Soma Ghosh

DBT BioCaRe Scientist

Curriculum Vitae

PERSONAL DETAILS

Birth	January 12, 1989
Address	44, Banerjee Para Road, Kolkata-41, West Bengal, India
Phone	(+91)-8697345956
E-mail	ghoshsoma1987@gmail.com

EDUCATION

Name of the examination	Year of passing	Institution	Board/University	Grand total/ percentage
Ph.D	2018	Dept. of Biotechnology, IIT Kharagpur	Indian Institute of Technology Kharagpur	
M.Sc (Microbiology)	2011	Bidhannagar Govt. College	West Bengal State University	70.9%
B.Sc (Microbiology Hons.)	2009	Vijaygarh Jyotish Ray College	University of Calcutta	67%
Higher Secondary examination	2005	D.A.V Public School	CBSE	80.4%
Secondary Examination	2003	Sacred Heart Convent	ICSE	83%

M.Sc Dessertation: "Role of *toxP* in virulence of *Vibrio cholarae*" under the guidance of Dr. Rukhsana Chowdhury, IICB Jadavpur, Kolkata

GATE 2011: AIR 483

JRF: July 2011- March 2014 in the project "Exploration of microbial diversity and microbial role in arsenic mobilization in As-contaminated groundwater of North Eastern states (Arunachal Pradesh and Assam)" at Dept. of Biotechnology, IIT Kharagpur

RESEARCH

PhD: under supervision of Dr. Pinaki Sar 2012-2018

Environmental microbiology and microbial genomics laboratory
Department of Biotechnology; Indian Institute of Technology Kharagpur

Thesis Title: Characterization of bacterial communities in arsenic contaminated groundwater of Brahmaputra river basin

Microbial diversity of arsenic (As) contaminated groundwater of North Eastern state (Assam) in the Brahmaputra river basin (BRB) was studied using culture dependent approach. Diversity of cultivable bacterial populations has revealed predominance of *Brevundimonas* (35%) and *Acidovorax* (23%) along with *Acinetobacter* (10%), *Pseudomonas* (9%), *Undibacterium, Herbaspirillum, Rhodococcus, Staphylococcus, Bosea, Bacillus, Ralstonia, Caulobacter* and *Rhizobiales* (<5%). The microbial diversity obtained exhibited high resistance to As, diverse metabolism related to their growth utilizing various C-sources and alternate inorganic electron acceptors [As^{5+}, Se^{6+}, Fe^{3+}, NO_3^-, SO_4^{2-}, $S_2O_3^{2-}$] during anaerobic growth. Enrichment study to explore the predominating anaerobic microbial community was performed through PCR-DGGE technique. Microbial enrichment microcosm study from As rich aquifer sediments revealed highest anaerobic microbial diversity in absence of added organic carbon. Phylogenetic analysis revealed the dominance of strict to facultative anaerobic bacterial members of *Clostridiaceae, Lachnospiraceae, Peptostreptococcaceae, Desulfotomaculum, Bacillus, Anaerostipes* etc. in the enrichment cultures. Addition of As5+ to the enrichment cultures had a profound impact on selective bacterial enrichment as well as elemental release in the supernatant. Geological analysis including XRD, SEM and EDX revealed sediment weathering due to microbial activity. Sulphate reduction in absence of added As^{5+} by potent sulphate reducers appears to be limited upon addition of As5+. Among the various genera detected through cultivable (aerobic) as well as enrichment (anaerobic) studies, *Bacillus* was found to be a facultative anaerobic bacterium which could be a potent As metaboliser in varying redox environments. Therefore, strain IIIJ3-1 a member of genus *Bacillus* was selected for further study. The bacterium was found to be gram positive, endospore forming, non-capsulated, catalase and oxidase positive, moderately alkaliphilic which exhibited facultative anaerobic growth with As5+ as TEA. Anaerobic growth kinetics and electron acceptor reduction profile revealed preference of As^{5+} followed by Fe^{3+}, Se^{6+}, NO_3^-, SO_4^{2-}. Phylogenetic analysis, biochemical properties, metabolic profiling, chemotaxonomic characters and molecular properties confirmed the isolate to be a novel member of *B. cereus sensu lato* for which the type strain is *Bacillus inferioriaquae* IIIJ3-1(T) (=MCC2980T =BCCM LMG 29433T =JCM 31241T). Deduced amino acid sequences of As homeostasis genes *arr*, *acr3(1*) and *arsB* obtained from strain IIIJ3-1 revealed phylogenetic relatedness with those reported from other As resistant *Bacillus* sp. whereas *aioB* showed phylogenetic incongruency. Microcosm studies showed enhanced ability of the strain IIIJ3 -1 to release As from As rich sand in presence of lactate as electron donor. EDX analysis and XRD data corroborated this observation. Addition of NO_3^- in aerobic or anaerobic condition further enhanced the release of As from sand by strain IIIJ3-1. Decoupled release of As with that of Fe was found. Arsenic sequestration occurred in the secondary mineral phases of the sediment coupled with release of Fe. Minimal concentrations of organic matter in the aqueous phase supports the growth of this strain under reducing conditions with NO_3^- as a favourable TEA. Addition of As5+ as TEA showed selective growth of the dominant bacterial species and abolished the sparse population. The study reports for the first time the identity and metabolic abilities of bacteria in As contaminated ground water of BRB, useful to elucidate the microbial role in influencing mobilization of As in the region.

M.Sc in Microbiology (% marks obtained: 70.9 %) 2009- 2011
Bidhannagar Govt. College, West Bengal State University

M.Sc dissertation: Role of toxP in virulence of Vibrio cholarae" under the guidance of Dr. Rukhsana Chowdhury, IICB Jadavpur, Kolkata

B.Sc in Microbiology Hons. (% marks obtained: 67 %) 2006-2009
Bijoygarh Jyotish Ray College, University of Calcutta

PROJECTS

Exploration of microbial diversity and microbial role in arsenic mobilization in As-contaminated groundwater of North Eastern states (Arunachal Pradesh and Assam) 2011-2014
Department of Biotechnology, India

Post served: JRF

Objective of this project was to decipher the predominant cultivable microbial communities present in arsenic (As) contaminated groundwater of Brahmaputra river basin and their role in mobilization of As from sediment to aquifers. The study reported predominance of Proteobacterial members and sparse populations of Firmicutes and Actinobacteria. Very high microbial tolerance to As (i.e 550 mM of As^{5+} and 50 mM of As^{3+}) and extremely high metabolic versatility indicated natural adaptation to As stress and varying underground nutrients. Microbial siderophore activity and anaerobic respiration utilizing As^{5+}, Fe^{3+}, SO_4^{2-}, NO_3^- and $S_2O_3^{2-}$ indicated siderophore dependent leaching of As complexed with Fe^{3+}. Besides, chemolithotrophic growth of few bacteria were also detected using As^{3+} as sole electron donor. This study was first of its kind to be conducted in the As contaminated sub-surface aquifers of North East India and was published in Water Research.

Comparative analysis of microbial diversity of Adi Ganga and its adjoining aquifers with subsequent designing of bioremediation strategy to clean Adi Ganga

2018-2019

CSIR, India

Post served: Research Associate

The objective of the project was to determine the major pollutants of Adi Ganga and their effect on groundwater quality of the adjoining areas. Surface water (SW) and groundwater (GW) collected from six locations along Adi Ganga were analyzed to understand the extent of degradation caused due to SW pollution. Among the important water quality parameters and heavy metal analysis- DO, turbidity, total hardness, alkalinity, BOD, oil and grease and Zn of both SW and GW were found to be much greater than their respective permissible limits (WHO, 2004). Both the SW and GW samples depicted PO_4^{3-} and HCO_3^- beyond their recommended values whereas, cations were well within the limit. A 5-fold higher bacterial count was obtained from surface water than that from groundwater of adjoining area. Multi- metal tolerance was observed in all of the isolates with 70% of the population solely indigenous to Adi Ganga resistant to 7 – 10 different heavy metals. Resistance profiling against broad spectrum antibiotics revealed that very high bacterial resistance occurred against ampicillin, chloramphenicol, aerosporin and streptomycin whereas the population was considerably sensitive to ciprofloxacin and gentamycin. The SW and GW isolates revealed a MAR index as high as 0.8 and 0.3, respectively. Correlation in heavy metal and antibiotic resistance was evident through cluster analysis and might be due to commonality in their resistance mechanisms. Hydrochemical facies analysis through Piper, Stiff, Stabler, Schoeller-Berkaloff and Wilcox diagrams indicated that the water is dominated by calcic and magnesian facies with chlorinated and bicarbonate water types with higher alkalinity. Average water quality index of 33.7 and 52.4 for SW and GW indicate that these are severely and marginally threatened, respectively. Cluster analysis and Pearson's correlation studies show similar trend for both SW and GW indicating role of SW pollution in quality degradation of GW. The work was published in the journal Chemosphere.

Perturbations in human gut microbiome and their interactions with host genetics on long term exposure of arsenic

2020-continuing

BioCaRe, Department of Biotechnology (DBT), India

Post serving: DBT BioCaRe Scientist (PI)

The objective of the project is to determine the changes in structural diversity of the gut microbiome of As exposed and unexposed populations (n=150) through next generation high throughput 16S rRNA gene amplicon sequencing from metagenomic DNA isolated stool samples of enrolled subjects. Bioinformatic analysis of the amplicon sequencing is being performed through DADA2. Study of polymorphisms in genes involved in As transportation,

biotransformation, oxidative stress response, and DNA repair in As exposed and unexposed populations are also being investigated in order to study the association between host genetic variations in the candidate genes and gut microbiome in As exposed and unexposed populations. Restriction enzyme based profiling of the SNP genotypes are being performed for 9 knowns SNPs of 3 human As metabolizing candidate genes. The exposure and excretory routes of arsenic in human is revisited with special importance to excretion through stool. Estimation of As concentration in human stool, urine, blood and groundwater are analysed through various spectroscopic techniques like ICP-OES, ICP-MS and AAS.

PUBLICATIONS

Journals Published

Soma Ghosh[1], *Sreemanta Pramanik (**2021**)"Structural diversity, functional aspects and future therapeutic applications of human gut microbiome"* ***Archives of microbiology, 1-28*** *https://doi.org/10.1007/s00203-021-02516-y*

Arijit Chakraborty, ***Soma Ghosh****, Bratisha Biswas, Sreemanta Pramanik, Jerome Nriagu, Subhamoy Bhowmick (**2021**)"Epigenetic modifications underlying arsenic-induced toxicity: A comprehensive review"* ***Science of the Total Environment 151218*** *https://doi.org/10.1016/j.scitotenv.2021.151218*

Soma Ghosh[1], *Sohini Majumder, Tarit Roychowdhury (**2021**) "Impact of microbial multimetal and broad spectrum antibiotic tolerance in urban surface water (Adi Ganga, Kolkata) on adjacent groundwater: A future threat"* ***Groundwater for Sustainable development,*** 100608, *https://doi.org/10.1016/j.gsd.2021.100608*

Soma Ghosh, *Balaram Mohapatra, Tulasi Satyanarayana, Pinaki Sar (**2020**)"Molecular and taxonomic characterization of arsenic (As) transforming Bacillus sp. strain IIIJ3-1 isolated from As-contaminated groundwater of Brahmaputra river basin, India"* ***BMC microbiology*** *20, no. 1: 1-20. https://doi.org/10.1186/s12866-020-01893-6*

Soma Ghosh *and Pinaki Sar (**2020**) "Microcosm based analysis of arsenic release potential of Bacillus sp. strain IIIJ3-1 under varying redox conditions."* ***World Journal of Microbiology and Biotechnology*** *36, no. 87: 87. https://doi.org/10.1007/s11274-020-02860-z*

Soma Ghosh[1]*, Sohini Majumdar, Tarit Roychowdhury (**2019**) "Assessment of the effect of urban pollution on surface water-groundwater system of Adi Ganga, a historical outlet of river Ganga"* ***Chemosphere*** *237: 124507. https://doi.org/10.1016/j.chemosphere.2019.124507*

Soma Ghosh*, Abhishek Gupta, Jayeeta Sarkar, Swati Verma, Abhijeet Mukherjee, & Pinaki Sar (**2019**). Enrichment of indigenous arsenate reducing anaerobic bacteria from arsenic rich aquifer sediment of Brahmaputra river basin and their potential role in As mobilization.* ***Journal of Environmental Science and Health, Part A****, 54(7), 635-647. https://doi.org/10.1080/10934529.2019.1579524*

Soma Ghosh *and Pinaki Sar. (**2013**)"Identification and characterization of metabolic properties of bacterial populations recovered from arsenic contaminated ground water of North East India (Assam)."* ***Water research*** *47, no. 19: 6992-7005. https://doi.org/10.1016/j.watres.2013.08.044*

[1] Corresponding author

*Nilanjana Roy Chowdhury, **Soma Ghosh[2]**, Madhurima Joardar, Duhita Kar, & Tarit Roychowdhury, (2018). Impact of arsenic contaminated groundwater used during domestic scale post harvesting of paddy crop in West Bengal: Arsenic partitioning in raw and parboiled whole grain. **Chemosphere** 211, 173-184.*
https://doi.org/10.1016/j.chemosphere.2018.07.128

*Nilanjana Roy Chowdhury, Reshmi Das, Madhurima Joardar, **Soma Ghosh**, Subhojit Bhowmick, & Tarit Roychowdhury (2018). Arsenic accumulation in paddy plants at different phases of pre-monsoon cultivation. **Chemosphere**, 987-997*
https://doi.org/10.1016/j.chemosphere.2018.07.041

Book Chapters published

***Soma Ghosh[1]**, Meenakshi Mukherjee and Pinaki Sar (2019) Impact of arsenic on structural and functional composition of dominant bacterial populations associated with various natural ecosystems. In, Environmental Pollution, Biodiversity and Sustainable Development. Apple Academic Press, USA.*

***Soma Ghosh** (2020). Class notes series- Microbiology, (Springer) Ed. Debasish Kar (In press).*

*Pinaki Sar, Balaram Mohapatra, **Soma Ghosh**, Dhiraj Paul, Angana Sarkar, Sufia K. Kazy, (2017). Geomicrobiology of arsenic contaminated groundwater of Bengal delta plain. In Handbook of Metal-Microbe Interactions and Bioremediation. (pp. 333 -353). Taylor and Francis.*

*Nilanjana Roy Chowdhury, Madhurima Joardar, **Soma Ghosh**, Subhojit Bhowmick, Tarit Roychowdhury (2019). Variation of Arsenic Accumulation in Paddy Plant with Special Reference to Rice Grain and Its Additional Entry During Post-harvesting Technology. In: Ray S. (eds) Ground Water Development – Issues and Sustainable Solutions. Springer, Singapore*

Communicated and under revision

***Soma Ghosh[1],** Meenakshi Mukherjee, Tarit Roychowdhury "Bacterial bio- mobilization and -sequestration of arsenic in contaminated paddy fields of West Bengal, India".*
Biocatalysis and Agricultural Biotechnology, Elsevier

Soma Ghosh[1],** Shaheen Akhtar, Sreemanta Pramanik, Kanchan Kumari "Environmental micro and nano plastic pollution with special reference to bacterial bioremedial consortium development: a review". **International Journal of Environmental Science and Technology, Springer

Soma Ghosh[1],** Suchetana Banerjee. "Microbial pigments and paints for cleaner environment" in **Microbial products for future industrialization"**, to be published by Springer Nature within a series "**Interdisciplinary Biotechnological Advances: Recent progress and future prospects" in Springer Nature publication

AWARDS/RECOGNITIONS

- Junior Research Fellowship, DBT (Project EMA) (2011-2014)
- DBT Travel Grant 2013, Department of Biotechnology, India
- Institute fellowship, IIT KGP (2014- 2016)
- CSIR- Research Associateship (2018-2019)
- Women's Scientist Award, ICBSEE-2018 (NIT Rourkela)
- DST Travel Grant (2020) (Selected but haulted due to CoVid)
- DBT BioCaRe Women Scientist (2020- continuing)

CONFERENCES

- Participated in workshop on "Plastic Pollution and Persistent Organic Pollutants (POPs) – Introduction to regulations, key concerns and sampling and analysis techniques" Organized by the India-Norway cooperation project on capacity building for reducing plastic and chemical pollution in India (INOPOL), supported by the Norwegian Embassy in New Delhi.

- Participated in training programme entitled ""Metagenomics and Environmental Pollution Control" organized by CSIR- NEERI, Nagpur on October 5, 2020

- Invited speaker at Water 2020 on "Evaluation of geogenic and anthropogenic impacts on groundwater and surface water quality: an environmental concern", IIT Guahati

- Oral Presentation at 1st International Conference on Bioprocess for Sustainable Environment and Energy [ICBSEE-India-2018] at NIT Rourkela, India
- Oral presentation at 2nd Regional Science and Technology Congress (West Bengal), 2017, Burdwan University

- Poster presention at 2nd International Conference on Water Research, IWA. 2013, Singapore

- Poster presentation at 56th International Conference of Association of Microbiologists of India 2015

- Organising member in MHRD/AICTE QIP Short Term course on Environmental Genomics and Biotechnology at Dept. of Biotechnology, IIT Kharagpur 2011

- Attended National Seminar on Microbiology: An environmental Perspective at Ramakrishna Mission, Belur Math. 2008

WORK EXPERIENCE

- I am currently working as DBT BioCaRe Scientist at CSIR-National Environmental Engineering Research Institute, Kolkata Zonal Centre since January, 2020

- Presently co-mentoring two M.Sc interns (Molecular Biology)

  1. Functional diversity of arsenic biotransformation genes (*aoxB* & *arsH*) in gut microbiome of As exposed and unexposed populations of West Bengal

  2. SNP genotyping of candidate As metabolising genes in As exposed populations of West Bengal

- I have worked as CSIR-Research Associate at School of Environmental Studies, Jadavpur University from May, 2018 to December, 2019. While my tenure, I have partially guided an M.Tech thesis on

  "Variation of Arsenic accumulation in paddy plant during post monsoon cultivation in West Bengal, India: special reference to its effects on photosynthetic pigments and a study of arsenic metabolizing bacterial population with a scope of bioremediation"

TEACHING EXPERIENCE

Worked as guest faculty at:

- School of Environmental Sciences: Jadavpur University (M.tech – Modern Biology) (2017-2018)
- Vijaygarh Jyotish Ray College: Calcutta University (M.Sc – RDT and Genomics) (2017-2018).

I have worked as Teaching Assistant in the following courses (B.Tech) in the Department of Biotechnology, IITKharagpur, India:

- Microbiology (Theory and Practicle classes; Autumn Sem, 2015; Spring and Autumn

Sem. 2016).

REFERENCES

- Dr. Pinaki Sar – (Ph.D Supervisor), Professor
  Department of Biotechnology, IIT Kharagpur
  Email**:** sarpinaki@yahoo.com; Contact No. +91-3222-283754

- Dr. Tarit Roychowdhury (Post- Doc Mentor), Associate Professor
  School of Environmental Studies, Jadavpur University
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- Dr. Sreemanta Pramanik (Co-PI in DBT BioCaRe Project)
  Senior Principal Scientist
  Kolkata Zonal Centre, CSIR- National Environmental Engineering Research Institute
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- Prof. Abhijit Mukherjee (honourable Doctoral Scrutiny Committee Member)
  Associate Professor
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- Prof. Mrinal Kumar Maity (honourable Doctoral Scrutiny Committee Member)
  Professor
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- Dr. Deepanjan Majumdar (Head, CSIR-NEERI KZC)
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