Results in Physics 26 (2021) 104454

Contents lists available at ScienceDirect

Results in Physics

journal homepage: www.elsevier.com/locate/rinp

Are population size and diverse climatic conditions the driving factors for next COVID-19 pandemic epicenter in India?

Palas Samanta [a,*], Sukhendu Dey [b], Apurba Ratan Ghosh [b]

[a] Department of Environmental Science, Sukanta Mahavidyalaya, University of North Bengal, Dhupguri, West Bengal, India
[b] Department of Environmental Science, The University of Burdwan, Burdwan, West Bengal, India

ARTICLE INFO

Keywords:
COVID-19
Sensitivity analysis
Receiver operating characteristics
Population mass
Ambient air temperature

ABSTRACT

Although a nationwide lockdown was imposed in India amid COVID-19 outbreak since March 24, 2020, the COVID-19 infection is increasing day-by-day. Till June 10, 2021 India has recorded 29,182,072 COVID cases and 359,695 deaths. A number of factors help to influence COVID-19 transmission rate and prevalence. Accordingly, the present study intended to integrate the climatic parameters, namely ambient air temperature (AT) and relative humidity (H) with population mass (PM) to determine their influence for rapid transmission of COVID-19 in India. The sensibility of AT, H and PM parameters on COVID-19 transmission was investigated based on receiver operating characteristics (ROC) classification model. The results depicted that AT and H models have very low sensibility (*i.e.,* lower area under curve value 0.26 and 0.37, respectively compared with AUC value 0.5) to induce virus transmission and discrimination between infected people and healthy ones. Contrarily, PM model is highly sensitive (AUC value is 0.912, greater than AUC value 0.5) towards COVID-19 transmission and discrimination between infected people and healthy ones and approximate population of 2.25 million must impose like social distancing, personal hygiene, *etc.* as strategic management policy. Therefore, it is predicted, India could be the next epicenter of COVID-19 outbreak because of its over population.

Introduction

The COVID-19 epidemic reported in Wuhan, China has been caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [19]. Higher transmissibility of this virus, mainly human-to-human, raised much concern globally. Since its outbreak from a wet market in Wuhan, it spread internationally and affected approximately 216 countries or territories [18]. Accordingly, this robust transmission internationally compelled WHO to substitute the epithet 'epidemic' with 'pandemic' [20]. World Health Organization (WHO) has recorded so far 173,674,509 confirmed cases and 3,744,408 deaths globally until June 10, 2021 [18]. Accordingly, the COVID-19 outbreaks have led to an adverse effect on the mental health in general population and healthcare staff professionals, which ultimately leading to a rise in anxiety, fear, depression, agony and associated mental illness due to implementation of emergencies and lockdowns, and healthcare regulation by governments [3]. In addition to this, the socio-economic and environmental aspects of Covid-19 outbreaks towards cleaner environments have also been documented by Bashir et al. [2].

Presently, the viral infection is spreading at high transmission rate in India, in comparison with neighboring countries including Bangladesh, Nepal, Bhutan, Srilanka, China, Afghanistan, and Pakistan [18]. However, the occurrence of first confirmed COVID-19 case was recorded on January 30, 2020 in Kerala state. From January 30, 2020 to June 10, 2021 India has acknowledged 29,182,072 confirmed COVID-19 cases encompassing 359,695 deaths and 27,645,225 recovery cases [18]. Southern states, namely Kerala and Karnataka and Maharashtra were initially the most affected states imposed curtails on mass gatherings on March 10th, 2020. Consequently, mass gatherings in places like institutions, shopping malls and theatres were closed across the country from March 16 onwards [14]. Furthermore, the Government curtails the movement of migratory workers across the country.

Different factors could influence the survival and transmission of the virus such as climatic conditions (mainly temperature and relative humidity) [15], medical care quality [17], personal hygiene and social distance [21]. A number of studies demonstrated the role of ambient temperature (AT) and relative humidity in COVID-19 virus transmission based on epidemiological researches [5,8,22]. They reported either increase or decrease in virus transmissibility and survivability in the environment. Apart from this, population mass (PM) could play a crucial

* Corresponding author.
E-mail address: samanta.palas2010@gmail.com (P. Samanta).

https://doi.org/10.1016/j.rinp.2021.104454
Received 15 January 2021; Received in revised form 10 June 2021; Accepted 10 June 2021
Available online 12 June 2021

International Journal of
Molecular Sciences

MDPI

Article

Developmental and Neurotoxicity of Acrylamide to Zebrafish

Jong-Su Park [1,†], Palas Samanta [1,2,†], Sangwoo Lee [1], Jieon Lee [1], Jae-Woo Cho [3], Hang-Suk Chun [1], Seokjoo Yoon [4] and Woo-Keun Kim [1,*]

[1] Biosystem Research Group, Korea Institute of Toxicology, Daejeon 34111, Korea; jongsu.park@pitt.edu (J.-S.P.); samanta.palas2010@gmail.com (P.S.); sangwoo.lee@kitox.re.kr (S.L.); jieon.lee@kitox.re.kr (J.L.); hangsuk.chun@kitox.re.kr (H.-S.C.)
[2] Department of Environmental Science, Sukanta Mahavidyalaya, University of North Bengal, Dhupguri, West Bengal 735210, India
[3] Toxic Pathology Research Group, Korea Institute of Toxicology, Daejeon 34111, Korea; cjwoo@kitox.re.kr
[4] Molecular Toxicity Research Group, Korea Institute of Toxicology, Daejeon 34111, Korea; sjyoon@kitox.re.kr
* Correspondence: wookkim@kitox.re.kr
† These authors contributed equally to the work.

Abstract: Acrylamide is a commonly used industrial chemical that is known to be neurotoxic to mammals. However, its developmental toxicity is rarely assessed in mammalian models because of the cost and complexity involved. We used zebrafish to assess the neurotoxicity, developmental and behavioral toxicity of acrylamide. At 6 h post fertilization, zebrafish embryos were exposed to four concentrations of acrylamide (10, 30, 100, or 300 mg/L) in a medium for 114 h. Acrylamide caused developmental toxicity characterized by yolk retention, scoliosis, swim bladder deficiency, and curvature of the body. Acrylamide also impaired locomotor activity, which was measured as swimming speed and distance traveled. In addition, treatment with 100 mg/L acrylamide shortened the width of the brain and spinal cord, indicating neuronal toxicity. In summary, acrylamide induces developmental toxicity and neurotoxicity in zebrafish. This can be used to study acrylamide neurotoxicity in a rapid and cost-efficient manner.

Keywords: acrylamide; neurotoxicity; zebrafish; developmental toxicity; disease models; neurodevelopmental disorders

Citation: Park, J.-S.; Samanta, P.; Lee, S.; Lee, J.; Cho, J.-W.; Chun, H.-S.; Yoon, S.; Kim, W.-K. Developmental and Neurotoxicity of Acrylamide to Zebrafish. *Int. J. Mol. Sci.* **2021**, *22*, 3518. https://doi.org/10.3390/ijms22073518

Academic Editor: João Pedro Silva

Received: 16 February 2021
Accepted: 25 March 2021
Published: 29 March 2021

1. Introduction

Acrylamide is a water-soluble alkene primarily used to synthesize polyacrylamide for personal care products, and is also used in various chemical industries, wastewater treatment processes, chemical grouting, and soil conditioning [1,2]. Acrylamide is a common ingredient in plant-based foods, such as potato and grain products and in roasted coffee [3,4]. Its polymeric form is non-toxic but its monomeric form is highly toxic to rats and mice [5,6], with carcinogenic [7], teratogenic [8,9], and neurotoxic [1,5] effects. Human exposure to acrylamide results in neurotoxicity that is characterized by lethargy, skeletal muscle weakness, gait abnormalities, weight loss, ataxia, numbness of the extremities, and polyneuropathy [6,10]. Acrylamide neurotoxicity has been associated with central–peripheral distal axonopathy [11,12]. Molecular initiating events of acrylamide neurotoxicity include formation of adducts with sulfhydryl thiolate sites specifically involved in synaptic vesicle recycling in vesicle docking (synaptotagmin, synaptophysin, and syntaxin), vesicle priming (complexin 2), SNARE (SNAP Receptor) core dissolution (*N*-ethylmaleimide-sensitive factor), endocytosis (clathrin), neurotransmitter re-uptake (membrane dopamine transporter), and vesicular storage (vesicular monoamine transporter) at nerve terminals [13]. The developmental toxicity of acrylamide has been characterized in laboratory animals, but developmental neurotoxicity has not, highlighting the need for validated animal models of acrylamide-induced developmental neurotoxicity for the clinical management of patients affected by occupational exposure to acrylamide [14,15].

Aquaculture 536 (2021) 736454

Contents lists available at ScienceDirect

Aquaculture

journal homepage: www.elsevier.com/locate/aquaculture

Trophic fractionation in an integrated multi-trophic aquaculture off Tongyoung Coast: A stable isotope approach

Mi Seon Park [a,1], Jang K. Kim [b,c,*], Sookkyung Shin [b,c], Byung Hwa Min [a], Palas Samanta [b,c,*,2]

[a] National Institute of Fisheries Science, 216 Gijanghaean-ro, Gijang-eup, Busan 46083, Republic of Korea
[b] Research Institute of Basic Sciences, Incheon National University, 119 Academy-ro, Yeonsu-gu, Incheon 22012, Republic of Korea
[c] Department of Marine Science, Incheon National University, 119 Academy-ro, Yeonsu-gu, Incheon 22012, Republic of Korea

ARTICLE INFO

Keywords:
Stable isotope
Integrated multi-trophic aquaculture
Bivalves and sea cucumber
Seaweeds
Red seabream

ABSTRACT

This study investigated trophic fractionation of fish-derived waste materials by co-cultured species in an integrated multi-trophic aquaculture (IMTA) practice off Tongyoung Coast. Additionally, this study was aimed to identify suitable extractive species based on stable isotope analysis. Red sea bream (*Pagrus major*) was cultured along with sea cucumber (*Apostichopus japonicus*), suspension feeding bivalves (*Crassostrea gigas* and *Mytilus galloprovincialis*) and seaweeds (*Ulva* sp., *Undaria pinnatifida* and *Sargassum fulvellum*). Stable isotope ratios namely $\delta^{13}C$, $\delta^{15}N$ and $\delta^{18}O$ were determined. The $\delta^{13}C$, $\delta^{15}N$ and $\delta^{18}O$ values recorded in *P. major* were -21.50 ± 0.20‰, 13.18 ± 0.17‰ and 17.52 ± 0.88‰, respectively. The $\delta^{13}C$, $\delta^{15}N$ and $\delta^{18}O$ values among the extractive species were ranged as (−19.90) – (−15.55) ‰, 6.14–10.82‰ and 15.14–23.17‰, respectively. The sea cucumber, *Apostichopus japonicus* was directly consuming finfish waste for their food and proved to be most important extractive co-cultured species in this IMTA system. *Crassostrea gigas* is the second most important species followed by *Mytilus galloprovincialis*. Cultured seaweeds are least responsible to reduce waste loads within IMTA system. However, the lack of isotopic consistency between IMTA and control feeders suggested that least contribution of aquaculture waste into neighboring coastal environment. Therefore, *Apostichopus japonicus*, *Crassostrea gigas* and *Mytilus galloprovincialis* should be considered as extractive organism in commercial IMTA system to reduce the waste load in ambient environment.

1. Introduction

Integrated multi-trophic aquaculture (IMTA) is a modern-day aquaculture farming technology that combines fed-and-extractive aquaculture components from different trophic levels to remove waste loadings (Irisarri et al. 2013, 2015; Alexander et al. 2016; Park et al. 2018). More specifically, in an IMTA system, the organic wastes from fed organisms such as finfish and shrimps, are utilized by sea cucumbers, mussels, oysters and sea urchins (Lander et al. 2013), and the inorganic nutrients are taken by seaweeds (Barrington et al. 2009; Yu et al. 2014; Kim et al. 2015). Moreover, the IMTA system can accelerate the higher production of aquaculture animals and seaweeds, reduce water column eutrophication, *etc.* (Ren et al. 2012; Silva et al. 2012; Kim et al. 2017). The extractive aquaculture species, generally, are used as bio-filters to reduce finfish-derived wastes such as particulate organic waste and inorganic nutrients as well. Accordingly, the success of IMTA system depends primarily on how the extractive aquaculture species bioremediate the fed-aquaculture derived wastes (Kim et al. 2013; Corey et al. 2014; Park et al. 2015, 2018). Therefore, the knowledge of trophic relationships would be the basic insights to understand the trophic transfer among the organisms.

Stable isotope technique has widely been considered to analyze the trophic relationship and/or interactions among different trophic levels organism and nutritional source identification (Vander Zanden et al. 1999; Redmond et al. 2010; Layman et al. 2012; Kim et al. 2014, 2015; Samanta et al. 2019). Additionally, stable isotope technique helps to analyze the food web pattern and energy flow in aquatic environment (Vander Zanden and Rasmussen 2001). Furthermore, the basic idea of using stable isotope technique is to identify the trophic position of a consumer, as lighter isotopes are generally assimilated either through

* Corresponding authors at: Research Institute of Basic Sciences, Incheon National University, 119 Academy-ro, Yeonsu-gu, Incheon 22012, Republic of Korea.
E-mail addresses: jang.kim@inu.ac.kr (J.K. Kim), samanta.palas2010@gmail.com (P. Samanta).
[1] Present address: Sustainable Shared Technology, Busan, Korea.
[2] Permanent address: Department of Environmental Science, Sukanta Mahavidyalaya, University of North Bengal, Dhupguri, West Bengal, India.

https://doi.org/10.1016/j.aquaculture.2021.736454
Received 18 July 2020; Received in revised form 19 December 2020; Accepted 30 January 2021
Available online 1 February 2021

ACS OMEGA

http://pubs.acs.org/journal/acsodf

Article

Time-Dependent Naphthalene Toxicity in *Anabas testudineus* (Bloch): A Multiple Endpoint Biomarker Approach

Sukhendu Dey, Puspita Ballav, Palas Samanta, Arghya Mandal, Atanu Patra, Subhas Das, Arnab Kumar Mondal, and Apurba Ratan Ghosh*

Cite This: *ACS Omega* 2021, 6, 317−325

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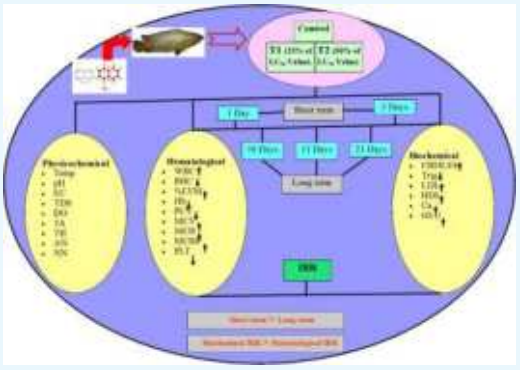
ABSTRACT: Polyaromatic compounds are the major, widespread contaminants in the aquatic environment. However, the adverse impacts of these compounds on blood pathophysiology (hematological profiling and serum biochemical responses) are poorly understood. As a consequence, this study was intended to evaluate the toxic effects of naphthalene, one of the polycyclic aromatic hydrocarbons, on the blood pathophysiology of *Anabas testudineus* using multiple end-point biomarker approach. *A. testudineus* was exposed to short-term (1 and 5 d) and long-term (10, 15, and 21 d) naphthalene concentrations, that is, T1 (0.71 mg/L indicates 25% of LC_{50}) and T2 (1.42 mg/L indicates 50% of LC_{50} value). The results disclosed significant decrease in red blood cells, hemoglobin (Hb), packed cell volume, and platelet levels, while other blood parameters, namely, white blood cells, percent lymphocyte, mean cell volume, mean corpuscular Hb, and mean corpuscular Hb concentration showed enhanced levels under naphthalene intoxication. Results were more detrimental under T2 concentration. Cholesterol, glucose, calcium, high-density lipoprotein, and low-density lipoprotein levels gradually increased throughout the different exposure periods under T1 and T2 concentrations, while the triglyceride level gradually decreased during exposure periods. Finally, integrated biomarker responses (IBR) analysis indicated that serum biochemical parameters are more powerful than hematological parameters for determining the naphthalene-induced fish health status. Additionally, the IBR study clearly identified that long-term (>5 d) exposure was more harmful than short-term (<5 d) naphthalene exposure. So, these responses may be derived as biomarkers for monitoring naphthalene pollution in an aquatic ecosystem.



1. INTRODUCTION

Polycyclic aromatic hydrocarbons (PAHs) are generally organic pollutants containing two or more condensed aromatic rings.[1] They are considered as the ninth most threatening compound to human health.[2] Contamination of environment by PAHs is now becoming a serious problem worldwide because of massive and irregular extraction of natural resources from the earth. PAHs are widely distributed in aquatic environment including sediments, benthic invertebrates, fish, sea birds, and mammals.[3,4] In particular, the naphthalene concentration in sediments ranges between 440 and 264,000 pg/g, in water, it ranges from 0.1 to 10 ng/L, and in biological samples, it ranges from 0.030 to 1.004 μg/g.[5,6] Naphthalene addressed here is a PAH that is widely distributed in soil, water, air, and aquatic environments.[7,8] Generally, in aquatic environment, PAHs originated from four different sources: petrogenic fuels, incomplete combustion (pyrogenic), organic metabolism (biogenic), and diagenetic transformation in sediments.[9] Among these, petrogenic and pyrogenic sources are the major contributors of aquatic pollution by PAHs.[10]

However, the major cascading aspect of PAHs is their mutagenic and carcinogenic properties.[5] First, the hydrophobic nature of PAHs induces gene expression of cytochrome P450 (CYP) family after its entry into cells.[11,12] In the next step, the expressed CYP enzyme family metabolizes PAHs to produce either intermediate or final metabolites, which bind directly with DNA to become mutagenic/carcinogenic.[10] The International Agency for Research on Cancer classified the PAHs under three major categories and grouped under carcinogenic chemicals (group 2A): benzo[*a*]pyrene, dibenz[*a*,*h*]anthracene, and benzo[*a*]anthracene. Additionally, the United States Environmental Protection Agency identified 16 major representatives of PAHs as priority one from different sources of emissions. Naphthalene, among them, is the very simplest one which has very low photo-oxidation capability and is highly persistent in aquatic environment.[13]

Different studies regarding developmental toxicity, oxidative stress, carcinogenicity, immunotoxicity, mutagenicity, and

Received: September 19, 2020
Accepted: November 20, 2020
Published: December 18, 2020

Environmental Toxicology and Pharmacology 80 (2020) 103490

Contents lists available at ScienceDirect

Environmental Toxicology and Pharmacology

journal homepage: www.elsevier.com/locate/etap

Blood Biochemical and Erythrocytic Morpho-pathological Consequences of Naphthalene Intoxication in Indian Teleost, *Anabas testudineus* (Bloch)

Sukhendu Dey [a], Puspita Ballav [a], Arghya Mandal [a], Palas Samanta [b], Atanu Patra [a], Subhas Das [a], Arnab Kumar Mondal [a], Apurba Ratan Ghosh [a,*]

[a] Department of Environmental Science, The University of Burdwan, Burdwan 713104, West Bengal, India
[b] Department of Environmental Science, Sukanta Mahavidyalaya, University of North Bengal, Dhupguri, West Bengal, India

ARTICLE INFO

Keywords:
Anabas testudineus
Naphthalene
Glutamic pyruvic transaminase
Erythrocytes
PAHs

ABSTRACT

Anabas testudineus (Bloch) was exposed to 0.71 mg/L and 1.42 mg/L (25 and 50% of LC_{50} value respectively) naphthalene, a polycyclic aromatic hydrocarbon (PAH), for 21 days. Blood biochemical parameters and erythrocytic morphological alterations were assessed to describe the naphthalene toxicity. Biochemical analysis showed a significant increase in glutamic pyruvic transaminase, GPT (576.7 ± 11.79 and 608.9 ± 12.08 U/L, respectively) and alkaline phosphatase, ALP (12.9 ± 0.69 and 13.4 ± 0.64 U/L, respectively) activities under two doses compared with control. Protein and albumin (ALB) content in blood decreased significantly, in comparison with control value in the tune of 22.67 ± 1.04 and 23.97 ± 1.24 g/dl, respectively and 10.7 ± 0.79 and 11.1 ± 0.67 g/dl, respectively. Erythrocytes showed varied symptomatic morphological changes under naphthalene exposure, which included severe denaturation, swelling in cells, appearance of sickle and tear drop cells, and cellular vacuolation. In particularly, the changes were more prominent under higher naphthalene exposure. Following the results, it has been able to establish that GPT, ALP, protein and ALB, and the morphological manifestations of erythrocytes would be good tools of biomarker in monitoring toxicological paradigm, especially to naphthalene exposure in aquatic bodies.

1. Introduction

Worldwide massive and irregular extraction and exploration of natural resources from the earth, unplanned anthropogenic forest fires, uncontrolled oil-spills, *etc.,* invite subconscious natural environmental degradation causing a serious conflict between man and environment (Bautista et al., 2019). Accordingly, contamination of aquatic resources has been recognized as a concern for augmenting vital awareness for 'save water quality' programme worldwide (Petersen et al., 2017; Bautista et al., 2019). Naphthalene addressed here is a polycyclic aromatic hydrocarbon (PAHs) that are widely distributed in soil, water, air and aquatic environments (Slezakova et al., 2013; Nakata et al., 2014). It is an important constituents of petroleum fuels (Honda and Suzuki, 2020). Abundance and ubiquitous distribution of naphthalene due to different man-made activities, such as oil-spillage, deposition in different media, terrestrial discharge and runoff, effluents from domestic and industrial sources, *etc.,* recognized as one of the important contributors of water pollution (Alderman et al., 2020). Aquatic organisms suffering from different type of lesions, *viz.,* tissue damage, cellular lesions, ulceration, and necrosis, *etc.,* mainly due to presence of lipophilic xenobiotics mainly PAHs in aquatic environment (Kennedy, 2014; Madison et al., 2017; Alsaadi et al., 2018). Generally, the impact of these xenobiotics is concerned with specific toxicity (Philibert et al., 2016; Honda and Suzuki, 2020). However, the toxic outcomes are evaluated based on their structural and functional damage intensity/potentiality within the biological system (Agamy, 2013; Medeiros et al., 2017; Alderman et al., 2020). PAHs undergo subsequent bioaccumulation in bottom dwellers, including mollusks and fish species (Barhoumi et al. 2016) due to their non-degradability and persistent nature in the medium. In case of filter feeders and fish, intake of food directly through gill (Cheikyula et al., 2008) is the easy entrance which leads to disturbance in the vital physiological functions (Elumalai and Balasubramanian, 1999) that ultimately affecting the total aquaculture production. In addition, PAHs and their metabolites are recognized as carcinogenic and mutagenic

* Corresponding author at: Ecotoxicology Lab, Department of Environmental Science, The University of Burdwan, Golapbag, Burdwan 713104, West Bengal, India.
E-mail addresses: sukhendudey.envs@gmail.com (S. Dey), puspitaballav27762@gmail.com (P. Ballav), arghyamandal065@gmail.com (A. Mandal), samanta.palas2010@gmail.com (P. Samanta), atanupatraenvs@gmail.com (A. Patra), subhasfeo@gmail.com (S. Das), arnab1990mondal@gmail.com (A.K. Mondal), apurbaghosh2010@gmail.com (A.R. Ghosh).

https://doi.org/10.1016/j.etap.2020.103490
Received 23 June 2020; Received in revised form 24 August 2020; Accepted 6 September 2020
Available online 7 September 2020

SciMedCentral

JSM Environmental Science & Ecology

Editorial

COVID-19 and Its Consequences among Medical Workers

Sukhendu Dey[1], Sandipan Pal[2], Apurba Ratan Ghosh[1], and Palas Samanta[3]*

[1]*Department of Environmental Science, The University of Burdwan, India*
[2]*Department of Environmental Science, AKPC Mahavidyalaya, India*
[3]*Department of Environmental Science, Sukanta Mahavidyalaya, University of North Bengal, India*

***Corresponding author**
Palas Samanta, Department of Environmental Science, Sukanta Mahavidyalaya, University of North Bengal, India, Tel and fax: +918327220799; email: samanta.palas2010@gmail.com

Submitted: 15 March 2021

Accepted: 18 March 2021

Published: 20 March 2021

ISSN: 2333-7141

DEAR EDITORS,

The COVID-19 (coronavirus disease) was first reported in Wuhan, PRC China and spread globally. The rapid spreading of COVID-19 disease, since its first outbreak in India, has forced many people to admit into the hospital; simultaneously, affected different aspects of people's lives including front-line workers such as medical workers. COVID-19 pandemic also triggered a wide variety of mental and psychological problems (namely panic disorder, irritability, anxiety, muscle aches, tiredness and depression) as well as generalized anxiety disorder (GAD) symptoms. Present study is the first nationwide report of COVID-19 associated consequences among medical workers during COVID-19 epidemic with particular emphasis on mental and psychological distress.

The COVID-19 (coronavirus disease), which is characterized by a series of unidentified pneumonia, was caused by β-coronavirus and was first reported in late December 2019 in Wuhan (Hubei Province) of PRC China. Initially it was named as novel coronavirus pneumonia, NCP by PRC Centers for Disease Control experts [1]. Simultaneously, the World Health Organization (WHO) named the disease as 2019-nCoV (2019-novel coronavirus) on 12 January 2020. Later on, WHO declared the disease officially as COVID-19 (coronavirus disease 2019) on 11 February 2020. COVID-19 pandemic is one of the most rapid spreading diseases in 21st century. It has arisen a series of symptoms and posed the threat to human civilization. As a result, firstly, the most notable clinical symptoms of COVID-19 are fever, dry cough, body pain, head ache, dyspnea, viral infection in lung and respiratory failure.

Different Asian country *viz.,* India still now facing the issue of spreading the COVID-19 transmission in over-populated areas. Till March 15, India recorded 1,14, 09, 831 covid cases and 1, 58, 856 deaths. The large-scale transmission among public health imposed the continuous pressure on India government and also the frontline worker *viz.,* doctor, nurse, pharmacist, student, sweepers, guards, analyst, technician and medical representative. This epidemic not only risks caused the death of populations from viral infection but also posed tremendous psychological pressure to the frontline worker in India and also the rest of the world [2,3]. Additionally, the tremendous transmission of the COVID-19 epidemic has posed threats to people's psychology and mental health including students. But the front-line workers are providing their best service beyond the regulated service time during the COVID-19 pandemic situation. Accordingly, they are simultaneously expected to disturb their normal psychological and mental health. Therefore, the major purpose of this study is to investigate the impact of COVID-19 pandemic situation on frontline worker mainly medical workers work there won work place in the COVID-19 pandemic situation. Finally, integration of frontline worker COVID-19 outbreaks (preventive and adaptive measures), is another prime objective of this study.

This study is the first survey-based study on psychological distress and mental health status in the medical sector frontline workers during the tumultuous time of the COVID-19 pandemic. A well-structured online questionnaire-based survey method was adopted to obtain the data from the medical sector frontline workers. Additionally, randomized double blind methodology was followed for this pilot study. The questionnaire (google feedback form) was composed of 24 questions considering the above-mentioned objectives. The survey form was distributed among all age group people through mail, WhatsApp and telegram. Data collection was beginning from September 14, 2020. SPSS v26 (IBM Corp) was used to analyze the obtained data.

This study received a total of 48 valid responses from 36 states and union territories of India. Among the respondents, 77.1%, were males and 22.9% were females mainly dominated by pharmacist (29.2%), followed by doctors (22.9%), and nurses (22.9%). Most of the respondents are worked in state-level hospitals (33.3%), followed by private practitioner (25%), and district-level hospitals (20.8%), predominantly West Bengal origin (85.4%). Additionally, the most of the participants (56.3%), were aged between 18 and 30 years. Those who were aged between 31 and 45 years made up 22.9% of the participants. The participants who were between 46 and 60 years and above 61 years older made up only 10.4% each of the participants. The participants were divided into five categories based on their scientific qualification. The most common scientific qualification was a UG or equivalent [B.A., B.Sc., B. Com or B. Tech, Diploma, (52.1%)], followed by PG or equivalent [M.A., M.Sc., M.Com or M. Tech, (29.2%)], while the least responses were

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Editorial

Recurrence Possibility of COVID-19 in India

Dey S[1], Pal S[2], Ghosh AR[1] and Samanta P[3]*

[1]Department of Environmental Science, The University of Burdwan, Burdwan, West Bengal, India

[2]Department of Environmental Science, AKPC Mahavidyalaya, Hooghly, West Bengal, India

[3]Department of Environmental Science, Sukanta Mahavidyalaya, University of North Bengal, Dhupguri, West Bengal, India

***Corresponding author:** Palas Samanta, Department of Environmental Science, Sukanta Mahavidyalaya, University of North Bengal, Dhupguri, West Bengal, India

Received: April 26, 2021; **Accepted:** May 11, 2021; **Published:** May 18, 2021

Editorial

Although nationwide lockdown was imposed in India amid COVID-19 outbreak since March 24, 2020, the COVID-19 infection is increasing day-by-day. India became world's second most affected country. By 13th May, 2021 India recorded 23,703,665 cases with 258,351 deaths and 19,734,823 recovered cases. Here, we described the possibility of COVID-19 reactivation and disease recurrence through horizontal transmission in individuals after recovery from COVID-19 infection, in particularly in India. Additionally, the study will demonstrate how COVID-19 reactivation/reinfection could play a dominant role in disease burden.

WHO (World Health Organization) recommended two times RT-PCR swabs test in discharged patients after clinical recovery from COVID-19 infection to confirm the disease recurrence globally. As per global data, the virus changing the molecular configuration and fluctuating time-by-time mainly because of viral load, occurrence of false-negative results at molecular test, inefficiency of sampling operator, even sampling procedure etc [1]. Recently, Ye et al. [2] mentioned that about 9% reactivation in COVID-19 patients occurred after discharge from the hospital. Further, they demonstrated host status, virologic features and steroid-induced immunosuppression as prime risk factor for the incidence of COVID-19 reactivation. Lombardi et al. [3] recommended domicile quarantine of 14 days after hospital discharge for safety purposes, but clear information about infectiousness time and virus shedding duration is still lacking. Rothe et al. [4] demonstrated that both pre-symptomatic and asymptomatic carriers might be responsible for COVID-19 reactivation, while Chen et al. [1] reported that convalescent might transmit the virus for further re-infection. Therefore, further investigations are needed to define appropriate quarantine period, to avoid transmission.

Recently, COVID-19 reinfection among COVID-19 patients has dazed scientific community, but uncertainty exists whether this second wave is due to reinfection or new virus strain. Till now 64 cases of reinfection has been reported globally in individuals, recovered from COVID-19 with an estimate ranging from 7.35 to 21.4% [5]. Immunological analysis in this regard plays an important role to determine viral reinfection properly as traditional diagnostic methods like RT-qPCR, high through put sequencing, CT scan; blood sample analysis has some limitations. Additionally, different swab sample source, improper sampling, and variable sensitivity/specificity of nucleic acid tests can lead to false negative results implying disease persistence rather than recurrence. Generally, immunoglobulins alone are not enough for long-term immunity. Evidences showed that virus specific $CD4^+$ T cells and $CD8^+$ T cells plays a crucial role in long-term COVID-19 reactivation due to their persistency up to 6 years after SARS-CoV-1 virus infection [6]. Accordingly, Zhang et al. [7] observed lower concentrations of monocyte ACE2 (Angiotensin Converting Enzyme 2) in COVID-19 patients than healthy individuals, which necessitate further study to distinguish between reinfection and new infection. Further, the COVID-19 reactivation duration after first infection may vary between different virus clades of SARS-CoV-2 virus (e.g., A2a, B1), resulting distinct virulence as well. Accordingly, the nature of protective Neutralizing Antibodies (NAbs) varies for different strains and this indicated that NAbs of primary infection are not able to protect re-infection by other strains, resulting lower concentrations of NAbs during reinfection [6].

More recently, virus latency period is considered as potential factor to determine virus reactivation. Wang et al. [8] observed viral latency period 24 days for reinfection. In another study, Ye et al. [2] reported maximum latency period 17 days among 5 patients, but reactivation characteristics were not properly demarcated. They opined that virus is getting reactivated from a latent stage to a lytic stage with similar symptomatic manifestations. Additionally, SARS-CoV-2 virus can survive and replicate in neuronal cell lines [9], which indicated that there is possibility of reactivation through neuro-invasion of virus at later stage. In India, till now, three re-infection cases, one in Ahmedabad and two in Mumbai were brought under ICMR scanner, ICMR Director General Prof. Balram Bhargava said. Tillett et al. [10] demonstrated that individuals recovered from SARS-CoV-2 may not guarantee future immunity and second infection, if happens, was more severe with higher clinical symptoms than the first attack, the report says [10]. Whether the criteria to define a re-infection case is 90 days or 100 days, WHO is still not decided yet the cut-off point, says ICMR Director General Prof. Balram Bharagava. Further, Prof. Balram Bharagava demonstrated that India is considering cut-off about 100 day. But, till now ICMR did not revealed any data regarding those re-infected persons.

Viral shedding is another potentially undetermined factor, which might cause reactivation or disease transmission from an apparently recovered individual or asymptomatic individual to healthy people [11]. Generally, viral shedding begins 2-3 days before symptoms appearance and it happens through non-respiratory or non-classical tract routes such as fecal-oral route, tears and conjunctival secretions etc. Virus remains unrecognized in all these non-respiratory or non-classical routes during patient's discharge, who are tested negative (nasopharyngeal RT-qPCR). But there is possibility of containing highly active viral titers in non-classical transmission sites of recovered patients, indicating that they not only reactivate themselves

Citation: Dey S, Pal S, Ghosh AR and Samanta P. Recurrence Possibility of COVID-19 in India. Austin J Plant Biol. 2021; 7(1): 1027.

International Journal of Applied Research

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 8.4
IJAR 2021; SP7: 01-04

Dr. MD Masihur Rahman
Assistant Professor,
Sukanta Mahavidyalaya
Dhupguri, Jalpaiguri, West
Bengal, India

Correspondence
Dr. MD Masihur Rahman
Assistant Professor,
Sukanta Mahavidyalaya
Dhupguri, Jalpaiguri, West
Bengal, India.

(*Special Issue*)
"Twenty-First Century: Cultural and Economic Globalization"

The Play of Biopolitics in Mahasweta Devi's *Draupadi*

Dr. MD Masihur Rahman

DOI: https://doi.org/10.22271/allresearch.2021.v7.i7Sa.8652

Abstract

Critically considering the Agambenian status of "Camp (which) is the very paradigm of political space at the point of which politics become Biopolitics and Homosacer is virtually confused with the citizen" and the Foucauldian concept of Biopolitics -a system of regulation of the human body both biologically and politically, this article would like to explore the biopolitical praxis in Mahasweta Devi's *Draupadi*– a short story which tells about the explicit and exploitative representation of state-sponsored violence and resistance to it by the subaltern representative. The state-sponsored violence and the activities of the rebels set in a fictional but politically reverberating setting is an attractive field of exploration. Looking at the short story through the Foucauldian and Agambenian concept of controlling Bios both biologically and politically, this article would like to assess the ways in which Biopolitics coerces the population. This article would like to explore the biopolitical subjugation of the subaltern and contributes to the discussion on Biopolitics.

Keywords: Biopolitics, Foucault, Agamben, State, coercion, incarceration, subaltern

Introduction

Biopolitics emerged in the 1970s as a distinct sub-discipline in the powerful work of Michel Foucault who first extensively examined the power of the state over the individual as well as its citizens. Foucault used the term to denote the social and political power over life. Biopolitics signifies the strategies and mechanism which directly or indirectly manage /channelize the individual as well as the population under the regime of authority. Often political systems resort to surveillance, incarceration and killings in order to regulate the thought process of the population as well as individuals. Foucault felt the ever-increasing danger of "*an omniscient government which conforms to the rule of right*" (Foucault, 296). This omniscient government accomplishes what is dictated by the capitalist economy. He used the term "*the polymorphous technique of power*" (P-11)to express a particular phenomenon in the modern political context, to point out the confluence/ "*deployment of power and knowledge*" (P-73).

Political structures are moulded aiming at controlling people working at a different level. Foucauldian biopolitics concerns itself with such production and management of power. Such understanding expands the dictionary definition. According to Oxford English Dictionary, *"Biopolitics is the interaction between politics and biology; specially politically motivated intervention in the growth and development of a population."* Foucault expounds on the regulation of the population using various devices. Political belief /position determines the living condition of the population/individuals.

Giorgio Agamben's work is vitally important in the context of 20th-century Biopolitics- *"ModernBiopolitics: the politics of the great totalitarian states of the 20th century* (Agamben, p- 119). Agamben concentrates, as part of modern biopolitics, on bare life – a status in which the biological life of human beings becomes subject to political decisions and objectification. He observes how 'bare life' is subjected /projected to a status of exception –

LOKARATNA

Volume XIV(2), 2021 ISSN: 2347-6427

Folklore Foundation, Bhubaneswar, India

LOKARATNA, Vol. XIV (2), 2021

Lokaratna is the e-journal of the Folklore Foundation, Bhubaneswar. *Lokaratna* is a peer-reviewed International journal with ISSN: 2347-6427.The purpose of the journal is to explore the rich cultural tradition of India for a wider readership. Any scholar across the globe interested to contribute on any aspect of folklore is welcome. This volume represents the articles on culture, folklore, education, and language pedagogy.

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Re-examining the Folklore and Folk Festivals of the Oraon or Kurukh Tribe with Special Reference to the Oraons of Dooars

Pawan Toppo

Assistant Professor of English

Sukanta Mahavidyalaya, Dhupguri, W.B

Abstract

A festival is a community event in which members of a particular social or religious group take part. It acts as markers of social, historical or mythological events by recalling the heroes and legends of a particular community. It also indicates the beginning or ending of a season and other important phases of a year and serves as a medium of understanding a particular community as it's through their institutionalization that one can witness the tradition, the legends and the folklores which are associated with a particular community. It begins as mere occasion but ultimately turns into deep rooted tradition of a community. The Oraon or Kurukh are the men of festivals. The most of the festivals of Oraon are seasonal involving the whole village community and are attached closely to agriculture activities which reflect the relation that exists between the tribe, nature and their religious beliefs such as DhanBuni, Hariari, Ban-gari, Kadleta, Nawakhani, Khaliyani (Xalxo, 2007) etc. In the past, the Oraons celebrated almost all these festivals, but at present these festivals can hardly be found in one village (Roy, 2019). The Oraons who are living the tea estates (especially in Dooars) are unaware or indifferent of these festivals as these festivals are mainly concerned with agriculture. So, it's a matter of serious concern as many of their festivals are moving towards extinction. But the major festivals like Fagua, Sarhul, Karam and Sohrae are celebrated by the entire Oraon community irrespective of their different religious identification.

ISSN: 1886-9300

A Gynocritic's Oeuvre: Daughters Towards Balance for Better[1]

Saptarshi Mallick
University of North Bengal
saptarshieng@gmail.com

https://dx.doi.org.10.12795/futhark.2021.i16.08

Fecha de recepción: 27.07.2021
Fecha de aceptación: 26.12.2021

Abstract: The language employed by women authors bear a 'difference' guaranteed by the author's femaleness. The evolution of the feminine aesthetic is complete when the 'psychodynamics of the individual or collective female literary tradition' (Showalter 1982: 15) receives the vindication of the canon of 'great' literature, at par with the literature authored by men. Women writers successfully continue the tradition of *ecriture féminine*, or an exclusive style of women's writing, through a voice of their own. It contributes towards strengthening the exclusive style of women's writing 'which draws upon the formless primeval song that emanates from the voice of the mother' (Bhaduri and Malhotra 2016: 112) which the male writing often attempts to erase thereby naturalizing their gender roles as the virtuous woman, the seductress and the sacrificing mother (Nayar 2010: 94). The patriarchal mechanisms augmented through the naturalization of power structures are interrogated through women's writings which contribute towards the birth of a literature of their own bearing a feminine creativity and inventiveness to represent her female protagonists' 'journey towards self-fulfillment with Jungian rites of passage' (Baym 1978: 11). The metaphorical concept of 'female identity' is an inherent process dependent upon a mother-daughter bond, which the female creators/authors develop with their female characters (Gardiner 1982: 179); and besides being the hero of the author's creation, she also becomes the author's daughter as this connection contributes towards women's psychological identities (Gardiner 1978: 244). Therefore the female authorship creates this association and an identity of this association contributes towards the development of a distinct engagement between the woman writer and her characters and 'indicates an analogous relationship between woman reader and character' (Gardiner 1982: 179). Through this literal identity often a reader feels remarkable and cogent in spite of being pharmaceutically subjected to a state of identity dissipation.

[1] This essay is for Mr Norman Aselmeyer for his enduring love and abiding support.

Therefore through this distinct female identity Indian women authors writing in English have been able to portray women as 'seats of consciousness' (Donovan 1997: 212), their selves, their female voices, the social setting and audiences, and their responses towards it which differs to the male tradition, only to metamorphose the 'voice' as a woman-centered criticism – portraying aspects of 'women's experience which generate the style and content of their writing; and to examine the means by which women offer resistance to patriarchy through their writing' (Spaull 1989: 86) and 'deactivates its components' (Kolodny 1991: 113). The female experience is the foundation of an 'autonomous art, extending the feminist analysis of culture to the forms and techniques of literature' (Showalter 1997: 218). This essay will discuss Sanjukta Dasgupta's attempts to explore women's experiences of trauma, frustration and fears imposed upon them through several constraints of the society through the oeuvre of her short stories. Her short stories emphasize upon the regular grapples undertaken by women [Dasgupta's fictional daughters] with whom we can relate and feel the author's anger which proliferate every corner of the narratives, thereby contributing towards the development of a separate sensibility and writing style for women and furthering the cause of women's literature and female creativity by transcending the various historical boundaries.

Keywords: Women author, short stories, difference, interrogating patriarchy, Balance for Better.

Sumario: Introduction. The Famale Author – Gynocriticism. The Bengali Gynocritic. The Annals of Dasgupta's Daughters. Conclusion.

Introduction

'Identity' is cardinal to the dynamics of contemporary ideological and moral criticism. It is a paradoxical term which not only enhances similitude, but also asserts difference or contradictions, especially when we explore the idea of 'identity' in the context of women authors, their writings and their creative characters. Patriarchal criticism subscribe to the dominant phallogocentric discourse to typify female identity through a language that develops in dullness of the womb, passes on like a woman's body fluids, and disseminates like her sexual pleasures. Dorin Schumacher considers a text as a unit of latent meaning and criticism as the method of contriving that meaning. She asserts that through a literal assessment of the text a critic thrusts upon a meaning which is generally 'gender-linked', and attempting a broadened interpretation for the words of the text as they connect to the model. Through these interpretive methods we have read male works well, but when it involves reading a work authored by a woman there is

propensity to 'ascertain the adequacy of any interpretive paradigm to a full reading of both male and female writing' which wittily relocates the critical centre from works to elucidative processes (Kolodny 1991: 97 – 116). This involves in a narrow process of 'representation of the world' which 'like the world itself, is the work of men; they describe it from their point of view, which they confuse with the absolute truth' (Beauvoir 1956: 162). As a result the men create the world from their point of view and it emerges as the truth to be described, ignoring women and their point of view towards creation (MacKinnon 1982: 537). This segregation has not only enabled the men to 'spring from the masses' to be 'propelled onward by circumstances', but also played an important role to corner the women on 'the margin of history, and circumstances are an obstacle for each individual, not a springboard' (Beauvoir 1956: 151). Therefore the history of women's struggle for vindicating their identity corroborates that women 'have been thwarted by our society's prescriptions concerning gender and disrupted by social norms dictating powerlessness' (Davidow 1989: 68) to enable her only to be the 'second sex'. This process of pseudo-identification of the women has programmed them to be comfortably considered by patriarchy as the 'second sex' where the 'difference' of their self, mind and soul remains unrecognized, dominated and exploited in one way or the other. These imposed identities are subtly coercive and seldom are women able to extract themselves from this strong hidden adhesive which unconsciously entraps them like a Venus-fly trap. The woman's body and its specific characteristics which are biologically, culturally and literally different becomes a space where patriarchy tends to explore in order to control and violate it. This violation serves as a reprimand upon the liberating, self-willed woman for interrogating the patriarchal advances, and also emerges as a metaphor of repercussions faced by any woman for employing her freedom of choice by crossing the 'lakshman-rekha' which she is not expected to transgress – a metaphorical patriarchal admonition and sexual politics meant to affirm manhood (Bagchi 2019: 7). Succumbed to these entrapping processes of imposed identities the woman emerges as the Eastern 'Lakshmi' (Dasgupta 2017: 11) and the Western 'Angel of the House' (Woolf 1970: 238) only to be subjected to sexual exploitation and violence at home and the world. Amidst all this turmoil which unfortunately continues even today, the true self of the woman is lost forever, and she survives as the 'other' sacrificing her life at the altar of patriarchy without any reverence and respect for her as an individual, but to her pseudo-identifications which satisfy the male ego where the idea of the individual identity of the person as a woman ceases to exist. It is of utmost necessity to debrief patriarchy and its violent ramifications, and enable women to lead a life of their own, realising their own selves. It is therefore imperative for women to be empowered in this era of cultural and economic globalization where they will exist and be respected and honoured at par with the men i.e. 'balance for better', the UN theme for the 2019 International

Women's Day. This clarion call ventured by the United Nations women's organization focuses on treading towards a gender-balanced world, where women are not considered and treated as the other. In recent times due to the spread of education and enthusiastic endeavours undertaken by various organisations' exploitation upon women have been checked to a great extent, if not completely eradicated. It is necessary to eradicate such inhuman crimes which are committed upon women – often these do not make it to the headlines, they remain concealed within the abysmal depths of the patriarchal structure of the society, unknown, and unheard of.

Women's experiences easily 'disappear, become mute, invalid and invisible, lost in the diagrams of the structuralist or the class conflict of the Marxists' (Showalter 1997: 219). Like feminist activists addressing such issues through various endeavours, the entelechy of the creative writers have enabled them to explore these unheard and unknown phases of women's life, the disguised and subdued messages of women in history, in anthropology, in psychology, and study these sensitive issues to vindicate its seriousness and emphasize through their creative medium the need for liberating women from the androcentric clenches. Sometimes they have been able to quiver the society through their argument leaving an indelible impression among all sensitive minds. Writing is an activism for a writer; it is the only possible way by which she/he can express her/his political standpoint, ideology, worldview, dreams and visions; leading towards a harmonious fusion of ideas (Dasgupta 2015) in 'a thinking, understanding world of creative participation' (Fraser 2015:66). Through their creative writing the creative artists continue the art of discovering the mystical humanity. As communication of life can only be possible through a living agency therefore writers through their art of writing communicate and nurture the growth, development and progress of a culture which grows, moves and multiplies in life (Tagore 2003: 21). Therefore the author being the 'world-worker' is able to 'transcend the limits of mortality' (Tagore 2005: 55) towards an existence where all the people are coordinated by the vision of the author to be 'receptive as well as creative' towards an 'inspiring atmosphere of creative activity' (Tagore 2003:2) through which 'a harmonious blending of voice, gesture and movement, words and action, in which [the poet's] generosity of conduct is expressed' (Tagore 2001: 495). Through an expression of her/his own worldview and ideology, the author is able to voice 'universal, human experience' (Parthasarathy 2002: 11); this has facilitated an interrogation of the hypothesis of 'marginality' (Paniker 1991:12) which has often been used to describe Indian literature written in the English.[2] Employing the global *lingua franca* the Indian

[2] Bruce Kings states, 'English is no longer the language of colonial rulers; it is a language of modern India in which words and expressions have recognized national rather than imported significances and references, attending to local realities, traditions and ways of feeling (1987: 3).

women writers continue to strive a reinvention of womanhood by addressing issues of women and their lives. Through their endeavours they have been able to break the silence and emphasize the need for women to journey towards 'self-discovery' and 'a search for identity' (Showalter 1977: 13) through their creative medium. These creative endeavours by women help their struggling fellow sisters and daughters to recognize themselves, and their identity, as Nancy Chodorow's psychoanalytic insights vindicate that all perspectives of identity are androcentric in nature, but female identity and experiences differs from the male model in profound and regular ways. This element of 'difference' contributes towards the evolution of a feminine aesthetic, a language which is particular to women's writing, whose 'difference' is pledged by the 'femaleness' of the author (Spaull 1989: 84). This feminine aestheticism acts as 'functionaries of resistant gender ideology, and unearthing from the debris of history the numerous women authors who were sidelined in the process of construction of an androcratic canon' (Bhaduri and Malhotra 2016: 115).

The Female Author - Gynocriticism

The evolution of the feminine aesthetic is complete when the collective female literary tradition receives the vindication of the canon of 'great' literature, at par with the literature authored by men. Women writers being enthralled by their 'inspirational eleventh muse' (Dasgupta 2017: 49) successfully continue the tradition of *ecriture féminine*, or an exclusive style of women's writing, through a voice of their own rapidly contributing towards strengthening the exclusive style of women's writing 'which draws upon the formless primeval song that emanates from the voice of the mother' (Bhaduri and Malhotra 2016: 112) which the male writing aims to stereotype as 'subordinate to the main stream: an undercurrent' (Moi 1985: 55) thereby naturalizes their gender roles as the virtuous woman, the seductress and the sacrificing mother (Nayar 2010: 94). This voices being heard will eventually facilitate the process of rediscovering 'the lost continent of the female tradition [which will rise] like Atlantis from the sea of English literature' (Bhaduri and Malhotra 2016: 122). As a result Elaine Showalter comments that 'each generation of women writers has found itself, in a sense, without a history, forced to rediscover the past anew, forging again and again the consciousness of their sex' (Showalter 1977: 11 - 12) which contributed towards the birth of a strong subculture within patriarchy (Nayar 2010: 97). Such patriarchal mechanisms augmented through the naturalization of power structures are interrogated through women's writings which contribute towards the birth of a literature of their own bearing a feminine creativity and inventiveness which is established

through the use of language by women authors to represent her female protagonists' 'journey towards self-fulfillment [inner awakening] with Jungian rites of passage' (Baym 1978: 11). This language used by women authors and poets contributes towards the birth of a literary canon by women as Showalter has argued by consigning the authors into three main types, equating to the three main stages in the evolution of women's writing itself in her *A Literature of their Own: British Women Novelists from Bronte to Lessing*. She coined the term 'gynocriticism' which involves in

> the study of women as *writers*, and its subjects are the history, styles, themes, genres, and structures of writing by women; the psychodynamics of female creativity; the trajectory of the individual or collective female career; and the evolution and laws of a feminist literary tradition (Showalter 1982: 14 - 15).

This facilitates Showalter to account for the woman writer as the author [creator] of texts and meanings involving critical interpretations and thereby 'uncover particular modes of women's writing by positioning the woman's experience as being at the centre of both writing and criticism' (Nayar 2010: 97).

The 'unique difference' (Showalter 1982: 16) in women's writing became a reality as women began to voice their causes, depict their real selves through their women characters as they should be, unlike the male authors whose women characters are repressed under patriarchy with limited opportunity to offer any kind of resistance against the exploitative institution. As a result the literary creation and critical interpretations by women authors gave birth to 'woman-centered criticism' and accelerated breaking their centuries' silence and ripping apart the imposed barriers of barbed wires towards 'a wider field of their talents'. Therefore women's literature is a firm response and challenge to patriarchy disintegrating at once 'the relative segregation of the women as [the second] sex, relaxes the restrictions that otherwise narrow women's functions' (Guha 2012: 267) by probing the 'servile submission to custom and practice without regard to their tendency for good or evil' (Banerjea 2009: 118). This process aims to revive and preserve 'the echo of women's literature' (Moers 1977: 66) and strengthens the female identity and the female literary tradition and for creating a world characterized by disenthrallment, egalitarianism and erudition where the woman writer cannot be contained, smothered, confined or silenced from gyrating the world with her perception embodied through her writings (Fraser 2015: 61).

The metaphorical concept of 'female identity' is an inherent process dependent upon a mother-daughter bond, which the female creators/authors develop with their female characters (Gardiner 1982: 179); and besides being the hero of the author's creation, she also becomes the author's daughter as this connection contributes towards women's psychological identities (Gardiner 1978:

244). Therefore the female authorship creates this association and an identity of this association contributes towards the development of a distinct engagement between the woman writer and her characters and 'indicates an analogous relationship between woman reader and character' (Gardiner 1982: 179). Through this literal identity often an individual/reader feels remarkable and cogent in spite of being pharmaceutically subjected to a state of identity dissipation. Therefore through this distinct female identity Indian women authors writing in English have been able to portray women as 'seats of consciousness' (Donovan 1997: 212), their selves, their female voices, the social setting and audiences, and their responses towards it which differs to the male tradition, only to metamorphose the 'voice' as a woman-centered criticism – portraying aspects of 'women's experience which generate the style and content of their writing; and to examine the means by which women offer some resistance to patriarchy through their writing' (Spaull 1989: 86) and 'deactivates its components' (Kolodny 1991: 113). The female experience is the foundation of an 'autonomous art, extending the feminist analysis of culture to the forms and techniques of literature' (Showalter 1997: 218).

The Bengali Gynocritic

Through her insightful contributions towards the genre of women's literature following an intuitive and distinctive style (Moers 1977: 66) Sanjukta Dasgupta has effectively contributed towards maneuvering 'the echo of women's literature' (Moers 1977: 66) which patriarchy tries to erase through several coercive mechanisms but remains unsuccessful. The dynamic feminine power of her creative outlook facilitates Dasgupta to re-vision women 'to seek out a feminine aesthetic, or 'essence', which differentiates women's writing from men's' (Spaull 1989: 84) and their varied dimensions in their respective cultures, questioning and revising the passive, impoverished and anaemic stereotypes, to 'celebrate and venerate the dignity and strength of the enlightened woman and represent a critique of the regressive ideals of patriarchy' (Kumar 2009: xxvi). Like her poetry, the remarkable style of Dasgupta's short stories, endorses an expression of a woman author's experiences of the home and the world and vindicates the 'self-defined critical consciousness' of women as 'opposed to a mass-produced or stereotypical identity' (Donovan 1997: 212); contributing to the style and content of women's writing 'by which women offer some resistance to patriarchy through their writing' (Spaull 1989: 86). Her short stories facilitate the birth of a 'unique and uniquely powerful voice capable of cancelling all those other voices' (Capkova 2011: 4) in order to 'resist gender hierarchies through literary practice [through] a combination of both the demand for exclusivity and real struggle into a truly subversive aesthetic' (Bhaduri and Malhotra 2016: 113). They echo the birth of a female reader impeding the strategic patriarchal alienation and manipulation of the female reader/writer and

the implanted male perspectives as expostulated by Judith Fetterley's arguments regarding the politics of manipulation, androcentric value system and the portrayal of female characters through 'male eyes' in her famous book *The Resisting Reader: A Feminist Approach to American Fiction* (1978). Like other women writers, Sanjukta Dasgupta's short stories are deeply engaged with issues involving not only to women's history, culture and literature, but also their plight and neglect by patriarchal generations which are often suppressed, unheard and unrepresented. As a woman writer she addresses them from the woman's experience facilitating the woman as the producer of textual meaning 'in their exclusivity [to] search for the trans-symbolic semiotic order of multiplicitous choral voices, rather than the glorified patriarchal monologism' (Bhaduri and Malhotra 2016: 112). This intense association and commitment towards her [female] characters not only make them lively and familiar, but also connects to them as her daughters, whose unheard stories and issues of life get addressed through her creative medium as it reaches to the common ear breaking the glass closet which patriarchy builds around women's writings. This is gynocriticism derived from Elaine Showalter's *la gynocritique: gynocritics* who are 'more self-contained and experimental, with connections to other modes of new feminist research' (Showalter 1997: 216). Through her short stories Dasgupta, an ardent gynocritic from Bengal [India] create 'a new understanding of our literature [in order] to make possible a new effect of that literature on us, and to make possible a new effect in turn to provide the conditions for changing the culture that the literature reflects' (Fetterley 1991: 497). Sanjukta Dasgupta is perhaps an Indian embodiment of Showalter's programme of gynocriticism.[3] This process of artistic creation by a woman author involves in a struggle to explore the spirit of difference. This is a struggle which like all female authors, even Dasgupta undertakes, dealing 'not against her precursor's [male] reading of the world but against his reading of *her*' (Gilbert and Gubar 2000: 49) and her texts.

Sanjukta Dasgupta's triumphant struggle vindicated through her characters [daughters] of her short stories as well as through her poetry bears the hallmark of [her] female creativity (Spaull and Millard 1989: 128). They emerge as the female precursors contributing towards a feminist poetics and a feminist literary tradition through a "uniquely female process of revision and redefinition that necessarily caused them to seem 'odd" (Gilbert and Gubar 2000: 73). Debriefing the androcentric codes and the cultural construction of femininity through her

[3] It involves the fabrication of 'a female framework for the analysis of women's literature, to develop new models based on the study of female experience, rather than to adapt male models and theories. Gynocritic[ism] begins at the point when we free ourselves from the linear absolutes of male literary history, stop trying to fit women between the lines of the male tradition, and focus instead on the nearly visible world of female culture (Showalter 1997: 217).

powerful feminist narrative in her short stories Dasgupta has been able to create some simple yet extremely powerful women characters who are very familiar to us, yet their stories are unknown and unheard. Dasgupta's association and feeling with them becomes lively in the course of the narratives, which establishes the metaphorical maternal association between the female author and her female characters. Dasgupta as the mother of all her characters [female] portray the dynamics of their life struggles (Mallick 2019: 54) – their quest for their own identity, their self-definition (Showalter 1977: 13) in order to be able to erase the lines of control which had trapped them within the humiliating and terrifying domestic space and to 'spread her arms like wings / [spin] wildly on her toes / [sing] like a Koel in spring' (Dasgupta 2017: 15). In this essay we will explore the struggles of Dasgupta's [fictional] daughters[4] – Saraju and Rani, Seema, Payal, Meera and Sabita, Pratibha, Nandini and Samita, Linda, Susmita, and Radha and Piyali, who have been able to resist 'the self-perpetuating and closed nature of patriarchal structure and institutions' (Palmer 1987: 183) by relentlessly fighting their way for their rights and helping other women at times of need. They are very common people whom we perhaps meet every day, but seldom do we hear and come to know of their distinctive female experiences. Sanjukta Dasgupta's short stories speak of the regular grapples undertaken by the common women with whom majority of us [the readers] can relate and thereby feel the author's anger which proliferate every corner of the narratives, thereby contributing towards the development of a separate sensibility and writing style for women and furthering the cause of women's literature.

The Annals of Dasgupta's Daughters

Saraju and Rani in 'The Gift', Seema in 'Break' and Payal in 'Dear Diary' are Dasgupta's daughters who are struggling within the abysmal depths of the androcentric society to carve a space and a room of their own.

Like the narrative of most of Dasgupta's stories, here too we observe how the society's stereotyped conventions act as a trap to continue the act of coercing women in the name of conventions, marriage and family. As the women often fail to escape from their *sasur-bari*, the prison house as Rabindranath Tagore had stated in *Tasher Desh*, they seek to virtually escape, even if it is temporarily, to a space of their own. Interrogating the stereotypes a widow is subjected to, Saraju emerges

[4] This essay discusses the stories of Saraju and Rani in 'The Gift', Seema in 'Break', Payal in 'Dear Diary', Meera and Sabita in 'Touch', Pratibha in 'Blood Ties', Nandini and Samita in 'Selfish', Linda in 'Black and White', Susmita in 'The American Dream', and Radha and Piyali in 'Compulsory'. All these short stories are anthologised in Sanjukta Dasgupta's *Abuse and Other Short Stories*.

victorious when she plays Tagore's songs over her esraj. It becomes a signifier of protest to defy the pain inflicted upon widows, and the true respite comes through a creative [music] expression. Through Seema, Dasgupta attacks the patriarchal notions regarding 'working' and 'non-working women', emphasizing that home-makers often work more than the women pursuing jobs. The orthodox attitude of the society towards women having jobs, and the subtle way of husbands coaxing their wives to be economically dependent upon them is brutally exposed through Pradip's 'oracle' on his togetherness with Seema (Dasgupta 2013: 20). Amidst such a trap, Seema discovers her freedom, a space to be her own. 'The Gift' and 'Break' vindicates that creative spaces debriefs the loneliness and helplessness of women, hence they should earn to [exercise] it well' (Dasgupta 2013: 18), if necessary surreptitiously. Payal in 'Dear Diary' escapes her depression through her diary where she can voice to her expressions. Her protest is silent but vivid one. She attains all the academic accolades, like qualifying GRE to receive an admission offer at the University of Columbia, she had laboured for in spite of being divorced by her husband who prioritized his career for the same accolades over his wife, and fails to attain them. Through their 'own subject, own system, own theory, and own voice' (Showalter 1982: 14) Saraju, Rani, Seema and Payal offer resistance and interrogates the violent gyres of the society through their creative pursuits.

Like Charlotte Perkins Gilman's 'The Yellow Wallpaper', through Meera and Sabita in 'Touch', Radha and Piyali in 'Compulsory', and to a certain extent Samita and Nandini in 'Selfish' Dasgupta explores female companionship. Through their association they seek answers to the questions that derive from their experiences, and to underscore the subtle and often neglected problems and issues, and here their experiences, problems and issues are both from their lives in the patriarchal society, as well as the occurrences in the lives of women in the society, who, like them, struggle to have a space exclusively of their own amidst the confinements of life. This friendship, as *Of Woman Born*, vindicates female 'physicality as a resource rather than a destiny' (Rich 1977: 62) interrogating at once the Freudian coordinates of 'penis envy, the castration complex, and the Oedipal phase' which determine women's relationship with language, fantasy, and culture (Showalter 1982: 24). Along with *ecriture feminine* Hélène Cixous is of the opinion that the feminine principle involves a woman giving without any expectation of return because unlike the male she does not undergo a trauma from castration anxiety. Meera escapes the conditioned gyre of her familial life through her masseur Sabita who made her feel 'a teenager again, eager, intense and very happy' (Dasgupta 2013: 39). Breaking all the social conditions of companionship both become friends and soon Meera urges for Sabita's presence in her life, perhaps for a few hours of respite from the existing trap named family. On a similar vein, Radha and Piyali raises serious questions on the persisting issue of money and material [dowry] in marriage and the dilemma of women within such internment in the modern day.

Samita in Dasgupta's 'Selfish' is an embodiment of the 'new woman' who is intelligent, educated, self-sufficient, sensitive, hard working and is the ever assuring space to her friend Nandini who in spite of all her labours towards her children is left lonely at her old age after the death of her husband. Though through the narrative we come to know of Samita's pragmatic advice and help to Nandini to start a tailoring venture and how she becomes her true mentor and changes her life for good. Nandini discovers her lost self, grows in her endeavour, employs others and feels no regret for her emphatic reply to her insensitive son who is selfish for his own interests over his mother's likings and associations. Through 'Touch', 'Compulsory' and 'Selfish', Dasgupta's Meera and Sabita, Radha and Piyali, and Samita and Nandini respectively, become the embodiment of Luce Irigaray's idea of a female 'homosexuality' as an extensive alternative to the dominating male 'homosexual' in order to resist patriarchy's attempts to sexually marginalize women in the 'foregrounding of the exclusivity of the female sexual organ as plural as opposed to the strictly unitarily focused genital masculine sexuality' (Bhaduri and Malhotra 2016: 115). The women support and help each other to posses 'a self-defined critical consciousness' and thereby challenge the various complexities of life which aim towards establishing 'a mass produced or stereotypical identity' of these women (Donovan 1997: 212). Like *A Room of One's Own*, this short story facilitates a feminist analysis of the material conditions – social, political and economic – in which women struggle to have a sphere and room of their own (Whitson 2004: 278). The woman's sphere is governed by the 'cult of true womanhood' and the 'feminine ideal' which develop the women's culture redefining women's activities and objectives from a woman's perspective through an 'assertion of equality and an awareness of sisterhood, the community of women' based on values, institutions and relationships and processes of communication consolidating female ordeal and culture (Lerner 1981: 52, 54).

Pratibha in 'Blood Ties', Linda in 'Black and White', Susmita in 'The American Dream' are the voices of women from three different age-groups who are subjected to stereotypes in different dimensions. In spite of all her labours of love towards her family, Pratibha Bose is not allowed by her children to remarry [after her husband's death] at the age of 75 to ward off her loneliness. She is not taken care by them, rather sent to Happy Home where she meets Ranjan Gupta, a 71 year old companion to live a proper life once again. Unlike Saraju, Pratibha dares to move ahead to take a decision on her own for the rest of her life. The septuagenarian couple's decision to donate their bodies after their death for medical research is indeed commendable and inspires the readers to rethink on the waste involved in the post-death rituals which are more often a 'show' of love for an individual after the individual's death than in reality. Linda's story in short can be put as 'Black People and Their Lives Matter'. She is rejected by the patriarchal Indian boy Rakesh Modi, even after spending quite some time with her, on the

account of the colour of her African American skin. Towards the end of this powerful story Linda realises that it would have been a mistake to be engaged with people like Rakesh, who in spite of their glamorous academic affiliations, remain deeply embedded in dogmatism against any ray of liberal, rational thinking where the heart and feelings matter over complexion, unfortunately. Susmita's story involves the predicament of many Bengali women being married by their parents to glamorous NRI professionals only to be metamorphosed to be their cook and 'good *desi* wives' (Dasgupta 2013: 72) at the foreign lands, at the cost of their brilliant careers. This story is an antidote against those parents who force their daughters to get married to NRI professionals only to enjoy the benefits [academic] of life at a foreign land, exposing the illusion behind such an activity.

Conclusion

With the freedom of words and dynamic courage of expressing women's unique experiences Sanjukta Dasgupta is a Bengali gynocritic whose short stories bear 'a new conceptual vantage point' (Showalter 1982: 15) of feminist literary tradition. It involves breaking free women's writings from 'the glass coffin of the male-authored text' only to attain and enjoy 'a dance of triumph, a dance into speech, a dance of authority' (Gilbert and Gubar 2000: 44). The narrative in her short stories possess a distinct Indian character, context, tone, sensitivity and language (Peeradina 2010: xi), intertextuality encapsulating that 'all creative art must rise out of a specific soil and flicker with a spirit of place' (Gifford 1986: 58) to 'open new windows and doors of perception enabling a holistic understanding of the world' (Dasgupta 2016). Dasgupta's entelechy is explored through her astute treatment of the issues of our everyday life through her short stories, like her poetry, which being embedded with a vibrant force inspires the sensitive reader to think and 'to stand up' against 'trauma, fears and oceans of tears' (Dasgupta 2017: 73, 77).

Like Sanjukta Dasgupta's poetry collections *Snapshots* (1996), *Dilemma: A Second Book of Poems* (2002), *First Language* (2005), *More Light* (2008), *Lakshmi Unbound* (2017) and *Sita's Sisters* (2019) her widely published short stories also interrogate and deconstruct 'the double blind with power and understanding' towards 'a wider trajectory of the cultural diversity' along with the 'ideological position of the subject's voice of power' (Dasgupta 2006: 178). Sanjukta Dasgupta's delicate perception through an intense self-reflexivity colour her 'female imagination' as the only feasible vent for women's true aspirations and interrogate the anxiety of authorship to emanate an emotion of motherhood towards her female characters, who as her daughters 'affirm in far-reaching ways the significance of their inner freedom' (Spacks 1976: 316). Dasgupta's short stories 'ceaselessly deconstructs the male [androcentric] discourse' (Jacobus 2012: 12, 13) only to

provide a window to witness and hear the long unheard voices, which are different and distinct, but orchestrated together in its identity and sensibility (Vatsyayan 2009: xviii); facilitating a realization of gender inclusiveness and gender equality – the harmony of androgyny, instead of misandry and misogyny (Dasgupta 2019). The 'dynamics of female friendship' (Abel 1981: 434) explored through Dasgupta's short stories by the mother – daughter bond between Sanjukta Dasgupta and her female characters represent women's experiences which differ from men's in profound and regular ways – as 'for every aspect of identity as men define it, female experience varies from the male model' (Gardiner 1982: 178, 179). It involves a shift in 'the point of view' (Spacks 1976: 315) to emphasize female imagination – creativity – voice - liberty by transcending historical boundaries; and it is through these great experiences as a woman Sanjukta Dasgupta envisions a reiteration of women's position and their own literature through a creative genre of postcolonial women's writing in Indian English.

Bibliography

ABEL, E. (1981). "(E)Merging Identities: The Dynamics of Female Friendship in Contemporary Fiction by Women". *Signs*, 6.3, 413 – 435.

BAGCHI, S. (2019). "Grim Tales". *The Telegraph*, 26 April, 7.

BANERJEA, K. M. (2009). A Prize Essay on Native Female Education. En. Sen, K. (ed.), *Inscribing Identity: Essays from Nineteenth Century Bengal*. Kolkata: K. P. Bagchi and Company, 116 – 124.

BAYM, N. (1978). *Women's Fiction: A Guide to Novels by and about Women in America 1820 – 1970*. Ithaca: Cornell University Press.

BEAUVOIR, S. de. (1956). *The Second Sex*. London: Jonathan Cape.

BHADURI, S. and MALHOTRA, S. (2016). (eds.), *Literary Theory: An Introductory Reader*. India: Anthem Press.

CAPKOVA, B. K. (2011). Selected Concepts of Woman As "The Other" In Critical Feminist Writings. En. Dasgupta, S. and Guha, C. (eds.), *Breaking The Silence: Reading Virginia Woolf, Ashapurna Devi and Simone De Beauvoir*. Kolkata: Das Gupta & Co. Pvt. Ltd., 3 – 27.

DASGUPTA, S. (2006). In a Double Blind: Indian Women Poets Writing in English. En. Arya, S. and Sikka, S. (eds.), *New Concerns: Voices in Indian Writing*. India: Macmillan, 161 – 180.

DASGUPTA, S. (2013). *Abuse and Other Short Stories*. Kolkata: Dasgupta & Co. (P) Ltd.

DASGUPTA, S. (2015). Surviving In My World: Growing of Dalit in Bengal http://www.youtube.com/watch?v=_NQuevxbcpY. [11 March 2021].

DASGUPTA, S. (2016). Interview. *Incredible Women of India: It's all about you and your story*. <incrediblewomenofindia.wordpress.com> [11 March 2021].

DASGUPTA, S. (2017). *Lakshmi Unbound*. Chitrangi.

DASGUPTA, S. (3 March 2019). "Balance for Better." *The Statesman* <www.thestatesman.com/opinion/balance-for-better-1502736058.html> [11 March 2021].

DAVIDOW, E. M. (1989). The Philosophical Bases of Feminist Literary Criticisms. En. Kauffman, L. (ed.), *Gender and Theory: Dialogues on Feminist Criticism*. Oxford: Basil Blackwell, 63 – 106.

DONOVAN, J. (1997). Beyond The Net: Feminist Criticism As A Moral Criticism. En. Newton, K. M. (ed.), *Twentieth-Century Literary Theory: A Reader*. London: Palgrave Macmillan, 211 – 215.

FETTERLEY, J. (1991). Introduction on the Politics of Literature. En. Warhol, R. R. and Herndl, D. P. (eds.), *Feminism: Anthology of Feminist Literary Theories*. New Brunswick, New Jersey: Rutgers University Press, 492 – 501.

FRASER, B. (2015). *Letters to My Mother and Other Mothers*. Edinburgh: Luath Press Limited.

GARDINER, J. K. (1978). The Heroine as Her Author's Daughter. En. Brown, C. L. and Olson, K. (eds.), *Feminist Criticism: Essays on Theory, Poetry and Prose*. New Jersey: The Scarecrow Press, 244 – 253.

GARDINER, J. K. (1982). On Female Identity and Writing by Women. En. Abel, E. (ed.), *Writing and Sexual Difference*, Chicago: University of Chicago Press, 177 – 191.

GIFFORD, H. (1986). *Poetry in a Divided World: The Clark Lectures 1985*. Cambridge: Cambridge University Press.

GILBERT, S. M. and GUBAR, S. (2000). *The Madwoman in the Attic: The Woman Writer And The Nineteenth Century Literary Imagination*. Yale: Yale University Press.

GUHA, R. (ed.). (2012). *Makers of Modern India*. New Delhi: Penguin Books.

JACOBUS, M. (2012). The Difference of View. En. Jacobus, M. (ed.), *Women Writing And Writing About Women*. London: Routledge, 10 – 21.

KING, B. (1987). *Modern Indian Poetry in English*. Delhi. New York: Oxford University Press.

KOLODNY, A. (1991). Dancing Through the Minefield. En. Warhol, R. R. and Herndl, D. P. (eds.), *Feminism: Anthology of Feminist Literary Theories*. New Brunswick and New Jersey: Rutgers University Press, 97 – 116.

KUMAR, S. P. and LAL, M. Introduction. En. Kumar, S. P. and Lal, M. (eds.), *Speaking for Myself: An Anthology of Asian Women's Writing*. New Delhi: Penguin Books, xix – xxviii.

LERNER, G. (1981). *The Majority Finds Its Past: Placing Women In History*. Oxford: Oxford University Press.

MACKINNON, C. A. (1982). "Feminism, Marxism, Method, and the State: An Agenda for Theory". *Signs*, 7.3, 515 – 544.

MALLICK, S. (2019). "Debriefing the Satanic Gyres of Patriarchy: A Bengali Gynocritic and Her Daughters". *Meridian Critic*, 33.2, 49 – 63.
MOERS, E. (1977). *Literary Women*. London: The Women's Press.
MOI, T. (1985). *Sexual/Textual Politics: Feminist Literary Theory*. London and New York: Methuen.
NAYAR, P. K. (2010). *Contemporary Literary and Cultural Theory: From Structuralism to Ecocriticism*. India: Pearson.
PALMER, P. (1987). From "Coded Mannequin" to Bird Woman: Angela Carter's Magic Flight. En. Roe, S. (ed.), *Women Reading Women's Writing*. New York: The Harvester Press, 177 – 205.
PANIKER, K. A. (1991). Introduction. En. Paniker, K. A. (ed.), *Modern Indian Poetry in English*. New Delhi: Sahitya Akademi, 11 – 19.
PARTHASARATHY, R. (2002). Introduction. En. Parthasarathy, R. (ed.), *Ten Twentieth Century Indian Poets*. Delhi and New York: Oxford University Press, 1 – 11.
PEERADINA, S. (2010). Introduction. En. Peeradina, S. (ed.), *Contemporary Indian Poetry in English: An Assessment and Selection*. India: Macmillan Publishers India Limited, ix – xi.
RICH, A. C. (1977). *Of Woman Born: Motherhood As Experience and Institution*. New York: Bantam Books.
SCHUMACHER, D. (1975). Subjectivities: A Theory of the Critical Process. En. Donovan, J. (ed.), *Feminist Literary Criticism: Explorations in Theory*. Kentucky: University Press of Kentucky, 1 – 28.
SHOWALTER, E. (1977). *A Literature of Their Own: British Women Novelists from Bronte to Lessing*. Princeton, New Jersey: Princeton University Press.
SHOWALTER, E. (1982). Feminist Criticism in the Wilderness. En. Abel, E. (ed.), *Writing and Sexual Difference*. Chicago: University of Chicago Press, 9 – 36.
SHOWALTER, E. Towards A Feminist Poetics. En. Newton, K. M. (ed.), *Twentieth-Century Literary Theory: A Reader*. U.K.: Palgrave Macmillan, 216 – 220.
SPACKS, P. M. (1976). *The Female Imagination: A Literary and Psychological Investigation of Women's Writing*. Allen and Unwin.
SPAULL, S. (1989). Gynocriticism. En. Mills, S., Pearce, L., Spaull, S., and Millard, E. (eds.), *Feminist Readings/Feminists Reading*. Hertfordshire: Harvester Wheatsheaf, 83 – 121.
SPAULL, S. and MILLARD, E. (1989). The Anxiety of Authorship. En. Mills, S., Pearce, L., Spaull, S., and Millard, E. (eds.), *Feminist Readings/Feminists Reading*. Hertfordshire: Harvester Wheatsheaf, 122 – 153.
TAGORE, R. (2001). Creative Unity. En. Das, S. K. (ed.), *The English Writings of Rabindranath Tagore* Volume II, New Delhi: Sahitya Akademi, 493 – 569.
TAGORE, R. (2003). *The Centre of Indian Culture*. Rupa & Co.
TAGORE, R. (2005). *The Religion of Man*. Rupa Publications India Pvt. Ltd.

VATSYAYAN, K. (2009). Foreword. En. Kumar, S. P. and Lal, M. (eds.), *Speaking for Myself: An Anthology of Asian Women's Writing*. New Delhi: Penguin Books, xv – xviii.

WHITSON, K. J. (2004). *The Encyclopedia of Feminist Literature*. London: Greenwood Press.

WOOLF, V. (1970). *The Death of the Moth and Other Essays*. New York: Harcourt Brace and Company.

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factors 8.4
IJAR 2021; SP7: 64-72

Dhiman Chakraborty
Research Scholar, Dept. of English, DBRAU, Agra, Uttar Pradesh, India

Correspondence
Dhiman Chakraborty
Research Scholar, Dept. of English, DBRAU, Agra, Uttar Pradesh, India

(Special Issue)
"Twenty-First Century: Cultural and Economic Globalization"

Depiction of Ethnic Identity in the North-East Indian Novel in English

Dhiman Chakraborty

DOI: https://doi.org/10.22271/allresearch.2021.v7.i7Sb.8677

Abstract

India is a place of variety with multicultural and multilingual dimensions. Various cultures are fused here with the inner bond of unity amid diversity. Thus, various religions like Buddhists, Hindus, Muslims, Jains, Sikhs coexisted here with friendship and loyalty. India with regional barriers like language or culture made a unique place in the globe. It had a history of more than a thousand years of amalgamations of different cultures. Every corner of India has a special unique feature which we cannot imagine! But the North-East culture has something to look upon with especial eyes. As literature is the eye of society, I am taken the works of literature available in English from the Indian North-East region where at least eight Indian state lives with unity in diversity. They have only one thing in common - the river Brahmaputra- which may be the backbone of North-Eastern civilizations! Here in this paper, I am trying a very brief survey of those states with their depicted reality that may be available in some selected novels of indigenous novelists.

Keywords: Ethnic identity, tribal, migration, marginal voice, race, etc.

Introduction

The Brahmaputra is one of the greatest rivers of the world, traversing three nations and many cultures, as it flows from Tibet through Northeast India and Bangladesh to the Bay of Bengal, on an extraordinary journey spanning nearly 3,000 kilometres... The river is revered in legend, ballads, and contemporary literature as the most visible face of Assam and the northeast, dominating the geography, history, and cultures of both Arunachal Pradesh and Assam...The Brahmaputra's extraordinary power can be seen in a simple fact: this single river carries as much water as almost all the rivers of India put together." (Hazarika 2006:245) [12].

The Brahmaputra is a river of the birthplace of a new culture and this is seen in various documentation of different books related to the culture that it reflects. Arup Kumar Dutta and Sanjay Hazarika make a beautiful observation in this regard. In his book, The Brahmaputra Arup Kumar Dutta shows the values and rituals, manner and culture, religion, and belief of the people of Brahmaputra valley. Strangers of the Mist by Sanjay Hazarika portrays a beautiful inter-relation between geography and psychology, 'mainstream' and 'other', an oral history of the tribes, and the epic the battles fought! Various descriptions also show a different entity of the main ground which relates the people of the land and the natural ecology: "The unbroken green of the landscape as seen from the Brahmaputra is soothing, and the rustic environment, unsullied by ugly scars of industrialization, imparts to the ambiance an extraordinary quiescence. Copses of the plantain, bamboo, coconut, betel nut, and other palm half- conceal clustered helmets, with thatched roofs and bamboo walled cottages. The hills rise in gentle slopes from the fringes of the valley, taking on a steeper gradient as one proceeds north to south." (Dutta 2005:67)

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Article

Ecological Risk Assessment of Heavy Metals in Adjoining Sediment of River Ecosystem

Bhanu Pratap Singh [1], Moharana Choudhury [2,3], Palas Samanta [4,*], Monu Gaur [1] and Maniram Kumar [1]

[1] Department of Civil Engineering, SRM Institute of Science and Technology, Delhi-NCR Campus, Ghaziabad 201204, India; bhanu.gkv1989@gmail.com (B.P.S.); monugauriitm@gmail.com (M.G.); maniramkumar7@gmail.com (M.K.)
[2] Department of Environmental Science, Tezpur University, Tezpur 784028, India; moharanachoudhury@gmail.com
[3] Voice of Environment (VoE), Guwahati 781034, India
[4] Department of Environmental Science, Sukanta Mahavidyalaya, University of North Bengal, Raja Rammohunpur 735210, India
* Correspondence: samanta.palas2010@gmail.com

Abstract: The present study was focused on heavy metal distribution patterns and the associated ecological risk assessment in the adjoining sediment of the Hindon River in Muzaffarnagar Region (U.P.), India. Lead (Pb), zinc (Zn), copper (Cu), cadmium (Cd), nickel (Ni), iron (Fe), aluminum (Al), sodium (Na), and potassium (K) were estimated from six sediment samples (Atali A and B, Budhana A and B, and Titavi A and B). The concentration of the heavy metals Zn, Pb, Cu, Ni, and Cd ranged from 25.5–74.7 mg kg^{-1}, 29.8–40.6 mg kg^{-1}, 7.0–29.2 mg kg^{-1}, 14.7–21.8 mg kg^{-1}, and 0.96–1.2 mg kg^{-1}, respectively and followed the sequence Zn > Pb > Cu > Ni > Cd, while major elements followed the sequence Na > Fe > Al > K. The enrichment factor (EF) and geo-accumulation index (I_{geo}) revealed that Atali A showed the highest enrichment and followed the sequence Zn > Cu > Pb > Ni > Cd. Contamination factor (CF) and contamination degree (CD) depicted that all of the sites (except Titavi B) were moderately to considerably contaminated. The highest degree of contamination (CF, CD, and PLI, pollution load index) was observed at Titavi A followed by Atali A and Budhana A. Eco-toxicological risk assessment (RI) indicated that the sites were moderately contaminated, predominantly by Ni and Pb and Zn. The results revealed that the metal contamination in sediment is alarming and might pose an adverse threat to ecosystem health.

Keywords: heavy metals; contamination; sediment; element; risk; pollution; health

Citation: Singh, B.P.; Choudhury, M.; Samanta, P.; Gaur, M.; Kumar, M. Ecological Risk Assessment of Heavy Metals in Adjoining Sediment of River Ecosystem. *Sustainability* **2021**, *13*, 10330. https://doi.org/10.3390/su131810330

Academic Editor: Salvador García-Ayllón Veintimilla

Received: 28 July 2021
Accepted: 7 September 2021
Published: 16 September 2021

1. Introduction

Heavy metal pollution in aquatic ecosystems has gained utmost concern because of its persistence and bioaccumulation nature [1,2]. Generally, heavy metals mainly enter aquatic ecosystems (e.g., lakes, rivers, reservoirs, and wetlands) by means of industrial or sewage discharge [3–7]. Apart from this, atmospheric deposition and anthropogenic activities have accelerated the accumulation of heavy metal levels in the aquatic ecosystems [8]. In particular, heavy metal pollution is inflicting damage upon rivers locally, especially in developing countries and has attracted the attention of scientific communities [9].

In a riverine ecosystem, sediments are considered as environmental indicators of metal pollution due to their high physico-chemical stability [1,10]. They also serve as both a source and sink of heavy metals [11,12]. Additionally, sedimental chemical analysis provides valuable information about the anthropogenic activities that have prevailed in these ecosystems [1]. Further, they are considered to be carriers of different contaminants into aquatic ecosystems. In the marine system's natural condition, most of the heavy metals are quickly deposited into the bottom sediment after their entry into the riverine system and are concentrated in higher amounts than in water and are particularly introduced

World Journal of Gastroenterology

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World J Gastroenterol 2021 September 21; 27(35): 5822-5850

DOI: 10.3748/wjg.v27.i35.5822

ISSN 1007-9327 (print) ISSN 2219-2840 (online)

REVIEW

Environmental perspectives of COVID-19 outbreaks: A review

Palas Samanta, Apurba Ratan Ghosh

ORCID number: Palas Samanta 0000-0001-9369-7502; Apurba Ratan Ghosh 0000-0003-1454-7720.

Author contributions: Samanta P contributed to the conceptualization, writing- original draft preparation, software running; Ghosh AR contributed to the conceptualization, supervision, writing- reviewing and editing.

Conflict-of-interest statement: The authors have no conflicts of interest to declare.

Manuscript source: Invited manuscript

Specialty type: Public, environmental and occupational health

Country/Territory of origin: India

Palas Samanta, Department of Environmental Science, Sukanta Mahavidyalaya, University of North Bengal, Dhupguri 735210, West Bengal, India

Apurba Ratan Ghosh, Department of Environmental Science, The University of Burdwan, Burdwan 713104, West Bengal, India

Corresponding author: Palas Samanta, PhD, Assistant Professor, Department of Environmental Science, Sukanta Mahavidyalaya, University of North Bengal, Dhupguri, Jalpaiguri, Dhupguri 735210, West Bengal, India. samanta.palas2010@gmail.com

Abstract

The coronavirus disease 2019 (COVID-19) pandemic, caused by the novel virus severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), began in December 2019 in China and has led to a global public health emergency. Previously, it was known as 2019-nCoV and caused disease mainly through respiratory pathways. The COVID-19 outbreak is ranked third globally as the most highly pathogenic disease of the twenty-first century, after the outbreak of SARS-CoV and Middle East respiratory syndrome in 2002 and 2012, respectively. Clinical, laboratory, and diagnostic methodology have been demonstrated in some observational studies. No systematic reviews on COVID-19 have been published regarding the integration of COVID-19 outbreaks (monitoring, fate and treatment) with environmental and human health perspectives. Accordingly, this review systematically addresses environmental aspects of COVID-19 outbreak such as the origin of SARS-CoV-2, epidemiological characteristics, diagnostic methodology, treatment options and technological advancement for the prevention of COVID-19 outbreaks. Finally, we integrate COVID-19 outbreaks (monitoring, fate and treatment) with environmental and human health perspectives. We believe that this review will help to understand the SARS-CoV-2 outbreak as a multipurpose document, not only for the scientific community but also for global citizens. Countries should adopt emergency preparedness such as prepare human resources, infrastructure and facilities to treat severe COVID-19 as the virus spreads rapidly globally.

Key Words: COVID-19; SARS-CoV-2 virus; Environmental perspectives; Epidemiological characteristics; Public health; Emergency preparedness

Indian Journal of Experimental Biology
Vol. 59, December 2021, pp. 877-883

Evaluation of health status of *Oreochromis niloticus* (L.) based on brain optic tectum morphopathology

Palas Samanta[1]* & Apurba Ratan Ghosh[2]

[1]Department of Environmental Science, Sukanta Mahavidyalaya, University of North Bengal, West Bengal, India

[2]Department of Environmental Science, The University of Burdwan, West Bengal, India

Received 15 May 2021; *revised 22 July 2021*

Oreochromis niloticus (L.) health status was evaluated based on brain optic tectum morphopathology. *O. niloticus* was exposed to sub-lethal Almix (66.67 mg/L) and Excel Mera 71 (17.2 mg/L) concentrations for 30 d. Results revealed that herbicides exposure caused different morphological changes in brain optic tectum. Almix treatment showed comparatively higher morphological changes compared with Excel Mera 71. The mean assessment value (MAV) showed significantly higher ($p < 0.0001$) value in Almix (4.36±0.09) and Excel Mera 71 (3.60±0.09) exposure, in comparison with control fish (0.09±0.02). Stratum album centrale (SAC) and stratum periventriculare (SPV) were most affected layer compared with others. The observed morphological alterations revealed impaired visual, sensory and motor functions, which ultimately alters brain physiology. In particularly, the existence of necrosis in neural cells, loss of Nissl substances, gliosis and vacuole formations under Almix and Excel Mera 71 exposure indicated neurotoxic nature of these herbicides. However, higher prevalence under Almix treatment indicated higher neurotoxic potential than Excel Mera 71. Therefore, the results presented here are highly significant to toxicologist considering its neurotoxic property. Finally, further studies are needed to explore detailed mode of action of neurotoxicity for adverse outcome pathways (AOP) development at molecular level.

Keywords: Adverse outcome pathways, Almix and Excel Mera 71, Brain, Herbicides, Neurotoxicity, Nile tilapia

The structural and functional integrity of tissue and/or cell is an integral part of regulatory toxicology and normally vary within fairly narrow range defined mainly by metabolism, specialisation and differentiation as well as by metabolic substrates availability and neighbouring tissue/cell constraints[1]. Xenobiotic exposure to tissue/cells can evoke either protective cellular adaptations or pathological changes, which can eventually lead to cell death and ultimately population decline[2-6]. These pathological changes are considered as powerful tool as well as biomarkers to evaluate health status of fish exposed to xenobiotic under both laboratory and field conditions[7-9]. The major advantage of using pathological biomarker over other biomarkers in toxicology is that it allows to evaluate specific target organs toxicity. For example, gills, liver and kidney play prominent role in respiration, accumulation and biotransformation, and excretion of xenobiotic, respectively from fish body[10,11]. Additionally, pathological changes can translate into higher biological levels and provides linkage between lower and higher biological levels to understand the adverse outcomes[1,9]. Moreover, pathological lesions observed in these organs are normally easier to identify than functional ones[11], and serve as an early and sensitive warning responses of xenobiotic damage to animal health[7,9]. Furthermore, pathological responses of xenobiotic exposure resulted ecological changes[2].

Fish brain is the controlling center of all functions, specifically related to sense organs, motor coordination, behaviour and metabolic regulation and movements in the body organisms as well[2,9,12]. Brain contains numerous nerve cells and sensory systems. Higher PUFA (polyunsaturated fatty acid) content and lower enzymatic and non-enzymatic oxidant level compared with other tissues makes it more susceptible to xenobiotic exposure[2]. Consequently, brain is considered as good biomarker of xenobiotic exposure because of its early warning signs. However, pathological responses in fish nervous system, in particularly on neurons and their associated processes such as neurobehavioral characteristic, apoptosis, *etc.*, are least studied. Additionally, only little information is available on the effects of pesticides on brain optic

*Correspondence:
Phone: +91 8327220799 (Mob.)
E-Mail: samanta.palas2010@gmail.com

THE JOURNAL OF PHYSICAL CHEMISTRY B

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Discriminating between Concerted and Sequential Allosteric Mechanisms by Comparing Equilibrium and Kinetic Hill Coefficients

Published as part of The Journal of Physical Chemistry virtual special issue "Dave Thirumalai Festschrift".

Amnon Horovitz* and Tridib Mondal

Cite This: *J. Phys. Chem. B* 2021, 125, 70–73 Read Online

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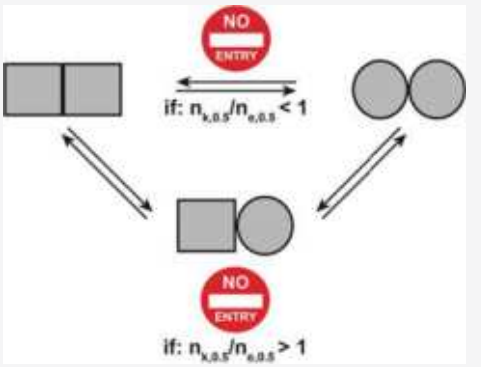
ABSTRACT: Hill coefficients, which provide a measure of cooperativity in ligand binding, can be determined for equilibrium (or steady-state) data by measuring fractional saturation (or initial reaction velocities) as a function of ligand concentration. Hill coefficients can also be determined for transient kinetic data from plots of the observed rate constant of the ligand-promoted conformational change as a function of ligand concentration. Here, it is shown that the ratio of the values of these two Hill coefficients can provide insight into the allosteric mechanism. Cases when the value of the kinetic Hill coefficient is equal to or greater than the value of the equilibrium coefficient indicate concerted transitions whereas ratios smaller than one indicate a sequential transition. The derivations in this work are for symmetric dimers but are expected to have general applicability for homo-oligomers.



INTRODUCTION

Insights into reaction mechanisms are often obtained through identifying and characterizing reaction intermediates. Consequently, various criteria have been proposed, for example, for determining the validity of the two-state approximation of protein folding reactions. Examples include a calorimetric criterion for two-state folding according to which the measured calorimetric enthalpy change upon unfolding should be equal to the van't Hoff enthalpy change calculated assuming a two-state transition.[1−3] Another criterion is that the *m*-value (i.e., the slope of the plot of the change in free energy vs denaturant concentration) for equilibrium denaturation should be equal to the sum of *m*-values for folding and unfolding obtained from transient kinetic data.[4] In contrast, there has been surprisingly little consideration of such criteria for the legitimacy of the two-state approximation of allosteric transitions as assumed, for example, in the classic Monod−Wyman−Changeux (MWC) model.[5] Here, we show that the ratio between the values of the Hill coefficients obtained for equilibrium binding data and transient kinetic data can provide such a criterion.

Cooperativity in the function of multisubunit proteins is often reflected in sigmoidal plots of fractional saturation of ligand binding sites as a function of ligand concentration. Such plots can be fitted to the Hill equation:

$$\bar{Y} = \frac{K[S]^{n_e}}{1 + K[S]^{n_e}} \quad (1)$$

where $\bar{Y}$ and K designate the fractional saturation and apparent binding constant, respectively, [S] is the ligand concentration, and n_e is the Hill coefficient, which provides a measure for the extent of cooperativity under equilibrium or steady-state (when $\bar{Y}$ is replaced by initial enzyme velocity divided by the maximal initial velocity, V/V_{max}) conditions. Cooperativity in ligand binding by multimeric proteins is often due to ligand-promoted conformational changes, which can be concerted, sequential, or probabilistic.[6] Regardless of the allosteric mechanism, plots of the rate of the conformational change, *k*, as a function of the ligand concentration are often also sigmoidal. Such plots can be fitted to a kinetic version of the Hill equation:[7]

$$k = \frac{k_0 + k_{max}K[S]^{n_k}}{1 + K[S]^{n_k}} \quad (2)$$

where k_0 and k_{max} are the respective rate constants of conformational change in the absence of ligand and at saturating ligand concentration, n_k is the Hill coefficient for transient kinetic data, and K and [S] are defined as before. In previous work,[8] it was shown that $n_k/n_e \neq 1$ can indicate that

Received: October 15, 2020
Revised: December 10, 2020
Published: January 5, 2021

https://dx.doi.org/10.1021/acs.jpcb.0c09351
J. Phys. Chem. B 2021, 125, 70−73

Insight into the Autosomal-Dominant Inheritance Pattern of SOD1-Associated ALS from Native Mass Spectrometry

Jelena Cveticanin [1‡], Tridib Mondal [2‡], Elizabeth M. Meiering [3*], Michal Sharon [1*] and Amnon Horovitz [2*]

1 - ***Department of Biomolecular Sciences,*** *Weizmann Institute of Science, Rehovot 7610001, Israel*
2 - ***Department of Structural Biology,*** *Weizmann Institute of Science, Rehovot 7610001, Israel*
3 - ***Department of Chemistry,*** *University of Waterloo, Waterloo, ON N2L 3G1, Canada*

Correspondence to Elizabeth M. Meiering, Michal Sharon and Amnon Horovitz:
meiering@uwaterloo.ca (E.M. Meiering),
Michal.Sharon@weizmann.ac.il (M. Sharon),
Amnon.Horovitz@weizmann.ac.il (A. Horovitz)
https://doi.org/10.1016/j.jmb.2020.09.025
Edited by Daniel Otzen

Jelena Cveticanin, Tridib Mondal, Elizabeth M. Meiering, Michal Sharon, and Amnon Horovitz

Legend: *The ice bucket challenge was initiated to raise awareness and encourage support of research on the motor neuron disease, amyotrophic lateral sclerosis (ALS). Mutations in the superoxide dismutase 1 (SOD1) dimer are one of the causes for this disease. The JMB article by Cveticanin et al. "Insight into the autosomal-dominant inheritance pattern of SOD1-associated ALS from native mass spectrometry" shows how native mass spectrometry can be employed to determine the extent of preferential association of mutant and wild-type SOD1 subunits. A strong correlation is found between the survival times associated with different mutations and the tendency for heterodimer formation.*

Abstract

About 20% of all familial amyotrophic lateral sclerosis (ALS) cases are associated with mutations in superoxide dismutase (SOD1), a homodimeric protein. The disease has an autosomal-dominant inheritance pattern. It is, therefore, important to determine whether wild-type and mutant SOD1 subunits self-associate randomly or preferentially. A measure for the extent of bias in subunit association is the coupling constant determined in a double-mutant cycle type analysis. Here, cell lysates containing co-expressed wild-type and mutant SOD1 subunits were analyzed by native mass spectrometry to determine these coupling constants. Strikingly, we find a linear positive correlation between the coupling constant and the reported average duration of the disease. Our results indicate that inter-subunit communication and a preference for heterodimerization greatly increase the disease severity.

Homodimeric proteins are widespread in Nature including in humans where they constitute about 25% of all proteins with a known crystal structure.[1] Mutations in homodimers are often associated with disease.[2] Examples include the involvement of Park7 (DJ1) in Parkinson's disease,[3] NAD(P)H quinone oxidoreductase 1 (NQO1) in cancer and certain neurological disorders (such

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Letter

Slowdown of Water Dynamics from the Top to the Bottom of the GroEL Cavity

Nicolas Macro, Long Chen, Yushan Yang, Tridib Mondal, Lijuan Wang, Amnon Horovitz,* and Dongping Zhong*

Cite This: *J. Phys. Chem. Lett.* 2021, 12, 5723−5730

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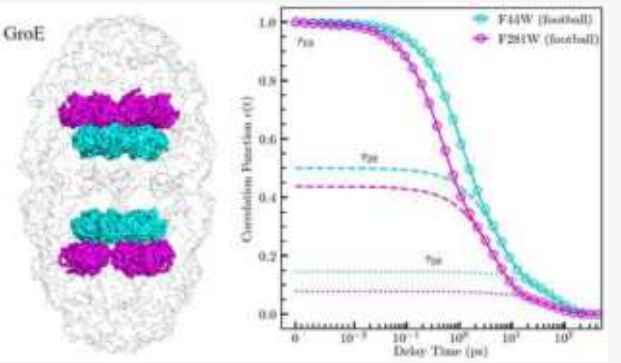
ABSTRACT: The GroE molecular chaperone system is a critical protein machine that assists the folding of substrate proteins in its cavity. Water in the cavity is suspected to play a role in substrate protein folding, but the mechanism is currently unknown. Herein, we report measurements of water dynamics in the equatorial and apical domains of the GroEL cavity in the apo and football states, using site-specific tryptophanyl mutagenesis as an intrinsic optical probe with femtosecond resolution combined with molecular dynamics simulations. We observed clearly different water dynamics in the two domains with a slowdown of the cavity water from the apical to equatorial region in the football state. The results suggest that the GroEL cavity provides a unique water environment that may facilitate substrate protein folding.



Molecular chaperones, which are found across biology, prevent aggregation and facilitate protein folding.[1] The GroE system from *Escherichia coli* is an ATP-dependent protein folding facilitator both *in vitro* and *in vivo* where it assists in the folding of ∼250 proteins and is required for the proper folding of ∼60 proteins.[2−5] The GroE system is composed of two proteins: GroEL and its helper-protein GroES (Figure 1). GroEL consists of 14 identical 56 kDa subunits that form two 7-member rings that are placed back-to-back, with cavities at each end.[6] The helper-protein GroES is a homoheptamer consisting of 10 kDa subunits that form a single ring. ATP-dependent binding of GroES to the apical domains of GroEL leads to encapsulation of the substrate protein in the cavity.[7] There are currently many models that describe the ATP- and substrate-dependent reaction cycle of GroEL[8−10] which is governed by cooperativity between GroEL monomers.[3] There is positive intraring cooperativity and negative inter-ring cooperativity in ATP binding producing two GroEL-GroES complexes that are both functional: the asymmetric $GroEL_{14}$:$GroES_7$ (bullet) and the symmetric $GroEL_{14}$:$GroES_{14}$ (football) complexes[10] (see Figure 1). The mechanism by which GroEL facilitates substrate folding is hotly debated with many models requiring experimental validation. There are two main categories of models describing the GroEL substrate folding mechanism, named the passive cage and the active model.[11−17] The passive cage model states that GroEL does not alter the folding pathway of the substrate and merely provides an environment for the normal pathway to occur.[11,12] The active model assumes there are some interactions between GroEL and the substrate that affect and sometimes enhance the folding process.[13−17] There are many factors that can affect substrate folding, such as cavity-wall chemical identity, steric confinement, and cavity water properties. Theoretical examinations have provided analysis that suggests the confinement of solvent could result in improved folding rate.[15,18] Alternatively, increased rigidity of water motions would promote protein unfolding and assist in an annealing mechanism.[17,19]

Water is a critical solvent for cytosolic proteins to fold into their native state and to function.[20−24] Water in the hydration layers near a protein surface has been observed to have significantly slower dynamics than that of bulk water.[25] Many previous studies have been performed to understand the hydration dynamics of water near the protein surface, including NMR,[26] neutron scattering,[27] 2D-IR,[28] THz absorption spectroscopy,[22,29] and molecular dynamics (MD) simulations.[30] These studies have determined that these hydration layers have dynamics that are significantly slowed compared to bulk-water dynamics. Additionally, just as the surface of proteins is highly heterogeneous with various charged, polar, and hydrophobic residues, the water dynamics across the surface is also highly heterogeneous. A previous study measured the dynamics of water near the apical domains of the GroEL cavity and found the

Received: April 15, 2021
Accepted: June 7, 2021

https://doi.org/10.1021/acs.jpclett.1c01216
J. Phys. Chem. Lett. 2021, 12, 5723−5730