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Thymoquinone incorporated chitosan-sodium alginate/psyllium husk derived biopolymeric composite films: A comparative antibacterial and anticancer profile

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ABSTRACT

The fabrication of biopolymeric film containing natural therapeutics envisioned to develop edible, nontoxic and biodegradable composite using polymers. Our study focused on extraction of psyllium husk mucilage, a medicinally acknowledged natural polysaccharide and develop a proper composite with chitosan. We combined chitosan with both alginate and husk mucilage separately to prepare two composite films. Drug release dynamics from the complex polymeric networks was evaluated where polymeric films showed sustained release of thymoquinone, a water-insoluble phytocomponent. Structural and physico-chemical properties of the films were confirmed by FTIR, XRD, FESEM, TGA analysis. Significant antimicrobial activities against both bacterial strains and strong anticancer activities against human prostate cancer cell line (PC3) and adenocarcinomic human alveolar basal epithelial cell line (A549) was observed. This biodegradable polymer combination suggests towards the possibility of potential applications for the food industry and variety of biomedical applications such as wound dressing, tissue scaffolding etc.

1. Introduction

Multifunctional biomaterials, polymer composite are extensively used in the field of pharmaceutical drug delivery because of their wide range of versatility, biocompatibility and stability to serve as a matrix or vehicle for drugs compared to synthetic or inorganic materials [1,2]. Polymer composites with proper ratio and modifications can be a better excipient constituent as sustained drug carrier with improved physical, mechanical, functional properties [3,4]. The stability of polymer composite could be affected by molecular weight, crystallinity, mixing ratio, presence of functional groups, pH of reaction medium, distribution of ionic groups, drying process, etc [5].

Chitosan has been used as a positively charged polymeric drug carrier due to its biocompatibility, biodegradability and relatively low production cost [6]. Alginate is a water soluble, unbranched, biodegradable polysaccharide consisting of alternating blocks of 1–4 linked -l-guluronic (G-block) and -d-mannuronic acid (M−block) residues [7]. Carboxylic acid groups of alginate is responsible for negative charges which attribute characteristic electrostatic interaction with the positively charged molecules [6]. Alginates are extracted from brown seaweeds and marine algae such as *Laminaria hyperborea*, *Ascophyllum nodosum* and *Macrocystis pyrifera* [4,8,9]. Since chitosan is positively charged at low pH values (below its pKa value), it spontaneously associates with negatively charged polyions like alginate in solution to form a special type of macromolecules, the polyelectrolyte complexes [4]. Psyllium mucilage obtained from the seed coat of *Plantago ovata* and *Plantago indica* belongs to the family Plantaginaceae which can be obtained by mechanical grinding of the outer layer of the seeds[10]. Psyllium mucilage is fibrous mucilaginous hydrocolloid used in treatment of intestinal inflammation, constipation, etc. [11]. Arabinoxylan, a complex heteroxylan of two pentose sugars i.e. arabinose and xylose is a highly branched hemicellulose [12–14]. Sodium alginate (Al) and

Abbreviations: Ch, Chitosan; Al, Sodium alginate; Ph, Psyllium husk mucilage; Tq, Thymoquinone.

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Dr. Shaktipada Kumar and
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The Myth of Harishchandra and Chhou Performance

5

back

<The Myth of Harishchandra and Chhou Performance: Interplaying of Memory, Mask and Music>

In Indian cultural traditions, the body is considered important because, without the body, one cannot even begin to think of cultural articulations. The numerous cultural forms of India, like the song, dance, storytelling traditions, and rituals are expressions of embodied cultural memories. These cultural forms are predominantly responsive in nature. Whenever Indian culture receives any myth, it responds and reflects upon it and re-enacts the myth in diverse ways, which gives birth to multifarious cultural forms; and what helps them to respond and reflect upon these myths is the cultural memory. In his *Cultures of Memory in South Asia: Orality, Literacy and the Problem of Inheritance*, D. Venkat Rao speaks of cultures that sustain their traditions through embodied cultural memories. He configures them as "cultures of memory" or at times "mnemocultures". According to him, "mnemocultures" emerge and disseminate memories through the media of speech and gestures, or song and performative compositions" (Rao 8). For millennia, the cultures of memory have exhibited a strong inclination towards bodily performances.

Chhou dance, which is one of the celebrated performative traditions of Purulia, West Bengal, is one such "mnemoculture" or culture of memory that has been preserving and disseminating generationally transmitted memory stored in the organic body of *Chhou* performers. When people of Purulia come across any myth, they compose *Chhou palas* based on them. They receive the myths and

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A

MATHEMATICAL, PHYSICAL AND ENGINEERING SCIENCES

Research articles

Development of research network on Quantum Annealing Computation and Information using Google Scholar data

Antika Sinha

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Abstract

We build and analyse the network of 100 top-cited nodes (research papers and books from Google Scholar; the strength or citation of the nodes range from about 44 000 up to 100) starting in early 1980 until last year. These searched publications (papers and books) are based on Quantum Annealing Computation and Information categorized into four different sets: (A) Quantum/Transverse Field Spin Glass Model, (B) Quantum Annealing, (C) Quantum Adiabatic Computation and (D) Quantum Computation Information in the title or abstract of the searched publications. We fitted the growth in the annual number of publication (n_p) in each of these four categories, A–D, to the form $n_p \sim \exp(t/\tau)$, where t denotes the time in years. We found the scaling time τ to be of the order of about 10 years for categories A and C, whereas τ is of the order of about 5 years for categories B and D.

This article is part of the theme issue 'Quantum annealing and computation: challenges and perspectives'.

Footnotes

One contribution of 12 to a theme issue 'Quantum annealing and computation: challenges and perspectives'.

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FOCUS

Image contrast improvement through a metaheuristic scheme

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Abstract
Contrast enhancement is an important pre-processing task for several image and video processing applications. The objective of a contrast enhancement method is to improve the quality of the visual information contained in the images for further processing. Due to the enormous challenges, it is still considered as an open research problem. Several approaches have been proposed in the literature based on spatial and fr uency domain techniques. Among them, the Incomplete Beta Function (IBF) is a popular scheme used for image contrast enhancement. In the IBF based image contrast enhancement technique, quality of an image is improved by two controlling parameters. Under such conditions, these parameters need to be tuned for obtaining better outcomes. In this paper, a new gray-scale contrast enhancement algorithm is introduced where, instead of tuning the controlling parameters of IBF experimentally, their near-optimal values are calculated with the help of a recently published meta-heuristic algorithm called Artificial Electric Field Algorithm (AEFA). The proposed method has been compared with many state-of-the-art techniques in terms of some standard metrics considering three different datasets, namely Kodak, MIT-Adobe FiveK and USC-SIPI. Simulation results demonstrate that the proposed AEFA based image enhancement technique increases the overall image contrast and enriches the information present in the image.

Keywords Contrast enhancement · Incomplete beta function · Meta-heuristic · Artificial electric field algorithm · Kodak dataset · MIT-Adobe FiveK dataset · USC-SIPI dataset

1 Introduction

The contrast of an image can be defined as the dissimilarity in pixel intensity values of two nearby pixels. Alternatively, it is the change in the visual aspect of an image that helps in differentiating an object of interest from other objects as well as from the background. An image with higher contrast is always preferable over its low contrast version from an aesthetic point of view or in terms of machine understanding. It is a general perception that a high contrast image implies a better quality image. These facts demand the need for enhancement of the low-quality images, thereby making it one of the essential tasks in different video and image-based applications. Some of the important areas where this has huge applicability are real-world hyperspectral image based applications (Hardie et al. 2004; Md Noor et al. 2017), medical imaging systems (Rundo et al. 2018; Dey et al. 2022; Qiu et al. 2019) and satellite image enhancement (Singh et al. 2019; Demirel and Anbarjafari 2011) and many more. In addition to this, image contrast enhancement also helps in improving the visual quality of images for human eyes as contrast is a major factor used for the emotional assessment of any image.

Several algorithms to achieve better contrast than that of the original contrast reduced image are found in the literature. These methods are broadly classified into two categories (Yu et al. 2021; Ray et al. 2021): spatial domain methods and

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ViXNet: Vision Transformer with Xception Network for deepfakes based video and image forgery detection

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ABSTRACT

With the advent of image generative technologies, there is a huge growth in the development of facial manipulation techniques that allow people to easily modify media data like videos and images by changing the identity or facial expression of the target person with another person's face. Colloquially, these manipulated videos and images are termed "deepfakes". As a result, every piece of content in digital media comes with a question — is this authentic? Hence, there is an unprecedented need for a competent deepfakes detection method. The rapid changes in forging methods make this a very challenging task and thus generalization of the detection methods is also of utmost required. However, the generalization strengths of the prevailing deepfakes detection methods are not satisfactory. In other words, these models perform well when trained and tested on the same dataset but fail to perform satisfactorily when models are trained on one dataset and tested on another. The most modern deep learning aided deepfakes detection techniques looked for a consistent pattern among the leftover artifacts in specific facial regions of the target face rather than the entire face. To this end, we propose a Vision Transformer with Xception Network (ViXNet) to learn the consistency of these almost imperceptible artifacts left by deepfaking methods on the entire facial region. The ViXNet comprises two branches — one tries to learn inconsistencies among local face region specifics by combining patch-wise self-attention module and vision transformer, and the other generates global spatial features using a deep convolutional neural network. To assess the performance of ViXNet, we evaluate it using two different experimental setups — intra-dataset and inter-dataset when using three standard deepfakes video datasets, namely FaceForensics++, and Celeb-DF (V2) and one deepfakes image dataset called Deepfakes. We have attained 98.57% (83.60%), 99.26% (74.78%), and 98.93% (75.13%) AUC scores using intra(inter)-dataset experimental setups on FaceForensics++, Celeb-DF (V2), and Deepfakes datasets respectively. Additionally, we have evaluated ViXNet on the Deepfake Detection Challenge (DFDC) dataset and we have obtained 86.32% AUC score and 79.06% F1-score on the said dataset. Performances of the proposed model are comparable to state-of-the-art methods. Besides, the obtained results ensure the robustness and the generalization ability of the proposed model.

1. Introduction

Images have been perceived as an authentic and reliable method of information transfer for a long time. However, with the emergence of digital technologies, the availability of a huge amount of data, and the continued increase in computing capability and memory capacity, it has become very easy to train even very large deep learning models for various image processing and pattern recognition tasks. This has also made it very easy to manipulate images and videos using some sophisticated deep learning models, mostly by using generative adversarial networks (GANs). As a side effect of this, several algorithms have been developed over the past few years to generate increasingly realistic media data having manipulated faces, conversationally called deepfakes. Formally speaking, deepfakes are synthetic media data like videos and images, where the malicious users replace a target person's face with someone else. There are two main categories of deepfakes techniques: (i) face swapping and (ii) face reenactment. In the face swap methods, the face of one individual is cropped and morphed to fit it in the context of another individual as depicted in Fig. 1, while

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TOPSIS aided ensemble of CNN models for screening COVID-19 in chest X-ray images

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The novel coronavirus (COVID-19), has undoubtedly imprinted our lives with its deadly impact. Early testing with isolation of the individual is the best possible way to curb the spread of this deadly virus. Computer aided diagnosis (CAD) provides an alternative and cheap option for screening of the said virus. In this paper, we propose a convolution neural network (CNN)-based CAD method for COVID-19 and pneumonia detection from chest X-ray images. We consider three input types for three identical base classifiers. To capture maximum possible complementary features, we consider the original RGB image, Red channel image and the original image stacked with Robert's edge information. After that we develop an ensemble strategy based on the technique for order preference by similarity to an ideal solution (TOPSIS) to aggregate the outcomes of base classifiers. The overall framework, called TOPCONet, is very light in comparison with standard CNN models in terms of the number of trainable parameters required. TOPCONet achieves state-of-the-art results when evaluated on the three publicly available datasets: (1) IEEE COVID-19 dataset + Kaggle Pneumonia Dataset, (2) Kaggle Radiography dataset and (3) COVIDx.

COVID-19 has a colossal impact on almost every sector of society. Numerous deaths and countless positive cases are causing increased agony. Besides, governments have imposed a lockdown to confine the spread of COVID-19, which largely impacts the world's economy and culture. More than 590 million positive cases and 6.4 million deaths due to COVID-19 alone have been recorded to date[1]. Diagnostic techniques, medicines and vaccines are some of the methods greatly researched to save humans from its disastrous consequences[2]. On the other hand, pneumonia (usually found in children) causes severe respiratory issues that occasionally lead to death. Just like any other disease, in case of both pneumonia and COVID-19, early diagnosis for detection of the same is the most essential step to not only receive proper medical attention but also curb the spread of this disease. One of the most commonly used methods for diagnosis includes a real-time reverse transcription-polymerase chain reaction (RRT-PCR) test from a nasopharyngeal swab sample. However, the major drawback of RRT-PCR is low sensitivity in detecting COVID-19 cases[3]. Moreover, these pathological diagnosis systems suffer from inter- and intra-observer variability in addition to being time-consuming.

As an alternative to pathological diagnosis, several radiological methods have been explored to diagnose COVID-19 efficiently. Computerised tomography (CT) scans, chest X-rays and magnetic resonance imaging (MRI) are some of the methods used to detect the presence of this deadly virus[4]. Computer-aided diagnosis (CAD) systems have been beneficial in easing the burden on medical professionals and ruling out the possibility of human errors. Artificial intelligence (AI) based solutions also have proven beneficial[5,6]. Notably, several research communications can be found recently that detect the presence of these viruses (COVID-19 and pneumonia) from both CT scans and chest X-ray images[7]. However, the new variants of the virus that causes COVID-19 make detection more challenging. One of the disadvantages of the reliance on radiological methods is the risk caused by radiation, which may damage the molecular structures of the human body[8]. Despite this risk factor, radiological diagnosis methods are still relied upon as they help in more accurate diagnosis than their counterparts[7,9] do.

Convolutional neural network (CNN) aided methods have been successfully used in the past for COVID-19 and pneumonia detection[7,10] from the chest X-ray images. The main reasons for preferring them over the duo-feature engineering and classical machine learning approaches are (1) limited need of domain knowledge for

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RESEARCH ARTICLE

Z-Transform-Based Profile Matching to Develop a Learning-Free Keyword Spotting Method for Handwritten Document Images

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Abstract

For easy accessibility of the information from the digitized document images, optical character recognition (OCR)-based software can be used. But in the case of handwritten documents, the performance of the state-of-the-art OCR systems is not satisfactory owing to the complexity of the unconstrained handwriting. Hence, research affinity comes up with an alternative solution for this problem called keyword spotting (KWS) which is much more practical than an OCR-based solution. This work proposes a novel learning-free KWS method that can be applied to a heterogeneous collection of handwritten documents. In this work, we introduce a new way of profile matching to compare the query word profiles (i.e., both upper and lower) with the target words' profiles. At first, both query and target words are binarized, and then two profiles from each such word are generated. Next, we formulate rules to filter out the irrelevant words concerning the query word and obtain the probable candidate query (i.e., target) words. Then we compare the profiles of the query and candidate query words in the Z-transform domain using the condition of resonance for the damped oscillator. However, before the match, we perform an affine transformation on the Bezier curve representation of the profiles of the candidate query words to reduce the effects like scaling, rotation, and shearing which might occur due to the variant writing styles of individuals. The proposed method achieves satisfactory performance compared to state-of-the-art learning-free methods when applied to four publicly available standard datasets namely ICFHR 2014 H-KWS competition Modern, IAM, ICFHR 2016 H-KWS competition Botany and ICFHR 2016 H-KWS competition Konzilsprotokolle datasets.

Keywords Keyword spotting · Z-transform · Handwritten document image · Affine transform

Abbreviations

OCR	Optical character recognition
KWS	Keyword spotting
H-KWS	Handwritten keyword spotting competition
ICFHR-2014	14th International Conference on Frontiers in Handwriting Recognition
QBE	Query by example
QBS	Query by string
DTW	Dynamic time warping
HOG	Histogram of oriented gradients
POG	Projection of oriented gradients
mPOG	Modified version of POG
LBP	Local binary pattern
SVM	Support vector machine

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Copy-move forgery detection using local tetra pattern based texture descriptor

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Abstract

In modern era it has become increasingly easier to manipulate and tamper digital images, one of the primary reasons being the boon of commonplace availability of powerful image editing tools and software. These tools become a bane when used for malicious reasons as users can possibly add or remove important features from an image without leaving any obvious marks of tampering. Hence the need of forgery detection techniques which show high accuracy in detection arises. One of the most prevalent forms of image tampering is the copy-move forgery attack. In this type of forgery, a part of an image is copied and then pasted somewhere else in the same image with the intent to hide key features of the image. This paper introduces a new copy-move image forgery detection technique which relies on a texture feature descriptor called Local Tetra Pattern (LTrP) for block level image comparison used to localize tampered region(s). Initially, the input image is divided into overlapping blocks, then LTrP features are extracted from each block to form a single feature vector. Next, the feature vectors of all image blocks are sorted lexicographically, and then similar blocks are identified by matching the features from neighboring blocks. Finally, blocks matched falsely due to the presence of homogeneous color information like sea, field, and sky are removed using a shift vector aided outlier removal method. Experiments have been conducted on two standard datasets - GRIP and CoMoFoD. We have obtained 0.9834 and 0.9093 average F_1 scores at pixel-level for GRIP and CoMoFoD datasets respectively. The experimental results demonstrate that the proposed technique has been able to detect the forged regions with higher accuracy as compared to many state-of-the-art copy-move forgery detection methods. Moreover, experimental results on CoMoFoD dataset show that the method is able to correctly detect the forgery even after various post-processing attacks. The source code of proposed method is available at https://github.com/RollingThunderSagnik/LTrP-Copy-Move-Forgery-Detection.

Keywords Copy-move forgery · Digital image forensics · GRIP · CoMoFoD · Duplicated region detection · Local tetra pattern

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An ensemble approach to detect copy-move forgery in videos

Sk Mohiuddin [1] · Samir Malakar [1] · Ram Sarkar [2]

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Abstract

In the recent past, video forgery has increased rapidly due to the easy availability of the required tools to accomplish that. Temporal copy-move or frame duplication is one of the most common video forgery methods in which a set of consecutive frames is copied somewhere in the same video. This work proposes an ensemble based method to detect duplicate frames from a video. In this method, first, the frames are pre-processed and then three different kinds of features - Haralick, custom Haralick and Local Binary Pattern (LBP) are extracted from each frame of a video. Next, lexicographical sorting is performed to arrange the frames having similar feature values consecutively. A filter method is applied to eliminate the false detection and it also creates a duplicate sequence for each category. In the end, a voting mechanism is employed to predict the duplicate frames, if they exist. The proposed method performs very well (detection accuracy is 99.32%, the true positive rate is 99.79%, and the true negative rate is 99.19%) over an in-house dataset containing 300 videos of seven different types. The robustness of the proposed method has also been tested by adding various postprocessing to the video samples. The proposed method outperforms many state-of-the-art methods used here for comparison.

Keywords Video forgery · Copy-move · Frame duplication · GLCM · Haralick · LBP

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S.I.: LATIN AMERICAN COMPUTATIONAL INTELLIGENCE

A hierarchical feature selection strategy for deepfake video detection

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Abstract
Digital face manipulation has become a concern in the last few years due to its harmful impacts on society. It is especially concerning for high-profile celebrities because their identities can be easily manipulated using mobile or web applications such as FaceSwap and FaceApp. These manipulated faces are so close to real ones that it becomes really hard to detect them, even with bare eyes. Though deep learning-based models are predominantly used by researchers, they hardly check for the presence of irrelevant or redundant features produced by those models. To this end, we have proposed a hierarchical feature selection (HFS)-based method to detect deepfake images or videos. First, we have extracted both handcrafted and deep learning features from the inputs. Next, the HFS is applied to select a near optimal set of features. In each stage of it, a hybrid feature selection method is employed that integrates a population-based meta-heuristic model, called Grey Wolf Optimization, and a single solution-based meta-heuristic model, called the Vortex Search algorithm. We have evaluated our model on three publicly available datasets, namely Celeb-DF (V2), FaceForensics++, and Deepfake Detection Challenge (DFDC). The model provides 99.35%, 99.16%, and 85.67% AUC scores on the Celeb-DF (V2), FaceForensics++, and DFDC datasets, respectively, while using only 11.50%, 12.65%, and 10.22% of actual features. Besides, our model outperforms most of the state-of-the-art methods found in our literature review and evaluated on these three datasets.

Keywords Deepfake detection · Handcrafted features · Deep learning features · Hierarchical feature selection

1 Introduction

Digital face manipulation has become a real concern in social media as well as in our society due to its detrimental consequences. Although face manipulation, in its early stages, used to be done for comic purposes, later it became a cause for concern for celebrities and political figures. Also, in the past, due to technological limitations, it was very difficult to create realistic face images, and thus identification of the manipulations could be done with ease with bare eyes. However, recent developments in artificial intelligence (AI) based on deep neural networks, especially generative adversarial networks (GANs), let forgers alter the identity of a person with almost no perceivable signs. As a result, existing faces or face attributes such as eyes and mouth in a video or image are very intelligently replaced or altered by borrowing the corresponding parts from other subjects. Such a manipulated approach is known as deepfake, which generates very natural face images, and thus it becomes really challenging to detect the changes made by bare human eyes. Figure 1 depicts how a target face image is coupled with a source image to generate a fake face image. Therefore, designing a solution to the

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A comprehensive survey on state-of-the-art video forgery detection techniques

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Abstract

Video plays a key role in carrying authenticity, especially in the surveillance system, medical field, court evidence, journalism, and social media among others. However, nowadays the trust in videos is decreasing day by day due to the forgery of the videos made by easily accessible video editing tools. Hence, a thrust for finding a robust solution to the problem of video forgery detection arises. As a result, researchers around the world are indulging themselves to come up with various methods for the said problem. In this article, we have comprehensively discussed many such initiatives made by researchers across the globe, keeping the focus on recent trends. In addition to this, we have also covered a wide range of forgery detection techniques that follow either an active or a passive approach, while the state-of-the-art surveys made so far on this research topic include only a few specific cases. In this article, we have described some recent technologies that are used in video forging, made a summary of the performances (provided categorically) of all the techniques discussed here, and briefed the available datasets. Finally, we have concluded this survey by clearly mentioning some future directions of the video forgery detection research based on a thorough review of existing techniques.

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A modified GNN architecture with enhanced aggregator and Message Passing Functions

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ABSTRACT

Graph neural networks (GNN) uphold the essence of irregularly structured information embedded in a graph via message passing among the nodes and aggregating the node features at various levels of the graph. In the past, researchers have extensively used the GNN models for several semi-supervised node classification tasks. Existing GNN models do not use nodes' information sufficiently. The use of inter-node feature-level correlational information with the existing GNN models might lead to more powerful learning models. Here, a weighting scheme has been developed for message passing and aggregation functions. This model has been named "Vector GNN", or in short, "VecGNN", due to its relationship with vector space. VecGNN takes into consideration the relative position of a node with respect to its neighboring nodes in the feature space, which influences the weight of features passed to the information aggregation phase. These weights are assigned using two different statistical measures: Jaccard's coefficient and Cosine similarity. The proposed weighting scheme uses a generalized approach that can be easily incorporated into several GNN frameworks. VecGNN is evaluated using three citation datasets: Citeseer, Pubmed, and Cora. On these datasets, three sets of experiments have been conducted with varying numbers of training and testing nodes. We have used training, validation, and test set nodes with ratios of 1:1:8, 2:1:7, and 3:1:6. Experimenting on these, we observe an improvement of 2%–4% over the baseline models: Graph Convolution Network (GCN), Graph Attention Network (GAT), and Jumping Knowledge Networks (JKNets). The source code is available at the link https://github.com/sourodeeproy/VecGNN.

Notation

The notations that are used throughout this paper to refer to different terms are listed in Table 1.

1. Introduction

Graph Neural Network (GNN) is a non-Euclidean space learning model that mimics the operators of Convolutional Neural Networks (CNNs) in the graph learning domain. In recent years, GNNs have gained widespread acceptance in fields such as social networking, protein modeling, drug discovery, and web networks. Its deterministic feature propagation process improves node representation learning by performing three major functions: neighborhood aggregation, message passing, and feature updating. As a result, GNNs can be used for tasks such as node classification (Kipf and Welling, 2017), graph classification (Ying et al., 2018), and link prediction (Zhang and Chen, 2018). They are just a few of the tasks that may be completed with the aid of GNNs (Wu et al., 2021; Zhang et al., 2022a; Mandal et al., 2022). Node classification foretells the labels or classes of the nodes. A challenge with node classification in cyber security, for instance, can be recognizing fraudulent organizations in the network. The possibility of connections (edges) between nodes is predicted through the use of links. For instance, a social networking site could suggest prospective buddy connections based on network information. A graph is classified into several groups using graph classification. To provide an example, the graph structure of a chemical molecule may be utilized to assess if it is risky or not. Many researchers are motivated by its strong learning ability to design GNN-based models in a variety of real-world applications such as offline signature verification (Roy et al., 2021), web page classification (Wu et al., 2022), social recommendation systems (Fan et al., 2022), e-commerce fraud detection (Zhang et al., 2022b), financial time series forecasting (Cheng et al., 2022), learning protein–protein interactions (Réau et al., 2023), and physics-based problems (Bhattoo et al., 2023). Many environmental problems

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OMRNet: A lightweight deep learning model for optical mark recognition

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Abstract
Existing Optical Mark Recognition (OMR) systems tend to be expensive and rigid in their operation, often resulting in erroneous evaluations due to strict correction protocols. This scenario airs the need for a flexible OMR system. Hence, in this work, we propose a lightweight transfer learning based Convolutional Neural Network (CNN) model, dubbed as OMRNet, which can classify answer boxes on any generalized OMR test sheet. Unlike most existing techniques that rely on image processing algorithms to recognize extracted answer boxes in two classes: confirmed and empty, the OMRNet is designed to classify the answer boxes into confirmed, crossed-out, and empty categories. That is, OMRNet is facilitating the crossing out of previously answered questions and thus removing the rigidity of templates in Multiple Choice Question (MCQ) tests. We have built OMRNet on top of a MobileNetV2 backbone connected to four fully connected layers with appropriate dropouts and activation functions in between. We have evaluated OMRNet on the Multiple Choice Answer Boxes dataset available at https://sites.google.com/view/mcq-dataset. We have performed experiments following a 5 fold cross validation scheme, and OMRNet has achieved accuracies of 95.29%, 95.88%, 93.97%, 97.45%, and 97.20%, with an average accuracy of 95.96%. Also, the experimental results confirm that the present model performs better than the compared state-of-the-art methods and standard CNN models in terms of accuracy, execution time, and memory required to store the trained module. Moreover, we have employed a quantization technique to make the trained module more memory efficient and deployed it to a web app using our own Representational State Transfer Application Programming Interface (REST API). It makes OMRNet available via a Hypertext Transfer Protocol (HTTP) endpoint, allowing potential users to connect to it via the Internet. The source code for the work is available at the following link: https://github.com/sa-y-an/OMRNet.

Keywords Optical mark recognition · Multiple choice question · Transfer learning · OMRNet

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Article

Toxicity of Nanoscaled Zero-Valent Iron Particles on Tilapia, *Oreochromis mossambicus*

Arivarasan Vishnu Kirthi,* Gaurav Kumar, Gaurav Pant, Manu Pant, Kaizar Hossain,* Akil Ahmad, and Mohammed B. Alshammari

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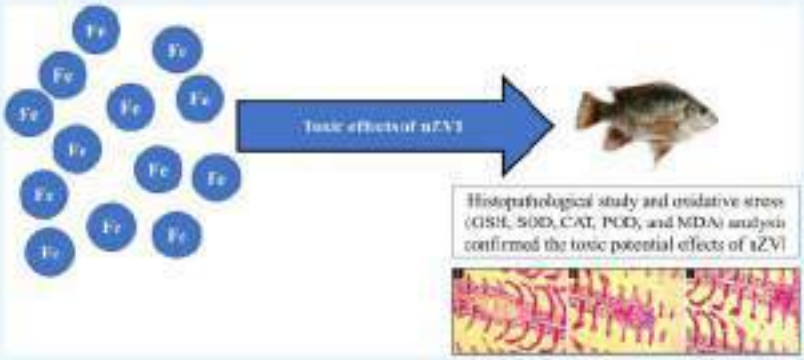

ABSTRACT: This research effort aims to evaluate the hazardous potential of the redox state (OH^-) of zero-valent iron nanoparticles (nZVI) and its histopathological and oxidative stress toward Mozambique tilapia, *Oreochromis mossambicus*. X-ray powder diffraction (XRD) validated the nZVI nanoparticles' chemical composition, while transmission electron microscopy (TEM) revealed that their physical form is round and oval. The exposure to 10 g/mL of nZVI induced the activation of the cellular superoxide dismutase (SOD) activity. Dose-dependent testing of *O. mossambicus* had a reduction in SOD and an increase in malondialdehyde (MDA) levels, suggesting that nZVI caused oxidative damage. At a concentration of 100 g/mL, the catalase (CAT) and peroxidase (POD) activities of diverse tissues exhibited a gradual decrease after 2 days of exposure and a fast increase until day 6. The scavenging of reactive oxygen species (ROS) in the epidermis, liver, and gills of *O. mossambicus* deteriorated and accumulated gradually. MDA levels in the skin, gill, and liver tissues were substantially higher after 8 days of exposure to 100 and 200 g/mL nZVI compared to those of the control group and those exposed to 10 and 50 g/mL nZVI for 2 days. Extreme histological and morphological abnormalities were seen in the skin, gill, and liver tissues of experimental animals, demonstrating that the damage resulted from direct contact with nZVI in water. A one-way ANOVA followed by Dunnett's post-test was performed to investigate significant differences.

INTRODUCTION

The properties of nanoparticles that contribute to biological perturbations strongly depend on their size, mineralogy, crystallinity, and surface reactivity, which is directly connected to nanoparticle toxicity through redox reactions, the production of oxygen- or nitrogen-free radicals, the dissolution of nanoparticles, the release of toxic ions, and the sorption and transport of metal ions or xenobiotic pollutants.[1] There is an understood assumption that zero-valent iron nanoparticles (nZVI) are relatively nontoxic because Fe^0 simply oxidizes to Fe^{2+} and then to Fe^{3+}, both of which are common chemical species in the environment that most organisms are well adjusted. However, the usage of nZVI applications increases the concentration of Fe^{2+} and/or Fe^{3+} substantially at a local level in the short term. nZVI oxidation can also contribute to the production of reactive oxygen species (ROS), such as hydroxyl radicals (OH^-) from superoxide (O_2^-) and hydrogen peroxide (H_2O_2) in living cells.[2−4] There are reports on the toxic effects of iron nanoparticles. Previous studies have reported the cytotoxic effects of iron oxide nanoparticles on the cytoskeleton of growing neurons and human melanoma cells.[5,6] Recent studies showed that uncoated nZVI produced neurotoxic in cultured neurons, whereas nZVI surface modified with polyaspartate decreased nanoparticle (NP) toxicity by

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Diversity, Composition and Abundance of Avian Species of Oxbow Lake and Surrounding Area in Purbasthali, West Bengal, India

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Avian diversity, Migratory birds, Oxbow lake, Shannon-Weiner index, Simpson's diversity index

Abstract: Purbasthali oxbow lake is an important habitat for thousands of migratory and resident avian species. This study aimed to determine the current status of avifaunal diversity of Purbasthali oxbow lake and its surrounding area. During this study, diversity, composition and abundance, feeding guilds and the relationship between their habitat preferences and the numbers of individuals were determined. Direct observation, line transects and point count methods were applied for bird surveys for three consecutive years from 2019 to 2022. A total of 145 species of birds were documented, belonging to 19 orders and 49 families. Among the total species, 57 are migratory in nature and 47 are showing declining global trend. Quantitative diversity estimation were performed during the study are the Shannon-Weiner index, Simpson's Diversity Index, Shannon equitability index and relative diversity. Density and diversity of avian species was highest during post-monsoon and lowest in pre monsoon. This indicates the winter assemblages of many migratory birds choose this lake as their feeding and resting grounds.

Introduction

Biodiversity provides important information about the overall health of an ecosystem (Díaz et al., 2007; Dudgeon et al., 2006). Species richness and diversity in an ecosystem are greatly influenced by the availability and distribution of resources in a particular habitat (Baer et al., 2004; Silvertown, 2004). Lakes are one of the most important freshwater resources on Earth and supports huge biodiversity (Gibbs, 1993). Wetlands/lakes are highly complex as well as productive ecosystems which helps to maintain the ecological balance by providing various ecological services like aquaculture, ground water recharge, flood control, wastewater treatment, drinking water source, agricultural water use, soil erosion control, nutrient cycling, habitat for a wide range of plant and animals etc. (Joy et al., 2005; Bhatta et al., 2016). The structure of an aquatic body also determines the species composition, density and diversity of a particular ecosystem (Watson et al., 2004). It is considered to be the most important habitat for various types of migratory and residential avian species for their wintering and breeding grounds (Szabo et al., 2017). In recent times freshwater lake ecosystem in India are threatened by various anthropogenic activities like habitat loss and degradation, habitat fragmentation, encroachment or unlawful filling of aquatic habitat, pollution, overexploitation of resources, waste dumping, heavy metal contamination, contamination from municipal and agricultural sources etc. These leads to aquatic body degradation, threatening the species thrives on the aquatic ecosystem (Sreekumari et al., 2016; Bassi et al., 2014; Bhattacharya, 2014; Roy et al., 2022).

Avian diversity is one of the most significant ecological factors determining the quality of aquatic ecosystems and acting as a bioindicator. Emerging threats of climate change, habitat loss, habitat fragmentation, over-extraction of resources and pollution raise new concerns over the degradation of aquatic ecosystems, which in turn threatens the existence of avian species diversity (Rahmani et al., 2022; Rajashekara et al., 2018). The oxbow lake at

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Spatio-Temporal Review of Urban Green Space Degradation at Administrative Level Using Geospatial Techniques and Multi-criteria Decision Analysis: A Case Study of Kolkata Urban Agglomeration

Anirban Kundu & Sayani Mukhopadhyay

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Abstract

The metropolitans of developing countries are experiencing an unplanned manner of urbanization that has led to a pessimistic state of deterioration of urban green space. But an ideal holistic methodological framework to quantify several facets of urban green space at the administrative level is still debatable. This study, therefore, intends to discern the decadal (1990–2020) change in the spatial distribution of the areal coverage, clustering, fragmentation and connectivity of urban green space in the administrative units of Kolkata Urban Agglomeration region using an experimental integrative methodology of combining remote sensing, landscape metrices and multi-criteria decision analysis. Using 9 landscape metrices, the result shows green space patches, in all the administrative units have experienced a certain degree of reduction in areal extent and connectivity with an increase in fragmentation. Moreover, using Mann–Kendall's Test with Sen's Slope estimator, it has been found that distance from the transport network plays a crucial part in the amount of change in landscape metrices. Finally, a Green Space Degradation Index has been formulated using the analytical hierarchy process, which shows the north-eastern and south-western municipalities have a higher degree of green space degradation, whereas the non-municipal areas have the least. This study not only has quantified the spatial intensity of deterioration of green space in the Kolkata Urban Agglomeration region, and such methodology might act as a comprehensive aid to policymakers and local urban bodies for a better understanding of urban green space degradation and formulation of sustainable management measures at the administrative level.

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New findings and appraisal of structural control on polygonal impact crater rim-geometry, a study from Mare Fecunditatis, Moon

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Highlights

- Explaining control on polygonal crater rim geometry, Mare Fecunditatis, Moon.
- Map of structural features of the study area, the Mare Fecunditatis, Moon.
- Trend comparison of structural features with polygonal impact crater rim segments.
- Geometry of polygonal impact craters was possibly controlled by pit crater chains.
- Faults associated with wrinkle ridges and grabens had no influence on the same.

Abstract

Polygonal Impact Craters (PICs), having a distinct polygonal rim geometry, are common on terrestrial planets, their natural satellites such as Earth's Moon and the asteroids. The straight segments of PIC-rims are arguably subparallel or oblique to existing fracture/fault planes in their vicinity, and such pre-existing structural weak planes are considered responsible for the shape of the PICs. The Mare Fecunditatis, a lunar maria, preserves mappable PICs as well as different geomorphic features like wrinkle ridges, grabens and pit crater chains which owe their origin to either compressional or extensional faulting. To understand the structural control, if any, on the PIC-rim geometry in Mare Fecunditatis, PICs, both simple and complex, and the deformational features are mapped, superposition relations between them are observed and trends are compared. The comparison between frequency of rim segment trends of the two types of PICs with wrinkle

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Increasing primary productivity in the oligotrophic Tethyan coastal ocean during the Paleocene-Eocene warming episode

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ABSTRACT

The coastal upwelling zones, occupying only ~0.5% of the global ocean, account for ~10% of the global primary productivity. The CO_2 fixation by primary producers amplifies in the upwelling zones during global warming due to the higher nutrient supply. Based on the presumption that the nutrient-deficient coastal ocean is less productive, the state of the oligotrophic coastal ocean is often neglected in the productivity-climate change studies. The present study investigated the changes in the primary productivity, redox condition, and nutrient content, using algal abundance, total organic carbon, and various major, trace, and rare earth elements and yttrium (REY) proxies, of the oligotrophic equatorial eastern Tethyan coastal ocean across the Paleocene-Eocene Thermal Maximum (PETM), a prominent paleo-global warming event. Despite the lower nutrient (lower Ni_{EF}, Cu_{EF}, and Zn_{EF}) contents, and invariable salinity, *p*H, and light conditions, the PETM interval shows extensive growth of coralline red algae in the hypoxic-oxic water column. Based on these observations, and inferences drawn from the previous laboratory experiments, conducted on the algal growth in varying pCO_2 by others, we postulate that the increased atmospheric CO_2 concentrations during the PETM probably enhanced the primary productivity of the oligotrophic Tethyan coastal ocean. If so, then the oligotrophic coastal ocean may be considered as an effective CO_2 sink and likely to play a pivotal role in carbon cycle-climate connection studies.

1. Introduction

About half of the total primary production on the Earth is contributed by the tiny phytoplankton in the oceans (Antoine et al., 1996; Field et al., 1998; Falkowski, 2012). The phytoplanktons fix a humongous amount of atmospheric CO_2*via.* photosynthesis and play a vital role in controlling the global carbon cycle and climate (Field et al., 1998). Acting as an effective CO_2 sink, their abundance is crucial during global warming, when there is excess CO_2 in the atmosphere. However, the warmer oceans during global warming are likely to hinder the phytoplankton growth by increasing the ocean thermal stratification and reducing the vertical mixing of the nutrients from the sub-surface layers to the upper layer of the ocean (Riebesell et al., 2000; Polovina et al., 2008; Boyce et al., 2010). On the contrary, phytoplanktons are likely to flourish in the coastal oceans, especially in the upwelling zones, where the intensified wind (due to the enhanced land-sea temperature gradients) accelerate the coastal upwelling and thereby, the nutrient content of the coastal waters (Bakun, 1990; Gregg et al., 2005; Boyce et al., 2010; Sydeman et al., 2014; Xiu et al., 2018). Thus, the upwelling zones, covering ~0.5% of the global ocean, probably act as major CO_2 sinks during global warming episodes (Bauer et al., 2013).

Except for the upwelling zones, significant areas of the coastal ocean are nutrient deficient or oligotrophic. Since oligotrophic coastal oceans are less productive in terms of phytoplankton growth, they have been grossly overlooked in the carbon cycle and climate change studies. Therefore, it is not well known whether the oligotrophic coastal ocean would remain less productive or become fertile during the global warming episodes (Barnet et al., 2020). The Paleocene-Eocene boundary (~56 Ma) witnessed one such extreme short-lived (~170 ± 30 Ka) warming episode (5–10 °C), popularly known as the Paleocene-Eocene Thermal Maximum (PETM; Dunkley Jones et al., 2013; Zeebe and Lourens, 2019; Stokke et al., 2020; Teng et al., 2021). The addition of an enormous amount of depleted greenhouse gases (CO_2 and CH_4) to the ocean-atmosphere system, recorded as negative carbon isotope

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ORIGINAL PAPER

Comparison of Pretreatment Methods for Organic-matter Removal and their Effects on the Hydrogen Isotope (δ^2H) Composition of Kaolinite

Arpita Samanta · M. K. Bera · Sruthi P. Sreenivasan · Anindya Sarkar

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Abstract The hydrogen isotopic composition (δ^2H) of authigenic clay minerals has been used extensively in paleoclimate studies. The separation of clay minerals from sediments/soils, using various chemicals, is a prerequisite for isotope ratio measurements, where carbonate, Fe-(oxyhydr)oxides, and organic matter are removed successively from the sediments for a greater clay yield. The commonly adopted organic matter-removal method using hydrogen peroxide (H_2O_2) is thought to either alter directly the pristine δ^2H values of the smectite clay minerals or to introduce organic hydrogen-bearing impurities through the ineffective removal of organic matter. The objective of the present study was to test whether H_2O_2 treatment can alter the δ^2H values of kaolinite (Kln) by comparing two organic matter-removal methods, namely, H_2O_2 and disodium peroxodisulfate ($Na_2S_2O_8$) combined with a neutral buffer. In doing so, kaolinite-rich, old (~56 Ma) sediment samples and pure kaolinite internal laboratory reference materials were used to understand the effectiveness and suitability of the above-mentioned methods in clay-sample preparation for δ^2H measurements. The δ^2H values of the H_2O_2-treated aliquots show smaller δ^2H values than those for the $Na_2S_2O_8$-treated aliquots. Estimated ambient water $\delta^{18}O$ values (−4‰) from the $Na_2S_2O_8$-treated aliquots agreed well with the bio-phosphate (fish vertebrae) based environmental water $\delta^{18}O$ estimation (−3.3‰). The present study indicated, therefore, that δ^2H values obtained after $Na_2S_2O_8$ treatment are likely to be more realistic for paleoclimate reconstruction.

Keywords δ^2H · Early-Eocene equatorial precipitation · Kaolinite · Organic matter-removal method

Introduction

The geochemistry of authigenic (both neoformed and transformed; Pozo & Calvo, 2018) clay minerals, particularly oxygen ($\delta^{18}O$) and hydrogen (δ^2H some time referred to as δD) isotopic compositions, is a potential tool for quantitative reconstruction of past climates (Andrzejewski & Tabor, 2020; Bukalo et al., 2019; Gilg, 2000; Gilg et al., 2004; Girard et al., 2000; Oyebanjo et al., 2018; Tabor & Montañez, 2005). Complete removal of organic matter from the soil/sediment samples without affecting the mineral phase is a prerequisite for studying the structure, physicochemical

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A simple but improved protocol for measuring carbon and oxygen isotope ratios of calcite in calcite-dolomite mixtures

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ABSTRACT

The extraction of stable carbon and oxygen isotope ratios ($\delta^{13}C$ and $\delta^{18}O$) of primarily precipitated calcite from partially dolomitized limestone is of prime interest because the $\delta^{13}C$ and $\delta^{18}O$ values of primary calcite are widely used in paleoclimate research. The differential acid extraction method (DAE) has been widely used to separate CO_2 evolved during the calcite-orthophosphoric acid reaction from CO_2 evolved from the dolomite-orthophosphoric acid reaction. However, the various laborious offline methods with inevitable uncertainties make DAE very challenging. We proposed a fully automatic-online DAE method in the present study, using an autosampler-GasBench II-Isotope Ratio Mass Spectrometer (IRMS). The results show that δ-values of calcite can be obtained from the mixture (grain size between 180 and 250 μm) having >50% calcite after ~15–100 min of reaction with orthophosphoric acid at 30 °C. Further, both the precision and the accuracy of the measurement using the autosampler-GasBench II-IRMS can be improved by attaching micro-vibrators to the sample tray.

1. Introduction

The carbon and oxygen isotopic composition ($\delta^{13}C$ and $\delta^{18}O$) of marine and non-marine carbonates have long been used to decipher the past climate, ecology, and vegetation history (Zachos et al., 2001; Sanyal et al., 2004; Song et al., 2013). However, primarily precipitated marine and non-marine carbonates are very susceptible to post-depositional alterations (Murray and Pray, 1965; Bathurst, 1983), thereby restricting their wide use in geologically old samples. The initially precipitated calcite ($CaCO_3$) in a limestone, upon the presence of Mg-rich fluids, re-precipitates as dolomite ($CaMg(CO_3)_2$), and therefore mild/partially dolomitized limestones are ubiquitous in sedimentary environments (Degens and Epstein, 1964; Murray and Pray, 1965; Fritz and Smith, 1970; Bathurst, 1983; Boggs, 2014). The co-existence of calcite and dolomite in an altered limestone makes it challenging to decipher the paleo-environmental signatures using the $\delta^{13}C$ and $\delta^{18}O$ values of the bulk limestone (using conventional acid-digestion) because the $\delta^{13}C$ and $\delta^{18}O$ values of the bulk limestone gives mixed signals coming from both initially precipitated calcite and re-precipitated/diagenetic dolomite.

Because of their similar physical properties, the physical separation of admixed calcite and dolomite is considered a herculean task. The futile attempts at the physical separation of calcite and dolomite inspired the development of a chemical separation method known as the differential acid extraction (DAE) method, first suggested by Epstein et al. (1964). The DAE method uses the differences in calcite and dolomite's reaction rates with orthophosphoric acid (H_3PO_4; referred to as acid at places). Since calcite reacts faster with acid, the CO_2 produced from the calcite will contribute more during the early stage of the reaction. However, it is not as simple as it seems since the reaction rates of calcite and dolomite overlap, depending upon many parameters, e.g., grain size, reaction temperature, dolomite stoichiometry, and possible interference resulting from isotopic kinetic/non-equilibrium fractionation during partial/incomplete acid reaction (Al-Aasm et al., 1990; Baudrand et al., 2012; Liu et al., 2019).

Many studies proposed various reaction protocols for separating calcite and dolomite from mixtures of varying proportions (Epstein et al., 1964; Wada and Suzuki, 1983; Walters et al., 1972; Matsumoto and Matsuda, 1988; Al-Aasm et al., 1990; Pleydell et al., 1990; Böttcher et al., 1998; Ray and Ramesh, 1998; Kyser et al., 2002; Yui and Gong, 2003; Liu et al., 2019; Du and Song, 2020) by constraining the grain size, reaction temperature, and dolomite stoichiometry. The plethora of DAE methods indicates the difficulty in proposing one DAE method acceptable to all varieties of altered limestones, which is quite understandable, considering the possible chemical and mineralogical variations resulting

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New findings and appraisal of structural control on polygonal impact crater rim-geometry, a study from Mare Fecunditatis, Moon

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Highlights

- Explaining control on polygonal crater rim geometry, Mare Fecunditatis, Moon.
- Map of structural features of the study area, the Mare Fecunditatis, Moon.
- Trend comparison of structural features with polygonal impact crater rim segments.
- Geometry of polygonal impact craters was possibly controlled by pit crater chains.
- Faults associated with wrinkle ridges and grabens had no influence on the same.

Abstract

Polygonal Impact Craters (PICs), having a distinct polygonal rim geometry, are common on terrestrial planets, their natural satellites such as Earth's Moon and the asteroids. The straight segments of PIC-rims are arguably subparallel or oblique to existing fracture/fault planes in their vicinity, and such pre-existing structural weak planes are considered responsible for the shape of the PICs. The Mare Fecunditatis, a lunar maria, preserves mappable PICs as well as different geomorphic features like wrinkle ridges, grabens and pit crater chains which owe their origin to either compressional or extensional faulting. To understand the structural control, if any, on the PIC-rim geometry in Mare Fecunditatis, PICs, both simple and complex, and the deformational features are mapped, superposition relations between them are observed and trends are compared. The comparison between frequency of rim segment trends of the two types of PICs with wrinkle

Imprints of vehicular pollution in roadside dust from Kolkata, India: insights from magnetic susceptibility, geo-statistical and SEM studies

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The present study aimed to determine the magnetic susceptibility of roadside dust collected from different parts of Kolkata city, West Bengal, India. The average value of susceptibility was 4.96×10^{-6} m^3/kg, the highest being 19.6×10^{-6} m^3/kg and the lowest being 1.2×10^{-6} m^3/kg. The frequency-dependent susceptibility value (average = 2.19) indicated the dominance of stable-single domain grains with a low concentration of superparamagnetic grains at a few locations. SEM analysis showed morphological diversity of road dust – irregular, aggregate, angular and cloudy. Energy dispersive X-ray spectroscopy analysis of the dust particles revealed that Ca-rich, Na-rich and Fe-rich particles were abundant. Compositions were variable with the morphology. The mapping of magnetic susceptibility indicated that the susceptibility values were higher in areas with heavy vehicular traffic and other polluting sources. However, some areas with high pollution had open spaces, indicating the dispersion of magnetic pollutants. The study indicated the degradation of the environment due to anthropogenic activities.

Keywords: Anthropogenic activities, magnetic susceptibility, morphological study, roadside dust, vehicular pollution.

INDUSTRIALIZATION coupled with high population density in the Indian subcontinent has led to a contaminated milieu, especially in large cities like Kolkata in West Bengal. This is due to vehicular traffic and industrial emissions associated with fly-ash particles[1–6]. Most of these environmental contaminants of varied sources and origins are magnetic[7]. Also, magnetic grain size and composition are important to identify the precise source of magnetic contaminants[1]. The contribution of anthropogenic contaminants in metropolitan cities due to vehicular traffic globally dominates over natural causes[1–3,6–9].

Environmental magnetism can act as a dependable non-destructive tool for assessing pollution[10–13]. The principle behind the application of magnetic techniques in the study of environmental pollution is to measure the magnetic properties (magnetic susceptibility in the present case) of the samples under consideration. It is well known that magnetite is a common component of roadside dust. Thereby a positive correlation develops between the concentration of magnetite and toxic elements[14,15]. Magnetite in road dust comes from several sources. The emission from automobiles caused by burning fossil fuels is the most prominent of them. Smelting, abrasion of asphalt-top roadways and vehicle brake systems contribute to magnetic contaminants.

Thompson and Oldfield were the pioneers in research on environmental magnetism[16–19]. Subsequently, Kapicka *et al.*[8] and Hoffman *et al.*[2] carried out magnetic susceptibility mapping in the Czech Republic and Tuebingen, Germany respectively. These studies brought out an interesting association between pollutants and magnetic particles. Boyko *et al.*[7] carried out magnetic susceptibility measurements of the topsoil for validating pollution intensity studies over the long term. In India, Goddu *et al.*[1] reported the magnetic characteristics of road dust from Visakhapatnam city in Andhra Pradesh and Mondal *et al.*[20] from the Bandel–Triveni area in West Bengal. In the present study, we demarcate the degree of environmental pollution by mapping the magnetic susceptibility from road dust samples collected in different parts of Kolkata.

Materials and methods

Study area

Kolkata extends in a roughly north–south direction along the eastern bank of the Hooghly River in eastern India[21]. As a part of the Indo-Gangetic Plains, the soil of the study area is of alluvial origin. According to the geologic setting, Kolkata is located in the peri-cratonic Tertiary Bengal Basin[22]. The climate is tropical wet and dry, which can be designated as 'Aw' under Koppen climatic classification[23]. Kolkata city, which is under the jurisdiction of the Kolkata Municipal Corporation (KMC), has an area of 185 sq. km. The western boundary is marked by the Hooghly River

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Morinda citrifolia L. (Noni) dietary supplementation ameliorates fluoride toxicity in the freshwater fish, *Cyprinus carpio* L.

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Fluoride is the organic and inorganic compound of the element fluorine, has detrimental effect to all animals including fish at higher concentration. Ground water with elevated concentration of fluoride is a major global problem including India. On the other hand, *Morinda citrifolia* (also called 'Noni' in Polynesia) is a medicinal plant, has antioxidative, anti-inflammatory and immunostimulatory properties. The ameliorating effect of *M. citrifolia* fruit extract dietary supplementation against fluoride induced toxicity on the growth performance, haematological parameters, and fluoride accumulation in the muscular tissue was investigated in the freshwater fish, *Cyprinus carpio* L. for 35 days in triplicate. One hundred and twenty acclimated *C. carpio* fingerlings were randomly allocated into five experimental groups (Groups I, II, III, IV and V) each with 24 fish divided into three replicates (eight fish/replicate). Group I (Control) and II (Toxic control or negative control) were provided with basal/control diet, whereas groups III, IV, and V were provided with 0.25% (2.5 g/kg), 0.50% (5.0 g/kg) and 0.75% (7.5 g/kg) *M. citrifolia* fruit extract supplemented diet respectively. All groups except for group I were exposed to 10% of the LC_{50} of fluoride. Selected growth and haematological parameters were estimated. The fluoride content in the muscular tissue of fish was also estimated following SPADNS method. Results revealed that exposure of sublethal concentration of fluoride significantly (P <0.05) reduced the growth performance and haematological parameters in Gr. II (toxic control) compared to the Gr. I (control). However, *M. citrifolia* dietary supplementation significantly (P <0.05) improved fluoride induced alteration of growth performance and haematological parameters of fish in the groups III, IV and V compared to Gr. II. *Morinda citrifolia* fruit extract dietary supplementation also significantly (P <0.05) decreased the accumulation fluoride in the muscular tissue of fish in groups III, IV and V compared to the Gr. II (toxic control). In conclusion, *M. citrifolia* dietary supplementation ameliorates the fluoride toxicity by preventing the accumulation of fluoride in the muscular tissue of the fish. The *M. citrifolia* dietary supplementation at 0.25% showed the best response, hence it is considered as the optimum dose.

Keywords: Aquatic pollution, Common carp, Dietary supplement, Trace elements

Fluorine is the most electronegative and highly reactive of all elements, form fluoride ion (F^-) by ionization. It occurs in 296 species of minerals but abundantly present in fluorite, fluorapatite, topaz and cryolite which are easily soluble in water, resulting in higher concentration in ground water[1]. Although fluoride has beneficial effect at lower concentration (0.5-1.0 mg/L) in growth and development of bone and teeth, but it causes dental- and skeletal fluorosis at higher concentration (>1.5 mg/L)[2]. Elevated concentration of fluoride in ground water is an endemic in different countries of the world, including India[3]. Fluoride contaminated ground water is prevalence in 23 out of 37 states and union territories of India[4] including West Bengal[5]. Having neurotoxicity of fluoride in the human development, several epidemiological studies placed it in the same category with toxic metals like lead, methyl mercury, arsenic, and polychlorinated biphenyls[6]. Several studies reported the detrimental effects of fluoride in animals including fish[7-13].

Morinda citrifolia L. (also called 'Noni' in Polynesia and 'Indian Mulberry' in India), a small evergreen tree of the family Rubiaceae is a well known medicinal plant in Southeastern Asia[14,15]. It is used in the treatment of many diseases like diabetes, high blood pressure, arthritis, hypertension, heart diseases, headache and fever[16]. *M. citrifolia* has antioxidant[17,18], anti-inflammatory[19-21], immunostimulatory[22] and antimicrobial[23] activities.

The common carp, *Cyprinus carpio* L (Cyprinidae) has been recognized as a suitable model organism for

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ANALYSIS THE IMPACT OF GROWTH WITH DIFFERENT SALINITY LEVELS OF CRABS *(Scylla serrata)*

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ABSTRACT: To ascertain the impact of various salinity levels on the survival and growth of Crablings of the mud crab (*Scylla serrata*) an experiment lasting eight weeks was carried out in a laboratory setting. The various salinity levels were examined (5 ppt, 10 ppt, 15 ppt, 20 ppt, and 25 ppt). The variations in growth increment in terms of body weight (BW) between various salinity treatments were significant (p 0.05). Significant (p 0.05) results were reported for the specific growth rate (SGR%/day) values at 5 ppt, 10 ppt, 15 ppt, 20 ppt, and 25 ppt, respectively. Crablings survival rates were found to be highest at 25 ppt and lowest at 5 ppt (p 0.05). The findings showed that the survival and growth of mud Crablings were significantly impacted by an increase in salinity from 5 ppt to 25 ppt. Polysaccharides are abundant in crabs, and those polysaccharides have a variety of pharmacological effects. $CaCO_3$ levels increased under stress, but $CaSO_4$, $CaPO_4$, and amino acids were at low levels. Asthma, cancer, hypertension, and giddiness are just a few of the ailments that can be treated with shellfish. Up to 90% of the total lipid content of crabs is made up of fatty acids. Crab is a good source of omega- 3 fatty acids, which are crucial in the treatment of many disorders.

KEY WORDS: Impact, Growth, Salinity Levels, Crabs and Fisheries

INTRODUCTION

A kind of crab known as *Scylla serrata*, sometimes known as mud crab, mangrove crab, or black crab, is significant economically. Mangroves are a type of tropical coastal vegetation. It is primarily found in the oceans of Africa, Asia and Australia (Keenan et al., 1998). Due to its usefulness, some nations have either contemplated using it in aquaculture or stock development programmes (Fushimi and Watanabe, 1999). Due to its size and high-quality meat, it is in high demand everywhere in the world (Marichamy and Rajapackian, 2001). Given its significant, market position in the fishing industry and rising landings over time, *S. serrata* is in constant demand (Allan and Fielder, 2003). *S. serrata* is regarded as one of the tastiest crab species, and because they can be cooked with their shells on, it is highly valued in places like Australia and South and South-east Asia. It is fast expanding and has a lot of flesh (FAO, 2012). The many life stages of *S. serrata* are widely farmed in various oceanic regions due to the strong demand for them. China, Philippines, Bangladesh, Indonesia, and India are the top exporting nations. Over the past few decades, there has been an increase in the output of mud crabs. More than 138 000 tonnes of mud crab (*S. serrata)* were produced in aquaculture in Asia and Africa in 2008, with a value of around USD 377 million.

SHODHASAMHITA
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TO STUDY ABOUT THE EFFECTS OF SALINITY ON GROWTH AND SURVIVAL OF CRABS *(Scylla serrata)*

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ABSTRACT Over the course of the experiment, a number of treatment combinations produced 100% survival with up to 16% daily growth rates appearing to be good. This would suggest that the experimental setups and methods formed a suitable experimental culture conform-for this species, ditions. According to the findings, young mud crabs (*S. serrata*) may survive in a wide range of salinity and temperature conditions, albeit deviations from these ideal values will have a significant impact on their ability to grow, survive, and produce. In this experiment, temperature had by far the greatest impact on the survival and growth of the organisms (for salinities between 5 ppt and 40 ppt). The temperature impact explained more variation in growth than the salinity influence did for any growth indicator evaluated in this experiment. The temperature and salinity both influenced the growth of the blue crab (*Callinectes sapidus*), although temperature had a bigger impact. These findings are similar to those of the present experiment.

KEY WORDS: Effects, Salinity, Growth, Survival, Crabs, Indicator Evaluated, Experiment

INTRODUCTION

Recent collaborative research on mud crabs of the genus *Scylla* has been conducted internationally, and advances in hatchery technology have been achieved to provide seed stock (Ruscoe et al., 2004). These moderately large crabs are typically found in the mangrove systems and the intertidal and sub-tidal zones of estuaries in the Northern Territory of Australia (O'Grady et al., 2003). The 5-month warm, wet season and the 7-month colder, dry season that make up this shallow-water tropical climate expose the crabs to significant annual, and even daily, variations in temperature and salinity. *S. serrata* is a desirable candidate for aquaculture because of its apparent wide range of temperature and salinity tolerances, which are supported by its natural range and preferred environment. To optimize industry development and farm practices, it is vital to characterize the impacts of temperature and salinity on crab performance.

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$P-V$ criticality of the nonlinear charged black hole solutions in massive gravity's rainbow

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In this paper, we explore the black hole solutions with the rainbow deformed metric in the presence of the exponential form of the nonlinear electrodynamics with asymptotic Reissner–Nordström properties. We calculate the exact solution of metric function and explore the geometrical properties in the background of massive gravity. From the obtained solution, the existence of the singularity is confirmed in proper limits. Using the solutions, we also investigate the thermodynamic properties of the solutions by checking the validity of the first law of thermodynamics. Continuing the thermodynamic study, we investigate the conditions under which the system is thermally stable from the heat capacity and the Gibbs free energy. We also discuss the possible phase transition and the criticality of the system. It was found that the quantum gravitational effects of gravity's rainbow render the thermodynamic system stable in the vicinity of the singularity. Hence, we obtained a first-order phase transition which is interpreted as the large/small black hole phase transition. From the equation of state, it was

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Klein–Gordon oscillator with scalar and vector potentials in topologically charged Ellis–Bronnikov-type wormhole

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In this work, we study the Klein–Gordon oscillator with equal scalar and vector potentials in a topologically charged Ellis–Bronnikov wormhole space-time background. The behaviour of a relativistic oscillator field is studied with a position-dependent mass via transformation $M^2 \to (M + S(x))^2$ and vector potential through a minimal substitution in the wave equation. Simplifying the Klein–Gordon oscillator equation for three different types of potential, such as linear confining, Coulomb-type, and Cornell-type potential and we arrive at a second-order differential equation known as the biconfluent Heun (BCH) equation and the corresponding confluent Heun function. Finally, we solve the wave equation by the Frobenius method as a power series expansion around the origin and obtain the energy levels and the wave function.

Keywords: Klein–Gordon oscillator; confluent Heun equation; topological defects; Ellis–Bronnikov-type wormhole; solutions of bound states.

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1. Introduction

It is known that phase transitions are associated with breaking of symmetry in condensed matter physics. Analogically it is expected to have objects in cosmological systems which can be termed as topological defects [1]. From the physical point of view topological defects are structures that divide a physical system into two or more physical states [2]. However from the mathematical point of view, they

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A time-dependent spacetime in $f(R,T)$ gravity: Gravitational collapse

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In this note, a time-dependent spacetime is explored in the background of $f(R,T)$ gravity via the gravitational collapse of a massive star. The star is modeled by the Vaidya spacetime which is time-dependent in nature. The coupling of matter with curvature is the key feature of $f(R,T)$ theory and here we have investigated its effects on a collapsing scenario. Two different types of models, one involving minimal and the other involving nonminimal coupling between matter and curvature are considered for our study. Power law and exponential functionalities are considered as examples to check the outcome of the gravitational collapse. A detailed analysis on the appearance of horizons in Vaidya spacetime is performed and its astrophysical implications are explored. Our prime objective is to explore the nature of singularities (black hole or naked singularity) that form as an end state of the collapse. Existence of outgoing radial null geodesics from the central singularity was probed and such existence implied the formation of naked singularities thus defying the cosmic censorship hypothesis. The absence of such outgoing null geodesics would imply the formation of an event horizon and the singularity formed becomes a black hole. Conditions under which such possibilities occur are derived for all the models and sub-models. Gravitational strength of the singularity is also investigated and the conditions under which we can get a strong or a weak singularity is derived. The results obtained are very interesting and may be attributed to the coupling between curvature and matter. It is seen that for nonminimal coupling there is a possibility of a globally naked singularity, whereas for a minimal coupling scenario local nakedness is the only option. It is also found that the singularity formed can be sufficiently weak in nature, which is cosmologically desirable.

Keywords: Gravitational collapse; modified gravity theory; black hole; naked singularity; Vaidya spacetime.

1. Introduction

For the last two decades we have been aware of the fact that our universe has entered into a phase of accelerated expansion.[1,2] Although this came as a total surprise to

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Energy–momentum squared symmetric Teleparallel gravity: $f(Q, T_{\mu\nu}T^{\mu\nu})$ gravity

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ABSTRACT

In this work we propose the $f(Q, T_{\mu\nu}T^{\mu\nu})$ gravity as a further extension of the $f(Q)$ and $f(Q, T)$ gravity theories, where Q is the non-metricity and $T_{\mu\nu}$ is the energy–momentum tensor. The action involves an arbitrary function of the non-metricity Q and $\mathbf{T}^2 = T_{\mu\nu}T^{\mu\nu}$ in the gravity Lagrangian. The field equations for the theory are derived in the metric-affine formalism. The theory involves a non-minimal coupling between the geometric and the matter sectors, and hence the covariant divergence of the energy–momentum tensor is non-zero, thus implying the non-conservation of the same. The vacuum solutions of the theory are investigated and it is found that the theory perfectly admits a de-Sitter-like evolution of the universe. The cosmological equations are derived and it is found that there are two correction terms arising as modification of the gravity. Two specific toy models of the form $Q+\eta\left(\mathbf{T}^2\right)^n$ and $f_0Q^m\left(\mathbf{T}^2\right)^n$ are explored to gain further insights into the dynamics of the theory. It is seen that the field equations of both the models have terms similar to those arising from the quantum gravity effects and are thus responsible for the avoidance of the singularity. One striking feature of the model is that the non-linear correction terms dominate in the early universe and gradually fade away at later times giving standard FLRW universe. Solutions for the FLRW equations are found wherever possible and the evolution of the scale factor and the matter energy density is plotted. Other cosmological parameters like the equation of state, deceleration parameters and Hubble functions are also studied. Finally the energy conditions are explored in the background of the theory. Using these conditions and some observational data the parameter spaces of the models are considerably constrained. $f(Q, T_{\mu\nu}T^{\mu\nu})$ is a theory that can perfectly explain the cosmological dynamics of both the early and the late universe without resorting to any dark energy.

1. Introduction

Currently the most comprehensive theory of gravity available to us is the theory of General Relativity (GR) [1] proposed by Albert Einstein in 1916. After a century of extensive research GR has been able to survive quite well with many of its predictions coming true. Some of them being the perihelion precession of mercury, deflection of light by sun [2], gravitational redshift [3], detection of gravitational waves [4] from the mergers of black holes and neutron stars, imaging a black hole shadow in the M87 galaxy by the Event horizon telescope [5], etc. Extensive reviews in experimental and observational tests of GR can be found in [6,7]. Nevertheless some observations did not go in favour of GR, quite expectedly. The most important one being the discovery of the late cosmic acceleration [8,9] at the turn of the last century. With this observation to light, GR became incompatible at cosmological distances. One more important observation was that GR was not able to explain the gravitational interaction at the quantum level. Moreover standard cosmology is plagued by problems like the singularity problem, cosmological constant problem, cosmic coincidence problem, etc. So it is clear that we are far from the theory that we need to comprehensively explain our observations. This provided motivation for extensive theoretical research in cosmology over the past century. With the development of quantum mechanics throughout the last century, scientists including Einstein took up the challenge of developing a proper theory of quantum gravity. As a result theories like string theory, loop quantum gravity theory, etc. were proposed, but till date they are far from being comprehensive. To resolve the incompatibility of GR at cosmological scales mainstream research has travelled in two different ways. The first path is the theory of dark energy (DE) where the matter content of the universe is modelled by an exotic fluid with negative pressure driving the acceleration. Extensive reviews on DE can be found in [10]. The alternative path is the theory of modified gravity, where the gravitational framework of GR has been modified to incorporate the cosmic acceleration. See [11–13] for extensive reviews

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Editorial: From the hydrophobic core to the globular-disorder interface: New challenges and insights into protein design

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protein design, intrinsically disordered proteins (IDPs), disorder—globular interface, mutational scanning, disorder transitions in proteins, prediction of protein-protein binding sites of IDPs, multi-step electron-transfer activity, high throughput approach

Editorial on the Research Topic
From the hydrophobic core to the globular-disorder interface: New challenges and insights into protein design

The biophysical foundations of protein folding (Dill and MacCallum, 2012) still remain largely unexplained despite the many years of intensive experimental (Dobson, 2004) and computational research (Callaway, 2020; Jumper et al., 2021). It is rightly believed that the most objective way of probing our understanding of the basic principles of protein folding is reflected in the ability to successfully resolve the 'inverse protein folding" problem (Yue and Dill, 1992); i.e., the capability to rationally design functional proteins, *de novo*. In recent years, the field has undoubtedly become diverse and complex, with the design of fold-switch proteins, proteins with targeted functional modulations etc.—one of the unmet goals of the latter of which is to aid 'protein therapy' (Dimitrov, 2012; Blazeck et al., 2022; Svilenov et al., 2022).

Furthermore, since the discovery of intrinsically disordered proteins (IDPs), with their characteristic binding promiscuity attributed to their physical flexibility, attempts to understand and design protein disorder transitions (Bandyopadhyay and Basu, 2020; Roy et al., 2022) and to address the "globular/ordered–disordered" evolutionary interface (Nagibina et al., 2020) in proteins are among the most intriguing challenges in this field. It is but natural that designs of ordered proteins and IDPs should use different principles and the field is enriching with ideas and findings on both (Figure 1). For example, in globular proteins, a given protein fold (or a hydrophobic core) can be modulated by the alternative modes of side-chain packing (Basu et al., 2011; Biswas et al., 2022), whereas in IDPs, the disorder-to-order transitions can be triggered by cumulative point mutations (Basu and Biswas, 2018). Although there are not yet general evolutionary rules regarding the origin of disordered and globular proteins, instances of successful design (for example) of folded globular repeats from disordered ancestors (Zhu et al., 2016) have raised much hope. A successful endeavor along these directions is of high biophysical and mechanistic

pharmaceutics

MDPI

Article

Phosphorylcholine and KR12-Containing Corneal Implants in HSV-1-Infected Rabbit Corneas

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Abstract: Severe HSV-1 infection can cause blindness due to tissue damage from severe inflammation. Due to the high risk of graft failure in HSV-1-infected individuals, cornea transplantation to restore vision is often contraindicated. We tested the capacity for cell-free biosynthetic implants made from recombinant human collagen type III and 2-methacryloyloxyethyl phosphorylcholine (RHCIII-MPC) to suppress inflammation and promote tissue regeneration in the damaged corneas. To block viral reactivation, we incorporated silica dioxide nanoparticles releasing KR12, the small bioactive core fragment of LL37, an innate cationic host defense peptide produced by corneal cells. KR12 is more reactive and smaller than LL37, so more KR12 molecules can be incorporated into nanoparticles for delivery. Unlike LL37, which was cytotoxic, KR12 was cell-friendly and showed little cytotoxicity at doses that blocked HSV-1 activity in vitro, instead enabling rapid wound closure in cultures of human epithelial cells. Composite implants released KR12 for up to 3 weeks in vitro. The implant was also tested in vivo on HSV-1-infected rabbit corneas where it was grafted by anterior lamellar keratoplasty. Adding KR12 to RHCIII-MPC did not reduce HSV-1 viral loads or the inflammation resulting in neovascularization. Nevertheless, the composite implants reduced viral spread sufficiently to allow stable corneal epithelium, stroma, and nerve regeneration over a 6-month observation period.

Keywords: HSV-1 infection; corneal implant; RHCIII-MPC; KR12; nanoparticles; rabbits; regeneration

1. Introduction

Herpes Simplex Virus serotype 1 (HSV-1) infection is the leading infectious cause of unilateral corneal blindness in developed nations and the third most common indication for patients requiring corneal transplantation worldwide [1–6]. A million new and 9,000,000 recurrent cases are reported each year globally [7]. Severe infections are accompanied by

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ORIGINAL PAPER

EnCPdock: a web-interface for direct conjoint comparative analyses of complementarity and binding energetics in inter-protein associations

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Abstract

Context Protein–protein interaction (PPI) is a key component linked to virtually all cellular processes. Be it an enzyme catalysis ('classic type functions' of proteins) or a signal transduction ('non-classic'), proteins generally function involving stable or quasi-stable multi-protein associations. The physical basis for such associations is inherent in the combined effect of shape and electrostatic complementarities (Sc, EC) of the interacting protein partners at their interface, which provides indirect probabilistic estimates of the stability and affinity of the interaction. While Sc is a necessary criterion for inter-protein associations, EC can be favorable as well as disfavored (e.g., in transient interactions). Estimating equilibrium thermodynamic parameters ($\Delta G_{\text{binding}}$, K_{d}) by experimental means is costly and time consuming, thereby opening windows for computational structural interventions. Attempts to empirically probe $\Delta G_{\text{binding}}$ from coarse-grain structural descriptors (primarily, surface area based terms) have lately been overtaken by physics-based, knowledge-based and their hybrid approaches (MM/PBSA, FoldX, etc.) that directly compute $\Delta G_{\text{binding}}$ without involving intermediate structural descriptors.

Methods Here, we present EnCPdock (https://www.scinetmol.in/EnCPdock/), a user-friendly web-interface for the direct conjoint comparative analyses of complementarity and binding energetics in proteins. EnCPdock returns an AI-predicted $\Delta G_{\text{binding}}$ computed by combining complementarity (Sc, EC) and other high-level structural descriptors (input feature vectors), and renders a prediction accuracy comparable to the state-of-the-art. EnCPdock further locates a PPI complex in terms of its {Sc, EC} values (taken as an ordered pair) in the two-dimensional complementarity plot (CP). In addition, it also generates mobile molecular graphics of the interfacial atomic contact network for further analyses. EnCPdock also furnishes individual feature trends along with the relative probability estimates (Pr_{fmax}) of the obtained feature-scores with respect to the events of their highest observed frequencies. Together, these functionalities are of real practical use for structural tinkering and intervention as might be relevant in the design of targeted protein-interfaces. Combining all its features and applications, EnCPdock presents a unique online tool that should be beneficial to structural biologists and researchers across related fraternities.

Keywords Protein–protein interactions (PPI) · Complementarity · Complementarity plot (CP) · Binding free energy ($\Delta G_{\text{binding}}$) · Support vector regression machines · Feature trends · EnCPdock

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ORIGINAL PAPER

Commercial Initiation of Feather Hydrolysate as Supreme Fertilizer: A Smart Bio-Cleaning Strategy of Poultry Waste

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Abstract

Purpose Economic development of India mainly depends on agricultural sectors. The Indian traditional agricultural system is mainly based on chemical fertilizer to get better yield. The main motto of this research work is to change the traditional faith of Indian farmers and rural Indian economy.

Methods Bioprocessing of feather prepared from an efficient newly isolated bacterial strain, identified as *Bacillus wiedmanni* SAB 10 is used to produce a nitrogen rich liquid fertilizer. The cell-free hydrolysate was prepared from submerged fermentation of poultry litter (1.25%, w/v) as sole media with supplemented as chicken feather (1%, w/v) in 79.41 h with pH 10.6.

Results Fermented hydrolysate contains a significant quantity of total amino acid (503.02 mg/L) with diversity (Cystine, Phenylalanine, Tyrosine, lysine, Valine, Proline and Alanine), total oligopeptides (4.65 mg/ml) and thiol content (58.09 µg/ml) which influence growth and yield (1.02 fold) of moong beans (*Vigna radiata*) plant in pot trials and as well as successfully scale up in field trials by the farmers. This liquid fertilizer not only makes plant healthy and has drought tolerance (proline content- 0.023 mg/g) capacity but also increases the grain quality by spraying the fertilizer on foliage with a ratio of 2:1 (Water: Feather hydrolysate) for two times (before the 1st flash and 2nd flash of flowering).

Conclusion Fermented feather hydrolysate is used full as a foliage fertilizer for the cultivation of moong beans. Some commercial properties and its eco-friendly, cost-effectiveness will make it a smart liquid fertilizer in near future.

Statement of novelty The Novalty of this tool is used for optimizing the growth/fermentation conditions for production of amino acids.

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Article

Green Assembly of Covalently Linked BiOBr/Graphene Composites for Efficient Visible Light Degradation of Dyes

Weiwei Tie, Surjya Sarathi Bhattacharyya, Cancan Han, Shuaibiao Qiu, Weiwei He,* and Seung Hee Lee*

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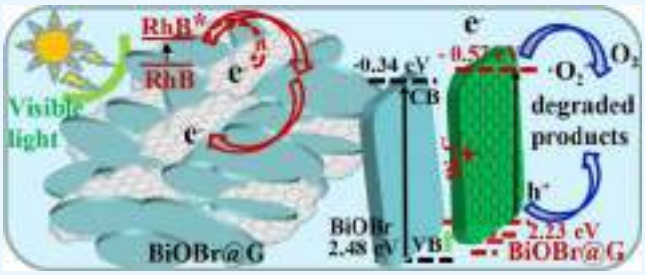
ABSTRACT: A novel high-performance BiOBr@graphene (BiOBr@G) photocatalyst with a new assembly structure had been demonstrated using a facile hydrothermal method through chemical bonding of reduced graphene oxide and structure-defined BiOBr flakes for improving charge separation and transfer performance, which were first synthesized at room temperature in immiscible solvents without corrosive acids. The prepared samples were characterized, and the BiOBr@G composite realized an efficient assembly portfolio of graphene and BiOBr flakes with defined structures, verified by scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction (XRD), and Raman and X-ray photoelectron spectroscopy (XPS), in which BiOBr flakes were covalently linked with the assembled graphene sheets through the Bi−C bond. This composite exhibited remarkable visible light absorbance and efficient photoinduced charge splitting characteristics in comparison with those of pure BiOBr, as established by DRS absorption, photoluminescence radiation, and photocurrent study. Hence, a very small amount (5 mg) of the BiOBr@G composite displayed a complete photodegradation effect on the rhodamine B dye under only 15 min of visible light excitation, which was three times faster than that of pure BiOBr and extremely superior to that of commercial P25. This was probably ascribed to the well-defined BiOBr structure itself, elevated light absorbance, and Bi−C chemical bond inducing quick charge separation and transfer in the BiOBr@G composite. Additionally, investigations on the photocatalytic mechanism displayed that the photogenerated holes in the BiOBr valence band and derivative superoxide radicals played vital roles in the photodegradation of RhB dyes, as reinforced by the electron spin resonance method, where the covalent linking of BiOBr and graphene served as an effective pathway for charge transportation.



1. INTRODUCTION

Organic dyes and pigments discharged into the environment mixed with industrial wastewater pose threats to human health and Mother Nature.[1,2] Efficient utilization of solar energy in terms of newly developed photocatalytic degradation technology has been identified as a clean and economic approach for toxicity removal from industrial liquid waste and hence reversing or stopping environmental damage.[3−6] Among the various semiconductor photocatalysts that have been developed, including TiO_2, ZnO, Ag_3PO_4, Bi_2WO_6, $BiVO_4$, and others, specific importance has been given to two-dimensional (2D) layered BiOBr fabricated by interleaving $[Bi_2O_2]$ slabs with slabs of double bromine. The band gap and internal interleaving electric field of 2D layered BiOBr are such that considerable photocatalytic activity can be achieved by visible light excitation.[7,8] However, individual BiOBr shows limited photocatalytic activity owing to least efficient captivation of visible light, sluggish charge transfer capability, and nonideal electron−hole pair separation efficiency.[9,10] Hence, research efforts have been made to fabricate composites of BiOBr with functional materials of recent interest such as graphene or graphitic-like flakes for developing advanced photocatalytic decontaminants, which open possibilities to combine favorable characteristics of both the materials.[11−15]

An atomic layer form of carbon with a π-conjugated aromatic structure and sp^2 bonding forms graphene. Additionally, oxygen-containing functional groups distinguish graphene oxide (GO) from graphene. Reduction of GO produces reduced graphene oxide (RGO), and it is commonly used as a precursor for simple and efficient fabrication of optimized composites due to graphene's unique properties such as exceptional electrical conductivity, huge specific surface area, and extraordinary transparency.[16−19] Thus, various BiOBr−

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Ambedkar's views on Social transformation and Buddhism: An Indian Experience

Dr. Satarupa Pal*

The caste system is deeply rooted in Hindu society. Since time immemorial, it has provided a rationale for preserving order in society by maintain hierarchy. We have seen so many challenges to this hierarchy in the form of various religious and social movements aimed at an egalitarian social order. In this respect, B. R. Ambedkar has been made an attempt on Buddhist ideologue. He focused on dehumanizing consequences of the Hindu social system in the pre-independence period. He tried to adopt religion as the [illegible] of reference for his new identity, and Buddhist [c]oncepts of society to redefine the social status of the [un]touchables. The mass conversions to Buddhism was [ta]ken place in the year 1956. The conversion event and [th]e resultant Ambedkarite Buddhism raise many [qu]estions. The focus of most of the work of Ambedkar's [has] been a rationalist critique of Hindu religion and social [syst]ems. Further, he employed notions of Enlightenment [ratio]nality to assess the impact of religious system on [hier]archical social structure and political discourse [illegible]am:1964). Amberdkar believed that justice must be [based] on the principles of liberty, equality and fraternity. [Ambe]dkar was very much eager to social transformation [by m]aking Indian society integrated in near future.

In this regard, Ambedkar embarked on a [illegible] Hinduism, more especially Hindu religious [illegible] emerged as a hegemonic system which [illegible] section of the population of their 'humanity' [illegible]

All the same it must be recognized that the [illegible] observe Caste not because they are inhuman [illegible] headed. They observe Caste because they are [illegible] religious. People are not wrong in observing Caste. [In] my view, what is wrong is their religion which has [in]culcated this notion of Caste. If this is correct, [then] obviously the enemy you must grapple with is not the people who observe Caste, but the Shastras which [taught] them this religion. Caste (Ambedkar, B.R. [illegible] (1979):68).

He focused his skills of textual criticism to critique the Hindu scriptures and pointed out inconsistencies [that] sustained the practice of varna system, turning it [into a] total ideology. His conversion to Buddhism must be [seen] in the context of such a critique of Brahmanism.

Dr. Ambedkar focused on two points of difference between Hinduism and Buddhism. We get an insight [into] his critique of Brhamanic order from those arguments. The first distinction he makes is on the basis of 'morality'. He conceded the view that morality is embedded in Buddhism. The idea of the Dhamma [put] forward by the Buddha referred to morality of the [illegible] order. The second issue is emphasized on the [illegible]

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Relevance of the reality of human life in Upanishad thought

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Man is one of the most advanced and thoughtful of all living beings in this world. Man can manage his life and society smoothly by his thinking power. Therefore, if you manage yourself through any environment or any thoughts in human life, life becomes beautiful, these are very relevant. If life can be managed through proper thinking, then life can be realized as a beautiful, fluent and joyful life. And if the truth of this thought cannot be judged, then maybe life is just a living being. But this is not the purpose of life. The real purpose of life is to search for the truth and match life with reality in terms of truth. This matching is called life and moving forward on the path of life is called life force. If one can move towards the main purpose of life by combining this true thinking and the power of life, then the meaning of life can be realized. Upanishads are our real helper in solving all these questions and all the problems of the living being. The Upanishads mention the truth of human life. Through which we can direct our thoughts in the path of many great ideals. Above all, by taking refuge in this Upanishad, we can understand the true nature of human life and through this truth, we will become eager to achieve the main goal of life by knowing the real truth.

Keywords- Action orientation, Pursuit of greater happiness, Value development, Epistemology

From birth to death, human life has to perceive various favorable and unfavorable experiences. But if from the beginning we know our truth to know the secret of life in our life and also by resorting to the knowledge of Upanishads if we try to understand the truth of human life then maybe our consciousness will rise. Without true consciousness, people are an illusion to society. Because consciousness brings consciousness, and consciousness gives people the opportunity to do new things and think new things. Therefore, in order to match the life in a beautiful way to the society and to make the society harmonious, people must be awakened to consciousness. What kind of consciousness or what kind of consciousness will awaken people and society will change that is, a harmonious society will be formed. Above all this sense is more needed. So what is the real consciousness and how it can be applied in human life, all these signs are found in the pages of Upanishad literature. That is, if a person falls upon the Upanishads with a pure mind, i.e., if he meditates on the Upanishads, then his full sense of consciousness will surely be awakened. If man cannot purify his mind then he will not find the means to survive in his life, so to know the true joy and mystery of life one must take refuge in the Upanishads. If you try to know this philosophical thought of Upanishad, a new consciousness gradually emerges in people and with that consciousness, people move towards the real secret of their life and learn to enjoy life properly. So to awaken the true consciousness one has to resort to the Upanishads, without the Upanishads this consciousness remains incomplete.

Objective

1. To develop life in the spirit of greater joy.
2. Savoring life to the fullest by immersing it in spirituality.
3. Finding the true source of religion.
4. To monitor the manifestation of the various ideologies of God.

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अभिज्ञानशाकुंतलम् : सामाजिक यथार्थ के आलोक में

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प्राचीन काल से लोगों ने सामाजिक रूप से उन्मुख तरीके से समाज का निर्माण करना सीखा है। मानव ने सामाजिक जीवन के युद्ध में स्वयं को शामिल कर वास्तविकता से संघर्ष करते हुए विभिन्न अनुभवों को संचित किया है। समाज लोगों को बहुत कुछ सिखाता है और हकीकत लोगों को अपनी उंगलियों से दिखाना सिखाती है। लेकिन यह समाज और वास्तविकता मिलकर विभिन्न विपरीत परिस्थितियों में लोगों को अलग-अलग चीजें सिखाते हैं, यह शिक्षा मानव जीवन में बहुत आवश्यक है। केवल नैतिक ज्ञान प्राप्त करने से लोग उचित शिक्षा प्राप्त नहीं कर सकते, क्योंकि लोगों को एक समय के लिए समाज का नेतृत्व करना होता है और कठिन वास्तविकताओं के सामने खुद का नेतृत्व करना होता है। इसलिए समाज और वास्तविकता का हमारे जीवन से गहरा संबंध है। अलग-अलग समय में समाज की जीवन तस्वीर अलग थी और उस समय की वास्तविक तस्वीर अलग थी। साथ ही अलग-अलग समय के मानव जीवन की जीवन शैली और कठोर वास्तविकता के संदर्भ को समझने के लिए हमें उन सामाजिक लोगों के साथ घुलना-मिलना होगा। लेकिन लोग समय की गति में हमेशा के लिए नहीं रह सकते। तो कुछ दस्तावेजों में उन सामाजिक और व्यावहारिक विचारों के निशान पाए जाते हैं। और इन दस्तावेजों में से एक किताब है। 'अभिज्ञान शकुंतला' नामक पुस्तक में कालिदास के समय के समाज और उसके व्यावहारिक संदर्भ और उससे संबंधित समकालीन विचारों को भी एक साथ लाया जा सकता है। यदि कालिदास द्वारा लिखित इस महान नाटक का एक चतुर पाठक अध्ययन कर सकता है और सामग्री को आत्मसात कर सकता है, तो वह उस समय और वर्तमान समय की जीवन शैली और वास्तविकता के बारे में जान सकेगा। दूसरे शब्दों में कहें तो 'अभिज्ञान शकुंतला' में पाया गया जीवन का चित्र और व्यावहारिक बोध हमारे जीवन को दूसरे स्तर पर ले जाता है।

सूचकांक ध्वनि - पत्नी शिक्षा, न्यायिक प्रणाली, निष्पक्ष आजीविका, सहायक

शोध पत्र के उद्देश्य -

1. उस काल में प्रचलित स्त्री शिक्षा के विषय की जानकारी देना।
2. समाज में न्याय व्यवस्था कितनी उन्नत थी, इस पर प्रकाश डालना।
3. समाज की प्रगति के लिए कराधान की व्यवस्था करना।
4. समाज के भीतर विभिन्न विचारधाराओं का संश्लेषण।

आश्रम शिक्षा सामाजिक तस्वीर में से एक है जिसे हम कालिदास द्वारा लिखित 'अभिज्ञान शकुंतला' नामक प्रसिद्ध नाटक के माध्यम से समझ सकते हैं। अर्थात् उस समय आम लोग आश्रमों में जाकर गुरुओं से वास्तविक शिक्षा प्राप्त करते थे। यदि हम उस समय के लोगों की जीवन शैली और नैतिक आदर्शों के दृष्टिकोण से आंक सकते हैं, तो यह देखा जाएगा कि लोग बहुत अधिक नैतिक और कर्तव्यनिष्ठ थे। अर्थात् मनुष्य को वास्तविक व्यक्ति बनाने वाली तपस्वी प्रणाली की पहचान कालिदास के प्रसिद्ध नाटक साहित्य से की जा सकती है। वहां गुरु के प्रति लोगों का प्रेम और आदर और उनके निर्देशानुसार विविध क्रियाएं करना और अक्षरश: उनके निर्देशों का पालन करना एक अलग भारतीय संस्कृति के लक्षण हैं। और न केवल कर्मकांड प्रणाली, आश्रम व्यवस्था की सुदृढ़ता के लिए, आश्रम व्यवस्था का मुख्य उद्देश्य उस समय लोगों को आध्यात्मिक शिक्षा के लिए ऊपर उठाना था। यदि लोगों को शिक्षा मिल जाए तो वे परमानंद में नैतिकता के साथ समाज के पथ पर चल सकते हैं। परन्तु वर्तमान समय में यह देखने में आता है कि इस आश्रम व्यवस्था के अभाव में अथवा वर्तमान में आश्रम व्यवस्था की शिक्षा व्यवस्था विद्यार्थियों पर लागू न होने के कारण समाज में न जाने कितनी अनैतिक घटनाएँ पल पल हो रही हैं। इसलिए यदि हम समाज को स्वस्थ, सामान्य और सक्रिय बनाना चाहते हैं और यदि हम मानव जाति को एक वास्तविक मानव संसाधन बनाना चाहते हैं, तो यह बहुत अच्छा है कि हम इस आश्रम प्रणाली के दर्शन को अपना सकें। इसलिए इस संसार में मोह के सारे बंधनों को छोड़कर जब मनुष्य वास्तविक शिक्षा प्राप्त करना चाहता है, तो उस शिक्षा के अलावा और कुछ भी उसके दिल को आकर्षित नहीं कर सकता और इसे आकर्षित न कर पाने के कारण लोगों के मन में एक अभूतपूर्व उदारता का जन्म होता है जिससे लोग दूसरे लोगों से प्यार करना सीखते हैं और लोगों के साथ खड़े होने की कोशिश करते हैं। इसलिए यदि हम एक स्वस्थ समाज का निर्माण करना चाहते हैं और वास्तविक वास्तविकता को समझना चाहते हैं, तो

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Divine Birth of Lord Buddha: In the light of Buddhacarita

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Asvaghosa is the famous Buddhist poet of Sanskrit literature in pre-Kalidasa period. He was a preacher, scholar, poet, philosopher, dramatist and musician. Asvaghosa is foremost among those who wrote poetry in the pre-Kalidasya period. Ashwaghosa's time was surrounded by a mysterious obsession. The poet community was divided between these two genres of writing - 'Kavyasastrat' and 'Shastrakavya'. Ashwaghosa concentrated on poetry in both these categories. He was a contemporary of King Kanishka in the first century AD and the court poet of Kanishka's royal court. We do not know anything special about his biography. According to popular legend, his mother's name is Subarnakshi. ParsvaBhagavatpada was his guru. Saket i.e. the city of Ayodhya was his residence after becoming Buddhist and Sannyas. He was born in a Brahmin family but later converted to Buddhism. For his erudition and genius, he was awarded the title of Mahakabi, Acharya, Mahabadin etc.

Legend has it that even the horses, mesmerized by his melodious voice, stopped eating grass and listened to his music. Seeing this incident, his sannyasin initiate Sugayaka named this poet as Ashwaghosh.

The tension of poetry is deep in the heart. Kavya or poetry makes the human heart pool a strange pool. And that is why, since ancient times, religious priests have resorted to poetry to present the mysterious information of philosophy and religion to the heart of the common people, the Buddhist poet Ashwaghosa, who was established in Pre-Kalidasya, was also attracted to poetry for this reason. We see a reflection of this in the following verse of Soundarananda Kavya

yanmokṣātkṛtamanyatra hi mayā tat kāvyadharmātkṛtam।
pātuṃtiktamivauṣadhaṃmadhuyutaṃhṛdyaṃkathaṃsyāditi।।saundarananda 18/63

That is, just as honey is needed for the consumption of bitter and bitter medicine, so it is better for the reader to sow the seeds of religious doctrine through poetry. And for this reason, Ashwaghosha took a vow to propagate Buddhism widely by writing poetic dramas after his asceticism. In his quest to spread Buddhism, he has three invaluable cars. Composed by - Buddhacharit, Soundarananda and ShariputraPrakaran. Of these, the first two are epics and the third is a scenario. Buddhcharita is a mature age composition of the poet and one of the best examples of his poetic craft.

Buddhacharita is an epic poem based on the life of Lord Buddha. It is divided into 28 sargas, but 17 sargas of the original epic are found in Sanskrit. Out of which the last 4 chapters are the work of a Nepali scholar, Amritananda. It is a rhetorical epic. In this epic poem, the poet has tried to express the harsh reality through a thoughtful description. By revealing the merciless form of decay, disease and death, the poet advises the people who are strongly addicted to material desires to renounce them and take initiation into Sannyas Dharma. This advice of the poet is expressed in the 'Kantasammit' language of the epic poem.

चण्डताण्डवम् : आधुनिक संस्कृत साहित्य में 'भाण'

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प्राचीन साहित्यिक आलोचकों ने साहित्य के संपूर्ण विषय को दो मुख्य श्रेणियों में विभाजित किया है- दृश्य काव्य और श्रव्य काव्य। दृश्य काव्य दृश्य होता है और श्रव्य काव्य श्रव्य होता है। मंच पर अभिनय के तमाशे से पटकथा का रस चखा जाता है। अत: दृश्य काव्य अभिनय प्रधान है। सामान्य तौर पर, नाटक नाटक के लिए एक शब्द है। लाक्षणिक भाषा में इसे 'रूपक' कहते हैं। लेकिन इसे 'नाट्य' और 'रूप' के रूप में भी सम्मानित किया जाता है। दशरूपककार धनंजय ने अपने ग्रन्थ नाट्य में अभिनय द्वारा नाटकीय वर-वधू की स्थिति का अनुकरण किया है - 'अवस्थानुकृतिर्नाट्यम्'। आचार्य भरत ने अपने नाट्यशास्त्र के प्रथम अध्याय में उल्लेख किया है- नाट्य संपूर्ण त्रिभुवन का प्रदर्शन है-

'लैलोकस्यास्य सर्वस्य नाट्यं भावनुकीर्तीतम्'।

सागर नंदी और अपनी पुस्तक 'नाटकलक्षणरत्नकोश' में नाटक रूप की परिभाषा के बारे में कहते हैं कि (सांसारिक) सुख और दुख ऋषियों के अनुसार मानव स्थिति के अभिनय के साथ संयुक्त हैं।

इस नाटकीय प्रदर्शन के माध्यम से, आंख बोधगम्य विषय पर केंद्रित है। इस दृश्यता या दृश्यता के लिए नेट का दूसरा नाम लाक्षणिक है- 'रूपं दृश्यतोच्यते'। साहित्य दर्पण के छठे अध्याय में स्थिति के अनुकरण को अभिनय कहा गया है - 'भवेदभिनयेऽवस्थानुकार:'। लाक्षणिक नामकरण के कारण के संदर्भ में दशरूप को कहा गया है- 'रूपकं तत् समारोपात्'। इसे (नाटकीय) रूपक रूप का पर्यायवाची कहा गया है। रूपक का मुख्य उद्देश्य या उद्देश्य संघर्ष के माध्यम से चलते या चलते हुए मानव जीवन की छवि को चित्रित करना है। भारत के अनुसार - कोई शास्त्र नहीं, कोई कला नहीं, कोई विज्ञान नहीं, कोई क्रिया या कोई समारोह नहीं है जो नाटकीय न हो-

न तच्छास्त्रं न तच्छिल्पं न सा विद्या न सा कला।
न स योगा न तत्कर्म यन्नाट्येहुस्मिन् न दृश्यते।।

इसमें कोई संदेह नहीं हो सकता कि भारत का नाट्यशास्त्र नाट्यशास्त्र पर उपलब्ध ग्रंथों में सबसे पुराना और सबसे प्रामाणिक है। यह पुस्तक चौथी-दूसरी ईसा पूर्व के आसपास लिखी गई थी; शतक पुस्तक नाटक और साहित्य की चर्चाओं से समृद्ध है। इस पुस्तक में नाटक की उत्पत्ति, नाटक रूप, रंगमंच, रस-भाव-अभिनय, नाट्यशास्त्र, कुशीलाव के अभिनय की विशेषताएं, नृत्य-गीत-संगीत आदि की चर्चा है। इसके अलावा, नाटक सिद्धांत पर अन्य उल्लेखनीय पुस्तकों में आचार्य नंदिकेश्वर द्वारा 'अभिनयदर्पण', सागर नंदी द्वारा 'नाटकलक्षणरत्नकोश', रामचंद्र और गुणचंद्र द्वारा 'नाट्यदर्पण', शारदतनय द्वारा 'भाव प्रकाशन', सिंह भूपाल द्वारा 'रसर्णव सुधाकर', 'दशरूपक' हैं। धनंजय द्वारा, 'साहित्य दर्पण' विश्वनाथ द्वारा, नकट चंद्रिका द्वारा रूपगोस्वामी, आदि। आचार्य ने भरत के बाद के विभिन्न सजावटी संस्कृत रूपकों या नाटकीय साहित्य की श्रेणियों और प्रत्येक श्रेणी के लक्षणों पर अपने संबोधित ग्रंथों में चर्चा की है। किसी के अनुसार उपमाओं की संख्या दस है तो किसी के अनुसार बारह। लेकिन आचार्य भरत के अनुसार रूपक दस हैं और यह सर्वसम्मत है। ये हैं- नाटक, पराकरण, भाण, प्रहसन, डिम, व्यायोग, सांबकर, मीठी, अंक और इहग। हालाँकि, इतने सारे रूपकों में नाटक मुख्य रूपक है। साहित्य दर्पण आचार्य विश्वनाथ और अन्य सज्जाकारों ने भी नाटक के महत्व को पहचाना।

कालिदास को संस्कृत काव्य समूह का केंद्रबिंदु माना जाता है। इस प्रकार उसे केंद्र में रखते हुए, दृश्य कविताओं को मोटे तौर पर तीन युगों में विभाजित किया जा सकता है - कालिदास पूर्व-युग, कालिदास युग और कालिदासोत्तर युग। अश्वघोष कृत 'सारिपुत्रप्रकरण' और भास कृत 13 रूपक कालिदास के पूर्व काल के महाकाव्यों में से हैं। कविकुला गुरु कालिदास द्वारा लिखित तीन नाटक हैं, - 'मालविकाग्निमित्र', 'विक्रमोर्वशीय' और 'अभिज्ञान-शकुंतला'। और कालिदासोत्तर काल में लिखी गई दृश्य कविताओं में उल्लेखनीय हैं 'मृच्छकटिका', 'बरुचि' की 'उभयविसारिका', शूद्रक की 'पद्मप्रवृतक', ईश्वर दत्त की 'धूर्तबित सनबाद', शमिलक की 'पदतारितका', श्रीहर्ष की नागानंद, 'रत्नावली और प्रियदर्शिका'। विशाखा दत्ता की 'मुद्रराक्षस', भट्ट नारायण की 'वेणिसंहार', भवभूति की 'मालतीमाधव', कृष्ण मिश्रा की 'प्रबोधचंद्रोदय' और कुछ अलंकारिक नाटक जैसे यशपाल की 'मोहराजपराजय', वेनकट वेदांतदेशिक की संकल्पसूर्योदय, आदि। संस्कृत नाटक के पतन का

Education and Muslims in India: A Reassessment of the Sachar Committee Report

Jayita Das

Abstract

Education plays an indispensable role for the progress of any country or society. It has the potential to ensure the economic growth of a nation and to eradicate the socio-economic disparities among the citizens of a country. India is characterized by diverse religions and ethnic minorities. Needless to say, for the development of the country, religious minority communities in India must have equal access to and accomplishments in education. However, as per the Sachar Committee Report, 2006 the condition of the Indian Muslims with respect to their status in education is not at all satisfactory. Their performance is poor at almost all levels of education. This paper tries to evaluate the significance as well as the limitations of the report presented specifically about position of the Muslims in India in case of education. This attempt might pave the way in exploring new areas of investigation in future required to assess the problems and demands of the Muslims in developing their status in the field of education.

Keywords: *Sachar Committee Report review on education, Educational Status of Muslims in India, Muslim educational backwardness.*

Introduction

"The Sachar Committee Report was submitted to the Government of India on 17th November, 2006."[1] "It was the first comprehensive report compiled in Independent India in order to intervene and take effective actions by the Government with regard to the prevailing social, economic and educational status of the Muslims in India."[2] Acquisition and advancement of education is a crucial and an integral part for the overall growth of the religious minorities in India. In this respect, proper in-depth assessment of the status of education of the Muslims in India, locating the deficiencies and correspondingly execution of effective Government initiatives according to the need of the beneficiaries are vital for promotion of education among them. It will not only contribute towards ameliorating the social and economic circumstances of the largest minority group in India but shall also maintain the equity and inclusion process in the country. Against this backdrop, the paper attempts to review, thereby