari <sup>a</sup>, Mohd. Shkir <sup>b</sup>, M. Bouzidi <sup>a, c</sup>, Mansour Mohamed <sup>a, d</sup>, Manish Kumar <sup>e</sup>, Rakesh K. Sonker <sup>f</sup>

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Acta Ecologica Sinica

Volume 43, Issue 1, February 2023, Pages 11-19



# A systematic review on the eco-safe management of mosquitoes with diflubenzuron: An effective growth regulatory agent

Manu Sankar, Sarita Kumar

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## Abstract

Mosquitoes serve as the major vector transmitting malaria, dengue, yellow fever and several other diseases of human concern. Rising in mosquito-borne diseases and



PLANT PHYSIOLOGY | [Published: 29 March 2022](#)

# Indigenous Plants Demonstrating Effective Antioxidant Properties

[Karmanyaraj Singh Yadav](#), [Roopa Rani Samal](#), [Arunima Sahgal](#) & [Sarita Kumar](#) 

[Biology Bulletin](#) 48, S62–S72 (2021) | [Cite this article](#)

41 Accesses | [Metrics](#)

## Abstract

Increased production of antioxidant herbal supplements utilizing traditional medicinal plants has been attributed to a high margin of economic effectiveness, environmental friendliness, and accessibility. Current investigations determined the antioxidant properties of leaf and stem extracts of five plants: *Quercus semialata*, *Artemisia monchensis*, *Thymus serpyllifolius*



**Bulletin of  
Entomological  
Research**

### Article contents

Abstract  
Introduction  
Materials and  
methods  
Results  
Discussion  
Conclusion  
Data

# Reversion of CYP450 monooxygenase-mediated acetamiprid larval resistance in dengue fever mosquito, *Aedes aegypti* L.

Published online by Cambridge University Press: 24 February 2022

Roopa Rani Samal , Kungreilu Panmei, P. Lanbiliu and Sarita Kumar 

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### Abstract

*Aedes*-borne diseases are on the rampant rise despite continued application of chemical insecticide-based interventions. The appearance of high degree of insecticide resistance in *Aedes* species and noxious effects on environment and non-targets have raised further concerns. Among new chemical interventions, neonicotinoids are considered a safe and effective approach. The present study investigated the control potency of acetamiprid and development of resistance in *Aedes aegypti* larvae; and the involvement of CYP450 monooxygenases in inducing resistance. The early fourth instars of *Ae. aegypti* parent susceptible strain (PS) were selected with acetamiprid for 15 generations (ACSF strain) increasing the resistance to 19.74-fold in ACSF-10 and 36.71-fold in ACSF-15. The ACSF-10 larvae

# Journal of Communicable Diseases (E-ISSN: 2581-351X & P-ISSN: 0019-5138)

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## Formulation of Clitoria ternatea Leaves-mediated Silver Nanoparticles to Control Aedes aegypti Larvae

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F

### Yanav Lall

Modern School, Barakhamba Road, New Delhi, India.

### Roopa Rani Samal

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### Sarita Kumar

Professor, Department of Zoology, Acharya Narendra Dev College, University of Delhi, Kalkaji, New Delhi, India.

**Keywords:** Larvicide, Nanocomposites, Clitoria ternatea, Aedes aegypti, DLS, SEM, TEM

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Volume 2022 | Article ID 2977454 | <https://doi.org/10.1155/2022/2977454>[Show citation](#)

## Attractive Sugar Bait Formulation for Development of Attractive Toxic Sugar Bait for Control of *Aedes aegypti* (Linnaeus)

Sarita Kumar ,<sup>1</sup> Aarti Sharma ,<sup>1</sup> Roopa Rani Samal ,<sup>1</sup> Manoj Kumar ,<sup>1</sup> Vaishali Verma ,<sup>2</sup> Ravinder Kumar Sagar ,<sup>1</sup> ShriPati Singh ,<sup>2</sup> and Kamaraju Raghavendra <sup>2,3</sup>

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Academic Editor: Riaz Ullah

Received

01 Feb 2022

Accepted

26 May 2022

Published

18 Jun 2022

### Abstract

Original Article | [Published: 07 May 2021](#)

## In vitro and in silico anticancer potential analysis of *Streptomyces* sp. extract against human lung cancer cell line, A549

Prateek Kumar, Anjali Chauhan, Munendra Kumar, Bijoy K. Kuanr, Aditi Kundu, Renu Solanki & Monisha Khanna Kapur 

3 *Biotech* 11, Article number: 254 (2021) | [Cite this article](#)

433 Accesses | 3 Citations | 2 Altmetric | [Metrics](#)

### Abstract

During our previous investigation, bioactive compounds present in the extract of *Streptomyces* sp. strain 196 were characterized using LC–MS/MS and <sup>1</sup>H NMR studies. These compounds were K-252-C aglycone indolocarbazole alkaloid, decoyinine, and cycloheximide; the study of these natural drugs against lung carcinoma is still limited. Focus of the current investigation was to study the anticancer effect of strain 196 extract on human lung cell-

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Published: 04 January 2022

## Molecular characterization and transcriptional modulation of stress-responsive genes under heavy metal stress in freshwater ciliate, *Euplotes aediculatus*

[Sripoorna Somasundaram](#), [Jeeva Susan Abraham](#), [Swati Maurya](#), [Ravi Toteja](#), [Renu Gupta](#) & [Seema Makhija](#) 

*Ecotoxicology* **31**, 271–288 (2022) | [Cite this article](#)

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### Abstract

Heavy metal pollutants in the environment are increasing exponentially due to various anthropogenic factors including mining, industrial and agricultural wastes. Living organisms exposed to heavy metals above a certain threshold level induces deleterious effects in these organisms. To live in such severe environments, microbes have developed a range of tolerance mechanisms which include upregulation of stress-responsive genes and/or antioxidant

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Review article | Published: 02 July 2022

## Microbial Journey: Mount Everest to Mars

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*Indian Journal of Microbiology* **62**, 323–337 (2022) | [Cite this article](#)

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### Abstract

A rigorous exploration of microbial diversity has revealed its presence on Earth, deep oceans, and vast space. The presence of microbial life in diverse environmental conditions, ranging from moderate to extreme temperature, pH, salinity, oxygen, radiations, and altitudes, has

DEGRADATION, REHABILITATION, AND CONSERVATION OF SOILS | [Published: 20 June 2022](#)

# A Comparative Study of Physical and Chemical Parameters and Ciliate Diversity of Leachate Contaminated Soil from the Landfill and the Soil from the Human Inhabitant Land

[S. Maurya](#), [J. S. Abraham](#), [S. Somasundaram](#), [Sandeep](#), [J. Dagar](#), [R. Gupta](#), [S. Makhija](#), [P. Bhagat](#) & [R. Toteja](#)  


[Eurasian Soil Science](#) **55**, 1161–1172 (2022) | [Cite this article](#)

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## Abstract

Landfilling is considered to be a safe and economical approach for waste disposal but this is true only for engineered landfills. Engineered landfills are seldom found in developing countries like India. The generation of leachate from the landfilled municipal solid waste (MSW) is a major concern nowadays. Leachate is the result of two main phenomena occurring

## SIGHTINGS OF THE TAILLESS LINEBLUE *PROSOTAS DUBIOSA* (INSECTA: LEPIDOPTERA: LYCAENIDAE) IN DELHI, INDIA

RAJESH CHAUDHARY<sup>1</sup> AND CHANDRA BHUSAN MAURYA<sup>2</sup>

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*rajeshchaudhary@andc.du.ac.in*

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*Reviewer: Piet van der Poel*

The floristic composition of Delhi has changed significantly during past one and half centuries (Maheshwari, 1963; Anonymous, 1991). Several non-native plant species have been introduced for afforestation and beautification of gardens and parks (Maheshwari, 1963). In addition, the city has also witnessed an increased plantation of vegetable and fruit plants (Maheshwari, 1963). Factors such as change in floristic characteristics, appearance of new microhabitats, change in land use and climate change, alone or in combination can cause an alteration to the butterflies species diversity in a geographical area (Kwon *et al.*, 2021; Mukherjee *et al.*, 2019). For instance, in Delhi, a few species of butterflies, such as Common Jay (*Graphium doson* C. & R. Felder, 1864), Red Pierrot (*Talicauda nysaeus* Guérin-Méneville, 1843) and Plains Cupid (*Chilades pandava* Horsfield, 1829), that are fairly common at present, were not recorded by previous workers (Donahue, 1967; Larsen, 2002). These butterfly species are thought to have been introduced in Delhi during the last two decades along with their host plants, which have ornamental value. Also, species which were once considered extremely rare in Delhi such as the Common Lineblue (*Prosotas nora* C. Felder, 1860) and the Dark Cerulean (*Jamides bochus* Stoll, 1782) have been sighted more often during the last three years, and possibly breed (in the case of Dark Cerulean) in the city (Chaudhary *et al.*,

2019; 2020). Besides these, there is a recent record of the Common Grass Dart (*Taractrocerma maevius*) (Madan & Dey, 2018) that had not been reported previously from Delhi. In the present communication, we report sightings of the Tailless Lineblue (*Prosotas dubiosa*) from various parts of Delhi and its vicinity.

Two individuals of the Tailless Lineblue were sighted in the Sanjay Van area (28° 31' 48"N, 77° 10' 15"E) of South Delhi during the late morning on 2.x.2021 (Figure 1). Both the individuals were found puddling together on a footpath. These were observed for about 10 minutes and photographed. Another individual of this species was sighted and photographed on the morning of 13.x.2021, basking on a tree in the R. K. Puram area (28° 33' 20"N, 77° 10' 49"E) of New Delhi. It is noteworthy that this butterfly species was also sighted by us on 14.x. and 16.x.2021 (two individuals each day) in Aravalli Biodiversity Park, Gurugram, Haryana (28° 28' 56"N, 77° 06' 39"E). Therefore, it is likely that the Tailless Lineblue is present in other parts of Delhi-NCR as well.

To the best of our knowledge, the Tailless Lineblue has not been reported previously from Delhi (Donahue, 1967; Larsen, 2002) or its immediate vicinity. Thus, this butterfly is a new addition to the checklist of butterflies of Delhi.

## SIGHTING OF PLAIN TIGER (*DANAUS CHRYSIPPUS* LINN., 1758) FORM *DORIPPUS* IN NEW DELHI, INDIA

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Four forms of *Danaus chrysippus* are known from India, viz. *chrysippus*, *alcippoides*, *amplifascia* and *dorippus* (Smetacek, 2001). The first form is the most common in the country whereas sighting of the other three forms are rare (Smetacek, 2001). The form *dorippus*, known to be a common form in Africa, is sighted only rarely in India (Smith *et al.*, 1997; Smetacek, 2001). This form is differentiated from the other forms by lack of a white band on the forewing (Smetacek, 2016). It has been observed only on few occasions in several states – Uttarakhand (foothills), Bengal, Bihar, Rajasthan and Maharashtra (Smetacek, 2001) and Andhra Pradesh (M. Yuvaraj & Smetacek, 2019). It was recorded by Ashton in the year 1972 from Delhi (Ashton, 1972).

Here, I report sighting of *Danaus chrysippus* form *dorippus* from Rohini area of Northwest Delhi, India in the afternoon of March 14, 2021. The butterfly was found to be gliding over flowers on the lawns of a residential society. It was observed for 10 minutes, and photographed using a digital camera (Fig. 1).

### References

- Ashton, R. 1972. Butterflies of New Delhi, India (Papilionoidea). *Journal of the Bombay Natural History Society* 69: 502-509.
- M. Yuvaraj & P. Smetacek. 2019. First report of *Danaus chrysippus* form *dorippus* (Insecta: Lepidoptera: Nymphalidae) from Andhra Pradesh, India. *Bionotes* 21(3): 65-66.
- Smetacek, P. 2001. Forms of *Danaus chrysippus* Linn. (Lepidoptera: Nymphalidae) in the Kumaon Himalaya. *Journal of the Bombay Natural History Society* 98: 131-132
- Smetacek, P. 2016. A Naturalist's Guide to the Butterflies of India, Pakistan, Nepal, Bhutan, Bangladesh and Sri Lanka. John Beaufoy Publishing, Oxford. 176 pp.
- Smith, D.A.S. & D.F. Owen. 1997. Colour Genes as Markers for Migratory Activity: The butterfly *Danaus chrysippus* in Africa. *Oikos* 78: 127-135.

**GENERA OF ANTS ASSOCIATED WITH LARVAE OF PLAINS CUPID (*CHILADES PANDAVA*, HORSFIELD, 1829) (INSECTA: LEPIDOPTERA: LYCAENIDAE) INFESTING *CYCAS*, IN DELHI, INDIA, AND AN INSIGHT INTO THE NATURE OF THEIR INTERACTION**

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**Abstract**

Larvae of many species of Lycaenid butterflies are known to associate with ants. With respect to larvae, the association can be facultative or obligatory. Also, larvae of some species of Lycaenids maintain a parasitic, and many others a mutualistic relationship with ants. Larvae of *Chilades pandava* (Lepidoptera:Lycaenid:Polyommata) -a butterfly that has recently extended its range along with the artificial introduction of its larval host plants, several species of *Cycas*, is known to associate with more than one genera/species of ants. We sampled ornamental *Cycas* plants in urban Delhi infested with *C. pandava* for the genera of ants that associate with the larvae of this butterfly. Results compiled from sampling studies in Delhi, and various reports from literature indicated that at least 13 genera of ants can associate with larvae of *C. pandava*. In the present communication, these results have been discussed in light of the nature of association between *C. pandava* and ants.

**Keywords** Lycaenid-ant Association, Mutualism

**Introduction**

The larvae of many Lycaenid butterflies are known to associate with ants- 'myrmecophily' (Pierce *et al.*, 2002). The relationship between larvae and ants can be parasitic, commensal or mutualistic (Baylis *et al.*, 1993; Fiedler, 2012).

segment which are known to secrete volatile substances, and Pore Cupola Organs (PCO) distributed on abdomen (Pierce *et al.*, 2002; Ekka *et al.*, 2020). The function of substances secreted from TO is similar to the ant alarm



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**COVID-19 and cardiovascular disease: Clinical implications of biochemical pathways**

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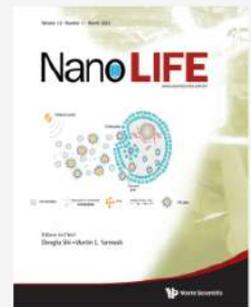
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## The Dynamical Study of Variable Mass Test Particle in Nonlinear Sense of Restricted 3-body Problem with Heterogeneous Primaries

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