

# INTRINSIC RESTRAINING FACTORS IN PRECISE EXTRATERRESTRIAL RADIO SIGNAL RECEPTION

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## Abstract

*In electromagnetic signal reception Gabor uncertainty is one of the fundamental concepts. A finite limitation has been noticed while we are receiving Jovian bursts and analyzing it at our observatory set at Bidhannagar College. Due to time-frequency restriction there is more than 0.1  $\mu$ s uncertainty in recording Jovian signal through Radio Jove Project or by spectrum analyzer. It also noted precise observation is largely limited by time synchronization through client computer and instrumental selection circuit choice. It challenges this backlash is hidden into modern days signal reception procedure.*

## Keywords:

*Uncertainty, Radio Signal, Jovian Burst, Spectrum Analyzer*

## 1. INTRODUCTION

We have crossed a long way in science and technology field throughout our civilised era. Despite our tremendous progress, we are still behind in time, namely for reception of galactic and extragalactic radio signals [1]-[2].

After the discovery of radio bursts from Jupiter, careful analysis of extraterrestrial signal to understand the cause behind. Most of the observed radio waves from Jupiter are polarized. Information wrapped in Jovian signal consists of meteorological conditions of Jupiter and about the medium in space between Jupiter and Earth through which signal travels. Polarized radio waves implied that Jupiter had a very intense magnetic field and when charged particles move through that magnetic field their paths are distorted. The particles are accelerated and move in spirals around magnetic field lines towards either the north or the south pole. Accelerated charged particles emit radiation in radio frequency range depending up on their energy, and called cyclotron emission. In our endeavour to receive Jovian radio emissions we need to know about the source of the radio signal as well as actually when it was detected. The time correlation is very important to distinguish Jovian bursts from ordinary radio frequency interference [3].

## 2. CONSTRAINS IN PRECISE DETECTION

Two major points may be considered for precise detection of radio signals from extra-terrestrial sources. They may be categorised as: Instrumental limitation and Time-frequency uncertainty.

### 2.1 INSTRUMENTAL LIMITATION

Data quality is a major criterion in any signal processing module [4]-[5]. Accuracy over precision is carrying more importance in our observation. A typical personal computer uses a quartz crystal oscillator for timestamp which is sensitive to temperature and drifts with time. So, we need to synchronize it

regularly. During this synchronization an estimation of time to communicate with reference and the time taken to process the request and response by reference plays a crucial role in updating computer clock. A few ms errors in assumptions accumulate to a second in result. We assume general PC quartz crystal has tolerance about 20 ppm when averaged over 1 day. At the end of a 24-hr time, the clock could diverge by  $\sim 1.8$  second. To some extent a PC clock is seems to be responsible for its own accuracy. The Network Time Protocol (NTP) is widely used for synchronizing PC clocks by exchanging messages between a time server and client PC containing information about time offsets and delays. We may consider that time in local computer consists of real time and a symmetric offset  $\delta$ . Computer sends a request to a time server with local time stamp  $(T_{in} + \delta)$ . Server receives it at time T and responses it which get processed by client with time stamp  $(T_f + \delta)$ . From observed relation

$$(T_{in} + \delta) < T < (T_f + \delta) \quad (1)$$

Client computer evaluates symmetric time offset.

$$\delta = T - (T_{in} + T_f)/2 \quad (2)$$

NTP can provide synchronization at the sub-tens of millisecond level. Sub-microsecond level precision can be achieved by using Precision Time Protocol (PTP), which is based on Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems standard [6].

## 3. TIME-FREQUENCY UNCERTAINTY

According to uncertainty principal energy of any function and its Fourier transform cannot be simultaneously localized [7]. Hence there is no suitable technique that can simultaneously localized a Jovian signal in both the time and frequency domain. When we analyse the signal received for a long window, we can have a good frequency resolution at the cost of temporal resolution. It causes a drop in accuracy. Let the signal and its Fourier transformation (FT) are respectively denoted by  $s(t)$  and  $s(\omega)$  in  $L_2(\mathfrak{R})$ ; where,  $L_2(\mathfrak{R})$  is Hilbert space of all integrable signals in real domain [8]. Here,

$$s(t) = \int_{-\infty}^{+\infty} s(\omega) e^{j2\pi\omega t} d\omega \quad (3)$$

and from Plancherel's theorem

$$s(\omega) = \int_{-\infty}^{+\infty} s(t) e^{-j2\pi\omega t} dt \quad (4)$$

In our problem, we assume Jovian signal as either continuous or pulse shaped for an adjustable length of time. Using the usual notations, we have,

## HEXAFLUOROISOPROPANOL-INDUCED SECONDARY STRUCTURE PERTURBATION OF SOYBEAN AGGLUTININ

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Department of Chemistry, Bidhanagar College, Salt Lake, Kolkata, West Bengal, India

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### Abstract

Fluorocohols like 1,1,1,1-tetrafluoroisopropanol (HFIP) are widely used as cosolvent along with the biological solvent water to perturb the native protein molecules. The non-native states obtained are of immense importance in the field of protein structure and folding, since these states may be present in the protein folding pathway or in the off pathway which leads to amyloid formation. In this study, HFIP induced structure perturbation at secondary level of the tetrameric legume lectin, soybean agglutinin (SBA) is examined by far-UV circular dichroism (CD) spectroscopy. Like other member of the legume lectin family, native SBA is also an all  $\beta$ -sheet protein. Analysis of the far-UV CD spectra shows formation of  $\alpha$ -helix rich conformations at the expense of native  $\beta$ -sheet in presence of higher concentration (50% or more) of HFIP.





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Issue

### Study of Organization and Dynamics of Multi-Tryptophan Protein Molecules Utilizing Red Edge Excitation Shift Approach: A Review

<https://doi.org/10.4431/ajchem.2023.241015>

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Journal of the Indian Chemical Society

Volume 98, Issue 7, July 2021, 100085



## Pyrrolo-benzodiazepine fluorophore for trace amount detection of $\text{Cu}^{2+}$ and application in living cells ☆

Arijit Kumar Adak<sup>a, \*</sup>, Basudeb Dutta<sup>b</sup>, Sk. Arzaf Ali<sup>a</sup>, Kunal Pal<sup>c, d</sup>, Eutadip Jana<sup>d</sup>,  
Shubhanwar Sarmanta<sup>e</sup>, Chittaranjan Sinha<sup>f</sup>  

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### Highlights

- (3-Methoxy-7-pyridin-2-yl-5, 6, 8, 13-tetrahydro-7H-8, 13a-diaza-benzo [f]naphtho [2,1-a]azulen-14-yl)-acetic acid methyl ester (HBPD).
- Turn-on fluorescence sensor of HBPD to  $\text{Cu}^{2+}$  in presence of other biologically important ions.



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## JOURNAL ARTICLE

## Homogeneous–heterogeneous reaction mechanism on MHD carbon nanotube flow over a stretching cylinder with prescribed heat flux using differential transform method

Ghrib Senkar Giri, Kalidas Das, Prashir Kumar Kundu

Journal of Computational Design and Engineering, Volume 7, Issue 3, June 2020, Pages  
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## Influence of nanoparticle diameter and interfacial layer on magnetohydrodynamic nanofluid flow with melting heat transfer inside rotating channel

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### Abstract

The present article addresses melting heat transmission phenomenon in MHD nanofluid flow between two horizontally located plates in rotating structure. This exploration is executed in engine oil-based nanofluid accompanied by graphene oxide nanoparticles.



# HEAT TRANSFER

RESEARCH ARTICLE

## Influence of Hall current effect on hybrid nanofluid flow over a slender stretching sheet with zero nanoparticle flux

Kallidas Das, Srib S. Giri  Prabh K. KunduFirst published: 28 June 2021 | <https://doi.org/10.1002/htj.22226> | Citations: 15

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### Abstract

The present article explores steady, incompressible, and electrically conducting viscous hybrid-nanofluid flow through an impermeable slender stretching sheet. We have opted for water ( $H_2O$ ) as base fluid and two nanoparticles namely  $Al_2O_3$  and graphene for the hybrid-nanofluid. The consequence of nonuniform magnetic field and Hall current is



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## Biocontrol Effect of Lytic Bacteriophages Against Various Food borne Diseases



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DOI: <https://dx.doi.org/10.13005/bpj/2171>

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### Abstract

Food borne disease is one of the major causes of hospitalization and death around the world. Many advance antimicrobial techniques, food sanitation techniques are present nowadays but still Food borne diseases are

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Research

## An analysis of *exo*-polygalacturonase bioprocess in submerged and solid-state fermentation by *Pleurotus ostreatus* using pomelo peel powder as carbon source

Kousik Majumdar<sup>1,2</sup>   , Bhubi Paul<sup>1</sup>, Rakhi Sundar<sup>1</sup>

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## On the estimation of population size under dependent dual-record system: an adjusted profile-likelihood approach

Kiranmay Chatterjee &amp; Dipenka Mukherjee

Pages 2190-2204 | Received 10 Feb 2020; Accepted 21 Mar 2021; Published online 22 Apr 2021

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### Abstract

Motivated by various applications in epidemiology, population studies, criminology, etc., the problem of estimating size of a homogeneous human population based on two-sample capture-recapture data is investigated in this article. The Unimodal Bayesian approach is used in this

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# Synthesis, characterization, DFT calculations, protein binding and molecular docking studies of mononuclear dioxomolybdenum(VI) complexes with ONS donor ligand

Malini Roy<sup>a</sup>, Debanjana Biswal<sup>a</sup>, Qisandriya Sarker<sup>a</sup>, Nishil Ranjan Pramanik<sup>b</sup>,  
Suvendu Paul<sup>c</sup>, Chandan Kumar Manna<sup>d</sup>, Tapan Kumar Mondal<sup>e</sup>, Syamal Chakrabarti<sup>f</sup>

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Polyhedron

Volume 200, 15 May 2021, 115944



# Structural elucidation, DFT calculations and catalytic activity of dioxomolybdenum(VI) complexes with N–N donor ligand: Role of halogen atom coordinated to the molybdenum centre

Malini Ray<sup>a</sup>, Debanjana Biswal<sup>a</sup>, Nibhil Ranjan Pramanik<sup>a</sup>  , Michael G.B. Drew<sup>c</sup>,  
Suvendu Paul<sup>a</sup>, Payal Kachhoo<sup>a</sup>, Chanchal Halder<sup>a</sup>, Swarnal Chakrabarti<sup>a</sup>  

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From the journal:

**New Journal of Chemistry**

## The vital role of ditopic *N-N* bridging ligands with different lengths in the formation of new binuclear dioxomolybdenum(*VI*) complexes: synthesis, crystal structures, supramolecular framework and protein binding studies †

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Dakshinamoorthy Biswal,<sup>a</sup> Malini Roy,<sup>a</sup> Nikhil Ranjan Bantank,<sup>a,b</sup> Sujanika Paul,<sup>c</sup> Michael G. B. Duce<sup>d</sup> and Suman Chatterjee<sup>a</sup>

[Author affiliations](#)

### Abstract

A new series of binuclear dioxomolybdenum(*VI*) complexes **1–4** of general formula  $[(MoO_2)_2(N-M)]$  with an ONS donor Schiff base ligand (H<sub>2</sub>L = *S*-benzo[1,5-*b*]imidazo[2-hydroxyphenyl]methylenedithiocarbazine) and bridging auxiliary

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> *Neurochem Res*. 2020 Aug;45(8):1962-1973. doi: 10.1007/s11064-020-03061-8. Epub 2020 Jun 1.

## Neuroprotective Role of Quercetin on Rotenone-Induced Toxicity in SH-SY5Y Cell Line Through Modulation of Apoptotic and Autophagic Pathways

Sourav Pakrashi<sup>1, 2</sup>, Joyeeta Chakraborty<sup>1</sup>, Jaya Bandyopadhyay<sup>3</sup>

Affiliations: + expand

PMID: 32488468 DOI: 10.1007/s11064-020-03061-8

### Abstract

The detrimental impact on the food chain due to the overuse of rotenone is partly responsible for alpha-synuclein ( $\alpha$ -syn) mediated neurotoxicity. It is hypothesized that rotenone overdose leads to cytosolic proteopathy resulting in modulation of apoptosis and autophagic pathways. The aim of our study is to explore the neuroprotective role of quercetin, a beneficial polyphenol against rotenone-



Volume 6, Issue 22  
June 15, 2021  
Pages 5603-5609

Communication

## Amidation and Intramolecular Aza-Michael Reaction: One-Pot Synthetic Strategy of Isoindolinones

Sk Azaf Ali, Anirban Bera, Dr. Mijunur Rahman Molla, Dr. Shubhankar Somanta

First published: 14 June 2021 | <https://doi.org/10.1002/slct.202101259>

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### Graphical Abstract

Herein, we report one-pot Cu(I) catalyzed open flask synthetic strategy of 3-substituted *N*-pyridinyl isoindolinones from alkyl (*E*)-3-(2-formylphenyl)acrylate by oxidative amidation and intramolecular aza-Michael reaction using cheap air stable Cu(I) single catalyst. We have also established a synthetic route of *N*-aryl substituted isoindolinones with add-amine coupling reaction of (*E*)-2-(3-alkoxy-3-oxoprop-1-en-1-yl)benzoic acid followed by aza-Michael reactions. Unexpected synthetic route of *N*-(1*H*-inden-1-yl)pyridin-2-amine derivatives have been documented from the same precursors using Cu(I) catalyst.

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Anirban Bera, Sri Koral Al, Anir Saha &amp; Shubhankar Samanta

Pages 2177-2186 | Received 27 Feb 2021 | Published online 24 Jun 2021

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## Abstract

The current study describes an efficient environmental benign synthetic route of *N*-aryl substituted *c*-fused pyrrole derivatives via neat approach. It also provides base-mediated intramolecular

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Issue: 2021 - Volume 42 [Issue 5]

## EFFECT OF FENVALERATE ON SUPEROXIDE ANION AND NITRIC OXIDE GENERATION IN THE JUVENILES OF *Bellamyia bengalensis* AN EDIBLE GASTROPOD OF WEST BENGAL

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\*Author to whom correspondence should be addressed.

### Abstract

Mollusc represents a vital component of freshwater ecosystem of our country. *Bellamyia bengalensis* is an edible viviparous gastropod constitutes a traditional food item of human, poultry and fish. It demands a special importance in ecology, ethnomedicine and economy. Natural habitat of *B. bengalensis* is under ecological risk due to indiscriminate and



## ASSESSMENT OF GUT HELMINTH OF BLACK BENGAL GOAT SLAUGHTERED AT KOLKATA MARKET, WEST BENGAL, INDIA

[SUMAN MURHERJEE](#) | [INDRANI BISWAS](#) | [DIPAN ACHIKARI](#)

UTTAR PRADESH JOURNAL OF ZOOLOGY, Volume 41, Issue 10, Page 77-85

Published: 20 August 2020.

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### Abstract

The present study was conducted to isolate and examine the different parasitic helminths, their distribution and prevalence in stomach and intestine of adult Black Bengal Goat during six months' time interval of the year 2017-2018. Goat organs were collected from Garia urban local market of Kolkata and after parasitological study, they were mainly found to be infested with cestodes and nematodes. The most prevalent parasites were *Choprotiaenia* sp., *Trichouris* sp., *Gasteragia* sp., *Strongyloides* sp., *Dicrocoelium* sp., *Haemonchus* sp., *Trichostrongylus* sp. The seasonal study revealed the maximum parasitic prevalence during pre and post winter season. The month November and April of a particular period studied exhibits most parasitic abundance and prevalence in relation to mixed infections. Histopathological study of the infected tissue revealed cellular damage, infiltration and disintegration.

## EVALUATION OF ACUTE TOXICITY STUDIES ON COPPER-INDUCED OXIDATIVE STRESS IN LATHYRUS SATIVUS L., (VARIETY RATAN) GERMINATING SEEDS: A BIOMARKER BASED RISK ASSESSMENT

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Published Nov 10, 2020

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**Abstract**



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## The Modulation of Oxidative Stress Biomarkers in Assessing Arsenic Induced Toxicity in *Channa punctatus*

Suman Mukherjee\*

Applied Ecology and Environmental Sciences, 2021, 9(3), 340-348. DOI: 10.1386/aees-9-3-4  
Received February 03, 2021; Revised March 08, 2021; Accepted March 18, 2021

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### Abstract

*Channa punctatus* is a common fresh water fish in India and regularly consumed because of its high nutritional value. Heavy metals are common pollutants of the aquatic environment because of their persistent and tendency to concentrate in aquatic organisms. This freshwater fish is continuously exposed to arsenic toxicity as this metalloid enters the body through gills and arsenic contaminated food. Fresh water

# A study on the seasonal fluctuation of water quality parameters and Ichthyofaunal diversity in determination of ecological health of Mathura Beel, A Flood plain Wetland of West Bengal

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(Received 12 September, 2020; accepted 4 October, 2020)

## ABSTRACT

Fish diversity and their correlation with seasonal fluctuation of water quality parameters of Mathura Beel was studied during the period 2015-16 to 2017-18. 39 species of fish belonging to 18 families under 8 orders were recorded from this floodplain wetland of North 24 Parganas district of West Bengal. The most dominant family was Cyprinidae with 13 species. The beel is alkaline in nature as the pH varies 7.7-10.5. The dissolved oxygen content is good. In this beel, Shannon-Weaver species diversity index ( $H'$ ) has positive correlation with Free CO<sub>2</sub>, DO, alkalinity and hardness whereas negative correlation with temperature, pH and BOD. Margalef's Species richness index ( $D$ ) has positive correlation with temperature, pH and BOD while has negative correlation with Free CO<sub>2</sub>, DO, alkalinity and hardness. Pielou's Species evenness index ( $J'$ ) has positive correlation with Free CO<sub>2</sub>, alkalinity, hardness and BOD whereas negative correlation with temperature, pH and DO. The overall ecological health of the beel was suitable for aquaculture.

**Key words :** Floodplain wetlands, Beels, Physicochemical parameters, Fish, Diversity indices

## Introduction

Floodplain wetlands are formed from main stream of river when river meanders are cuts due to erosion and siltation of river banks. Some floodplain lakes are permanently cut offs from the river and forms closed ecosystem and others remains seasonally connected with river. These wetlands or lakes are known as beels or bours or ox-bow lakes. (Jhingran and Jha, 1988). These beels houses many aquaculture industries in India particularly eastern part of

the country and act as important source of inland fisheries also (Mondal and Kaviraj, 2009).

West Bengal, a state of eastern India, has more than 150 floodplain wetlands which covers almost 42,000 ha, constitutes 22% of state's total freshwater area (ICAR, 2006). These beels functions vitally in waste water treatment, water storage, ground water recharge and controlling flood. Not only that, beels acts as natural habitats of many common and rare fish species also. The diversity of fish and their occurrence in such type of beels are greatly influenced

## Antifungal Activity of Bacteria Isolated from Rotten Fruits and Vegetables: their Partial Morphological and Biochemical Characterization

Abul Kalam<sup>1</sup> and S Rehan Ahmad<sup>2\*</sup>

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<sup>2</sup>Department of Zoology, HMM College for Women, Kolkata, West Bengal, India

### ABSTRACT

Anti-metabolites are produced by the microorganisms and have the highest potential as the agents of bio-preservation. The aim of the present research work was to study the antimicrobial activities of some selected antimicrobial and anti-metabolites producing microorganisms, against the microorganisms responsible for food spoilage. In addition to this, we tried to extract and isolate these microorganisms from natural sources available. In the present research work, a total of 75 bacterial cultures were extracted and isolated from different food samples and later they were purified and screened to record their antimicrobial activity against some food spoiling standard bacterial cultures and fungi which were isolated from spoiled vegetables and fruits. The isolated bacteria were kept and maintained on MRS medium which is a fast growing mesophile with low generation time. Czapek-Dox agar media was used to keep and maintained the fungi isolated from several spoiled vegetables after purification. In order to test the antimicrobial activity of the supernatants from the isolates after the span of 18 hours of incubation against the fungi isolated from rotten vegetable like Tomato (*Solanum lycopersicum*), Cucumber (*Cucumis sativus*), Brinjal (*Solanum melonngena*) and rotten fruits like Orange (*Citrus x sinensis*), Grape (*Vitis vinifera*) and Apple (*Malus domestica*) the paper disk assay method was used. The antimicrobial activity of the supernatant was evidenced by the clear zone of inhibition ranging from 1.9 -3.5 cm by using 50 µl soup. It was found that out of seventy-five (75) isolates, three isolates, IP-1 (isolated from rotten peach), IVP-2 (isolated from vermicompost) and IRF-1 (isolated from a teleost fish Rohu, *Labeo rohita*) have most prominent and potent activity against standard bacterial cultures and fungi isolated from spoiled vegetable and fruits. It is evident from the present research that bio-control can be a potent method for food preservation.

**KEY WORDS:** BIO-PRESERVATIVE, LAB, ROTTEN VEGETABLE AND ROTTEN FRUITS.

### INTRODUCTION

Food products that are likely to be perished, require protection from spoilage during the process of their

preparation, storage and distribution. One of the biggest concerned and challenge for the food industry is safety and quality of food product, as there is huge demand for processed fresh food products across globe after the food industry being globalised. There is constant threat of contamination of these food products by microbes. Many of these microorganisms can cause undesirable reactions that deteriorate flavor, odor, color, sensory, and textural properties of foods.

The development and survival of common spoilage and pathogenic microorganisms such as *Clostridium perfringens*, *Escherichia coli*, *Staphylococcus aureus*, *Aspergillus niger*, *Listeria monocytogenes*, *Saccharomyces*

#### Article Information:

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## INHIBITION OF AMYLOID BETA FIBRILIZATION BY SMALL ORGANIC MOLECULES: AN IMPLICATION TO THERAPEUTIC ROUTE OF ALZHEIMER'S DISEASE

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### ABSTRACT

The exact reason of Alzheimer's disease is still not understood but deposition of extracellular plaques formed by the aggregation of amyloid  $\beta$  peptide and intracellular accumulation of neurofibril tangles (NFT) formed by phosphorylated tau protein are the two hall marks of Alzheimer's disease. Therapeutic route to Alzheimer's disease is still unknown. Studies with natural products, short peptides and synthetic organic molecules have identified a pool of small organic molecules with aggregation inhibitory activity. These molecules can be considered as lead compounds in the drug discovery of Alzheimer's disease.

**Keywords:** Amyloid  $\beta$  protein, Aggregation, Alzheimer's disease, Small organic molecule.

### 1. INTRODUCTION

Neurodegenerative diseases significantly affect the quality of life of elderly people across the globe. Alzheimer's Disease (AD) and Parkinson's disease are the most common among the neurodegenerative diseases [1]. Loss of memory is the most prominent symptom of Alzheimer's disease. Degeneration of brain neurons causes gradual loss of movement, breathing, talking in AD patients [2]. Protein misfolding is the main reason of Alzheimer's disease. AD patients suffer from damage of brain cell neurons due to formation of extracellular plaques by aggregation of amyloid  $\beta$  protein and intracellular accumulation of neurofibril tangles (NFT) by tau protein [3, 4]. Prevalence of Alzheimer's disease has inspired scientific community of whole world to find therapeutic route to but till now very few medicines are available which can only treat the disease symptomatically and provide limited benefit. In this context, it is very much important to find ways to inhibit the aggregation process of amyloid beta and tau protein which can stop or postpone Alzheimer's disease. Many studies are taking place all over the world in which natural products, synthetically accessible small molecules and also peptides are being used as potential amyloid  $\beta$  inhibitors [5-9]. This article aims to review the *in vitro* and *in vivo* studies with small and simple organic molecules which show ability to suppress or postponed

fibrillation process of amyloid  $\beta$  protein and thus can be very important in the path of drug discovery of Alzheimer's disease.

### 2. PROTEIN MISFOLDING

Proteins are workhorse of the living cell. They act as enzymes, hormones, neurotransmitters, nutrient storage, antibodies and many more to regulate the life of a living cell [10]. Proteins have marvelous versatility in their structure and keen specificity in their function. Structure and function of protein molecules are crucially related [11]. Specific function of protein molecules is completely governed by its correctly folded native structure. Most protein fold in the posttranslational period [12]. Protein disulfide isomerase (PDI) and peptidyl-prolyl cis-trans isomerase (PPI) have important role in the protein folding phenomenon [13, 14]. Chaperons assist significantly in correct folding of proteins. Chaperons can rescue incorrectly folded proteins to proper route of folding [15]. Beside chaperon, cell has its own quality control mechanism which discriminates between correctly folded and misfolded structures and ultimately degrades the misfolded protein into the amino acids [16, 17]. In spite of these protective mechanism, protein misfolding takes place within the life time of a cell. Misfolding can be induced by somatic mutations in gene sequence; error involved in transcription or translation;



## Evaluation of Phagocytosis and Cytotoxicity Response in Fresh Water Snail, *Bellamya bengalensis*, Following Exposure to Chlorpyrifos

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### ABSTRACT

Freshwater edible mollusc *Bellamya bengalensis* (Mollusca: Gastropoda) is an economically important species. Chlorpyrifos is a crystalline organophosphate insecticide and is used in the agricultural field for control insect pests. Mollusc mostly elicits effective immunological responses by producing cytotoxic molecules like generation of superoxide anion and nitric oxide against environmental xenobiotics. Haemocytes of *B. bengalensis* are an immune effector cell of haemolymph and are capable of discrimination self and nonself surface, phagocytosis of foreign particles and production of cytotoxic molecules as an antimicrobial agent. The cells lining the digestive tubule participate in moving the food, secreting substances in the lumen, phagocytosis and generation of cytotoxic molecules. Fresh water *Bellamya bengalensis* were exposed to sublethal concentrations of chlorpyrifos for varied span of time in controlled laboratory condition to examine phagocytic response in haemocyte, histopathology and cytotoxic activity in digestive tubule. The tissue pathology demonstrates a state of inflammation which is related to possible disruption of cellular homeostasis. Alteration in phagocytic response of haemocyte challenged with yeast (*Saccharomyces cerevisiae*) and increment of activity of superoxide anion (SOA) along with parallel decrease in the activities of nitric oxide (NO) in digestive tubule appeared to be detrimental for survival of *Bellamya bengalensis* in the chlorpyrifos contaminated environment. Data is indicative of cellular metabolic stress in the edible gastropod that may lead to decline of population size in freshwater aquatic system of West Bengal.

**Key words:** Chlorpyrifos, *Bellamya bengalensis*, Haemocyte, Digestive tubule

*Bellamya bengalensis* is a freshwater mollusc widely distributed in the wetland of different states of India. Animal is regularly consumed by human population and serves as a source of dietary protein to human, poultry and fish. Chlorpyrifos is a crystalline organophosphate insecticide used for control insect pest of various agricultural crops [1]. Freshwater natural habitat of the animal faces the risk of pesticide contamination by agricultural runoff during monsoon [2]. Haemocytes, the circulating blood cells of gastropod, function as the immunological effector cells under exposures of toxin and parasite [3]. They are involved in various types of physiological functions such as cell aggregation, self-nonself discrimination, wound

repairing and phagocytic responses [4].

Digestive tubule is the principal site of detoxification and multiple metabolic activities of molluscs [5]. The digestive diverticula of gastropod are closely packed together containing secretory basophilic cells. Superoxide anion is reported as a defence molecule against intruding pathogenic microorganisms [6]. Nitric oxide is a vital cytotoxic molecule generated in response to oxidative stress and provides immunological defense to the host by deactivating foreign microorganisms [7]. Information of toxicity of chlorpyrifos in freshwater gastropod of India is scanty. In this present study, cellular modulation of haemocyte, histopathology and cytotoxic activity of digestive tubule were examined under the sub-lethal exposure of chlorpyrifos in controlled laboratory condition. Information will provide a data in understanding the degree of cellular modulation in haemocyte and impairment of digestive tubule function of gastropod in presence of sublethal concentrations of chlorpyrifos and to establish its suitability as a biomarker of aquatic toxicity in contaminated habitat.

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## Transition metal-free advanced synthetic approaches for isoindolinones and their fused analogues

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Shubhankar Samanta,<sup>1</sup> <sup>\*</sup> Sk Arif Ali,<sup>2</sup> <sup>\*</sup> Anshu Bera,<sup>3</sup> Smaran Giri,<sup>4</sup> <sup>\*</sup> and Rimkon Samanta<sup>5</sup>

 Author affiliations

### Abstract

Isoindolinones are the core structures of many natural products and drug molecules and are useful in materials science as fluorescent probes and synthetic dyes. The fused analogues of these blended lactams also have a wide range of applications in medicinal chemistry and chemical biology. Different synthetic approaches and the use of versatile reagents have been reported for the synthesis of these novel molecules. Different research groups have focused their efforts on improving synthetic protocols towards the synthesis of the isoindolinone frame both in the



# Assessment of biochemical, hematological and behavioral biomarkers of *Cyprinus carpio* on exposure to a type-II pyrethroid insecticide Alpha-cypermethrin

Suman Bej<sup>a,b,c</sup> , Kaushik Ghosh<sup>b</sup> , Arnob Chatterjee<sup>c</sup>, Nimal Chandra Saha<sup>d</sup>  

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## Highlights

- Alpha-cypermethrin altered survivability and behavior in *Cyprinus carpio* L.
- A-cyp altered haematological parameters in *C. carpio* L. during sublethal exposure.

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## Seasonal Incidence and Histopathologic Study of Protozoan Infestation in *Clarias* sp., Collected From A Local Fish Market of Kolkata, West Bengal (India)

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### Abstract

Protozoans exhibit highly diverse ecological inter-relationship and most complicated host-relationship. The catfish *Clarias* sp. is important component in human diet in many countries especially those in tropical and subtropical areas where malnutrition is a major problem. *Clarias* sp. (size 20-22 cm, weight 80-90 g) were collected from a local fish market of Kolkata (India) during pre-monsoon, monsoon and post-monsoon seasons of 2017-2019. The blood, gill and skin of catfish were examined in laboratory for protozoan parasites and routine histopathological study of selected tissues was performed. Photodocumentation was done using microscope fitted with digital camera. The study revealed that the intensity of infestation was more in skin parasites, and the fish had marked lesions in gills and skin. The highest parasitic infestation was observed in post-monsoon season (i.e. from November to February), followed by pre-monsoon period, while the lowest infestation was noted in monsoon season (i.e. from July to October). The study revealed that the environmental factors are responsible for spreading infestation.


### Keywords

Catfish, Gill, Protozoa, Skin

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A Survey on Parasitic Prevalence of Gut in  
*Heteropneustes fossilis* Collected from Local  
Market of Kolkata

Suman Mukherjee and Lipika Medda

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C A R A S



# A Survey on Parasitic Prevalence of Gut in *Heteropneustes fossilis* Collected from Local Market of Kolkata

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**Key words:** *Heteropneustes fossilis*, Parasites, Fish, Prevalence, Infection

Fish serve as a potential source of animal protein and provide 16% of the world population's protein requirements. Majority of the fishes serve as an intermediate host for many parasites, which reduces the food value and cause mass mortality. The indigenous catfish popularly known as Singhi, *Heteropneustes fossilis* has been contributed greatly as a delicious and nutritious food of the tropical countries as well as in the Indian subcontinent [1]. Fish parasites are an integral part of aquatic ecosystems and they are commonly found in wild and aqua cultural systems [2]. Due to certain environmental circumstances and stressful condition, the fish become more susceptible to a wide variety of opportunistic parasite and pathogen [3]. The present study is indicative of extensive distribution of parasites in stomach and intestine of edible catfish. The parasitic infection of this experimental fish results in economic losses due to not only mortality, but also higher treatment costs and decreasing growth that reduces the expansion of aquaculture.

A total of 150 individuals of *Heteropneustes fossilis* (size 22-27 cm, weighing 70-80 gm) were collected from a local market of Kolkata, West Bengal, India during November to April in a year i.e., during the entire period of study and freshwater fishes were transported to the laboratory in large containers. The collected fishes were taken immediately for experimentation.

## Parasitological studies

Fish samples collected from local market were taken in live condition during each time interval i.e., Nov-Dec, Jan-Feb and Mar-Apr for experimentation. The fishes were dissected in

order to collect the parasites. An incision was made along with mid-ventral line of the fish. After separating the internal organ stomach and intestine was examined individually for parasite in petri dishes with formalin solution. The gut was carefully opened by an incision and then was shaken to dislodge the parasites that might remain attached to the lining of the epithelium by their head ends. The epithelial layers of the gut were scrapped with a scalpel to remove any parasites that remain attached to the layers. The collected parasites were then washed in fresh saline solution. The contents of each Petri dish were then stirred well and allowed to settle in the bottom of it. The sediment was then examined with a dissecting microscope. The collected parasites were fixed in AFA (Alcohol Formalin Acetic acid) for a few minutes. After fixation, the parasites were preserved in 70% ethyl alcohol in vials for prolonged storage [4]. The collected helminthic parasites were kept in lacto phenol for five to seven days for visibility of the internal organs as well as its mounting. The parasites were stained with borax carmine for one and half to two hours and then after dehydrating in alcohol graded series of 50%, 70%, 90% and 100%, the parasites were cleaned with xylene and mounted in Canada Balsam [5] for microscopic study and photo documentation.

## Analysis of parasitic infestation

The analyses of parasitic manifestation (prevalence) were studied as Margolis *et al.* [6].

$$\text{Prevalence} = \frac{\text{Total no of host infected}}{\text{Total no of host examined}} \times 100$$

The analyses of parasitic infestation for index were carried out by following formulae after Williams [7] as:

$$\text{Index of infection} = \frac{\text{No of host infected} \times \text{No. of parasites collected}}{\text{Total hosts examined}}$$

Out of 150 specimens of *Heteropneustes fossilis* examined in the time of interval, 133 were found infected with nematode, like *Contracaecum sp.* (Fig 1A), Acanthocephalon like *Pallisentis sp.* (Fig 1B) and trematodes, like *Clinostomum sp.* (Fig 2) and Monogenea (Fig 3). The maximum prevalence of parasitic infection (90%) (Fig 4) was recorded during the

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## MINI-REVIEW

### Study of Protein Structures under the Influence of Imidazolium Based Ionic Liquids

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Ionic liquids are nowadays extremely popular in the advanced research field of many disciplines including chemistry, chemical engineering, material science, biology and pharmaceuticals. Unique physico-chemical properties of the ionic liquids such as low vapor pressure, stability, large liquid range, broad solubility and easy modification of structures are responsible for its vast application. Imidazolium based ionic liquids are one of the most widely used ionic liquids and these are extensively studied in the field of protein research. In this mini-review, imidazolium ionic liquid induced effect on the structure and function of protein molecules are discussed.

**Keywords:** Ionic liquid, Imidazolium, Protein structure, Disaggregation.

## INTRODUCTION

Ionic liquid (IL) was first prepared over a century ago in the year 1914 by German chemist, Paul Walden [1]. But the ionic liquids (ILs) became widely popular among the scientific community only in the beginning of the current century and these have been extensively utilized in various hot research topic of chemistry as well as in multidisciplinary research areas including chemistry, chemical engineering, material science and biology [2-6]. Normally liquids consist of neutral molecules and various weak intermolecular attractive forces (*e.g.* hydrogen bonding, dipolar interaction, van der Waal's forces, *etc.*) operates among the molecules. On the other hand, ionic compounds have high melting point because of strong inter-ionic attraction and those are solid at room temperature. In contrast to those, there exists another type of chemicals which are ionic in nature, yet liquid at room temperature and these are called 'ionic liquids'. By definition, ionic liquids are ionic compounds which melts at temperature below the boiling point of water (100 °C) [3]. In other words, ionic liquids can be described as "low temperature molten salts". Fig. 1 represents some of the common cations and anions, which combine to form an ionic liquid. It is evident that in case of ionic liquids the cation is always an organic ion and the counterpart may be an organic

or inorganic anions. Due to the large size mismatch between the bulky cation and the smaller anion, packing of lattice in these salts is not as great as in many inorganic salts and hence melting point of these salts are much lower [7]. In the growing context of "green chemistry", ionic liquids turned up as promising alternative to the traditional volatile organic solvents because of its unique physico-chemical properties such as negligible vapour pressure, non-flammability, high thermal stability, large liquid range, broad solubility, moisture and air compatibility [8]. In addition, these properties can be tuned as per requirement by modifying the constituent ions. Thus, ionic liquids emerged as a popular choice in the last decades based on its 'green' and 'designer' properties [2,4].

In chemistry, ionic liquids are vastly employed in various chemical reactions in the form of reagents, solvents or catalysts [6]. Apart from that, ionic liquids are also used in the field of analytical chemistry, electrochemistry, polymer chemistry and most importantly these are frequently reported for various biological applications [2]. Ionic liquids are extensively studied for its biocompatibility and its application in pharmaceutical chemistry, enzyme activity and protein stability [9-11].

Importance of proteins are well known and relationship of its structure with function is also well established. Each protein has unique three-dimensional quaternary/tertiary structure and

# Inverse Variational Problem for Nonlinear Dynamical Systems

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Two different approaches to solving the inverse problem of the calculus of variation for nonlinear equations are introduced. The first approach is based on an integral representation of the Lagrangian function, while the second one relies on the generalization of Lagrangian symmetry. As an application of the first approach, we initially provide some useful remarks on the Lagrangians of the modified Emden-type equation, and then construct Lagrangian functions for (i) a cubic–quintic Duffing oscillator, (ii) Liénard-type oscillator and (iii) Mathews–Lakshmanan oscillator. Using the second approach, we obtain analytic (Lagrangian) representations for the three velocity-dependent equations, namely, (iv) Abraham–Lorentz oscillator, (v) Helmholtz oscillator and (vi) Van der Pol oscillator. For each of the systems in (i)–(vi) we find the Jacobi integral and thereby provide a method for obtaining the Hamiltonian function.

topics: Lagrangians, Jacobi integrals, Hamiltonians, nonlinear differential equations

## 1. Introduction

The inverse problem in the calculus of variation involves deciding whether a given system of second-order ordinary differential equations representing dynamical systems is a solution of the Euler–Lagrange equation and eventually finding its Lagrangian representation, if the solution exists [1]. For linear ordinary differential equations, the set of constraints for the existence of Lagrangians is provided by the so-called Helmholtz conditions [2, 3]. The equation of motion of a damped harmonic oscillator

$$\ddot{x}(t) + \gamma \dot{x}(t) + \omega^2 x(t) = 0 \quad (1)$$

violates these conditions such that we cannot find a time-independent Lagrangian representation for it. In (1), the over-dots denote the differentiation with respect to  $t$ . Here  $\gamma$  represents the frictional coefficient of the medium in which the oscillator of angular frequency  $\omega$  is embedded. An explicitly time-dependent Lagrangian of the damped system was actually found [4, 5] during 1940's. For this Lagrangian, the canonical momentum is time-dependent. This provides an awkward analytical constraint to use the corresponding Hamiltonian to quantize the system [6]. In 1931, Bate-man [7, 8] suggested a very ingenious method to find an explicitly time-independent Lagrangian for the damped harmonic oscillator by doubling the

number of the system's degrees of freedom. More specifically, in conjunction with (1), an auxiliary oscillator equation

$$\ddot{y}(t) - \gamma \dot{y}(t) + \omega^2 y(t) = 0 \quad (2)$$

was considered to obtain the Lagrangian

$$L = \dot{x}(t)\dot{y}(t) + \frac{\gamma}{2} (x(t)\dot{y}(t) - \dot{x}(t)y(t)) - \omega^2 x(t)y(t). \quad (3)$$

Physically, the energy drained out from the oscillator in (1) is completely absorbed by that in (2) such that these two oscillators together represent a conservative system. The Euler–Lagrange equation [9] written in terms of  $y(t)(x(t))$  gives the equation of motion for  $x(t)(y(t))$ . Because of this unusual behavior, the Lagrangian (3) is said to provide an indirect analytic (Lagrangian) representation of the system. The canonical quantization of damped harmonic oscillator using the indirect Lagrangian representation has been found to be quite satisfactory [10–12] because the corresponding Hamiltonian is time independent [5].

Traditionally, the Lagrangian function  $L$  of the autonomous differential equation is expressed as  $L = T - V$ , where  $T$  and  $V$  stand respectively for the kinetic and potential energies of the system represented by the equation. Such a Lagrangian is referred to as standard. Relatively recently, a new type of Lagrangian functions [13] has been proposed





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### **Twin Flowers: Ecology and Economy during the Reign of the Koches (Early Medieval to Colonial Period)**

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#### **Abstract:**

*Economic activities and its related development depend on the resources of nature. After the fall of the Khen dynasty in 1498 C.E., Viswa Singha, one of the chief of Koch clan established the Koch kingdom. The river Karatoya was its western boundary and the Baranadi marked its eastern boundary. The Koch state is bounded in the northern side by the Himalaya. With some geographical deviation Koches maintained their identity as a ruler till the emergence of the British. The extensive river network system, spreading all over this region is the lifeline of the people of this region. These rivers created extensive well-cultivated plains, the numerous hills and dales, forests and marshes, rising grounds, thick jungles etc. These are the basic geographical features of this land. The vast fertile plain of the state is good for agriculture and its associated economic growth. Various manufacturing industries developed during the reign of the Koches. Silk-fabrics, cotton-fabrics and jute-fabrics were not only the popular fabrics of the state, but also fulfill the needs of the neighbouring state. It is easy for the Koch ruler to develop the economy of the state with the help of some technology and other basic modifications of the resources.*

**Keywords: Economy, Ecology, Agriculture, Industry, Floods, Drought, Earthquake, Koch, etc.**

In this age of Post-modern and globalization, the subject ecology and its related issues are very important. The term 'ecology' derived from the Greek root 'oikos' and 'logy'. In Greek 'oikos' means 'house' or 'home' and 'logy' means 'the study of' or 'the science of'. Thus, etymologically 'ecology' means the scientific study of the earth as a house.<sup>1</sup> The term ecology first used in 1869.<sup>2</sup> Ecology is the study of the earth's plants, animals, soil, lands, water, air, microorganism, people and no doubt, everything related to the earth. Simply, ecology is the science related with the relationships between and among all organisms i. e. living and non-living of the environment.<sup>3</sup> This paper mainly concentrated on the relationship between economy and ecology during the reign of the Koches. This paper also categorically discusses how the ecological features helped the Koch people to develop their socio-economic parameters of the state.

During the early medieval period, Khenas were the powerful ruler of the *Kamarupa* and adjoining areas. After the fall of the Khen dynasty in 1498 C.E.,<sup>4</sup> *Viswa Singha*, one of the chief of Koch clan established the Koch kingdom.<sup>5</sup> Later, he came into conflict with the *Baro-Bhuinyas*<sup>6</sup> and some other tribal groups of North-East India. The river *Karatoya* was its eastern boundary and the *Baranadi* marked its western boundary.<sup>7</sup> With some geographical deviation Koches maintained their identity as a ruler till the emergence of the British.<sup>8</sup>

## ■ Biological Chemistry &amp; Chemical Biology

A New Benzimidazolium Ion-Based “Turn Off” Fluorescent Compound for Detection of Fe<sup>3+</sup> Ion and Its Application towards Antimicrobial, Antibiofilm and Cell Imaging StudySusanta Kumar Manna,<sup>\*,[a]</sup> Sudipta Chakraborty,<sup>[b]</sup> Arup Kumar Adak,<sup>[a]</sup> and Shubhankar Samanta<sup>[a]</sup>

A novel water soluble fluorescent compound methylated polycyclic benzimidazolium ion **4** based on benzimidazolium ion (85% yield) for the response of Fe<sup>3+</sup> has been demonstrated for the first time due to its excellent photophysical properties. The molecule is highly sensitive and selective towards Fe<sup>3+</sup>. A dramatic fluorescence switch on-off-on has been observed during interchange from Fe<sup>3+</sup> to EDTA and the

detection limit is 15.8 nM (3σ method) for Fe<sup>3+</sup> ions. The compound **4** exhibits excellent antimicrobial and anti-biofilm activities against *E. cloacae* and *S. aureus*. Cell imaging and mammalian cell cytotoxicity were also investigated. The synthesized molecule exhibits selective activity toward gram-positive bacteria than gram-negative ones among six different bacterial species.

## Introduction

Iron is the second most abundant metal, after Aluminium in the earth's crust. It is the most important transition element for the living systems. It plays an important role in enzyme catalysis, cellular metabolism, and as an oxygen carrier in hemoglobin and a cofactor in many enzymatic reactions.<sup>[1]</sup> However, both the deficiency and overload of iron in a human body induces the occurrence of many diseases such as anemia, liver and kidney damages, diabetes and heart diseases.<sup>[2]</sup> Several analytical methods including atomic absorption spectroscopy, electrochemical method, inductively coupled plasma mass spectrometry, inductively coupled plasma atomic emission spectrometry, have been developed for detection of several metal ions in water including Fe<sup>3+</sup>.<sup>[3]</sup> However, those methods are usually high priced, time consuming, or need complicated sample preparation process.<sup>[4]</sup> Thus, seeking a simple and low-cost method is very important for the identification and monitoring of Fe<sup>3+</sup> ions from the biological, environmental, and industrial samples. Recently, fluorescent chemosensors have been considered as one kind of promising materials for metal ions sensing through the change of fluorescence.<sup>[5]</sup> Additionally, different types of small-molecule fluorescence sensors have been commonly used to detect Fe<sup>3+</sup> ions because of changing their fluorescence signal in response to chemical reactions or variations in their adjacent environment.<sup>[6]</sup> These sensors are designed by covalently join-

ing binding sites with many kinds of signaling units such as BODIPY, fluorescein, rhodamine, coumarin, benzimidazole, etc.<sup>[7]</sup> Among all these, the benzimidazole, being one of the ideal structure for detecting analytes/metal ions due to its brilliant photophysical properties, remarkable long-wavelength emission, high molar extinction coefficient, and fluorescence quantum yields.

The benzimidazole nucleus and its derivatives are ubiquitous in nature and important due to their physicochemical properties<sup>[8]</sup> and biological activities especially analgesic,<sup>[9]</sup> antitumor,<sup>[10]</sup> cytotoxic activities.<sup>[11]</sup> Benzimidazole units and N-alkylated Benzimidazole/ N-alkylated Benzimidazolium ions are the core structure of a range of clinical medicines/natural product<sup>[12,13]</sup> albendazole,<sup>[12a]</sup> AKT inhibitor-iv,<sup>[14]</sup> Telmisartan<sup>[15]</sup> (Micardis), Nk109,<sup>[16]</sup> Nitidine<sup>[16]</sup> Berberine<sup>[17]</sup> (Figure 1)

Previously we have reported an easy synthesis of polycyclic benzimidazole<sup>[18]</sup> which shows interesting photophysical properties. We have also reported the synthesis of an ionic compound pyridopyrimidinium ion<sup>[19]</sup> and we find its interesting photophysical and biological properties. Therefore, we are inspired and wish to prepare the ionic derivatives of the N-heterocycle i.e., polycyclic benzimidazole. Herein we report the methylation of a pentacyclic benzimidazole and transform it into an ionic one which is more polar and water-soluble. Furthermore, these compounds are highly fluorescent. In addition to this interesting fluorescent switch on-off-on- study an extensive antimicrobial study has been demonstrated.

In addition to this in the biological point of view scientists are searching for a molecule which will show anti-microbial and anti-biofilm activity. This molecule is highly effective to fulfilling the above mentioned both properties.

In the present work, we have determined the antibacterial activity of a novel benzimidazole compound against six different bacterial species: three Gram-positive: *Enterococcus faecalis*, *Staphylococcus pneumoniae* and *Staphylococcus aureus* and

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# Neat synthesis of isothiazole compounds, and studies on their synthetic applications and photophysical properties†

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Ammonium thiocyanate-promoted simple, rapid and eco-friendly neat synthesis of isothiazoles is developed for the first time. It is noteworthy that an instantaneous valuable synthetic route of  $\beta$ -enaminones is also documented during the mechanistic investigation of isothiazole formation. A detailed mechanistic explanation of the isothiazole formation reaction is clearly explained by the control experiments. NBS-promoted aromatisation of isothiazole derivatives and photophysical properties of an isothiazole-pyrene hybrid molecule have been investigated.

## Introduction

Nitrogen (N) and sulfur (S) are the main constituents of alkaloids and hence five membered heterocyclic compounds containing those heteroatoms, *i.e.* thiazoles, are very common in Nature.<sup>1</sup> Although their isomeric compounds,<sup>2a</sup> isothiazoles, are rarely found in Nature (*e.g.* brassilexin, sinalexin *etc.*), they are highly important due to their pharmacological interest in biological science (Fig. 1).<sup>2</sup> Substituted isothiazoles and their fused derivatives are well known in drug discovery due to their significant biological activities, such as analgesic, antipyretic, fungicidal, and herbicidal properties.<sup>3</sup> Monocyclic isothiazole skeletons, such as sulfasomizole and denotivir, display antibacterial and antiviral properties, respectively (Fig. 1).<sup>4</sup> Isothiazolonaphthoquinone, aulosirazole, isolated from blue-green algae exhibited tumor-selective cytotoxicity (Fig. 1).<sup>5</sup> Another quinone-embedded isothiazole pronquodine A, regulates prostaglandin release from human synovial sarcoma cells (Fig. 1). The antipsychotic drug zipracidone containing a *d*-fused isothiazole (brand name Geodon) is used to treat schizophrenia and bipolar disorder (Fig. 1).<sup>6</sup> Isothiazole scaffolds have emissive properties when they are attached with ribonucleoside purine mimics or a pyridine nucleus. Highly electron-rich polyfunctional isothiazoles have exceptional importance in the construction of metal complexes of different

types, in particular, valuable organometallic frameworks and functional materials.<sup>7</sup>

The broad spectrum of pharmaceutical use and low natural abundance of the isothiazole moiety have inspired synthetic chemists to prepare such molecules decorated with valuable functionalities.<sup>8</sup> Modern preparative methods for the isothiazole compounds include *S*-nitrosation of *o*-mercaptoacylphenones followed by intramolecular aza-Wittig reaction,<sup>9a</sup> transition metal-free oxidative cyclization using amidines and elemental sulfur,<sup>9b</sup> and cyclization of aryl *tert*-butyl sulfoxides with an *ortho*-sulfinamidomethyl group in the presence of NBS/acid.<sup>9c</sup> Two independent groups reported the synthesis of 4,5-diaryl isothiazoles and *d*-fused isothiazole from  $\beta$ -halo vinyl aldehyde using ammonium thiocyanate in an acetone medium and NaSCN/urea in the presence of microwave irradiation, respectively.<sup>10</sup> However, these procedures suffer from drawbacks such as longer reaction times, tedious workups, harsh reaction conditions, lower yields, and use of special microwave techniques to synthesize the isothiazole molecules. Therefore, the development of more economic and environmentally benign procedures that can avoid or reduce the use of volatile organic solvents without imposing longer reaction times is not only attractive, but has also become essential to organic synthesis. Although many common heterocyclic compounds have been synthesized following the neat approach, but synthesis of isothiazoles under solvent-free conditions has not been reported to date.

In continuation of our research work involving the neat reaction technology,<sup>11</sup> we report here for the first time, a solvent-free rapid synthetic route of isothiazoles **2** *via* ammonium thiocyanate-promoted single reagent transformation from  $\beta$ -halo vinyl aldehyde **1**. The current protocol reduces

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# On the exact revival of Morse oscillator wave packets

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## Abstract

The exact analytic expressions of the autocorrelation function and Husimi distribution function for a Morse oscillator wave packet have been derived and we use them to see the evolution of the wave packet. The dynamics of Morse oscillator wave packets for the dimers ArXe, Be<sub>2</sub> and Li<sub>2</sub> have been discussed. Special emphasis has been given on the revival phenomenon of such wave packets. It is obtained that the exact revivals of wave packets for ArXe, Be<sub>2</sub> and Li<sub>2</sub> do not occur at the revival times ( $t_{rev}$ ) but at the instances 3.5, 8.5 and 33.5 times and their simple multiple of  $t_{rev}$  respectively.

**Keywords** Morse oscillator · Molecular wave packet · Autocorrelation function · Husimi distribution function · Revival

## 1 Introduction

The simplest model for studying molecular wave packet dynamics is to consider the Morse oscillator [1]. It is an exactly solvable system and largely used to study rotating vibrational states of diatomic molecules [2]. Due to anharmonicity of the potential, the energy eigenvalues are nonlinear. It causes the initial wave packet to disperse which causes the collapse and after some time the collapsed wave packet gets back its initial form which is called the revival. The revival phenomena are not only theoretically described [3] but also experimentally verified for high- $n$  Rydberg atoms [4], ion traps [5], semiconductor quantum wells [6], cavity QED [7], molecular vibrational states [8–10] etc. Revival of a wave packet tells us many internal information of the system. For the coherent control of a wave packet [8] it is necessary to know time of revival. A single laser pulse creates a wave packet but to study the ionization probability, phase-space localization or shaping the wave packet a time delayed second pulse is applied. Moreover, the power transfer from the second pulse is maximum when the wave packet is at the inner turning point of the

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## SIGNAL RESPONSE BETWEEN NITRIC OXIDE SYNTHASE AND METALLOTHIONEIN IN CHROMIUM AND LEAD TREATED BACTERIA ISOLATED FROM COAL MINE AREA

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### ABSTRACT

In the study an attempt was made to reveal signal cross talk between metallothionein (MT) and Nitric Oxide Synthase (NOS) in the bacteria isolated from soil of Raniganj Coal mine area after treatment of bacteria with Chromium (Cr) and Lead (Pb). Cr(VI) reducing ability of the bacteria and hence its metal remediation was studied by the Chromate reductase activity of the bacteria. Lead bioremediation was assayed by the Atomic absorption spectroscopy (AAS) after treatment of bacteria with Pb(II). MT was extracted from bacteria isolated from coal mine area. Induction of protein like MT having molecular weight 14 kD occurs in isolated bacteria upon treatment with heavy metals like Cr(VI) and Pb(II) as evidenced from SDS PAGE. The thiol content in metal treated bacteria increased in comparison with the control (metal untreated bacteria). Metals induce NOS activity when it is compared to the control. NOS binds transition metals and demonstrates increment in expression of NOS activity in presence of metals like Cr(VI) and Pb(II). In this study, the effects of these heavy metals on the activity of NOS and the effects of NOS on the thiol content of proteins have been discussed. The mechanism of action of xenobiotics like Pb and trace metals like Cr are to some extent different in terms of thiol content and NOS activity. A hypothesis regarding the relationship between MT and NOS has been proposed here. Bacteria where MT synthesis is regulated by NOS can be used in sites contaminated with higher concentrations of heavy metals.

**Keywords:** Metallothionein, Lead, Chromium, bacteria, Nitric oxide synthase.

### 1. INTRODUCTION

Cr(VI) is harmful for the living system whereas Cr(III) is not, instead it acts as an essential micronutrient in humans. Isolation of chromium reducing bacteria which are Cr(VI) resistant can be used for environmental clean-up and bioremediation of heavy metals contaminated industrial wastes by evaluating their Cr(VI) reducing ability to Cr(III) through chromate reductase assay. In the present study, the effect of Chromium on bacteria isolated from the coal mine area is observed and its chromate reductase activity and thus its metal remediation capacity are ascertained [1].

Chromium toxicity is one of the major causes of environmental pollution emanating from tannery effluents. The Cr(III) species predominantly existing as hydroxides, oxides, or sulphates, are less water soluble, mobile (100 times less toxic), and (1,000 times less) mutagenic. Chemical reduction and precipitation, adsorption on activated carbon, ion exchange, and reverse osmosis, in a basic medium are the principal techniques for recovering or removing Cr(VI), from wastewater. However, these methods have certain

drawbacks, namely, high cost, low efficiency, and generation of toxic sludge or other wastes that require disposal and imply operational complexity [2,3]. Bioremediation of Cr(VI) by bacteria is an eco-friendly approach.

Lead is a ubiquitous toxic metal which have mutagenic, carcinogenic, genotoxic, anthropogenic, and phytotoxic effects [4]. Lead is a xenobiotic heavy metal present as a pollutant in the environment which must be remediated. The use of fossil fuels including past use of leaded gasoline, some types of industrial facilities, and past use of lead-based paint in homes are the sources of lead exposure. Pb(II) can be also bioremediated by bacteria.

The defining feature of a nitric oxide synthase (NOS) is a heme and pterin-binding oxygenase domain, and enzymes that possess this domain are found in animals and bacteria. Recent progress in defining the functions of bacterially derived nitric oxide (NO), notably in protection from various stresses and as a potential transcriptional regulator is described [5].

The nitric oxide synthases are family of enzymes cataly-



## EFFECT OF CADMIUM AND ZINC HEAVY METALS ON THE SOIL BACTERIA ISOLATED FROM COAL MINE REGION

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### ABSTRACT

Study of growth pattern of isolated soil bacteria from Raniganj coal mine area shows an unusual increase in growth rate of the isolated bacteria when treated with heavy metal stress in the culture media. The metals used were Cadmium (Cd) and Zinc (Zn). Utilization of metal ions by the bacterial cells was studied by detection of leftover metal in the culture medium after optimal growth, by Dithizone method and surface adsorption of metal ions on bacterial cell by FTIR technique. The amount of total thiol and non-protein thiol of the bacterial culture was assayed for the presence of thiol containing protein like Metallothionein. Metallothionein production was also studied using SDS-PAGE and Western blot technique to find if the cells were stressed in the presence of increasing concentration of  $Zn^{2+}$  and  $Cd^{2+}$ . Metallothioneins (MTs) are proteins rich in cysteine residues having low molecular weight. They perform different functions like scavenging of free radicals, involvement in maintaining metal balance, regulation of metabolic activities and protective role against damage caused by heavy metals. Metallothioneins can be correlated with heavy metal contamination of an environment and thus may be considered as bio-marker for environmental pollution.

**Keywords:** Cadmium, Zinc, Dithizone, Bacteria, Metallothionein.

### 1. INTRODUCTION

Persistence of heavy metals having toxicity in biogeochemical cycle largely depends on microbes. Microbes also help to remove contamination of toxic heavy metals. Metals possessing atomic density greater than  $4000 \text{ Kg/m}^3$  are known as heavy metals [1]. At high concentration, Zinc, Nickel, Copper, Cobalt and Manganese have toxic effect on human health and different organisms [2]. On the other hand, Cadmium, Mercury, Lead etc. do not have any biological role and are harmful to the organisms even at minute concentration [3]. The existence of heavy metals occurs both in bioavailable and non-bioavailable forms. Mobility of heavy metals depends on the metallic element precipitating as positively charged ions as well as the one, which constitute negatively charged part of salt. Detrimental effects are observed on the environmental microbes when the concentration of heavy metals exceeds threshold levels. Otherwise, microorganisms might develop higher resistance against toxic heavy metals when they are exposed to the increased concentrations of these metals [4-6]. Additionally, various means have been developed by the microorganisms dwelling in metal polluted soils to

withstand metal stress. Such metal resistant microorganisms can show strong bioremediation capacity. To survive in the metal stressed conditions, bacteria have devised various pathways to resist the intake of heavy metal ions. The pathways adopted for withstanding the heavy metals are accumulation and complexation of the metal ions inside the cell, reduction of the heavy metal ions to a less toxic state [6,7,8] and metal ions efflux outside the cell. Reports already exists on the different metal-resistant bacteria. Isolation of bacteria was done from contaminated sediments, soils, and waters.

Margoshes and Valee discovered Metallothioneins in 1957 as newly invented proteins isolated from the tissue [9] of a horse renal cortex. These proteins possess high degree of homology in whole animal kingdom. Similar proteins are expressed by bacteria, fungi and even plants express similar proteins. MTs are low molecular weight (from 5 to 14 kDa) proteins possessing cysteine residues (higher than 30 % of its amino acidic residues) along with 7-12 metal atoms per molecule [10, 11]. Aromatic amino acids are absent in Metallothioneins.

MTs bind several trace elements like Cadmium (Cd), Zinc (Zn), Mercury (Hg), Silver (Ag) and Platinum (Pt)

## **Classification of Hot Jupiter Population through Statistical Framework**

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### **Abstract**

The recent trend in the discovery of a range of exoplanets opens up a door to evaluate their origin and classification under the light of different planetary attributes. This paper enthusiastically focused on a typical branch of exoplanets, hot Jupiter, and several planetary characteristics were observed to frame the population into substantive categories. In this paper, a statistical framework was also established to understand different planetary formation processes for hot Jupiters. Finally, the relevance of hot Jupiters in search of habitable planets is also discussed briefly.

*Keywords:* Hot Jupiters; Planetary formation; Star metallicity; Habitable zone.

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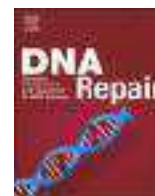
### **1. Introduction**

It is not far back when the concept of planetary systems except our solar system was the only stuff of theory and informed speculation. As time progresses, the catalog of exoplanets and their parent stars gets longer, and it helps mold different models of planetary formation around complex data. A special class emerges from the large pool of exoplanets due to their intriguing characteristics, inflated size, and proximity to the parent star. They are popular under the name of "Hot Jupiter," as during the first quadrant of their discovery period, most of them were found to have a mass comparable to our solar Jupiter [1]. Due to the propinquity of the parent star (semi-major axis  $<0.1$  AU), Hot Jupiters have a concise orbital period (around a few days only) while our solar system Jupiter has a very long period of  $\sim 12$  years orbits at  $\sim 5$  AU from the Sun [2,3].

Mayor and Queloz discovered the first hot Jupiter through periodic Doppler shifts caused by the gravitational tug of 51 Pegasi [4]. This technique is biased towards finding hot Jupiters around less massive stars. After two decades since then, there are many more techniques, viz., radial velocity planets and dedicated photometric transits surveys, that have been deployed to detect and probe their physical attributes [5-8]. A group of these planets will have orbital inclinations close enough to edge in so that wide-angle CCD lenses capture the dimness of starlight during their transits in front of its parent star. Stars targeted by ground-based transit surveys are often amenable to radial velocity follow-up

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## Review Article

# Non-canonical function of nuclear PTEN and its implication on tumorigenesis

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## ARTICLE INFO

## Keywords:

PTEN Post translational modification  
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## ABSTRACT

Suppression of genomic instability is the key to prevent tumor development. PTEN is a unique tumor suppressor protein having both lipid and protein phosphatase activities. Interestingly though it is a cytoplasmic protein, but a significant pool of PTEN can also be localized in nucleus. The function of cytoplasmic PTEN is well defined and extensively studied in various literatures focusing mainly on the negative regulation of oncogenic PI-3Kinase-AKT pathway but functional regulation of nuclear PTEN is less defined and therefore it is a fascinating subject of research in cancer biology. Post-translation modulation of PTEN such as phosphorylation, sumoylation, acetylation and methylation also regulates its cellular localization, protein-protein association and catalytic function. Loss or mutation in PTEN is associated with the development of tumors in various tissues from the brain to prostate. Here we have summarized the role of nuclear PTEN and its epigenetic modulation in various DNA metabolic pathways, for example, DNA damage response, DNA repair, DNA replication, DNA segregation etc. Further, pathways involved in nuclear PTEN degradation are also discussed. Additionally, we also emphasize probable potential targets associated with PTEN pathway for chemotherapeutic purpose.

## 1. Introduction

Phosphatase and Tensin homolog deleted on chromosome ten (PTEN) is a unique and bona fide tumor suppressor protein that possesses both lipid and protein phosphatase activity. This protein has been identified simultaneously by two research groups in the year 1997 as tumor suppressor genes located at chromosome 10q23 in glioblastoma and prostate cancer cell lines [1,2]. Soon after its discovery, it has been found that the frequency of monoallelic mutations at this locus has been estimated at 50%–80% in sporadic endometrial carcinoma, and at 30%–50% in breast, colon, and lung carcinoma. Accumulation of PTEN germline mutations develops in a group of autosomal dominant syndromes characterized by various developmental disorder, neurological deficits, multiple hamartomas, and an increased risk of breast, thyroid, and endometrial cancers which are collectively referred to as the PTEN hamartoma tumor syndromes (PHTS), that includes Cowden syndrome, Lhermitte-Duclos disease, Bannayan-Riley-Ruvalcaba syndrome and Proteus and Proteus-like syndromes [3]. The latest list of COSMIC cancer database includes more than 2700 mutations in PTEN in 28 different tumor types, and the cBio portal of The Cancer Genome Atlas (TCGA)

lists 1120 mutations in 27 tumor types. Considering the vast mutational diversity of PTEN in different tumor specimens, it is essential to understand the functional regulation of PTEN in cancer.

The crystal structure of PTEN (403 amino acid) revealed that it is a multi domain protein: N terminal phosphatase domain, the C2 domain and the C-terminal tail. C2 domain as well as 6 to 15 amino acid residues of N-terminus are involved in membrane localization through interaction with phospholipid PIP3 [3–5]. The C-terminal tail contains a number of phosphorylation sites at Serine 370, Serine 380, Threonine 382, Threonine 383, and Serine 385 residues. Interestingly phosphorylation of Ser 380, Thr 382, Thr 383 residues (collectively named STT motif) but not Ser 370 or Ser 385, increases the stability of PTEN and at the same time decreases its phosphatase activity [6]. It has been suggested that mutations or dephosphorylation of this STT cluster unwraps the protein conformation, making it less stable, but increases its phosphatase activity [6,7]. Thus STT motif of PTEN regulates its catalytic activity as well as its stability. Apart from C terminal phosphorylation sites, there are also multiple phosphorylation, sumoylation, acetylation and methylation sites which are important for PTEN nuclear functions (See Fig. 1 and Table 1). PTEN specifically dephosphorylates the D3

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# Architectural Anthropology in Urban Housing Complex: A Spatial Study on the Culture Construct of a Community Design Architecture

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[journals.sagepub.com/home/ans](http://journals.sagepub.com/home/ans)**Sankha Priya Guha<sup>1</sup>****Abstract**

The science and art of architecture skilfully relate parts to a greater whole as well as creates a form, which is uniquely appropriate for the exercise of a specific set of functions. There is no single approach to the study of architecture, but many. Anthropological approach considers buildings as cultural artefacts and can be revealing of the relationship of dwellings to family, social structure and mores. Architectural anthropology is an emerging discipline which has its scope in the interface of physical and cultural spaces of a community. The present study is an empirical attempt to understand the anthropological and phenomenological dimensions of architecture in two urban housing complexes located in Kolkata in India. The key concept to be used in the present study is space both in terms of theoretical discourse and empirical representation. The study do establish the fact that buildings have social lives with physical structure, needs, uniqueness, characters as well as cognitive identity. The social identity of these buildings is drawn from a number of socio-economic variables of the residents guided by time–space determinants.

**Keywords**

Architecture, culture, space, anthropology, phenomenology

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# Multi-arm covariate adjusted response adaptive designs for ordinal outcome clinical trials

Statistical Methods in Medical Research

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[journals.sagepub.com/home/smm](https://journals.sagepub.com/home/smm)Soumyadeep Das<sup>1</sup> , Rahul Bhattacharya<sup>2</sup>  and Atanu Biswas<sup>3</sup> 

## Abstract

Covariate adjusted response adaptive designs are developed with ordinal categorical responses for phase III clinical trial involving multiple treatments. Stochastic ordering principle is used to order the treatments according to effectiveness and consequently allocation functions are developed by combining the cumulative odds ratios suitably. The performance of the proposed designs is investigated through relevant exact as well as large sample measures. To investigate the performance in a real situation, a real clinical trial involving lung cancer patients is further redesigned using the proposed allocation design.

## Keywords

Covariate adjusted response adaptive design, ordinal categorical responses, cumulative odds ratio, proportional odds model.

## 1 Introduction

Clinical trials are carefully conducted research studies to find out the treatments that work best on subjects with a certain disease. Among the several phases of a clinical trial, phase III comprises of the large scale evaluation of treatments and hence is a crucial phase. In phase III of the clinical trial, the patients enter sequentially into the trial and assigned one of the available treatments. Complete randomization (CR) is the widely used allocation design in this regard for its simplicity and statistical performance (e.g. higher power). But from a critic's viewpoint, CR lacks individual ethics as it is blind to treatment performances and hence does not skew the allocation towards the better performing treatments. On the other hand, response adaptive randomization (RAR) uses the available allocation and response information of the patients to update the allocation probabilities so that treatments doing better are used more often.<sup>1,2</sup> Thus a RAR is more desirable as it compromises collective ethics (identifying a true difference in treatment effectiveness with high statistical power) with individual ethics (maximum number of patients are treated by the superior treatments eventually).

Depending on the nature of the trial, often the responses of the patients are measured in ordinal categorical scale. For example, the response of a rheumatoid arthritis<sup>3</sup> patient can be any of the following: nil, mild, moderate, and severe. As another example, the responses in cancer trial may be either of the ordinal categories: death, progressive disease to complete remission. Ordinal responses are also reported in trauma<sup>4</sup> and sports related knee injury<sup>5</sup> trials. Another example of ordinal outcomes is the WHO Clinical Progression Scale, which is a 11-point scale (0: not infected to 10: dead) and is advantageous for the use in an emerging infectious disease epidemic. In a very recent article on the final report of the Remdesivir trial with Covid-19 patients,<sup>6</sup> though the primary outcome is length of recovery time, but the patient response was measured in an ordinal eight point scale. Although these real trials used fixed allocation designs, but development and advantage of RAR in this context can be found in the works of Bandyopadhyay and Biswas,<sup>7,8</sup> Biswas et al.,<sup>9</sup> Biswas et al.,<sup>10–12</sup> and Das et al.,<sup>13</sup> among others.

Although these developments assumed homogeneity of patients, but in reality, they may differ with respect to covariates like age, sex and health conditions. So, adapting covariate information into the design phase of the trial is desirable to

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## MINI REVIEW

### Cross-Linked Ionic Polysaccharides: Insights from the Structure to Stimuli-Sensitive Drug Delivery System Applications

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The review provides an insight regarding the state of the art of cross-linked ionic polysaccharides, which are a part of common drug delivery systems, which are involved in the regulation of release of drug in specific required sites. The changes in pH, ion concentration, wavelength, redox potential, temperature, electric and magnetic field intensity are the stimuli sensitive functions, which play a major roles. Due to their high reproducibility and better characterization from natural resources, the polysaccharides remains as a point of interest for compiling many stimuli-responsive drug delivery systems. The hydrogel networks are formed from ready cross-linking of ionic polysaccharides, subject to control of internal and external variables. These hydrogel networks become operative for drug release on-off through complex mechanisms. The polysaccharide-based drug delivery systems are now responsive to different hybrids, composites and grafted polymers with a broad range of stimuli functions.

**Keywords:** Ionic polysaccharides, Chitosan, Carboxymethyl cellulose, Heparin, Stimuli sensitive, Drug delivery system.

## INTRODUCTION

It has been long time since natural polysaccharides, owing to their structural diversities and properties, have contributed immensely to the medical field. The developing nations have adopted the use of polysaccharides replacing the use of costly items widely in advanced diagnosis of a disease. Now-a-days, every effort is being made to convert the discarded wastes into useful materials from renewable sources with added properties. We are focusing here largely on the applications of polysaccharides family. Polysaccharides may be isolated and extracted from marine, plant, animal and synthetic sources [1]. The naturally growing seaweeds are a good source of sulfated polysaccharides, as reported in most of the cases [2]. In many cases, higher plants, edible fruit, bark, fungi and bacterial sources are reported to contain polysaccharides, which were extracted using standard procedures and cheap solvents, thereby discarding the other byproducts in the process. After the extraction process is over, chemical profiling, Smith degradation and linkage pattern determination is mostly done to establish the

structure of the extracted polysaccharides from the natural or synthetic sources [3]. The proposed structure is thereafter confirmed from IR, NMR and GC-MS spectroscopic studies, compared to standard monosaccharides [4]. In fact, these polysaccharides may also be synthesized of diverse architecture with desired molecular weight and functional group. It is due to the coupling of the organic chemistry with the polymer science that has led to the formation of several new materials [5].

The polysaccharides and its composite materials were used in the aquatic feeds and agricultural byproducts in the last two decades. With passing time, gradually the synthetic materials have been replaced by these composite polysaccharide materials synthesized with the help of pharmaceutical technology. There has been an increase in search of the new materials using biomedical and pharmaceutical technology produced from daily household waste materials, which in turn would additionally reduce the large accumulation of unutilized waste. The polysaccharides are also found biocompatible due to their similarity in structure in many components in plants, animals and human systems. In food processing industries, there have been reports



# Synthesis and structure of vanadium (IV) single-stranded dihelicate involving multi-ring nitrogen-heterocyclic ligand

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## ABSTRACT

1 The single stranded-helicate Vanadium(IV) complex  $[V_2O_2Cl_4(L)(H_2O)_2]$  (1) involving heterocyclic bis-bidentate ligand viz. 3,3'-dipyridine-2-yl-[1.1']bi[imidazo[1,5-a]pyridine] (L) with biological relevance is prepared and characterized by X-ray diffraction analysis. The compound lacks molecular center of symmetry where coordination environments around V(1) and V(2) centres are distorted octahedral (V...V# separation of 5.827 Å). Structure of the compound in the solid state structure shows anion- $\pi$  interactions, classical and C<sub>arene</sub>-H—anion non-classical H-bonding interactions. These interactions play significant roles in shaping the extended structure of this molecule.

## 1. Introduction

The programmed self-assembly of discrete helicates has been the topic of extensive research over the last few decades [1–4] because of their aesthetic appeal as well as biomimetic relevance [1a-c,3]. The basic principles of self-organization and molecular recognition [2] can be understood by the basic mechanistic and energetic findings obtained from study of formation, properties and structure of the helicates. Such studies are important for the rational designing of complex architectures [1,3a,5]. Among various types of ligands that are particularly shown to be suitable for the formation of different types of helical compounds, polypyridine derivatives dominate [1b-c, 6–9]. Many transition metals with polypyridine ligands produce dihelicates. Dihelical chemistry is mostly dominated by double stranded compounds of the types  $M_2L_2$  and triple stranded compounds of the types  $M_2L_3$  where L is a bis-bidentate ligand [1b-c,10]. Relatively rare are single-stranded dihelical complexes involving a single ligand coordinating two metal centres in a helical structure [11].

Furthermore, there are other potential features associated with the metal complexes of polypyridine type ligands. Being  $\pi$ -electron deficient, such heteroaromatics in favorable circumstances display moderate to strong interactions with various anions [12]. Such type of non-covalent interactions are specially relevant for the design of molecular receptors [12a,12c,12g,12m,13] and transporters [14] which

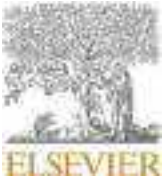
would be of prime importance for environmental [12a,15], medicinal and biological applications [12a,12k,13a,13b,16] as well as in catalysis [17].

Recently supramolecular chemistry has unveiled that non-conventional H-bonds, such as (a) C–H ... X (X = O, N, F, Cl) (b) X–H ...  $\pi$  (X = N, O, C, Si &  $\pi$  = double, triple or aromatic) (c) X–H .....M (M as acceptors, M = Pt, Pd, Cu & X = N, O), M–H .....H (M as donors, M = Os, Ir), (d) M ... (H–C) (agostic interactions), (e) X–H .....H–M (X = C, N, O, S, dihydrogen bonding) often play crucial structural and biological roles [18]. Detailed theoretical studies and experimental evidences on such weak interactions may provide valuable informations for the development of effective systems capable of recognizing different molecules through non-covalent interactions.

We have synthesized [19,20] a  $\pi$ -electron-deficient N-heterocyclic ligand (L) having two biologically relevant [21] imidazo[1,5-a]pyridine parts. The ligand L can act as a bis-bidentate ligand, and its Cu(II) compound provides a unique example of valence tautomerism in solution [20]. Herein, we report the synthesis of a oxovanadium(IV) complex (1) with the N-heterocyclic electron deficient ligand (L). The compound has single stranded dihelical structure. X-ray diffraction analysis has been done to analyze the compound.

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# The eye of the tongue sole *Cynoglossus bilineatus* (Lacepède, 1802) (Teleostei: Pleuronectiformes)

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## ABSTRACT

We report the ocular features of the tongue sole, *Cynoglossus bilineatus* (Lacepède, 1802), a marine, bottom-dwelling flatfish. In this species, both eyes are located juxtaposed on the same side of the flat head. Histology revealed the sclera to be fibrous (collagenous) in nature. The choroid possesses the choriocapillaris, and adjacent to it, 3–4 rows of iridophores with stacks of cytoplasmic platelets. No choroidal gland is present. The retinal pigment epithelium (RPE) contains scanty melanin granules. Its vitread half is modified into a dense tapetum with lipid spheres (about 0.34  $\mu\text{m}$  in diameter). In juveniles, the tapetal spheres arise by budding from the smooth endoplasmic reticulum of the RPE. There are blood vessels within the retina; the vitreal vessels penetrate the retina and ramify close to the level of the outer limiting membrane. The vessels are capillaries in nature. The photoreceptor layer contains abundant rods, and twin cones and single cones, being arranged into square mosaics. The optic disc is non-pleated and shows pan-cytokeratin immunopositivity, which is related to the bundled cytokeratin filaments detected in astrocytes by electron microscopy. The retinal tapetum and choroidal iridophores help the species to live in a muddy bottom having dim-light environment. The lack of a choroidal gland, hypoxic aquatic condition and presence of a dense retinal tapetum (that limits  $\text{O}_2$  transport to the photoreceptors) appear to have favored the proliferation of vitreal vessels within the retina in this species. The fibrous sclera has probably arisen to provide structural support to the eye in migration from the lateral to the dorsal aspect of the head during larval metamorphosis.

## 1. Introduction

The eyes are unique sensory organs that function best to an ambient illumination to which a species is adapted to. Among the fishes, teleosts occupy diverse ecological niches from shallow freshwater ponds, lakes and rivers to major seas and oceans and as such they show extreme variations in eye morphology in response to wide photic environments inhabited by them (Walls, 1942; Munk, 1966; Ali and Anctil, 1975; Locket, 1977; Pankhurst, 1987; Bowmaker, 1990; Collin, 1997; Wagner et al., 1998; Nag and Bhattacharjee, 2002; Fritsches et al., 2003; Reckel and Melzer, 2003; Warrant and Locket, 2004; Taylor et al., 2015; Fritsch et al., 2017a; Cortesi et al., 2020; de Busserolles et al., 2020d).

In teleosts (and also in amphibians, reptiles and birds), the sclera is

mainly cartilaginous in nature, which protects the choroid and retina from mechanical damage and at the same time maintains the eye rigidity and shape (Walls, 1942). The choroid contains a unique structure of anastomosed arterial and venous capillaries, called the choroid gland (Barnett, 1951; Wittenberg and Wittenberg, 1974), and a layer of continuous capillaries, the choriocapillaris, both of which deliver nutrients and oxygen to the outer retina, especially to the photoreceptor cells (Nag et al., 2021). The retinal pigment epithelium (RPE) is rich in melanin that protects the photoreceptor outer segments from excessive light. In some species that inhabit low-light environment (turbid or deep-water habitats), a part of the RPE and choroid is modified to act as tapetum lucidum that helps to enhance photon capture by photoreceptor cells (Walls, 1942; Munk, 1977; Nicol, 1981; Douglas et al., 1998; Nag,

**Abbreviations:** RPE, Retinal pigment epithelium; PB, Phosphate buffer; TEM, Transmission electron microscopy; ONL, Outer nuclear layer; OD, Optic disc; IFs, Intermediate filaments; RTL, Retinal tapetum lucidum; PAS, Periodic acid Schiff; SER, Smooth endoplasmic reticulum; OLM, Outer limiting membrane; INL, Inner nuclear layer.

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এবং বৈশাখ - আষাঢ় ১৪২৯  
মুশায়েরা

ক্রোড়পত্র  
বিমল কর  
কবি ও কবিতা



## গণিকালয় মার্সেল শোয়াব

মার্সেল শোয়াব একজন বিখ্যাত ফরাসি ইমেজিষ্ট গল্পকার। তার জন্ম ১৮৬৭তে, মারা যান ১৯০৫-এ। তাঁকে স্যুরেরয়ালিজনের পূর্বগামী বলা হয়ে থাকে। হোর্হে লুই বোর্হেস ও রবের্তে বোহালিও'র উপরে তাঁর প্রভাব রয়েছে, বলে মনে করা হয়।

নয়া চালু রাস্তার উপরে ছাই রংয়ের লজ্জকড় একটা অদ্ভুত বাড়ি। জানালার টিম টিম করছে আলো। বড় সাইজের সাব রঙের দরজা। তাতে না আছে কী-হোল, না ডোর-বেল, না নক করার মতো কোনও ব্যবস্থা। দরজার উপরে একটা লাল ক্রশ চিহ্ন আঁকা। বেশ পুরনো বলে রঙ ফিকে হয়ে গেছিল। তাই দ্বিতীয়বার লাল রঙ চাপানো হয়েছে। ক্রশ-চিহ্নের নিচেই লেখা আছে- *ইশ্বরের কৃপা আপনার উপরে বর্ষিত হোক। সংক্রমণের আবহের মধ্যেই যেন এই সাবধান বাণীটিকে স্থাপন করা হয়েছে। হাতে পারে মার্জিয়ানা চক দিয়ে জায়গাটিকে দাগিয়ে দিয়েছে, নেহাতই চোর-গুণ্ডাদের ঠকাবার জন্যে। কিন্তু সময়ের জীর্ণতা দুটো চিহ্নকেই ফিকে করে দিয়েছে, বিশেষ করে কাঠের উপরে দায়সারা সাব রঙের প্রলেপ অপরাধ এবং মহানরী কারুর বার্তাই আর বহন করছে না এবং নৈশকোয়ার মধ্যে জেলখানার স্তালা খোলানো লৌহকপাটের মতো দেখাচ্ছে সেটাকে।*

জানালাগুলোয় সূর্যের আলো ঢোকান পথ বন্ধ। পাল্লা দুটো এমনভাবে সেঁটে আছে যে, জয়গাটা অন্ধকারাচ্ছন্ন হয়ে রয়েছে। বেশি মাত্রায় গরম পড়লেও জানালার খড়খড়ির দু'ধারে আঙ্গুল বেলালে, ঠাণ্ডার ভাবটাই অনুভূত হয়। ঘরের ভেতর থেকে শীতল ছায়ার ঝোঙটি যেন বাইরে প্রবাহিত হয়ে আসে। তারপর বৃষ্টিবাদলার দিনে কড় নামে যখন, বাজ চমকায়, কুমকুমিয়ে বৃষ্টি এসে ভাসিয়ে দেয় ফুটপাথ, পাল্লা দুটো থেকে থেকে একটু একটু করে ফীক হতে থাকে, যেন কড়ের মধ্যে খানিকটা শাস নেয় আর ভেতরের গোপন সেই বেডরুমের গাঢ় অন্ধকারে লাল রঙের পর্দাখানা প্রবলভাবে দুলাতে থাকে হাওয়ায়।

দিনের বেলা বাড়িটা থাকে আশ্চর্য রকমের সুনশান। কোনও দুধওয়ালি বা ডাকপিয়নকে দেখা যায় না দরজায় নক করতে। বাড়িটার ভৌগোলিক অবস্থানটাই এরকম যে, উত্তর ইন্ডিস্টের সিয়েন শহরের মতো এখানেও উত্তরায়ণের দুপুরে মাটিতে কোনও মানুষের ছায়া পড়ে না। সূর্যের আলোর ছটায় দেয়ালগুলো ফুটে ওঠে না কখনই, রাস্তিরে আবার দেয়ালগুলি অন্ধকারে পুরোপুরি সেঁধিয়ে যায়।

এক মুশায়েরা

মুখ ওটা নাল পর্যাখানির পেছনে একখানি মুখ চোখে পড়ল আমাদের। না কোনও  
কোনো মুখ নয়। বাচ্চা একটা মেয়ের একখানি বিষাদমগ্ন মুখ, যার মাথায় সোনালি  
শেখোই সে বিকটভাবে মুখ ভেঙে চীৎকার করে গালিগালাজ শুরু করেছিল। পেছন থেকে  
একখানি হাত তাকে ঘরের ভেতরের দিকে টেনে নিয়ে গিয়েছিল। তারপর জানালার ঝাঁপ  
নকিয়ে দিয়েছিল।

রাত আরও বাড়লে তীব্র একটা কিচমিচশব্দ ঘুম ভেঙে গিয়েছিল আমাদের। কারার  
আওয়াজ, মেঝেতে আসবাবপত্র আছড়ে পড়ার শব্দ, আয়নার কাচ গুঁড়ো হয়ে সোকেতে  
বুঁজি পড়ার শব্দ, কানে আসছিল। অণুছালো পোশাকেই ঘর থেকে বেরিয়ে এসেছিলুম  
আমরা। সমস্ত গণিকালয়টা জুড়ে আলোর ছড়াছড়ি ছিল, চারিদিকে সেগুলো আর্দ্রিত  
হয়েছিল। একটা হলদে বাতির পেছনে অন্য একটা লাল বাতি ছুটছিল, আশার অন্য একটা  
জালদায় হলদে আর একটা বাতি ছুটছিল। জানালার একটা ঝাঁপের পেছনে লালচে আর  
একটা বাতি ধীরে ধীরে গোল হয়ে ঘূর্ণিত হচ্ছিল।

এই ঘূর্ণমান বাতিগুলোর মধ্যে আমরা আতঙ্ক মেশানো কিছু মিনতি ও চাপা কারার  
আওয়াজ শুনতে পেয়েছিলুম। যাবতীয় ভয় সত্ত্বেও সাহসে বুক বেঁধে আমরা দ্রুত ওই সাদা  
বস্তার সামনে গিয়ে তাতে সজোরে ঘা মারতে শুরু করেছিলুম। তখন তীব্র একটা  
গোষ্ঠার আওয়াজ কানে ভেসে এসেছিল, মরার আগে কেউ যেভাবে গোষ্ঠার আর কি।  
তারপর সব চূপচাপ। আবার ফিরে এসেছিল সেই সন্ত্রস্ত নীরবতা, যেমনটা ছিল আগে।  
এক একে সব আলোগুলি নিভে গিয়েছিল, সকাল ফুটে ওঠার আগেই। আমাদের সমস্ত  
ইকরাকের কোনও সাজা পাওয়া যায় নি আর।

সকাল না হওয়া পর্যন্ত আমরা বিছানার সঁটে ছিলাম। কিন্তু লালচে মেয়ের ফাঁক গলে  
নকলকোর সোনা রোদ ছড়িয়ে পড়ার সঙ্গে সঙ্গেই আমরা ঘরের জানালাগুলো খুলে  
নিয়েছিলুম। গণিকালয়টার জানালার একটা ঝাঁপ খানিকটা ফাঁক হয়ে ছিল। সিঁড়ি দিয়ে  
হাতছাড়া নিচে নেমে গিয়েছিলুম আমরা। দেখতে পেয়েছিলুম যে, সূর্যের আলোর  
সোনালি চুলের বাচ্চা মেয়েটা হাসছে। আমরা যখন তাকে দু'একটা প্রশ্ন করেছিলুম, কোনও  
উত্তর না দিয়ে মেয়েটা একটুখানি হেসেছিল শুধু। ওর ছোট্ট হাতখানি আমার হাতে তুলে  
দিয়েছিলুম, হাতখানি ময়লা, নখের ভেতরে রক্তের ছোপ।

এর পরে আমরা পুলিশে খবর দিয়েছিলুম। ততক্ষণে মেয়েটা হাওয়া। আমরা লক্ষ্য  
করেছিলুম যে, গণিকালয়টা পুরোপুরি পরিষ্কার, পরিচ্ছন্ন, কোথাও কোনও আসবাবপত্রের  
অস্তিত্ব নেই। সাদা দরজার উপরে ক্রু দিয়ে সঁটা বিজ্ঞাপনখানার দিকে দালানগুলো  
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তাকিয়ে হাসতে লাগল ওই লোকগুলো।

অনুবাদ উদয়শঙ্কর বর্মা



এবং শারদীয় ১৪২৮  
মুশায়েরা

ক্রোড়পত্র : শঙ্খ ঘোষ



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আমার কথা

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উদয় শংকর বর্মা

ভাষার স্বাধীনতা প্রাপ্তি ও বঙ্গবিভাগের তেরো বছর পরে ১৯৬১-৬২ সালে পশ্চিমবঙ্গে ১৭ই মে তারিখে একটি সাতা জাগরণে আন্দোলন সংঘটিত হয়। তার নাম হাংরি জেনারেশন আন্দোলন। ওরফে সঙ্গে সঙ্গে সারা বিশ্ব জুড়ে এ আন্দোলনের প্রতিক্রিয়া লক্ষ্য করা গিয়েছিল। অনেকের অভিযোগ এই যে, এই প্রতিক্রিয়ার কারণ মত না সাহিত্যমূলক তার চেয়ে বেশি রাজনৈতিক। যদিও এই আন্দোলনের পৃথিবীতে কেউই সেভাবে সাহিত্যের সঙ্গে রাজনীতিকে জড়ান নি। কিন্তু মার্কসবাদের এ কথা তো হিত যে, তত্ত্ব কোনোকিছুই রাজনীতির বাইরে নয়। আসলে হাংরি জেনারেশনের রাজনীতি এইখানে যে, তা সমাজের প্রচলিত প্রকরণটিকে, সমাজের প্রচলিত অভ্যাসটিকে আঘাত করেছিল। সামাজিক নিয়ম কানূনের তোয়াক্কা না করে ব্যক্তির সর্বস্বিন ইচ্ছে অনিয়ন্ত্রিতকৈ শুধু নয় তার যখন দৃষ্টি কোণটিকেও রক্ষাভাবে প্রচার করেছিল। অতিপূর্বজ 'কল্লোলী'র মত 'হাংরি'র অবদানের উন্মোচন করেন নি। (সাম্প্রদায়িক, প্রেনেত্র নিহের 'বিকৃত কৃষার কানে বন্দী মোর ভগবান কীদে' বা বুদ্ধদেব বসুর 'সাদনার বক্ষমাঝে কেঁদে মরে ক্ষুধিত বৌবন।') হাংরিরা প্রকরণকেই স্বীকার করেন নি। তাঁরা হাতে চেয়েছিলেন অবদানমুক্ত সমাজের এক সপ্রাপ্ত প্রতিচ্ছবি। আর শুধু তো যৌনতা নয়, সমাজ, জীবন, সাহিত্য, শিল্প সব কিছু নিয়েই এদের ভাবনা ছিল। বাংলা সাহিত্যের আর কোনো আন্দোলন জীবনের এতখানি ব্যাপক প্রেক্ষিত নিয়ে মনন করেনি। গোষ্ঠীত্বের কারণে এই আন্দোলন ভেসে স্তিমিত হয়ে না পড়লে তা যে কী রূপ নিত তা আজ আর বলা সম্ভব নয়। তবে হাংরি জেনারেশন আন্দোলনের প্রকরণে তাঁদের আন্দোলনকে যে তাত্ত্বিক ও সাহিত্যিক রসমূর্তি দান করেছিলেন তা আজও অনন্য।

হাংরি জেনারেশন আন্দোলনের উৎপত্তিকাল হিসেবে দুটি সালের চল আছে। ১৯৬১ ও ১৯৬২। কারণ এই আন্দোলনের দুই পৃথিবীতে মলয় রায়চৌধুরী ও শৈলেশ্বর ঘোষের মধ্যে মতানৈক্য রয়েছে। মলয়ের মতে ১৯৬১ সালে প্রথম হাংরি মেনিফেস্টোটি বার হয়। সেটি মুদ্রা করা করেছিলেন তিনি নিজেই এবং সেখানে 'হাংরি জেনারেশন'-এই অভিবাতি মনুত হয়েছিল চন্দারের "In the sower hungry time" বাক্যবছের অনুসরণে। মার্কস এবং অসওয়াল্ড স্পেন্সারের নিমজ্জিত মলয়কে চন্দারের ভাবনাও প্রভাবিত করেছিল বলে স্বীকার্য জানিয়েছেন মলয়। যেহেতু মেনিফেস্টোর প্রথম দিকে তারিখ দেবার চল ছিল

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বোদলেয়ারের তিনটি কবিতার

ফরাসি থেকে অনুবাদ : উদাশকের বর্মা

### অনুতাপ আর বাউতুলে ভ্রমণ (Maesta et errabunda)

আগাথা, আমাকে বলো তো, মাঝে মাঝে তোমার মনটি কি  
নোরো এই শহরের কালো সমুদ্র পেরিয়ে  
অন্য কোনও সমুদ্রের সেই উজ্জ্বল উল্লাসের দিকে উড়ে যায়  
যা সুনীল ও স্বচ্ছ : যেন কোনও এক পৃথিবীর নিষ্পাপ কৌমার্য।  
আগাথা, আমাকে বলো তো, মাঝে মাঝে তোমার মনটি কি উড়ে যায় সেখানে?

সহুদ্র, বিশাল সমুদ্র, আমাদের মেহনৎকে দেয় সাহুদনা  
কোনও এক দানব, উদ্দাম পায়ক তাকে ভরিয়ে তোলে,  
দানব হাওয়ার খাপখামো করে তার সঙ্গত।  
যেন দেলনায় দেল দেওয়ার দায়িত্ব নেয় সে  
বিশাল সমুদ্র আমাদের মেহনৎকে দেয় সাহুদনা।

হে পরিবহন, আমাকে নিয়ে চলো,  
হে রণতরী, নিয়ে চলো আমাকে  
দূরে, বহু দূরে-  
এখানকার কাপামাটি জেখেন জলে তৈরি  
আগাথার বিষয় হৃদয় বে মাঝে মাঝে বলে-  
"অপরাধ থেকে, অনুতাপ থেকে, দুঃখ থেকে  
আমাকে সরিয়ে নিয়ে যাও, হে পরিবহন, হে রণতরী", তা কি সত্যি?

ওগো গন্ধবিধুর স্বর্গ, কত দূরে তুমি  
নীল আকাশের নীচে যেখানে শুধুই ভালোবাসা আর আনন্দ  
যেখানে ভালোবাসার পাত্রপাত্রীরা এক অনন্য জুটি  
যেখানে নারাক্ষণ নির্ভেজাল আনন্দে ডুবে থাকে হৃদয়  
গন্ধবিধুর সেই স্বর্গ, ওগো বলো, তুমি কতদূরে?

বিশোর প্রেমের সেই সবুজ স্বর্গ  
সেই ছোটোছুটি চারদিকে, পান পাওয়া, চুনু খাওয়া, ফুলের তোড়া  
পাহাড় পেরিয়ে আসা বেহালার নুরেলা কম্পন

## অশুভ তোমার কোন পথ দিয়ে

উদয়শংকর বর্মা

ইভল বা অশুভের অস্তিত্ব অত্যন্ত পুরনো। প্রাচীন ধর্মশাস্ত্রে এই ইভলের প্রতিনিধি হিসেবে শয়তান বা অসুরদের কথা আছে। মনুব্যাকৃত পাপও ইভল। ব্যামি ও ত্রিতাপ যন্ত্রণাও ইভল। সুতরাং ইভলের ধারণাটি ব্যাপক, বহুধাবিভূত। ধর্মশাস্ত্র, দর্শনশাস্ত্র ও সাহিত্যের উপরে ইভলের প্রভাব প্রাচীন কাল থেকেই চলে আসছে। কিন্তু আধুনিক কবিতার একেবারে কেন্দ্রে ইভলকে রেখে সৌন্দর্য রচনার সাহস বোদলেয়ারই প্রথম দেখিয়েছেন। তাঁর কাব্যগ্রন্থটির নামের মধ্যেই সেটা প্রতিফলিত। তাঁর কাব্যগ্রন্থের নাম-‘লে ফ্লোর দ্য মাল’, যার ইংরেজি করলে হয় ‘দ্য ফ্লোরগার্স অব ইভল’। আর বাংলা করলে ‘ইভলের ফুলগুলি’। ‘ইভল’এর বাংলা যদি ‘অশুভ’ করা যায়, তাহলে বিগত বাঙালয় বোদলেয়ারের এই কাব্যগ্রন্থটির নাম হয়- ‘অশুভ ফুলগুলি’।

খ্রিস্টীয় ধর্ম অনুসারে মানুষ বেদিন থেকে তার স্বাধীন ইচ্ছের দুঃপ্রয়োগ করে ঈশ্বরের ব্যর্থ না মেনে নিবিদ্ধ ফল ভক্ষণ করেছে, সেদিনই তার পতন হয়েছে। পাপ হয়েছে। একাধিক জগতে প্রথম ইভলের সৃষ্টি হয়েছে, আর তাকেই বলা হয়েছে নৈতিক ইভল। এই নৈতিক ইভলের জন্যে ঈশ্বর যে শাস্তি দেন, তাতেই উন্মূত হয় প্রাকৃতিক ইভল। ভালো কাজের জন্যে ঈশ্বর মানুষকে অবশ্য পুরস্কারও দিয়ে থাকেন। ফলে মানুষ তার জীবনে পুরস্কার এবং সুখ, শান্তি এবং যন্ত্রণা উভয়ই অর্জন করেন। তখন দেখা দেয় ধর্মীয় ইভল। বোদলেয়ারের কবিতায় এই ধর্মীয় ইভলের পরিচয় অবশ্যই আছে। বিশেষ করে ‘অশীর্বাদ’, ‘অতীত জীবন’, ‘বৈপরীত্য’, ‘ভ্রমণ’ প্রভৃতি কবিতায়। ধর্মীয় ইভলের ভাবনার বোদলেয়ার মূলত ক্যাথলিক দার্শনিক জোসেফ দ্য মেন্ড্রু দ্বারা অনুপ্রাণিত। দ্য মেন্ড্রু’র মতেই বোদলেয়ারেরও মনে হয়েছিল যে, নিয়তির উপরে মানুষের কোনও নিয়ন্ত্রণ নেই। অতএব প্রার্থনার মাধ্যমেই মানুষকে নিজের দুর্বিপাক থেকে মুক্ত হতে হবে। এ কারণে উক্ত প্রতিটি কবিতাতেই পাপ, যন্ত্রণা, কষ্ট ইত্যাদি থেকে পরিত্রাণের কথা বেশ স্পষ্টভাবেই বলা হয়েছে। তাছাড়া দ্য মেন্ড্রু যে আদি পাপে বিশ্বাস করতেন ও তা থেকে পরিত্রাণের কথা বলেছিলেন, বোদলেয়ার সেটিকে দেশবাসীর প্রগতি-অনুরাগের বিরুদ্ধে একটি রাজনৈতিক অস্ত্র হিসেবেও ব্যবহার করেছিলেন। কারণ ১৮৪৮ এর গণ বিদ্রোহ সম্পর্কে তাঁর মোহভঙ্গ ঘটেছিল। তাই তিনি তাঁর ‘জার্নালে’ লিখেছিলেন যে, ‘সত্যিকারের সভ্যতার সূত্রটিকে গ্যাসের আবিষ্কার, বাষ্পের প্রয়োগকৌশল কিংবা রিভলভিং টেবিলের



এবং  
মুশায়েরা

# দস্তয়েভস্কি



F. Dostoevsky

## সূচিপত্র

২৮ বর্ষ ৪র্থ সংখ্যা। ১৪২৮। ২০২২

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## দস্তয়েভ্‌স্কির উপন্যাস 'দানবেরা'

উদয়শংকর বর্মা

'দানবেরা (Demons)' বা 'শয়তানেরা (The Devils)' বা 'অপসেবতাগ্রস্ত (The Possessed)' দস্তয়েভ্‌স্কির ষষ্ঠ উপন্যাস। তাঁর স্ত্রী অ্যানার বয়ান থেকে জানা যায় যে, ১৮৬৯ খ্রিস্টাব্দে দস্তয়েভ্‌স্কি যখন জার্মানীর হেসসেনে স্বৈচ্ছাবৃত্ত নির্বাসনে ছিলেন, তখনই এই উপন্যাসটি রচনার কথা তাঁর মাথায় আসে। রাশিয়া থেকে সুদূর জার্মানে বসে দস্তয়েভ্‌স্কি সে সময় সংবাদপত্রের মাধ্যমে স্বদেশের নানা খবরাখবর পাচ্ছিলেন। সেসবের মধ্যে পেত্রভস্তিয়া আর্থিকালচারাল অকাদেমির ছাত্রছাত্রীদের রাজনৈতিক বিক্ষোভ-আন্দোলনের ব্যাপারটিও ছিল। সমকালীন এই ছাত্র আন্দোলনকে ভিত্তি করে দস্তয়েভ্‌স্কি তখন একখানি 'প্যামফ্লেট নভেল' রচনার কথা ভাবছিলেন। কিন্তু এই বিপ্লবী দলের এক সদস্য ইভান ইভানভ হঠাৎ খুন হয়ে যাওয়ায় দস্তয়েভ্‌স্কি অত্যন্ত বিচলিত হয়ে পড়েন এবং তাঁর 'প্যামফ্লেট নভেল' তথা পুরোদস্তুর রাজনৈতিক উপন্যাস রচনার পরিকল্পনাটিকে বাতিল করে দেন। স্বাক্ষরকে লেখা এক চিঠিতে দস্তয়েভ্‌স্কি জানান যে, জ্যাকোগিনকে কেন্দ্রীয় চরিত্র করে বিশুদ্ধ 'প্যামফ্লেট নভেলে'র বদলে তিনি এবারে অন্য ভাবধারার কোনও উপন্যাস রচনা করবেন। তাই তাঁর উপন্যাসের মুখ্য চরিত্রটি সেভাবে কোনও রাজনৈতিক ব্যক্তিত্ব হবেন না। হয়ত এ জন্যই 'দানবেরা' উপন্যাসের নায়ক পিয়োর স্তেপানোভিচকে না ভেবে নিকোলাই জ্যাকোগিনকে বেছে নিয়েছিলেন দস্তয়েভ্‌স্কি, যাকে একজন নিষ্ক্রিয় রাজনৈতিক কর্মী ও দুরাচারী বলাই সম্ভব। হয়ত তিনি এরকম ভেবেছিলেন বলেই তাঁর পূর্ববর্তী উপন্যাস 'আহাম্বক (The Idiot)' ও পূর্বপরিকল্পিত 'নাস্তিক্যবাদ (Atheism)' ও 'এক মহাপাতকের কাহিনী (The story of a great Sinner)' উপন্যাসের ভাববস্তুকে এই নতুন উপন্যাসটির মধ্যে গ্রহণ করেছিলেন।

এতদসত্ত্বেও 'দানবেরা' উপন্যাসটিতে রাজনীতির আবর্তচক্র ছিলই। যে জ্বলজ্বালন্ত রাজনৈতিক হত্যাকে অবলম্বন করে উপন্যাসটি রচিত হয়েছিল, তার ঐতিহাসিক ও সমাজতাত্ত্বিক গুরুত্ব রাশিয়ায় ছিল অপরিসীম। বামপন্থী বিপ্লবী দলের সদস্য ইভানভ ১৮৬৯ খ্রিস্টাব্দে মস্কোয় খুন হয়েছিলেন। ইভানভ ছিলেন একজন তরুণ ছাত্র। তাঁর দলেরই চার সদস্য তাঁকে খুন করেছিলেন। তাঁদের সন্দেহ ছিল যে, ইভানভ তাঁদের রাজনৈতিক কর্মকাণ্ডের খবরাখবর সরকারী কর্তৃপক্ষের কাছে পাচার করে দিচ্ছেন। যে চারজন ইভানভকে খুন করেছিলেন, তাঁদের নেতৃত্ব দিয়েছিলেন সেগেই নেচায়োভ। তিনি

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## দস্তেইভ্‌স্কির ভয়ঙ্কর দানবেরা ওরহান পামুক

আমার মতে দানবেরা (Demons) পৃথিবীর সর্বকালের সেরা একখানি রাজনৈতিক উপন্যাস। বইটি প্রথম যখন পড়ি, তখন আমার বয়স ছিল কুড়ি। বইটির প্রভাব সম্পর্কে আমি এটাই বলতে পরি যে, বইটি পড়ে আমি বিমূঢ়, বিস্মিত ও আতঙ্কিত হয়ে পড়েছিলুম এবং বইটির গুরুত্ব অনুধাবন করতে পেরেছিলুম। অন্য কোনও উপন্যাস তখন আমাকে এত গভীরভাবে আলোড়িত করে নি, অন্য কোনও কাহিনী মানবজাতির যন্ত্রণাদীর্ণ অভিজ্ঞতার সঙ্গে এভাবে আমাকে পরিচয় করিয়ে দেয়নি। ক্ষমতার জন্যে মানুষের উদ্দীবতা, অনোর প্রতি ক্ষমাশীলতা, নিজেকে ও অন্যকে প্রবঞ্চিত করার সামর্থ্য, যুগের প্রতি অনুরক্তি, বিশ্বাসের জন্যে প্রয়োজন বোধ, পবিত্র ও অপবিত্র বিষয়গুলোর প্রতি আকর্ষণ : এ সমস্ত কিছুই যা আমাকে আহত করেছিল তা এই যে, দস্তেইভ্‌স্কি এই গণতান্ত্রিক সংমিশ্রিতভাবে এবং রাজনীতি, প্রতারণা ও মৃত্যুর সাধারণ তালগোল পাকানো বৃক্সে হিত দেখতে পেয়েছিলেন। নিজের সর্বাতিশায়ী প্রজ্ঞা যে দ্রুততার এ উপন্যাসটি আমাদের মধ্যে ছড়িয়ে দিয়েছিল, আমি সেটির প্রশংসা করেছিলুম। সাহিত্যের এটাই হরত প্রাথমিক গুণ : মহৎ উপন্যাসগুলো দ্রুত আমাদের একটা ঘোরের ভেতরে টেনে নেয়, সেই একই দ্রুততায় তাদের নায়কেরাও ধাক্কিত হয় নানা জটিল বিষয়ের আবর্তে। আমি দস্তেইভ্‌স্কি র ভবিষ্যৎদ্রষ্টাসুলভ কঠখরে যে আগ্রহ নিয়ে আস্থা রাখতুম, সেই আগ্রহ নিয়েই আস্থা রাখতুম তাঁর চরিত্রগুলোর উপরে, তাদের স্বীকায়োক্তির নেশাগ্রস্ততাকে।

বইটি আমার চিন্তে কেন অতো জীতির সঞ্চার করেছিল, তা নির্ণয় করা ছিল বেশ কঠিন। আঘাতের দৃশ্যটিতে (মোমবাতি নিভে যাওয়া এবং অন্ধকারে পাশের ঘরের দৃশ্যমান অন্যান্য নানা ঘটনার সমাবেশে) এবং আতঙ্কসঞ্জাত বসন্তলবী হত্যাকাণ্ডের হিংস্রতার বিশেষভাবে বিচলিত হয়েছিলুম আমি। যে গতিতে উপন্যাসের নায়কেরা তাদের গভীর ভাবনা ও ক্ষুদ্র আঞ্চলিক জীবনযাত্রার মধ্যে চলাচল করছিল এবং যে সাহসিকতা দস্তেইভ্‌স্কি তাদের মধ্যে লক্ষ্য না করে নিজের মধ্যেই লক্ষ্য করছিলেন, সে ব্যাপারটিই সম্ভবত আমাকে নাড়া দিয়েছিল। এ উপন্যাসটি যখন আমরা পাঠ করি মনে হয় যেন, প্রাত্যহিক জীবনের ক্ষুদ্রাতিক্ষুদ্র ঘটনাগুলোও চরিত্রগুলির গভীর ভাবনার সঙ্গে বাঁধা পড়ে গিয়েছে এবং এ ধরনের সম্পর্ক দেখে আমরা বাতুলগ্রস্তদের সেই ভয় ধরানো

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উপন্যাস এই 'দানবেরা'। বিশেষ করে জীড়ের বর্ণনার দস্তেইভুস্কি এ উপন্যাসে একজন নক সাটারারিস্ট হয়ে উঠেছেন। কারমাকিনোভ চরিত্রটির মধ্যে দস্তেইভুস্কি তুগেনিভের একটি শীতল রূপ খুঁজিয়ে তুলেছেন। কারণ ব্যক্তিগত জীবনে তুগেনিভের প্রতি তিনি যুগপৎ ঘৃণা ও ভালোবাসা অনুভব করতেন। একজন ধনাঢ্য ভূমিদার হিসেবে তুগেনিভ নিহিলাস্টদের ও পশ্চিমী অনুকারকদের প্রশ্রয় দিতেন এবং রূশ সংস্কৃতিকে অলঙ্কর করতেন (দস্তেইভুস্কির এমনটাই মন হতো)। দানবেরা কতকংশে ছিল তাঁর রচিত এমন একখানি উপন্যাস যা (তুগেনিভের) কাব্যরস অ্যাণ্ড সল-এর সঙ্গে তর্ক জুড়তে চায়।

বামপন্থী উপায়বানী এবং পশ্চিমীমনস্কদের প্রতি দস্তেইভুস্কি রুষ্ট থাকলেও, যেহেতু তাঁদের তিনি নিবিত্তভাবে চিনতেন, তাই নানা সময়ে মমতাত্তরে তাঁদের নিয়ে আলোচনা না করে থাকতে পারতেন না। রুশ কৃষকদের নিয়ে চিরদিনই তিনি যেমন যত্ন দেখেন সেদিকমতোই স্ত্রোপান ভ্রমোভিচের পরিণতি এবং তার সাফল্য উপন্যাসে তিনি ব্যক্তি করে দিয়েছিলেন এবং তা করেছিলেন এমন মর্মস্পর্শী কাব্যময়তার সঙ্গে যে, বহু উপন্যাসে ওই মানুষটির ভাবভঙ্গীর প্রতি উপহাস করে গেছেন যে পাঠক, তিনিও এ কাব্যটির প্রশংসা না করে পারেন নি।

এক দিক থেকে 'দানবেরা'-কে চরম পাশ্চাত্যপন্থী বিপ্লবী বুদ্ধিজীবীদের প্রতি দস্তেইভুস্কির একধরনের বিদায় বার্তা হিসেবে দেখা যেতে পারে। তিনি যেন সেই বুদ্ধিজীবীদের তাঁদের আবেগ-তাড়না, আশ্রিত্য আর ভয়ঙ্করের মধ্যে নিশ্চিত্তে ছুঁতে পারেনি।

চিরদিনই 'দানবেরা'-কে আমি সেই রকম একখানি খই হিসেবে দেখেছি, যা বলহীন সত্যের ঘোষক, বাক্য ব্যাভিধান বুদ্ধিজীবীরা (বীরা ইউরোপের মূল কেন্দ্র থেকে বহু দূর পশ্চিমী যাত্রের সঙ্গে লড়াই করছেন এবং ইশ্বর সম্পর্কে অবিশ্বাসী হয়ে এক-ঘরে হয়ে পড়েছেন) আমাদের কাছে গোপন করতে চান।

অনুবাদ: উদয়শঙ্কর বর্মা

## একজন হাস্যাস্পদ মানুষের স্বপ্ন

দস্তয়েভস্কি

আমি একজন হাস্যাস্পদ মানুষ। আজকাল লোক আমাকে পাগল বলে। যদি তা না হলে আমি ওদের চোখে আগের মতোই হাস্যাস্পদ হয়ে থাকতুম, তাহলে সেটা আমার পক্ষে এক ধরনের পদোন্নতি হিসেবে গণ্য হতো। কিন্তু ও নিয়ে আর আমার কোনও ফোভ নেই। ওরা সকলেই এখন আমার প্রিয়। এমনকি যখন ওরা আমাকে নিয়ে হাসাহাসি করে, তখনও ওরা আমার বিশেষ আপন হয়ে ওঠে। আলাপ কোনও ব্যক্তি হিসেবে নয়, ওদের প্রতি আমার ভালোবাসার মতো দিয়ে ওদের হাস্যোচ্ছলতার আমিও যোগদান করতে পারি, যদি না ওদের দিকে তাকিয়ে খুব বিমর্ষ বোধ করি। হ্যাঁ, বিমর্ষ। কেননা, সত্য কী, সেটা ওরা জানে না। অথচ আমি তা জানি। হায়, একমাত্র সেই ব্যক্তিটি হয়ে ওঠা কী নির্মম, সত্য কী, তা যে জানে। কিন্তু ওরা সেটা বুঝতে পারবে না। না, না ওরা সেটা বুঝতে পারবে না।

আমাকে হাস্যাস্পদ লাগত বলে আগে আমি খুব ভয়ে ভয়ে থাকতুম। আমাকে যে শুধু ওরকম লাগত তাই না, আসলে ওরকমই তো ছিলাম। সব সময়ই আমি হাস্যাস্পদ ছিলাম আর আমি তা জানতুম, সম্ভবত জন্মাবধিই জানতুম। মোটামুটি সাত বছর বয়স থেকেই জানতুম যে, আমি হাস্যাস্পদ। তারপর স্কুলে ভর্তি হলাম, বিশ্ববিদ্যালয়ে পড়াশুনা করলুম, আর আপনারা জানেন, যত বেশি পড়াশুনা করলুম, ততো বেশি করে বুঝতে পারলুম যে, আমি হাস্যাস্পদ। শেষ পর্যায়ে এমন হলো যে, বিশ্ববিদ্যালয়ে যতটুকু জ্ঞান আহরণ করলুম, যত বেশি তার পতীরে প্রবেশ করলুম, ততই বিশ্ববিদ্যালয়ের সেই আহৃত জ্ঞানের অভাব হয়ে উঠল এটা প্রমাণিত করা যে, আমি হাস্যাস্পদ। জ্ঞানের দিক থেকে যা অর্জন করলুম জীবনের ক্ষেত্রেও তাই ঘটলো। ফলে পরবর্তী বছরগুলিতে ওই চেতনাটিই আমার মধ্যে পরিপুষ্ট হলো এবং আমার ভিতরে এই ধারণাটিকে প্রবল করে তুলল যে, সব দিক থেকেই আমার চেহারাটি হাস্য উদ্বেককারী। সবাই আমাকে উপহাস করত এবং তা করত সব সময়। কিন্তু ওদের একজনও জানত না বা ভাবতেও পারত না যে, পৃথিবীতে অন্য সকলের বাইরে আর একজনও যদি কেউ জানত যে, আমি হাস্যাস্পদ, সেই মানুষটি আমি নিজেই। কিন্তু আমার প্রবলতম ফোভ এটাই যে, সেটা ওরা জানত না। তবে এর জন্য আমি নিজেও দায়ী ছিলাম। কারণ, আমি এত দান্তিক ছিলাম যে, কোনও কারণেই কখনও কারও কাছে সেটা (আমার নিজেকে জানার ব্যাপারটা) স্বীকার করিনি। এই দস্ত অনেক বছর ধরে আমার ভিতরে গড়ে উঠেছিল। আর যদি তেমনটা ঘটত অর্থাৎ আদৌ যদি এক মুগাহেরা

আজ্ঞা, স্বপ্ন কাকে বলে? আরে আমাদের জীবনটাই কি একটা স্বপ্ন নয়? এর পরেও আমি বলব: ধরে নাও, স্বপ্নটি কখনই সত্য হয়ে উঠবে না এবং স্বর্গেরিও কোনও অস্তিত্ব নেই (আমি নিজেও তা বুঝতে পারি!), কিন্তু তাতেও নিরবিচ্ছিন্নভাবে আমার উপদেশ চলতেই থাকবে। আর এসব সত্ত্বও সহজ ব্যাপার এটাই: একদিনে, এক ঘণ্টার ভিতরে মৃত্যুভয়ে মধো যা কিছু প্রয়োজনীয় তাকে তৈরি করে নেওয়া যায়। কেননা মূল কথা হো এটাই: নিজেকে যেমন ভালোবাসো, তেমন করেই ভালোবাসো অন্যকেও। এটাই মূল ব্যাপার, এটাই সব, এ ছাড়া অন্য কিছুই প্রয়োজন নেই: কীভাবে সে সব তৈরি করা সম্ভব শিখিয়ে তুমি তা দেখতে পাবে। জীবনের চিরকালীন সত্য এটাই। এর আগে লক্ষ লক্ষ বার অনেক তা বলেও গিয়েছেন। কেবল সেটি আমাদের জীবনের অংশ হয়ে ওঠে নি, এই না! জীবনের থেকেও জীবনের চেতনা বড়, সুখের থেকেও সুখের নিয়মকানূনের জ্ঞান বড়। এ সবের জন্য সবাইকেই লড়তে হবে। আমিও লড়ব। ইচ্ছে করলেই পৃথিবীর যে কেই মৃত্যুর মধো এগুলোকে আয়ত্ত করতে পারবে।

আর সেই যে ছোট্ট মেয়েটা, তাকে আমি খুঁজে পেয়েছি... এবার তার কাছে যাব আমি, নিশ্চয়ই যাব!

The dream of a ridiculous man

অনুবাদ : উদয়শঙ্কর বর্মা



## The Dynamics of Place and Space in the Mountain Village of Sillarygaon in Kalimpong District, West Bengal

SOMDIP PAUL GUHA AND KALINDI BHATTACHARYA

Department of Anthropology, Duttanagar College, Kolkata

**Abstract:** The present paper is an outcome of a fieldwork conducted in a multiethnic mountain village of Sillarygaon, district Kalimpong, West Bengal, India. The strategic location of the village facing the picturesque Kanchenjunga range has opened up a new avenue of livelihood in form of tourism for the residents of the village. Most of the resident families (51-59%) have constructed 'Homestay' which is a new form of staying place for the tourists. This staying place for the tourists has led to creation of an 'Inscribed Space', controlled by social and economic capital which has a considerable impact on the material life of the locally settled communities. However, the communities have continuously kept on trying to sustain their tradition, be it in terms of material, social or supernatural realms of everyday life and thereby reproducing the sense of proxemics which has its imprint written over the entire community landscape.

**Key words:** Homestay, Place, Space, Capital, Proxemics, Sillarygaon, West Bengal

### INTRODUCTION

The concept of 'Place' and 'Space' is most significant in the production of culture across societies and communities around the globe. De Certeau (1984) has stated that "space is a practised place" where historically and culturally situated people create a locality of familiar 'here' and 'there' in the same way as the speakers act out language system in creation of vernacular meanings. 'Place Making' in terms of dwelling unit represents "ethnography of locality" which in Cohen's term is "an account of how people experience and express their difference from others" and the "way in which people express their attachment to a locality" (Cohen 1982: 2-3). Cohen's focus was on the social relations between people and groups that make up the local population. 'Locality' and 'Place' tend to be treated as passive settings for relational matrix among people (Rodman 1992: 640-641, 643). In recent years, a growing number of ethnographers and geographers are interested to understanding the process of place making by examining the way people create place from their attachments and simultaneously definition of the self (Basso, 1996; Bender, 1993; Feld and Basso, 1996; Rodman, 1992).

'Inscribed Space' has its focus on the fundamental relationship between the humans and the environment they occupy. It implies the way humans write in an enduring way about their presence in their surroundings (Low and Zuniga, 2003). Anthropologists over the years have contributed in documenting the way people form meaningful relationships with the localities they occupy; the way humans attach relational meaning to space with different

Amali Mishra  
Anagabamik



## European Journal of Physics

PAPER

# Insights from intracules and Coulomb holes

Golam Ali Sekh<sup>1</sup> , Benoy Talukdar<sup>2</sup>  and  
Supriya Chatterjee<sup>3</sup> 

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# A response adaptive design for ordinal categorical responses weighing the cumulative odds ratios

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## ABSTRACT

Weighing the cumulative odds ratios suitably, a two treatment response adaptive design for phase III clinical trial is proposed for ordinal categorical responses. Properties of the proposed design are investigated theoretically as well as empirically. Applicability of the design is further verified using a data pertaining to a real clinical trial with trauma patients, where the responses are observed in an ordinal categorical scale.

## ARTICLE HISTORY

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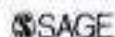
Response adaptive design;  
ordinal categorical  
responses; cumulative odds  
ratio

## 1. Introduction

A clinical trial is a large-scale experimentation with human patients to answer relevant health-related questions. Among the four phases of a clinical trial, phase III is very crucial, where entering subjects are randomized to different treatments under consideration. However, assignment of an incoming subject is a trade off between individual and collective ethics [1], where individual ethics refers to maximizing the benefit of each individual patient and collective ethics is concerned with maximizing the benefit of entire patient group to be treated. Naturally, the former demands more assignment of patients to the better treatment eventually whereas the latter requires detection of a significant treatment effect with higher precision. Complete randomization (CR), where the treatments are assigned to equal fractions of patients, is often the popular choice, but only takes care of the collective ethics. On the other hand, maintaining individual ethics requires knowledge of treatment effects. But treatment effectiveness is never known in advance and therefore, data driven randomization, where the allocation strategy is updated dynamically based on the available data, is a way to balance between the requirements of individual and collective ethics. Response adaptive randomization (RAR) is a data driven procedure (see, e.g. the book length treatments of [1,2]), which uses the past allocation and response information of the patients and skews the allocation towards the better performing treatment. But response adaptive allocations, in general, sacrifice the power of a test of equality of treatment effects [3] and hence may provide a safeguard to the individual but compromises a little in terms of collective ethics.

# Autoethnography of an Anthropology Fieldworker in Two Housing Complexes in the City of Kolkata in India: A Semiotic Study on Anthropology of Space

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Sankha Priya Guha<sup>1</sup>

## Abstract

The following paper is an outcome of a research project conducted on "Anthropology of Space" in two housing complexes in the city of Kolkata in India. I am to present my write up in two different contexts: the first one of which will include my fieldwork experience in an autoethnographic form in the studied complexes. One of the two is my own residential housing complex, while the other is new one for me. Majority of the residents of these complexes are the educated middle-class Bengali people, popularly and colloquially called *Muddiyabitta*. The second one will complement my fieldwork experience with theoretical discourse on "Anthropology of Space," the domain of the study. The collected information is thereafter analyzed using "semiotic cluster" and "semiotic chain" techniques. Finally, I will try to narrate the way, my fieldwork experience has led to the construction of an autoethnography in the studied complexes.

## Keywords

Autoethnography, space, semiotics, urban

## Introduction

### *Doing Anthropology in Housing Complex in a City*

City life of today is characterized by a new form of settlement, popularly called housing complex. The concept of housing, in its broadest sense, refers to

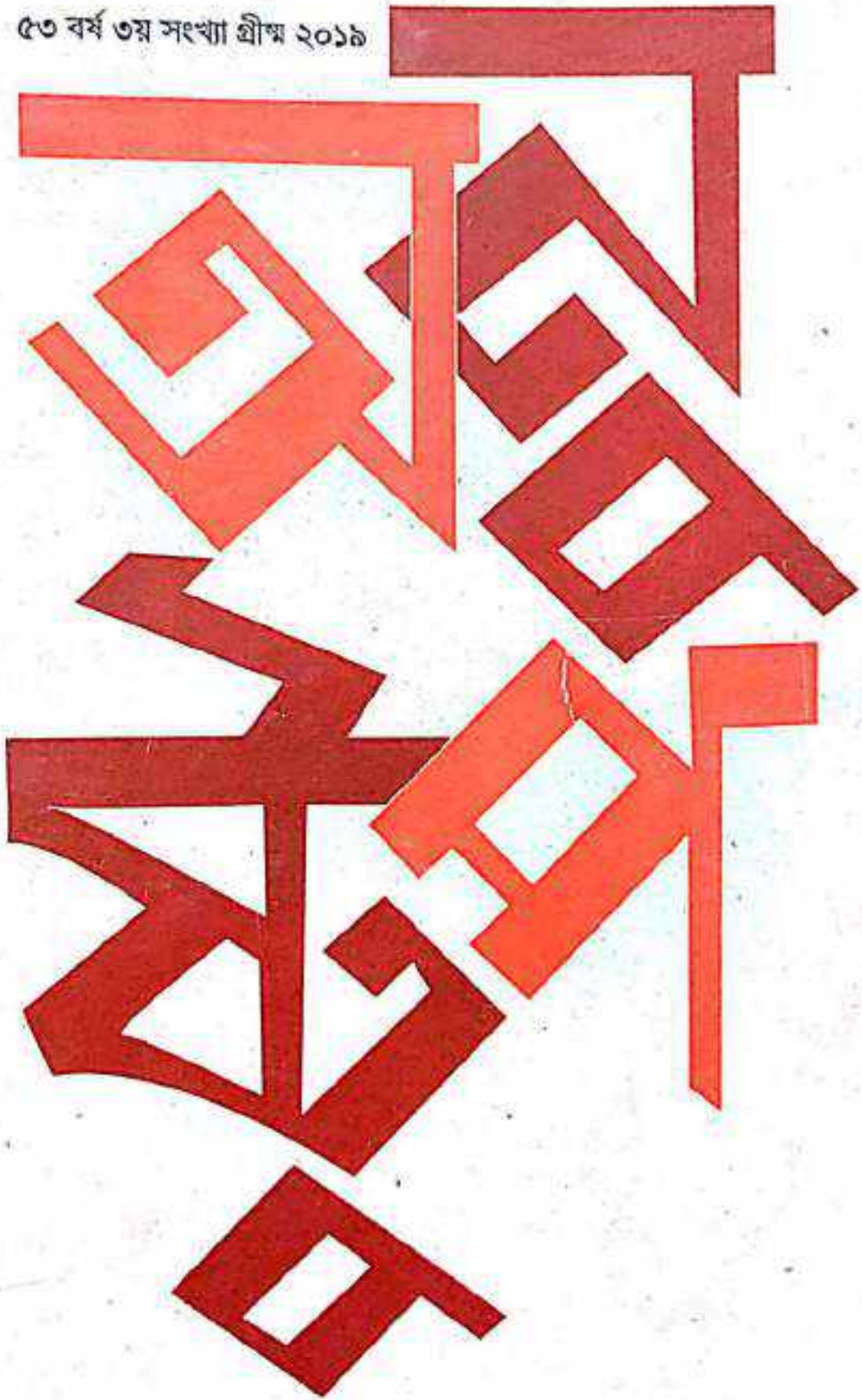
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সাহিত্য ও সংস্কৃতি বিষয়ক ত্রৈমাসিক পত্রিকা

৫৩ বর্ষ ৩য় সংখ্যা গ্রীষ্ম ২০১৯



একটি অশ্রুপতন/৪৮০, উদয়শংকর বর্মা: আধুনিকতাবাদী সমালোচক অশ্রুকুমার/  
৪৮৬, অলোক গোস্বামী: প্রসঙ্গ যখন খোদ নবীন যদু/৪৯৪, মধুময় পাল: অশ্রুদা, তাঁর  
বই এবং এক আশ্রয়বাসী/৫০২

অশ্রুকুমার সিকদার: গ্রন্থপঞ্জি এবং/৫১১

আপনকথায়-যাপনকথায়: অশ্রুকুমার সিকদার: জীবনপঞ্জি/৫৪৫

অতিথি সম্পাদকের নিবেদন/৫৪৯

### গ্রন্থ সমালোচনা

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## আধুনিকতাবাদী সমালোচক অশ্রুকুমার

উদয়শংকর বর্মা

বিশ শতকের দ্বিতীয়ার্ধের বাঙালি আধুনিকতাবাদী সমালোচকদের মধ্যে অশ্রুকুমার অগ্রগণ্য। কারণ, আধুনিকতার তত্ত্ব এবং প্রধানত বাংলা সাহিত্যে তার প্রকাশ নিয়ে অশ্রুকুমারের মতো সানুপুঙ্খ পর্যালোচনা আর কেউ করেননি। মূলত রবীন্দ্রনাথ ও রবীন্দ্রোত্তর যুগের সাহিত্য ও সমাজকে কেন্দ্র করেই তাঁর আধুনিকতার চর্চা অব্যাহত ছিল। কারণ, আমাদের সাহিত্যে আধুনিকতার সুস্পষ্ট রূপটি রবীন্দ্রোত্তর সাহিত্যেই বিকশিত হয়। কেউ কেউ যখন বলেন যে, কবি ভারতচন্দ্রের মৃত্যুতে বাংলা সাহিত্যে আধুনিক যুগের শুরু, তখন সেটা আমাদের দেশে উপনিবেশের পশুনকেই বোঝায়। আসলে যে মানদণ্ডেই বিচার করি-না কেন, ইউরোপে আধুনিকতার উদ্ভব যতটা পুরোনো, আমাদের এখানে তা নয়। ইউরোপে আধুনিকতার উন্মেষলগ্ন হিসেবে ষোলো শতকেই ধার্য করা হয়েছে। কেননা, ততদিনে ওখানে মুদ্রণযন্ত্রের প্রচলন হয়েছে ১৪৭৬-এ ইংল্যান্ডে মুদ্রণযন্ত্র প্রতিষ্ঠা হয়। এবং মেকিয়াভেলি, মণ্টেইন, শেকসপিয়ার, বেন জনসনের মতো লেখকেরা আবির্ভূত হয়েছেন। আর আমাদের এখানে তখনও নির্ভর করতে হচ্ছে হাতে লেখা পুথির উপরে। ফলে কবি মুকুন্দর সমাজচিত্রণেই তৃপ্ত থাকতে হচ্ছে আমাদের। যা-ই হোক, মার্শাল বার্ম্যান (Marshall Berman) ইউরোপের আধুনিকতাকে তিনটি পর্বে বিন্যস্ত করেছিলেন। তিনি প্রথম পর্বের সময়সীমা নির্ধারণ করেছিলেন, ষোলো শতক থেকে আঠারো শতকের প্রায় অন্তিম সময় পর্যন্ত, দ্বিতীয় পর্বের ফরাসি বিপ্লব (১৭৮৯) থেকে উনিশ শতক পর্যন্ত এবং তৃতীয় পর্বটিকে পুরো বিশ শতকের মধ্যে পরিকীর্ণ রেখেছিলেন। আধুনিকতার প্রথম পর্বে দুটি যুগান্তকারী আন্দোলন সংঘটিত হয়। যথা রিকর্মেশন আন্দোলন ও রেনেসাঁস আন্দোলন। আধুনিকতার উন্মেষে এই আন্দোলন দুটির ভূমিকা অপরিসীম।

# এবং মুশায়েরা

সাহিত্য ও সংস্কৃতি বিষয়ক ত্রৈমাসিক পত্রিকা

ষড়বিংশ বর্ষ □ ২য় ও ৩য় সংখ্যা

শ্রাবণ-আশ্বিন ১৪২৬ □ জুলাই-সেপ্টেম্বর ২০১৯

কার্তিক-পৌষ ১৪২৬ □ অক্টোবর-ডিসেম্বর ২০১৯

গদ্যকার সংখ্যা

সম্পাদক : সুবল সামন্ত

এবং  
মুশায়েরা

৩৮/এ/১, নবীনচন্দ্র দাস রোড, কলকাতা ৭০০০৯০

দূরভাষ : ২৫১০০৭৮৭ / ৯৪৩২২৫৪৩১৩

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দাম : তিনশত পঞ্চাশ টাকা

## সৈয়দ মুজতবা আলীর ফরাসি কথার তাকিয়া

উদয়শংকর বর্মা

সৈয়দ মুজতবা আলীর মজলিসী স্বভাব, রসবোধ ও পাণ্ডিত্য কোনও বাঙালি পাঠকেরই অজানা নয়। ধর্ম, ভাষাতত্ত্ব, রাজনীতি, দর্শন, ইতিহাস, সমাজতত্ত্ব ও সাহিত্য নিয়ে তাঁর কথকতা রমণীয় এবং প্রবাদপ্রতিম। শুধু পনেরোটি ভাবার পারদমতায় বা বিপুলা জ্ঞানের মাধুরী বৃত্তিতেই নয়, পাঠক চিন্তে সে জ্ঞান সঞ্চারিত করার ক্ষেত্রেও তিনি অদ্বিতীয়। কেননা আলী সাহেব পাঠককে কখনই তত্ত্ব বা তথ্যভারে ক্লিষ্ট করেন না। তাঁর কথার তাকিয়ায় সমাসীন পাঠক সর্বদাই নিঃসন্দেহে এক নৈসর্গিক আয়েস লাভ করেন। ফরাসি ভাষার কিছু শব্দ আলোচনা করতে গিয়ে তিনি নিজেই এই বিশেষ তাকিয়াটির কথা বলেছেন। তিনি সেখানে একটি ফার্সী শব্দবন্ধ ব্যবহার করেছেন। শব্দবন্ধটি হলো তাকিয়া-ই-ক্লাস। তিনি জানান যে, তাকিয়া-ই-ক্লাস মানে হচ্ছে কথার তাকিয়া অর্থাৎ যার উপর ভর করে কথাবার্তা আরাম পায় — জমে ওঠে। সন্দেহ নেই যে, এই কথার তাকিয়ায় আসীন হয়ে আসর জমাতে আলী সাহেবের তুলনা নেই। আর তা যদি হয় ফরাসি দেশ, ফরাসি ভাষা ও সাহিত্যের প্রসঙ্গ, তবে তো সোনায়ে সোহাগা।

যাকে বিধিবদ্ধ সমালোচনা বলে সেরকম কোনও আঁটসাঁট শৈলীতে সৈয়দ মুজতবা আলী কখনই উৎসাহিত বোধ করেছেন বলে মনে হয় না। কিন্তু বিধিবদ্ধ সমালোচনার যে সুফল তাকে সহজ সৌন্দর্যে আলী সাহেব তাঁর কথকতায় বিন্যস্ত করেছেন। গল্প বলুন, উপন্যাস বলুন, ভ্রমণকাহিনি বলুন, স্মৃতিকাহিনি বলুন, প্রবন্ধ বা রম্যরচনা যাই বলুন সর্বত্রই আয়েস করে আসর বসানোর ক্ষেত্রে তিনি যেন বাংলা গদ্যের মধ্যমণি। কথায় কথায় অনর্গলভাবে রবীন্দ্রনাথের কবিতা, সংস্কৃত শ্লোক, ফার্সী বয়েত, ইংরেজি, জার্মান, ফরাসি কবি সাহিত্যিক, দার্শনিকদের উচ্ছ্বল বাক্যমালায় পাঠকদের তিনি মুগ্ধ বিস্ময়ে জাগিয়ে রেখেছেন। সম্ভবত সংশ্লিষ্ট যাবতীয় ভাষা ও সংস্কৃতিগুলির প্রতি তাঁর গভীর অনুরাগ ও অনুসন্ধিৎসাই তাঁকে এই সাফল্য এনে দিয়েছে। আরবী, ফার্সী, ইংরেজি, জার্মান প্রভৃতি বিদেশি এবং বাংলা, হিন্দী, উর্দুর গা ঘেঁষাঘেঁষি করে ফরাসি ভাষা নিয়ে মুজতবা আলী কখনও সিরিয়াস ভঙ্গিতে, কখনও বা লঘুভাবে অনেক কথা বলেছেন। সেসবের মধ্যে তাঁর ভাষাজ্ঞান, চিন্তাশীলতা ও রসিকতার আভা ফুটে বেরিয়েছে। কখনও তিনি ফরাসি ভাষার বিশিষ্টতা ও গুরুত্ব নিয়ে মন্তব্য করেছেন। কখনও ফরাসি সাহিত্যিকদের নিয়ে তাঁর অভিজ্ঞতা, মতামত ব্যক্ত করেছেন। নিজস্ব ভঙ্গীতে তাঁদের মূল্যায়ন করেছেন। কখনও

## সমালোচক সত্যেন্দ্রনাথ রায়

উদয়শংকর বর্মা

রবীন্দ্রনাথের সাহিত্যতত্ত্ব, দর্শন, ধর্ম, ইতিহাস, শিক্ষা ও স্বদেশ ভাবনা; এককথায় রবীন্দ্রজীবনদর্শনের বিভিন্ন দিক নিয়ে আলোচনার সত্যেন্দ্রনাথ রায়ের উজ্জ্বল মনীষা প্রকাশিত হয়েছে। বঙ্কিমচন্দ্রের সমালোচনাসাহিত্যের বিশ্লেষণেও তাই। এমনকি বাংলা উপন্যাসের আধুনিকতা নিয়েও তিনি নতুন দৃষ্টিভঙ্গীর পরিচয় দিয়েছেন। এর পাশাপাশি তাঁর আলোচনার বৃত্তে রয়েছে এ যুগের ধর্মসংকট, বাংলা নাটক, গান ইত্যাদি। আছে পূর্বাচলের পানে তাকাই (২০০৬) নামে একখানি স্মৃতিকথাও। সুতরাং সত্যেন্দ্রনাথ রায়ের রচনাসম্ভারের ব্যাপকতা ও বিচিত্রতা অনুমেয়। কিন্তু আমাদের দুর্ভাগ্য এই যে, তাঁর রচিত এ গ্রন্থগুলির অধিকাংশই আর এখন সুলভ নয়, কিছু কিছু দুস্ত্রাপ্যও বটে। সে জন্যেই কিনা জানা নেই যে, ২০১৮ সালটি তাঁর জন্মের শতবর্ষ হওয়া সত্ত্বেও তাঁকে নিয়ে কোথাও একটি স্মরণলেখও প্রকাশিত হলো না! অথচ এ কালের এই অগ্রণী সমালোচককে বিস্মরণের আঁধারে পাঠিয়ে বাংলা সমালোচনা সাহিত্যের একটি গুণমানসম্পন্ন ঐতিহ্যকে কতটা রক্ষা করা গেল সে প্রশ্ন ওঠা অসঙ্গত নয়। অনেকটা সে কারণেই সত্যেন্দ্রনাথ রায়ের রচনা নিয়ে ক্ষুদ্র এ নিবন্ধের অবতারণা। বলাই বাহুল্য, সত্যেন্দ্রনাথ রায় সম্পর্কিত নিবন্ধে তাঁর বঙ্কিমচন্দ্র ও রবীন্দ্রসাহিত্যতত্ত্ব বীক্ষণের দিকটিকেই সূচনাবিন্দু হিসেবে মান্যতা দেওয়া হচ্ছে।

### বঙ্কিম ও রবীন্দ্রসাহিত্যতত্ত্ব

সমালোচক সত্যেন্দ্রনাথ রায়ের মূল অভিনিবেশের কেন্দ্র বঙ্কিমচন্দ্র ও রবীন্দ্রনাথের সাহিত্যতত্ত্ব ও সমালোচনা পদ্ধতি। এ নিয়ে বাংলা ভাষায় তিনিই যে প্রথম সবিস্তারে আলোচনা করেছেন, তা নয়। কেননা এর আগে ১৯৬০-এ বেরিয়েছিল সুবোধচন্দ্র সেনগুপ্তের 'বাংলা সমালোচনা পরিচয়' এবং ১৯৬৯-এ অসিতকুমার বন্দ্যোপাধ্যায়ের 'সাহিত্য জিজ্ঞাসায় রবীন্দ্রনাথ (প্রথম খণ্ড)' ইত্যাদি গ্রন্থ। কিন্তু নিঃসন্দেহে পূর্বসূরীদের বিচারপদ্ধতি ও উপস্থাপনরীতি থেকে সত্যেন্দ্রনাথ সম্পূর্ণ আলাদা পথ অবলম্বন করেছেন। সুবোধচন্দ্র তাঁর গ্রন্থে প্রথমেই প্রাচ্য ও পাশ্চাত্য সমালোচনার তুলনামূলক ইতিহাস ও উভয়ের স্বরূপ ব্যাখ্যান করেছিলেন। পরে বাংলা সমালোচনা সাহিত্যের ইতিহাস বর্ণনা করেছেন এবং সেই ইতিহাসের সূত্রেই বঙ্কিমচন্দ্র থেকে রবীন্দ্রনাথ প্রমুখ সাহিত্য এবং মুশায়েরা

# এবং মুশায়েরা

সাহিত্য ও সংস্কৃতি বিষয়ক ত্রৈমাসিক পত্রিকা

ষড়বিংশ বর্ষ □ ৪র্থ সংখ্যা

মাঘ-চৈত্র ১৪২৬ □ জানুয়ারি - মার্চ ২০২০

৮১

মার্টিন হাইডেগার বিশেষ সংখ্যা

সম্পাদক : সুবল সামন্ত

এবং  
মুশায়েরা

৩৮/এ/১, নবীনচন্দ্র দাস রোড, কলকাতা ৭০০০৯০

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দাম : চারশত টাকা

## হাইডেগারের কাব্য ভাবনা

উদয়শংকর বর্মা

অতি সংক্ষিপ্ত পরিসরে কয়েকটি মাত্র সূত্র-সম্বায়ে হাইডেগারের কাব্যভাবনার পরিচয় দেওয়া নিঃসন্দেহে খুব কঠিন। কারণ তাঁর অনুধ্যানমূলক (contemplative) কাব্যভাবনা সাহিত্যের আদর্শের চেয়ে দর্শনের ভাব্যকেই প্রাধান্য দিয়েছে। হাইডেগারের পূর্বদূরী অ্যারিস্টটল কিন্তু কাব্যতত্ত্ব রচনার সময় দর্শনকে সরিয়ে রেখে বিশুদ্ধ সাহিত্যাদর্শকেই প্রাধান্য দিয়েছিলেন। কবিতার বিষয় এবং অঙ্গিক উভয় দিক নিয়েই অ্যারিস্টটল আলোচনা করেছিলেন। কিন্তু হাইডেগার তা করেন নি। কবিতাকে তিনি অস্তিত্ব কিংবা সত্তার প্রকাশ ছাড়া অন্য কোনও রূপে দেখতে চান নি এবং সেই প্রকাশের শৈলী নিয়েও তাঁর কোনও মাথাব্যথা ছিল না। *সত্তা ও সময় (Being and Time)* গ্রন্থে হাইডেগার লিখেছেন যে, শব্দের মধ্যে এক ধরনের মৌল আবির্ভাবই কবিতা। এ ছাড়া কিছু নয়।<sup>১</sup> অর্থাৎ পৃথিবীতে সত্তা হিসেবে অস্তিত্বের উন্মোচনই কবিতা। অন্যত্রও তিনি বলেছিলেন যে, কবিতা বলতে প্রকৃতপক্ষে বোঝায় কারুর সত্তার জাগরণ ঘটানো বা শৃঙ্খলাবোধ তৈরি করা যার মাধ্যমে সেই ব্যক্তিটি তার স্থায় অস্তিত্বের ভূমিতে ফিরে যেতে পারে। হোল্ডারলিনের কবিতা নিয়ে আলোচনা করার সময় (*Hölderlin's Hymns Germania and the Rhine*) তিনি বলেছিলেন যে, হোল্ডারলিনের কবিতায় চিন্তাগর্ভ হৃদয় যখন সত্তার উন্মোচনের সময় প্রাধান্য লাভ করে তখনই হোল্ডারলিনের কবিতা কাব্যিকতা অর্জন করে।<sup>২</sup> অ্যারিস্টটল অবশ্য কবিতায় পেয়েছিলেন জগতের অনুকরণ; কবিতা সেখানে ছিল জগতের এক ধরনের প্রতিবিশ্ব। হাইডেগার সুস্পষ্টভাবে অ্যারিস্টটলের মাইমেসিস তত্ত্বের বিরোধিতা করেছিলেন।

বস্তুত দর্শনে হাইডেগার যে বীয়িং বা সত্তার মৌল সমস্যাটির উত্থাপন করেছিলেন, কবিতায়ও তারই প্রকাশ লক্ষ্য করেছেন। হাইডেগার সত্তাকে শুধু কালিক ও ঐতিহাসিক মনে করেন নি, সত্তাকে অস্তিত্বের প্রতিবিশ্ব মনে করেছেন। তাঁর মতে সত্তা অস্তিত্বশীল কোনও বিষয় বা বস্তু থেকে উদ্ভূত নয়, তা স্বয়ং অস্তিত্ব বা স্বয়ম্ভূ অস্তিত্ব (Being in itself)। হাইডেগার তাঁর এই অস্তিত্ব-ভাবনাটিকে তুলে ধরেছেন তাঁর *ডাসাইন (Dasein)* তত্ত্বে। এই তত্ত্ব অনুযায়ী মানুষই একমাত্র অস্তিত্বশীল। কারণ মানুষই একমাত্র নিজের অস্তিত্ব সম্পর্কে সচেতন, জড় পদার্থ বা অন্য প্রাণীরা নয়। তাই মনুষ্যতর প্রাণীর কোনও সত্তা থাকতে পারে না। বস্তুত অস্তিত্ববান হওয়া বা সত্তাশীল হওয়া মানে নিজেকে নিয়ে চিন্তা

# এবং মুশায়েরা

সাহিত্য ও সংস্কৃতি বিষয়ক ত্রৈমাসিক পত্রিকা

সপ্তবিংশ বর্ষ □ ১ম-২য় সংখ্যা

বৈশাখ - আষাঢ় ১৪২৭ □ এপ্রিল - জুন ২০২০

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৮২

শারদীয় ১৪২৭

সম্পাদক : সুবল সামন্ত

এবং  
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প্রচ্ছদ : গগনেন্দ্রনাথ ঠাকুর		

দাম : পাঁচশত টাকা

# ফরাসি সাহিত্যের ইতিহাস

উদয়শংকর বর্মা

আঠারো শতক

আলোকপ্রাপ্তির যুগ

পটভূমি

ইতিহাসের প্রেক্ষিত

সতেরো শতকের দ্বিতীয়ার্ধের ফরাসি সাহিত্যে রাজা, রাজপুরুষ ও রাজসভার ব্যাপক প্রভাব ছিল। ওই সাহিত্য একদিকে ছিল ধর্মকেন্দ্রিক অন্য দিকে ধ্রুপদী ঘরানার। আঠারো শতকের ফরাসি সাহিত্য ওই তিনটি প্রভাব থেকেই প্রায় বেগিয়ে এসেছিল। তবে নতুন ধারার এই সাহিত্য মহৎ শিল্পবোধের চেয়ে সমকালীন উগ্র মতবাদকে বেশি প্রশয় দিয়েছিল। সাহিত্যের বিষয় ও ভাবনাকে প্রভাবিত করেছিল নানা ধরনের রাজনৈতিক হিসেবনিকেশ, সমালোচনা, বিজ্ঞান ও সংশয়বাদী দার্শনিক চিন্তাধারাগুলি। বস্তুত ১৬৯৯ খ্রিস্টাব্দে রাসিনের মৃত্যুর পরই ফ্রান্সে নতুন সাহিত্য ও সমালোচনা-রীতির উদ্ভব হয়েছে। ঘনিষ্ঠে এসেছে সতেরো শতকের সমাপ্তি। ১৭০৪ খ্রিস্টাব্দে আতোয়ান গালোঁ ফরাসি ভাষায় সহস্র এক আরব্য রজনীর প্রথম চার খণ্ডের অনুবাদ প্রকাশ করেছিলেন। সম্ভবত আতোয়ান ওরাতোও এই সময়ই তাঁর বিখ্যাত চিত্রকর্মগুলি অঙ্কণ করেছিলেন।

লক্ষণীয় যে, আঠারো শতকের গোড়ায় ১৭১৫ খ্রিস্টাব্দের দিকে চতুর্দশ লুই মারা যাওয়ার বেশ আগে থেকেই ফ্রান্সের রাষ্ট্রীয় ব্যবস্থায় ভাঙন দেখা দিয়েছিল। যুদ্ধ, দুর্ভিক্ষ, রাষ্ট্রীয় ঋণ, রাজস্বের অস্বাভাবিক বৃদ্ধি ইত্যাদি সবই সত্রাটের মাহাত্ম্যকে ক্ষুণ্ণ করেছিল। নতের অনুশাসনের পুনঃপ্রবর্তন প্রটেস্টান্টদের পুনরায় দেশ থেকে বিতারনের ব্যবস্থা করেছিল। যে *পোর্ট রয়্যাল* নৈতিক বিশ্বাসের একটা আশ্রয়স্থল হয়ে উঠেছিল, তার বিনষ্টি ঘটেছিল। ইউজেনিটাস বুল অর্থাৎ পোপের অনুশাসন চার্চের আধ্যাত্মিক উপাদানগুলোকে ছাঁটাই করে ফেলেছিল। ইতিমধ্যে ইউরোপে বিজ্ঞানের লক্ষণীয় অগ্রগতি ঘটে গেছে। ফলে, ধর্মীয় শূন্যতার স্থানটিকে বিজ্ঞান দখল করে নিয়েছিল। ১৭১৫ খ্রিস্টাব্দে চতুর্দশ লুই মারা যাওয়ার পর ফ্রান্সের শাসনতন্ত্র ভেঙে পড়তে শুরু করেছিল। বস্তুত ১৭১৫ খ্রিস্টাব্দ থেকে ১৭২০ খ্রিস্টাব্দ পর্যন্ত অধ্যায়টি ছিল ছিল ফ্রান্সের কাছে একটা যুগসন্ধির কাল। কারণ ১৭১৫য় যখন পঞ্চদশ লুই (জন্ম ১৭১০ খ্রিস্টাব্দ) সত্রাটের পদে অভিষিক্ত হন, তখন তাঁর বয়স ছিল মাত্রই পাঁচ বছর। তাঁর তেরো বছর বয়স না হওয়া পর্যন্ত দেশ চালাতেন

এবং মুশায়েরা

৩৮৫



# Do Urinary Volatiles Carry Communicative Messages in Himalayan Snow Leopards [*Panthera uncia*, (Schreber, 1775)]?

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**Abstract.** Felids urinate and spray ‘Marking Fluid’ for territorial maintenance and to transmit messages of their reproductive status. The very rare Himalayan snow leopard also utilises these two primary modes for chemical communication. The present paper is the first report on the volatiles in urine of snow leopards which were analysed with the help of headspace solid phase micro extraction gas chromatography mass spectrometry. Chemical profiles revealed the presence of numerous low molecular weight compounds with different functional groups like alcohols, aldehydes, ketones, sulphur containing compounds. Many monoterpene alcohols, which are common secondary metabolites of plants, are abundant in the urine collected during the months of October to December, the typical reproductive season of the snow leopard in the Darjeeling hills of the Eastern Himalaya. 6-Methyl-5-hepten-2-one was identified from this felid which has a characteristic odour perceptible by the human nose. Among many sulphur containing compounds, Dimethyl disulfide and Dimethyl trisulfide were common in all urine samples of both sexes. Saturated, monounsaturated and polyunsaturated fatty acids were also identified from the lipid fraction of the urine which, in nature, may play an important role by increasing the durability of the volatiles.

## 1 Introduction

‘Chemical signals’ which regulate a variety of physiological phenomena in many felids are the primary mode of information transfer related to the reproductive behaviour of these carnivores. (Albone 1984; Brahmachary and Dutta 1981, 1984; Wyatt 2014). All cat species, in general, have two modes of pheromonal communication, ordinary Urination and the spraying of Marking Fluid (MF) (Brahmachary and Dutta 1979, 1984, 1987; Brahmachary 1996; Brahmachary and Poddar-Sarkar 2015; Poddar-Sarkar and Brahmachary 2014). Alongside visual, auditory and tactile cues, members of the cat family predominantly use these two behavioural modes to mark their territory and to



## REVIEW

### Study of Organization and Dynamics of Multi-Tryptophan Protein Molecules Utilizing Red Edge Excitation Shift Approach

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A shift in the fluorescence emission maxima with gradual increase in excitation wavelength is termed as red edge excitation shift (REES). Tryptophan residues are widely utilized as intrinsic fluorescence probe to investigate the protein structures. Wavelength selective tryptophan fluorescence can explore the dynamics of surrounded water molecules, the ubiquitous biological solvent. Thus REES experiment of various protein conformational states can provide significant input to the study of protein folding pathway and it can also be useful to study interaction of proteins with others. In this review article, we shall focus on red edge effect of various multi-tryptophan proteins in their respective native, intermediate and denatured state.

**Keywords:** Fluorescence, Multi-tryptophan protein, Red edge excitation shift, Red edge effect, Protein structure.

## INTRODUCTION

Proteins, the ubiquitous biological macromolecules, are workhorse of the living cell. They regulate numerous biological processes *in vivo* by acting as enzymes, antibodies, hormones, neurotransmitter, nutrient storage and many more. Polypeptide chains, build up from naturally occurring amino acids, fold into unique native structure of protein, in post translational period. Protein molecules are often organized in highly ordered conformation in the crowded milieu of the cell. These conformations show characteristic dynamic properties which enable the interaction of protein molecule with its counter parts and owes significantly to protein function [1]. Thus the interplay between structure and dynamics of protein molecules is crucial for its function. Crystallization and thereafter X-ray crystallographic diffraction analysis of many soluble proteins provides detailed and precise information about their structure [2]. But all these information about protein structure obtained from X-ray crystallography, are necessarily static in nature and can't give insight into the dynamic properties of protein molecules which is intricately related with its function [3]. Again in case of membrane proteins, we have lesser crystallographic information since

crystallization of the membrane proteins are extremely challenging [4]. Further, apart from its native form protein molecules can also exist in different conformations like molten globule, denatured or misfolded states depending on environmental demand. It is not often possible to characterize these states by crystallographic technique because of the transient nature of these non native states. In this context, spectroscopic techniques are very much appreciated because they can provide subtle information about the structure as well as organization and dynamics of protein molecules.

Fluorescence spectroscopy is a widely used technique for analysis of protein structure, dynamics and function because of its intrinsic sensitivity, suitable time scale, non-invasive nature and minimum perturbation [5]. Tryptophan, the essential amino acid, serves as the intrinsic fluorescence probe of protein molecules. Tryptophan fluorescence is widely used spectroscopic technique for extracting information about protein structure in solution. A shift in the emission maximum of fluorescence spectra towards higher wavelength due to shift of the excitation wavelength towards the red edge of the absorption spectrum, is termed as red edge excitation shift (REES) [5]. The study of REES is a novel approach of fluorescence spectroscopy to



## HEXAFLUOROISOPROPANOL-INDUCED SECONDARY STRUCTURE PERTURBATION OF SOYBEAN AGGLUTININ

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### ABSTRACT

Fluoroalcohols like 1,1,1,3,3,3-hexafluoroisopropanol (HFIP) are widely used as cosolvent along with the biological solvent water to perturb the native protein molecules. The non native states obtained are of immense importance in the field of protein structure and folding, since these states may be present in the protein folding pathway or in the off pathway which leads to amyloid formation. In this study, HFIP-induced structure perturbation at secondary level of the tetrameric legume lectin, soybean agglutinin (SBA) is examined by far-UV circular dichroism (CD) spectroscopy. Like other member of the legume lectin family, native SBA is also an all  $\beta$ -sheet protein. Analysis of the far-UV CD spectra shows formation of  $\alpha$ -helix rich conformations at the expense of native  $\beta$ -sheet in presence of higher concentration (50% or more) of HFIP. Visible aggregation is noticed at lower HFIP concentration ( $\sim$ 10%) which disappears at higher concentration of HFIP with concomitant induction of the  $\alpha$ -helical secondary structure. The results confirm about the helix propensity of amino acid sequence of SBA and helical intermediates may be involved in the early stage of its folding process.

**Keywords:** Solvent perturbation, Hexafluoroisopropanol, Lectin,  $\beta$ -Sheet,  $\alpha$ -Helix, Far-UV CD

### 1. INTRODUCTION

Perturbation of protein native structure is of paramount importance in the study of protein structure and folding. Non native states obtained by structure perturbation may resemble the 'folding intermediates' present in the folding pathway of a nascent polypeptide chain leading to the native functional protein [1] or these states may be representative of off pathway structures leading to protein aggregation and eventually amyloid formation [2, 3]. Alcohols and mostly fluoroalcohols are extensively used as cosolvent along with the biological solvent water to perturb the native proteins [4, 5]. 2,2,2-Trifluoroethanol (TFE) and 1,1,1,3,3,3-hexafluoroisopropanol (HFIP) are the two fluorinated alcohols used frequently for this purpose. Fluorinated alcohols tend to stabilize conformers with predominantly helix secondary structure as seen in case of various peptides and proteins [6-9]. Even proteins with natively  $\beta$ -sheet structure were also reported for high helical conformation in presence of fluoroalcohol [10-12]. In order to address the reasoning behind alcohol perturbation, the whole problem can be viewed as two parts. First, there occurs perturbation of native protein

structure and secondly, formation of a regular secondary structure mainly alpha helix. Disruption of the native structure happens because of decreasing hydrophobic effect in alcoholic medium [13]. But why does it adopt preferentially helical structure? Explicit answer to this question still remains unknown. Theoretical computational study using a two-dimensional lattice model indicates about weakening nonlocal hydrophobic contacts and strengthening local helical interactions [14]. Helix forming ability does not depend on exclusively on the property of added alcohol, but also on the intrinsic properties of a particular peptide or protein. So the amino acid sequence is also a determining factor [15, 16]. Lectins, an important protein family, are comprised of protein molecules which bind carbohydrates specifically and reversibly [17]. Lectins are oligomeric proteins and have been involved in various biological processes. Soybean Agglutinin (SBA) is a member of most extensively studied lectin sub-family – legume lectins. SBA is a GalNAc / Gal-specific tetrameric glycoprotein with one Man-9 oligomannose type chain per monomer [18]. Like all other lectins, SBA is also comprised of  $\beta$ -sheet component as the principal secondary structure



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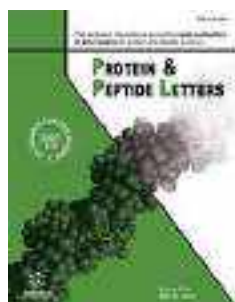
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General Review Article

## Solvent Perturbation of Protein Structures - A Review Study with Lectins

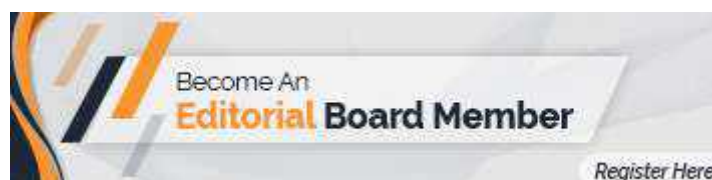
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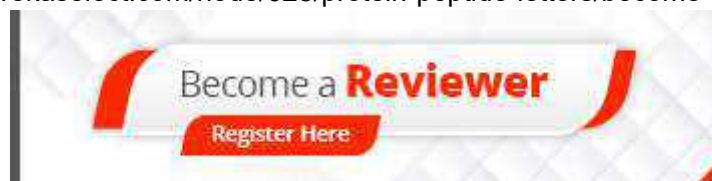
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## MEDIUM RING BENZOFUSED HETEROCYCLIC COMPOUNDS: RELEVANCE AND RECENT SYNTHETIC APPROACHES

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### ABSTRACT

Benzofused medium ring heterocycles find a wide range of application in pharmaceuticals and medicinal chemistry due to their binding capability with multiple receptors. Synthesis and exploration of these types of compounds will help researchers to discover biologically active compounds with a broad range of medicinal values.

**Keywords:** Heterocycles, Synthesis, Pd-catalyzed reactions, ring closing metathesis, radical cyclization

### 1. INTRODUCTION

The term 'medium size ring' introduced by Prelog and Brown [1] is usually applied to alicyclic compounds having a ring size in the range of 8 to 11. However, 7-membered and 12-membered rings are often included for comparison purpose. Benzofused medium ring heterocyclic compounds are worth our attention for many reasons; chief among them are their biological activities. More than 80 % of approved drug molecules contain a nitrogen heterocycle within their structure [2]. Almost all of these are easy-to-make 5-7 membered rings. Although medium-ring nitrogen heterocycles (containing 8–11 members) are present in biologically active natural products, they are absent from medicinally important structures. This is principally due to the difficulties associated with their synthesis. Efficient access to medium-sized rings remains a challenging goal in synthetic organic chemistry. The unfavorable entropy effect and transannular interactions are among the difficulties that have to be overcome in order to achieve such transformations. Therefore, organic chemists have been making extensive efforts to produce these heterocyclic compounds by developing new and efficient synthetic transformations.

Benzofused cyclic molecules incorporating at least one nitrogen atom in the structure are often referred to as "privileged structures" owing to their capability of binding to multiple receptors with high affinity [3]. Benzofused seven- or eight membered cyclic amines, named as benzazepines or benzazocines respectively, exhibit important pharmacological properties and are currently under intense scrutiny for their physiological

activity. For example, 1-benzazepine systems [4] have shown significant antimicrobial and analgesic activity. 2-Benzazepines have been reported [5] to be used as non-peptide mimics for the well-known tri-peptide sequence Arg-Gly-Asp (RGD), which interacts with  $\alpha v \beta 3$  integrin, a pivotal protein that plays a key role in cell-cell signaling and acts as its antagonist. 3-Benzazepines have inhibitory effect on reverse transcriptase [6]. 1-Benzazocine derivatives are described as CCR-5 antagonists and used against HIV infections and some other diseases also [7]. These cyclic amine moieties are present in many pharmaceutically active naturally occurring molecules, for example: i) Galanthamine (1) [8] isolated from *Galanthus woronowii* or *Galanthus nivalis* is one of the effective drugs for Alzheimer disease, the most common case of elderly dementia; ii) (+) –FR900482 (2) [9] isolated from *Streptomyces sandaensis* and acts as an anti-tumor antibiotic;. iii) (-) Pancracine (3) [10] isolated from *Rhodophiala bifida* of USA shows hypotensive and anticonvulsive activities. Lorcaserin (4), [11] a 3-benzazepine derivative, is a selective serotonin 5-HT<sub>2C</sub> receptor agonist for the treatment of obesity is recently synthesised. Besides cephalotaxine (5), [12] buflavine (6), [13] lycoramine (7), [14] chilenine (8), [15] and montanine (9) [16] are notable for their unique and synthetically challenging structures (Fig 1). Similarly a number of natural products endowed with diverse biological activities are found to incorporate oxygen heterocycles of varying ring sizes, linearly fused with aromatic moiety (Fig 1). Among them heliannuol A (10) belongs to a new group of phenolic allelochemicals.

# Supramolecular Interactions through Lone pair (lp)- $\pi$ and Anion- $\pi$ in Triple-Stranded Dihelicates of Copper (II) Involving Multiring Nitrogen-Heterocyclic Ligand: A Structural Study

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**Abstract:** Copper (II) complexes of redox-active bis-bidentate nitrogenous heterocyclic ligand, viz., 3,3'-dipyridin-2-yl[1,1']bi[imidazo[1,5-a]pyridinyl] (L), [Cu<sub>2</sub>(L)<sub>3</sub>](ClO<sub>4</sub>)<sub>4</sub>.3CH<sub>2</sub>Cl<sub>2</sub> (2), [Cu<sub>2</sub>(L)<sub>3</sub>](ClO<sub>4</sub>)<sub>4</sub>.2H<sub>2</sub>O (3) have been synthesized and characterized by single-crystal X-ray diffraction analysis. In the solid state, the compounds along with compound 1 [[Cu<sub>2</sub>(L)<sub>3</sub>](ClO<sub>4</sub>)<sub>4</sub>.3CH<sub>3</sub>CN] have triple stranded helical structures. Being  $\pi$ -electron deficient, the heteroaromatic ligand display moderate to strong interactions with perchlorate anions of the complexes as well as with lone pairs of electron rich molecules (solvent of crystallizations, namely, acetonitrile, dichloromethane, water). The structures also involve C<sub>arene</sub>-H---anion nonclassical hydrogen bonds. Interplay among such non covalent interactions help to shape the extended structures of the molecules in the solid state. Compounds 1 and 2 represents experimental proof for unprecedented type of lone-pair- $\pi$ - $\pi$ -anion interactions.

**IndexTerms -** Copper (II) triple helicate, Multiring nitrogen heterocyclic ligand, Non-covalent interactions

## I. INTRODUCTION

Non-covalent interactions involving  $\pi$ -systems have been extensively studied in recent years.<sup>1</sup> Such interactions play a crucial role in many frontline areas of contemporary science, from molecular biology to crystal engineering.<sup>2,3</sup> For example, face to face  $\pi$ -stacking interactions involving aryl rings of nucleobase pairs are important for the stability of DNA double helix.<sup>1,4</sup> The interactions between neutral molecule (e.g. Lewis base) and electron deficient aromatic nucleus have been demonstrated to play important roles in a number of chemical and biological systems.<sup>5</sup> For example, interactions between water and the aryl rings of nucleobase pairs help to stabilize RNA pseudoknots.<sup>5</sup> Such interactions are also important for the frame shifting activity of the pseudoknot.<sup>5b</sup> An electrostatic interaction between anionic species and  $\pi$ -system<sup>6</sup> has been overlooked until recently due to counterintuitive nature (anion- $\pi$  interaction is expected to be repulsive) of such interaction and has only emerged in the field of supramolecular chemistry since 2004 as a result of several favorable theoretical investigations.<sup>6,7</sup> Scientists have realized the importance of this type of interaction in the preparation of highly selective synthetic receptors for the recognition of anions with important biological and medicinal applications,<sup>6,8</sup> since more than 70% of enzyme substrate and cofactors are anions.<sup>9</sup>

Finally, the influence of different types of non-covalent forces are often difficult to measure in solution because only the time average of such interactions are normally observed in solution. The solid state structural analysis not only offers an opportunity to estimate the intermolecular forces of host-guest interactions in a static environment but also provide information about the size, shape, chirality and geometric deformations in such systems. These informations are important for the design of effective systems capable of recognizing cation, anion and neutral entities.

We have recently synthesized<sup>10,11</sup> a  $\pi$ -electron-deficient *N*-heterocyclic compound, viz., 3,3'-dipyridin-2-yl[1,1']bi[imidazo[1,5-a]pyridinyl] (L) containing a pair of biologically relevant<sup>12</sup> imidazo[1,5-a]pyridine moieties. The ligand L is redox-active and capable of acting as a bis-bidentate ligand, and its copper(II) compound (1) offers a unique example of valence tautomerism in solution.<sup>11</sup> Herein, we report the synthesis of two new triple stranded helicates of copper(II) with this ligand (2, 3) in two different solvent systems, also different from 1 to investigate the phenomena of lone-pair- $\pi$  interactions. This unique heteroaromatic ligand with its flexible backbone as well as electron deficient aromatic rings is capable of influencing the supramolecular structures of these helicates (1-3) through a variety of non-covalent interactions of viz.  $\pi$ - $\pi$ , anion- $\pi$  and solvent- $\pi$  types.



## Organic &amp; Supramolecular Chemistry

## Polycyclic Benzimidazole: Synthesis and Photophysical Properties

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Benzimidazole has tremendous application in medicinal chemistry and material science. The fusion of ring/substitution to benzimidazole nucleus produce polycyclic benzimidazole e.g., pyrido[1,2-*a*]benzimidazole, benzimidazo[1,2-*a*]quinoline, pyrrolo[1,2-*c*]benzimidazolequinones (PBIs) and benzimidazo[2,1-*a*]isoquinolines and these are the important synthetic strategies in drug discovery. Benzimidazole analogues have versatile therapeutic properties which encouraged the researchers to develop new therapeutic agents. Hence, the

synthetic literature survey towards the polycyclic benzimidazole is paramount important. Due to the beautiful fluorescent properties of fused benzimidazole moiety, they are also used in optoelectronics, optical lasers, and organic luminophores. In addition, this scaffold has broad applications in organometallic catalysis, co-ordination chemistry, and asymmetric catalysis. Herein, we report a vast synthetic route of benzimidazole embedded polyheterocycles in the last eight years and their photophysical application in the modern research field.

## 1. Introduction

*N*-containing heterocyclic compound like benzimidazole 4 (the combination of benzene and imidazole) is bicyclic in nature and was first reported by Hobrecker in 1872.<sup>[1]</sup> Its structural similarity with several naturally occurring nucleotides allows it to interact with the biological system (s). Generally, the condensation of *o*-phenylenediamine 1 and formic acid or trimethyl orthoformate 2 produced benzimidazole 3 in the laboratory (Scheme 1).



Scheme 1. General schematic path for the synthesis of benzimidazole.

Two nitrogen atoms present in the imidazole ring are different in character and make the properties of the ring system diverse in nature. Due to the tautomerization of N–H proton with the other nitrogen atom present in the ring, the C-2 position of benzimidazole is reactive towards electrophilic as well as nucleophilic substrate (Scheme 2).

## 1.1. Importance of benzimidazole unit

The compound has got tremendous attention due to various physiochemical and pharmaceutical properties such as anti-



Scheme 2. Tautomerization of benzimidazole

microbial, antiviral, antifungal, antiprotozoal, anticancer, anti-coagulant, antioxidant, antidiabetic, anti-inflammatory and antihypertensive activities.<sup>[2–4]</sup> Benzimidazole units are the core structure of a range of clinical medicines.<sup>[5]</sup>

Many drugs have been designed based upon benzimidazole core structure like lansoprazole<sup>[6]</sup> and pimobendan<sup>[7]</sup> which are act as therapeutic agents for proton pump inhibitor and congestive heart failure respectively. 2-substituted benzimidazole, albendazole has antiparasitic properties and is using in infections of tapeworms or other parasites.<sup>[8]</sup> The antifungal agent benomyl was first reported as a fungicide against a broad spectrum of agricultural fungal diseases and is using in plant cell and protoplast culture (Figure 1).<sup>[9]</sup> Later on, it has

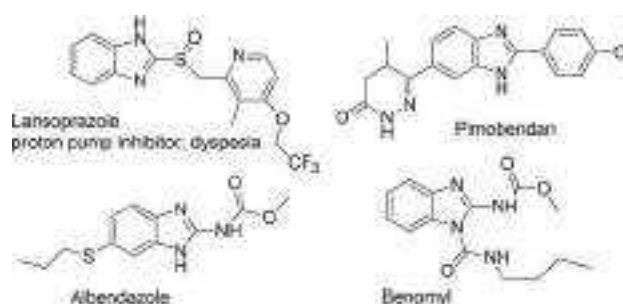


Figure 1. Marketed drugs containing benzimidazole core

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## Accepted Article

**Title:** Cu(I) catalyzed first example of decarboalkoxymethylation of alkyl 2-(1-(pyridin-2-yl)-1H-pyrrol-2-yl)acetates

**Authors:** Sk Asraf Ali, Anirban Bera, Susanta Kumar Manna, Subrata Santra, Mijanur Rahaman Molla, and Shubhankar Samanta

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## Cu(I) catalyzed first example of decarboalkoxymethylation of alkyl 2-(1-(pyridin-2-yl)-1H-pyrrol-2-yl)acetates

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### Abstract:

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Herein we report an unprecedented functional group assisted decarboalkoxymethylation (-CH<sub>2</sub>CO<sub>2</sub>R) of *N*-pyridinyl pyrrolo esters by using air stable and cheap copper (I) catalyst. 2-formyl substituent of pyrrole unit is the key isolated intermediate for this novel transformation. This methodology is quick and tolerates a wide range of functional groups in open flask conditions. This protocol provides a large array of tricyclic *N*-pyridinyl 2, 5 unsubstituted fused pyrrole derivatives with high yield (up to 92%).

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Towards the discovery of drugs, medicines, natural products and synthetic building block, many methods have been adopted by using various new molecules and the progress is going on by leaps and bounds. Among them, defunctionalization reactions have an fair share importance in chemical synthesis; especially for the preparation of simple organic motif from complex one.<sup>1</sup> High bond dissociation energy of C-C or C-X (X = heteroatom) bond possess a challenge in the selective removal of functional groups (FGs). Despite this challenge, a significant number of defunctionalization reactions (decarboxylation, decarbonylation, deoxygenation, dehalogenation, etc.) have successfully developed over the last couple of decades. This can be easier by metal catalyzed reaction,<sup>2</sup> where organometallic intermediate creates an electrophilic/nucleophilic center for further incorporation of another functionality.<sup>3</sup> There is a lot of example of decarboxylation of aromatic or heteroaromatic derivatives *via* copper catalyst with numerous ligand.<sup>4</sup> In the current era, metal-assisted de-esterification is considered as the growing field due to the



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# A solvent- and catalyst-free tandem reaction: synthesis, and photophysical and biological applications of isoindoloquinazolinones†

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An easy green synthetic approach for fused isoindoloquinazolinones has been developed under neat reaction (yields up to 91%) conditions. This new one-pot tandem methodology involves condensation of readily available anthranilamide with 3-(2-formylcycloalkenyl)-acrylic ester under solvent- and catalyst-free conditions. This strategy avoids the use of oxidant, and heavy metal catalysts and also is free from work-up and generation of toxic by-products. A dramatic change of photophysical properties of dihydroisoindoloquinazolinones in basic and aqueous media has also been documented in our study. Moreover, our model synthetic compound shows cytotoxic activity towards metastatic HepG2 and PC3 cancer cell lines.

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## Introduction

In recent years, one-pot tandem chemical transformations under metal- and solvent-free conditions have widely been used for complex organic molecule syntheses with reduced reaction time period and minimum energy requirement. A variety of chemical conversions, like oxidation, reduction, substitution, condensation, *etc.* have been developed using this principle.<sup>1</sup> Hence, heterocyclic ring formation using this green technique has been an active and attractive field in the recent era.<sup>2</sup>

Among the heterocyclic molecular architectures, *N*-fused heterocycles are ubiquitous in nature and a common structural motif for bioactive molecules and drug candidates. In particular, substituted quinazolinones have a wide range of biological and pharmacological activities, such as diuretic, anti-inflammatory, antidiabetic, anti-hepatitis C, anticonvulsant, antileishmanial, anticancer and so forth.<sup>3</sup> Two major types of fused quinazolinones available in nature are carbocycle fused quinazolinones, such as phaitanthrin, tryptanthrin, vasicione *etc.* (Fig. 1)<sup>4</sup> and heterocycle fused quinazolinones, like luotonin A and wuzhuyurutine A.<sup>5</sup> Quinazolinone molecular frameworks are also popular as efficient organic fluorescence materials.<sup>6</sup> Hence, development of a modern

synthetic strategy for fused quinazolinones and their applications in *in vitro* and *in vivo* bio-systems are highly needed.<sup>7</sup>

Different approaches have been reported in the literature to synthesize highly condensed quinazolinone derivatives.<sup>8</sup> Suzuki coupling followed by Pd/Cu catalysed oxidative C–H amination,<sup>9</sup> and tandem Sonogashira coupling and hydroamination cyclization<sup>10</sup> are the two independent approaches towards fused quinazolinone, where 2-bromobenzaldehyde and anthranilamide were taken as the starting materials. Another recent report involves ruthenium(II)-catalyzed one-pot oxidative C–H/N–H functionalization of substituted dihydroquinazolinones with alkynes.<sup>11</sup> Radical cyclization of *N*-(2-iodobenzyl)-*N*-acylcyanamides is another reported strategy to access fused pyrroloquinazolinone.<sup>12</sup> Li-Jiang Xuan and his group synthesized the same scaffolds *via* ruthenium-catalyzed oxidative coupling of 2-arylquinazolinones followed by an intramolecular aza-Michael reaction.<sup>13</sup> However, to the best of our knowledge, no attention has been devoted towards the synthesis of fused quinazolinones under metal- and solvent-free conditions. For eco-friendly reaction conditions, the chemical community always searches for green reactions under metal-free and solvent-free conditions. It is always better to perform the reaction in a non-hazardous solvent medium such as water, but it is also far better to run a reaction without any solvent, which reduces the steps in a multistep procedure *e.g.* work up and purification. As a part of our ongoing studies devoted towards the development of new heterocycles,<sup>14</sup> we have disclosed here an operatively simple, catalyst- and solvent-free synthesis of pyrrolo/isoindolo quinazolinone derivatives from 3-(2-formylcycloalkenyl)-acrylic ester derivatives **1** and anthranilamide **2** under heating conditions (120 °C) with moderate to good yields (Scheme 1). In addition, their photophysical properties have been studied, which are limited in the literature.

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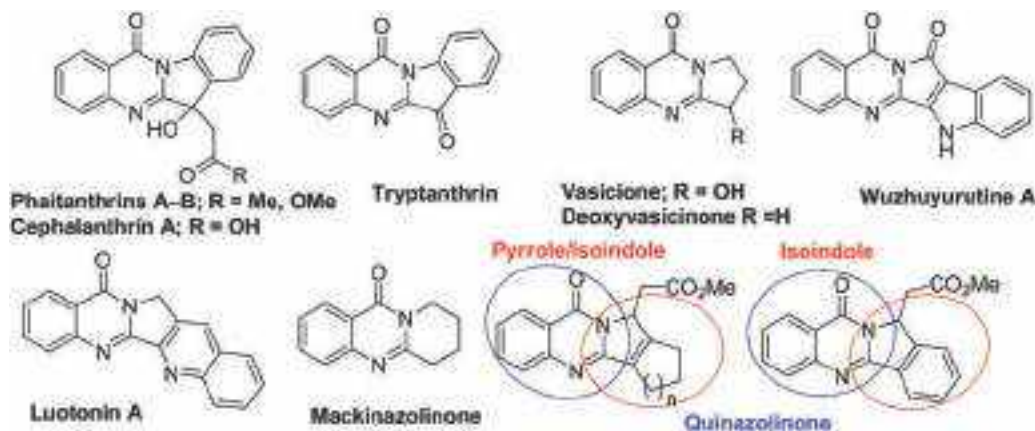
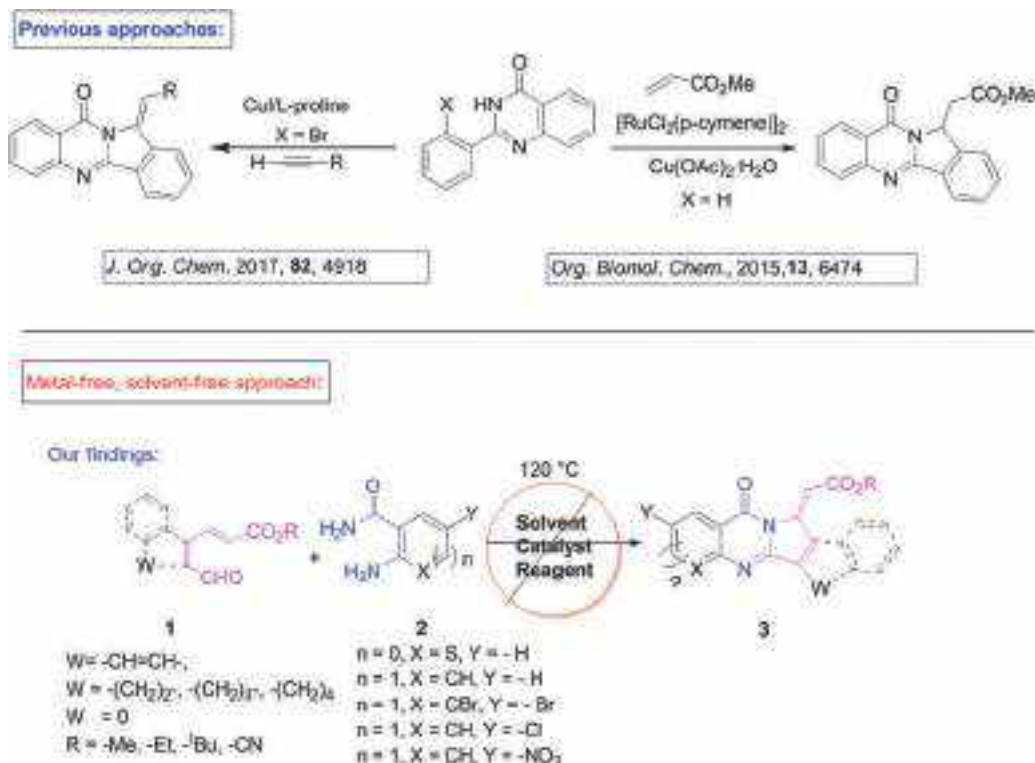


Fig. 1 Naturally occurring bioactive fused quinazolinone scaffolds.



Scheme 1 Previous approaches vs. the present approach towards polycyclic fused quinazolinone.

## Results and discussion

At the outset of this investigation to synthesize highly condensed fused quinazolinone derivatives **3**, the reaction was commenced with (*E*)-methyl 3-(2-formylphenyl)acrylate **1a** and anthranilamide **2a** in DMSO at room temperature, but no reaction occurred (Table 1; entry 1). However, the intermolecular condensation reaction followed by intramolecular aza-cyclization in one-pot succeeded by increasing the temperature up to 120 °C in DMSO (entry 4). It was found that cyclization was inefficient below 120 °C (entries 2 and 3). The two component coupling reaction proceeds satisfactorily in toluene and ethanol (entries 5 and 6). However, no fruitful product was isolated in acetonitrile, THF

and dioxane (entries 7–9). In order to increase the efficacy of our developed methodology, studies without any solvent were carried out and the desired fused quinazolinone **3a** was obtained in very good yield (91%), (entry 10).

With the optimal conditions in hand, the scope of the new two-component neat reaction was evaluated with a variety of substrates as shown in Table 2. Methyl/ethyl/tertiary butyl (*E*)-3-(2-formylphenyl)acrylates were smoothly converted to the corresponding isoindoloquinazolines **3a–3c** in moderate to high yields. The cyclised product **3b** was unambiguously confirmed by X-ray crystal structure as shown in Table 2.<sup>15</sup> With this encouraging result in hand, the scope of the neat reaction was examined with different cycloalkenyl derivatives. Formation of



## Synthesis and crystal structure of a mixed bridged trinuclear Ni(II) complex derived from a tridentate NNO donor Schiff base ligand

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A new trinuclear Ni(II) complex  $[\text{Ni}_3\text{L}_2(o\text{-}(\text{NO}_2)\text{C}_6\text{H}_4\text{COO})_2(\mu\text{-N}_3)_2(\text{CH}_3\text{OH})_2] \cdot 2\text{H}_2\text{O}$  (**1**) has been synthesized using a tridentate NNO donor Schiff base ligand, 1-[(3-dimethylamino-propylimino)-methyl]-naphthalen-2-ol (HL). Complex **1** has been characterized by X-ray crystallography, elemental analysis, IR and UV-Vis spectroscopy. Single crystal X-ray structure shows that complex **1** is a linear trinuclear Ni(II) complex containing  $\mu$ -phenoxido,  $\mu$ -azido and *syn-syn* *o*-nitrobenzoato bridges between the terminal and the central Ni(II) ions. Complex **1** is crystallized in the monoclinic sp. gr. *P*21/*c* with the unit cell parameters  $a = 12.246(5)$  Å,  $b = 14.683(5)$  Å,  $c = 17.688(5)$  Å, and  $\beta = 104.208(5)^\circ$ ,  $Z = 2$ . The terminally coordinated methanol molecule involves in hydrogen bonding through the hydrogen atom H(7) with the oxygen atom O(22) of the solvent water molecule.

Keywords: Synthesis, crystal structure, Schiff base, mixed bridged, Ni(II) complex.

### Introduction

Polynuclear nickel(II) complexes of tridentate NNO donor Schiff base ligands have received considerable attention due to their potential applications in the field of structural chemistry, biological systems, catalysis and magnetism<sup>1-4</sup>. These types of NNO donor Schiff base ligands along with various polyatomic anions ( $\text{N}_3^-$ ,  $\text{NO}_2^-$ ,  $\text{NO}_3^-$ ,  $\text{N}(\text{CN})_2^-$ ,  $\text{RCOO}^-$ ) are excellent combination to produce coordination polymers with structural diversity and interesting magnetic properties also<sup>4,5</sup>. It is difficult to predict the structures of such mixed bridged Ni(II) polynuclear complexes in which Schiff base and more than one polyatomic bridging moieties are present together. In such cases there are too many factors that should be taken into consideration. In contrast to the phenoxido bridged Ni(II) complexes, the metal ions that are connected via mixed bridging ligands are less studied systems<sup>6</sup>. In connection to the synthesis of mixed bridged complexes, both azide and carboxylate ligands deserve special mention due to their wide variety of coordination modes. Among them the most common bridging modes of azide are end-to-end ( $\mu\text{-N}_3$ , EE) and end-on ( $\mu\text{-N}_3$ , EO)<sup>7</sup>. In general, monodentate terminal and bidentate bridging modes of carboxylate ligands are mostly studied but sometimes it may be coordinated to the metal center in tridentate fashion<sup>8</sup>. Fur-

thermore, these bridging ligands (phenoxido, azido and carboxylato) may simultaneously exist in the same species, leading to interesting topologies and magnetic behaviors<sup>9,10</sup>.

Literature survey reveals that mixed bridged trinuclear Ni(II) complexes containing a tridentate Schiff base ligand along with carboxylate and azide groups are comparatively rare. It should be noted that Ghosh *et al.* previously reported a similar compound of Ni(II) with an NNO donor Schiff base ligand (HL') (2-[(3-dimethylamino-propylimino)-methyl]-phenol) in which the three Ni(II) centers are triply bridged by  $\mu$ -phenoxido,  $\mu$ -azido and *syn-syn* acetato bridges<sup>5</sup>. Herein, we report synthesis, crystal structure and spectral studies of a new linear trinuclear Ni(II) complex derived from a tridentate NNO donor Schiff base ligand along with  $\mu$ -azide and *syn-syn* *o*-nitrobenzoate as two bridging co-ligands.

### Experimental

#### Material:

The N,N-dimethyl-1,3-propanediamine and 2-hydroxy-1-naphthaldehyde were purchased from Lancaster Chemical Co. The chemicals were of reagent grade and used without further purification. *o*-Nitrobenzoate salt of nickel(II) was prepared by the reaction of nickel carbonate and *o*-nitrobenzoic acid in hot aqueous solution.



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# Synthesis, crystal structure, DFT calculations, protein interaction, anticancer potential and bromoperoxidase mimicking activity of oxidoalkoxidovanadium(v) complexes†

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The tridentate ONO donor ligand, dipicolinic acid (H<sub>2</sub>L), upon reaction with [V<sup>IV</sup>O(acac)<sub>2</sub>] in various alcoholic media (ROH = ethanol/*n*-propanol/*n*-butanol) yields a series of homologous water soluble mononuclear oxidoalkoxidovanadium(v) complexes **1–3** of general formula [VOL(OR)(H<sub>2</sub>O)] [R = Et (**1**), *n*-Pr (**2**), and *n*-Bu (**3**)]. All the synthesized complexes have been characterized by elemental analysis, various spectroscopic (IR, <sup>1</sup>H NMR, and UV-vis) techniques, cyclic voltammetry and TG/DT analysis. The molecular structures of complexes **1** and **2** are successfully established by the single-crystal X-ray diffraction technique. The vanadium centre occupies a distorted octahedral environment in the complexes. DFT calculations are carried out to estimate the bond parameters, non-covalent interactions and to obtain the frontier orbitals for complexes **1–3**. The binding interaction of the complexes with BSA protein is studied by employing spectroscopic methods (absorption, fluorimetric titration, and circular dichroism) and molecular docking. The water soluble complexes **1–3** can be employed as efficient anticancer agents against human breast adenocarcinoma (MCF-7) cancer cells. The bromoperoxidase (VHPO) activities of the complexes **1–3** have been demonstrated through their efficient catalytic performance in the oxidative bromination of thymol. Both the biological and catalytic activities of the complexes are found to show strong dependence on their molecular structures.

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## Introduction

The coordination chemistry of vanadium is appealing and has driven a considerable amount of research because of its

existence in various oxidation states from –3 to +5.<sup>1</sup> Under physiological conditions, *in vivo*, vanadium complexes are usually stable in their +4 and +5 oxidation states. In higher oxidation states, vanadium is highly oxophilic.<sup>2</sup> Among various transition metal complexes, the importance of vanadium chemistry is currently receiving considerable recognition owing to its diverse applications in biology and pharmacology.<sup>3</sup> This continuous upsurge of interest in vanadium is due to the important therapeutic role of vanadium as anticancer,<sup>4</sup> antimicrobial and antidiabetic agents.<sup>5</sup> Breast carcinoma is the most common malignant disease among women and is drawing significant concern. The prevention, diagnosis and treatment of cancer are equally important and demand great attention. Major discoveries regarding anticancer drugs are cases of serendipity or inhibition of the crucial metabolic pathways of cell division. Thus, the exact mechanism of action of a drug at the molecular level is challenging and a fertile field of research. The evolving paradigms of anticancer metallodrug development demonstrate the increasing importance of metal ions and their coordination chemistry. Knowledge regarding the molecular structure of compounds is important for understanding the structure–activity relationships (SARs) underlying their biological

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† Electronic supplementary information (ESI) available: Fig. S1–S9 contain photograph of single crystals of complex **1**, ESI-MS, IR, <sup>1</sup>H NMR, electronic spectra of all the complexes, TG–DT curves, frontier orbitals and CD spectra. Tables S1 and S2 contain the CD secondary structure estimation of BSA and results of molecular docking. CCDC 1893278 (**1**) and 1893279 (**2**). For ESI and crystallographic data in CIF or other electronic format see DOI: 10.1039/c9nj02471a

# Identifying the Direction of Behavioral Dependence in Two-Sample Capture-Recapture Study

Kiranmoy Chatterjee<sup>1</sup> and Diganta Mukherjee<sup>2</sup>

With the possibility of dependence between the sources in a capture-recapture type experiment, identification of the direction of such dependence in dual system of data collection is vital. This has a wide range of applications, including in the domains of public health, official statistics and social sciences. Owing to the insufficiency of data for analyzing a behavioral dependence model in dual system, our contribution lies in the construction of several strategies that can identify the direction of underlying dependence between the two lists in the dual system, that is, whether the two lists are positively or negatively dependent. Our proposed classification strategies would be quite appealing for improving the inference as evident from recent literature. Simulation studies are carried out to explore the comparative performance of the proposed strategies. Finally, applications on three real data sets from various fields are illustrated.

*Key words:* Classification; direction of behavioral dependence; human population; randomized rule; recapture probability.

## 1. Introduction and Motivation

Estimation of the size of a given population is an important statistical concern that has vast application in the field of public health, population studies and animal abundance. In practice, it is mostly impossible to count all the individuals in a population accurately by any attempt, especially when the population is large enough or very hard to reach. As a remedy, more than one attempt is carried out independently and the population size ( $N$ ) is estimated by matching the available (two or more) lists of information. This kind of data structure is known as a multiple-record system, which is equivalent to the capture-recapture system popularly relevant to abundance of animal population. However, in the context of a closed human population, use of more than two sources of information is uncommon in the official registration systems of most countries. When two attempts have been made to estimate the  $N$  in capture-recapture format, then the resulting data structure is known as a dual-record system (DRS), which is presented in [Table 1](#). Estimation of census coverage error ([Gerritse et al. 2017](#); [Chatterjee and Mukherjee 2016a](#)), epidemiological events ([Iñigo et al. 2003](#); [Granerod et al. 2013](#)), size of hard-to-count

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# On the estimation of population size from a dependent triple-record system

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**Summary.** Population size estimation based on a capture–recapture experiment under a triple-record system is an interesting problem in various fields including epidemiology and population studies. In many real life scenarios, there is inherent dependence between capture and recapture attempts. We propose a novel model that successfully incorporates the possible dependence and the associated parameters have nice interpretations. We provide estimation methodology for the population size and the associated model parameters based on the maximum likelihood method. The model proposed is applied to analyse real data sets from public health and census coverage evaluation studies. The performance of the estimate proposed is evaluated through extensive simulation study and the results are compared with existing competitors. The results exhibit superiority of the model over the existing competitors both in real data analysis and in a simulation study.

**Keywords:** Behavioural dependence; Disease surveillance; Maximum likelihood; Time-ordered capture; Trivariate Bernoulli model

## 1. Introduction

Estimation of population size or the number of vital events that have occurred, during a given time span, is a relevant statistical problem in various scientific disciplines including epidemiology, population studies and life sciences. Federal agencies are generally interested in such estimates for planning and policy formulation. In general, a census or any registration system often fails to capture all the individuals and that leads to undercoverage of the population under consideration. However, in some instances, duplicate records or members outside the target population are included in the census or any other registers because of erroneous enumeration. This issue is known as overcoverage, and it is a common practice to identify and remove the erroneous inclusions through administrative follow-up actions (Chipperfield *et al.*, 2017) or to adjust the census data on the basis of an estimate of the overcoverage rate (Zhang, 2015). In this paper, we focus only on the issues that are related to the commonly encountered problem of undercoverage, assuming that the available data are free from any erroneous inclusion. To reduce the undercoverage error, information from more than one attempt needs to be considered. The data that are obtained from various sources are summarized by matching the lists of captured individuals and analysed to obtain an estimate of the unknown population size (Rastogi and

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# On the estimation of population size from a post-stratified two-sample capture–recapture data under dependence

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## ABSTRACT

Population size estimation based on a two-sample capture–recapture type experiment is an interesting problem in various fields including epidemiology, public health, population studies, etc. The Lincoln–Petersen estimate is popularly used under the assumption that the capture and recapture statuses of each individual is independent. However, in many real-life scenarios, there is an inherent dependency between capture and recapture attempts which is not well studied in the literature of the dual system or two-sample capture–recapture method. In this article, we propose a novel model that successfully incorporates the possible causal dependency and provide corresponding estimation methodologies for the associated model parameters based on post-stratified two-sample capture–recapture data. The superiority of the performance of the proposed model over the existing competitors is established through an extensive simulation study. The method is illustrated through analyses of some real data sets.

## ARTICLE HISTORY

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## KEYWORDS

Behavioural dependency; bivariate Bernoulli; disease surveillance; method of moments; maximum likelihood; post-stratification

## 1. Introduction

Estimation of the size of a population is an interesting problem in different disciplines of epidemiological, medical, social and demographic studies. In order to formulate policies for public health related issues, federal agencies are generally interested to know the actual size of a diseased population (e.g. Encephalitis patients) or vital events (e.g. child mortality) in a specified region. Any attempt to count all the individuals belonging to a population of interest is always subject to error and the degree of error depends on many factors, such as population size, individual's capture probability, etc. In this context, two sources of information have extensive use for the human population as more than two sources are hardly found in the demographic study due to various practical constraints such as survey cost, human mobility, etc. [1]. In order to draw inference from two capture attempts, one needs to combine the data obtained from the two surveys and determine how many people are included in both the lists and how many are included exactly in one of the lists. Therefore, an incomplete  $2 \times 2$  cross-classified data structure is obtained and

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RESEARCH ARTICLE

OPEN ACCESS

## Optimization of Biofertilizer Production and its Application in Plants using Pot Culture Technique

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### Abstract

Mass production of *Bacillus thuringiensis* A5-BRSC culture as biofertilizer, using cheap carbon sources revealed that mashed potato is the most effective carbon source followed by arrowroot and liquid waste of boiled rice. Biomass was mixed with charcoal, the carrier, and applied to the pots to study its plant growth stimulating effect using *Abelmoschus esculentus* as test plant. Biofertilizer inoculated plants showed high shoot and root length, high numbers of leaves, more numbers of fruits, increased fruit weight in comparison to control plants where no biofertilizer was inoculated. Microbial activity of biofertilizer in pot soil was studied by both soil dehydrogenase assay and carbon evolution method. Both of the study revealed that the biofertilizer is stable in soil condition up to 45 days.

**Keywords:** Biofertilizer, Bioprocess productivity, pot culture, charcoal, *Bacillus thuringiensis*.

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# Induced magnetic field and second order velocity slip effects on $\text{TiO}_2$ -water/ethylene glycol nanofluids

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## Abstract

This paper explores stagnation-point flow mechanism and the convective heat transmission of an incompressible viscous fluid encouraged by impermeable stretching sheet. Water ( $\text{H}_2\text{O}$ ) and the ethylene glycol (EG) driven nanofluids comprising titanium oxide ( $\text{TiO}_2$ ) nanoparticles in company of non-uniform heat source/sink accounted here. Effect of second order velocity slip and induced magnetic-field accounted in the presumed model. Primary equations of adopted model have been standardized through similarity methodology and resolved the subsequent equations numerically by expending RK-4 shooting exercise. The stimulus of encouraging flow parameters on the flow specific is made accurately through diagrams and charts. We measure the strength besides trend of the relation amongst the numerous emergent flow parameters with Skin friction coefficient, Nusselt number by using correlation co-efficient and the impression of the relation confirmed by employing Fisher's  $t$ -test. Here dual characteristic of induced magnetic-field has been witnessed for magnetic Prandtl number.

Keywords: induced magnetic field, titanium oxide nanoparticle, slip condition

(Some figures may appear in colour only in the online journal)

## Nomenclature

$u, v$	velocity components	$T$	temperature of the nanofluid
$u_w, u_e$	stretching and free stream velocity	$T_\infty$	Ambient temperature of the nanofluid
$H_1, H_2$	magnetic components	$A^*, B^*$	space and temperature dependent heat source/sink factors
$H_e$	magnetic field at free stream	$\sigma_s, \sigma_f$	electrical conductivity of nanoparticles and base-fluid
$\mu_{\text{nf}}$	viscosity of the nanofluid	$\phi$	is nanoparticles concentration
$\rho_{\text{nf}}$	density of the nanofluid	$a, c, A, B$	constant parameters
$\kappa_{\text{nf}}$	thermal conductivity of the nanofluid	$\alpha$	coefficient of momentum
$\alpha_{\text{nf}}$	electrical conductivity of the nanofluid	$\lambda$	molecular mean free path
$\nu_f, \rho_f$	kinematic viscosity and the density of fluid	$K_n$	Knudsen number
$\alpha_1$	magnetic diffusivity	$L$	characteristic length of the flow
		$M$	magnetic parameter
		$Pr$	Prandtl number

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# Dynamics of nonuniform viscosity of unsteady CuO–H<sub>2</sub>O nanofluid flow from a spinning body

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## Abstract

This paper studies an unsteady rotating flow over a sphere. The substantial effect of nonuniform viscosity is accounted in the extant study. CuO–H<sub>2</sub>O nanofluid is used in adopted nanofluid model. A comparative study among the upshot of nonuniform viscosity and uniform viscosity on present nanofluid model is established here. Primary equations of adopted model have been standardized through similarity methodology and the subsequent equations have been resolved numerically by expending an RK-4 shooting exercise. The stimulus of encouraging flow parameters on the flow specific is made accurately through diagrams and charts. We witnessed that the heat transmission rate is intensified for unsteadiness factor of the present flow, which suggests that the rate of cooling improves. The unsteadiness factor supports the flow to upsurge in  $x$  – direction and the reverse consequence originates in the spinning direction. The heat transmission rate is higher in case of nonuniform viscosity than uniform viscosity.

## KEYWORDS

CuO, rotating sphere, variable viscosity

## 1 | INTRODUCTION

In various engineering divisions, such as chemical and industrial engineering,<sup>1,2</sup> external fluids flowing from rotating bodies are remarkable. In rotating schemes, rotation strongly sways



RESEARCH ARTICLE

# Homogeneous–heterogeneous reaction mechanism on MHD carbon nanotube flow over a stretching cylinder with prescribed heat flux using differential transform method

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2010 Mathematics Subject Classification: 76W05.

## Abstract

Hydromagnetic nanofluid flow through an incompressible stretching cylinder accompanying with homogeneous–heterogeneous chemical reaction has been executed in current literature. SWCNTs (single-walled carbon nanotubes) and MWCNTs (multiwalled carbon nanotubes) as nanoparticles in appearance of prescribed heat flux are accounted here. Leading equations of the assumed model have been normalized through similarity practice and succeeding equations resolved numerically by spending RK-4 shooting practice and analytically by engaging differential transform method. The impulse of promising flow constraints on the flow characteristic is finalized precisely through graphs and charts. We perceived that velocity outlines and temperature transmission are advanced in MWCNT than SWCNT in every case.

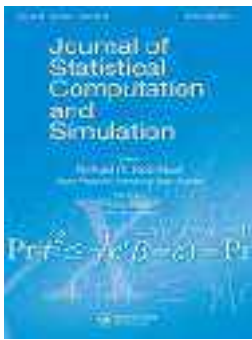
**Keywords:** carbon nanotubes; nanofluid; stretching cylinder; prescribed heat flux; homogeneous–heterogeneous chemical reaction; DTM

## 1. Introduction

To utilize solar energy, researchers, scientists, and engineers are devoted to develop energy resources and the energy technologies due to significant dependence on it of human society. It is a well-known reality that improvement in thermal characteristic can be made by adding little amount of nanoparticles having high thermal characteristic. However, in recent times nanofluid (Bhatti, Abbas, & Rashidi, 2017; Daniel, Aziz, Ismail, & Salah, 2018; Dhlamini, Kameswaran, Sibanda, Motsa, & Mondal, 2019; Mondal, Almakki, & Sibanda, 2019), which is a new kind of fluid categorized due to solid–liquid arrangement in metal or nonmetal nanoparticle suspension; originated by Choi (1995), to heighten thermal conductivity of the fluid. Carbon nanotubes basically are the cylinder of single or multiple sheets of graphene. Centered on sheets of the graphene, carbon nanotubes are distinguished into two types viz. single and multiple-walled carbon nanotubes (SWCNTs and MWCNTs). CNT is generally used in electrodes, anodes, catalyst, and various

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## Nonparametric approaches for comparing three-period, two-treatment, four-sequence crossover designs

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# Nonparametric approaches for comparing three-period, two-treatment, four-sequence crossover designs

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## ABSTRACT

The paper describes nonparametric approaches for comparing three-period, two-treatment, four-sequence crossover designs through testing the hypothesis that the treatments are interchangeable. The proposed approaches are based on a model which incorporates, along with the direct treatment effects, self and mixed carryover effects. Related asymptotic results are obtained. Comparisons among the designs are made numerically with respect to type I error rate and power of the tests considering compound symmetry and autoregressive covariance structures of the response variables. Lengths of the confidence intervals of the treatment differences are also used to make comparative study among the designs.

## ARTICLE HISTORY

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## KEYWORDS

Asymptotic distribution; asymptotically distribution-free; Balaam's design; crossover design; mixed carryover effect; self carryover effect; step-down approach

## 1. Introduction

In clinical research, where two or more treatments are under comparison, patients receive treatments in groups. Here it is important that single measurement from each patient is not appropriate in the statistical sense and it may produce bias due to his/her initial condition. This emerges the concept of repeated measurement studies by which subjects are given treatments more than once over time. Crossover and parallel group trials produce such studies in practice. In particular, when disease under study is chronic and stable (e.g., cancer, arthritis, obesity, asthma), clinical researchers are inclined to crossover trials as they possess certain medical ethics.

In crossover design with more than two periods, there should be a restriction to those designs in which the first two periods represent one of the basic crossover designs. Thus, for comparing two treatments, denoted by  $A$  and  $B$ , through crossover design, the first two periods should be  $\{AB, BA\}$  (usual crossover design) or  $\{AA, AB, BA, BB\}$  (Balaam's design). See, for example [1–3]. This is because of the fact that, if the extra treatment periods result in an excessive number of withdrawals, it will still be possible to carryout analysis with the first two periods in the usual way [4]. This leads us an approach to get a three-period design with a view to achieve higher efficiency than the corresponding two-period crossover design.

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# A Tripartite Interaction among the Basidiomycete *Rhodotorula mucilaginosa*, N<sub>2</sub>-Fixing Endobacteria, and Rice Improves Plant Nitrogen Nutrition

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**Nitrogen (N) limits crop yield, and improvement of N nutrition remains a key goal for crop research; one approach to improve N nutrition is identifying plant-interacting, N<sub>2</sub>-fixing microbes. *Rhodotorula mucilaginosa* JGTA-S1 is a basidiomycetous yeast endophyte of narrowleaf cattail (*Typha angustifolia*). JGTA-S1 could not convert nitrate or nitrite to ammonium but harbors diazotrophic (N<sub>2</sub>-fixing) endobacteria (*Pseudomonas stutzeri*) that allow JGTA-S1 to fix N<sub>2</sub> and grow in a N-free environment; moreover, *P. stutzeri* dinitrogen reductase was transcribed in JGTA-S1 even under adequate N. Endobacteria-deficient JGTA-S1 had reduced fitness, which was restored by reintroducing *P. stutzeri*. JGTA-S1 colonizes rice (*Oryza sativa*), significantly improving its growth, N content, and relative N-use efficiency. Endofungal *P. stutzeri* plays a significant role in increasing the biomass and ammonium content of rice treated with JGTA-S1; also, JGTA-S1 has better N<sub>2</sub>-fixing ability than free-living *P. stutzeri* and provides fixed N to the plant. Genes involved in N metabolism, N transporters, and *NODULE INCEPTION*-like transcription factors were upregulated in rice roots within 24 h of JGTA-S1 treatment. In association with rice, JGTA-S1 has a filamentous phase and *P. stutzeri* only penetrated filamentous JGTA-S1. Together, these results demonstrate an interkingdom interaction that improves rice N nutrition.**

## INTRODUCTION

Nitrogen (N) is a vital macronutrient for plant growth, but the limited availability of usable N has led to the extensive use of N fertilizers, which are both energy intensive to produce and environmentally unfriendly to use. N fixation, that is the conversion of N<sub>2</sub> to forms the plant can use, provides an attractive alternative to exogenous fertilizers. However, the ability to fix atmospheric

N<sub>2</sub> is exclusive to prokaryotes and these N<sub>2</sub>-fixing prokaryotes are termed diazotrophs. Moreover, only a monophyletic group of angiosperms of the order Eurosids I interacts with a group of specific diazotrophs to exploit the N fixed by these diazotrophs within symbiotic nodules (Soltis et al., 1995). These findings have prompted the development of synthetic biology approaches to engineer N<sub>2</sub>-fixing symbiosis in cereals (Rogers and Oldroyd, 2014).



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## Study of Ecotoxicological impacts of alpha cypermethrin 10 EC on fresh water snail *Bellamya bengalensis* Lamark, 1822 (Gastropoda: Viviparidae) in West Bengal, India

Nandini Pal and Suman Bej

### Abstract

*Bellamya bengalensis* is one of the most important edible protein sources having great economic importance. Here the experiment was conducted to study the impact of Alpha Cypermethrin (10 EC) emphasizing on different physiological aspects on *Bellamya bengalensis*. It has been found that exposure of the test animal in different concentrations of Alpha Cypermethrin lead to various physiological changes like mucous secretion, floating behavior, avoidance reaction. Considering the chronic toxicity, exposed to 0.0015ppm of Alpha Cypermethrin for 7 days expressed an increase in glass surface adhesion of haemocytes and maximum percentage of haemocyte aggregation was recorded in 0.0015ppm of pesticide formulation for 7 and 10 days of exposure.

**Keywords:** *Bellamya bengalensis*, alpha cypermethrin, acute toxicity, chronic toxicity, lethal concentration

### Introduction

Molluscs are the group of organisms which constitute the second largest invertebrates and most successful group next to insects (Abbot, 1989; Rao, 1989; Bouchet, 1991)<sup>[1,2]</sup>. Extensive study throughout the world has been carried out against the Mollusc and it is estimated that number of described species varies from 80,000 to 135,000 and it has been found that among the described species about 3000 species are belong to fresh water ecosystem (Abbot, 1989; Seddon, 2000)<sup>[1, 10]</sup>. Though viviparids prefer stagnant water bodies for their long time sustainability, these are also found in the irrigated paddy fields and rarely running water (Saha *et al.*, 2017). Most of the snails specially focusing on freshwater habitat served as an intermediate hosts for various parasitic worms of man and his domestic animals. The predilection of snails for fungal foods increases the attractiveness of diseased plant and possibility of spreading of the disease by these snails (Abirrao, 2002)<sup>[12]</sup>. The fresh water snail *Bellamya bengalensis* is considered as an important economical species with a high demand of edible protein (17.2%), carbohydrate (13.12%) and lipid (4.83%) and they play an important role in aquatic ecosystem as Bioindicator (Khalua and Tripathya, 2014)<sup>[13]</sup>. After green revolution the modern agriculture is solely dependent upon the application of pesticides which are widely used to combat agricultural pest and their application has greatly contributed to boost up the agricultural production. But none of these pesticides employed are specific and due to their indiscriminate and wide spread use, several non-target organisms like snails, fishes, crabs etc. of the ecosystem are adversely affected (Magare, 1993)<sup>[7]</sup>. Alpha Cypermethrin is the fourth generation synthetic pyrethroid insecticide used extensively in agricultural field to suppress the pest population due to its quick knock-down property but bioaccumulation in the living aquatic organisms is another important related issue of this insecticide due to its high lipophilic property and low water solubility which leads various physiological hazards to these aquatic fauna (Bacci *et al.*, 1987)<sup>[11]</sup>. Henceforth considering from all possible angles the present study has been conducted to investigate the physiological change of freshwater snail, *Bellamya bengalensis* exposed to various concentration of Alpha Cypermethrin.

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