

Somnath Mazumder

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Department of Zoology
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EDUCATION

Doctor of Philosophy (Ph.D.) in Science

January 2012- June 2018

Department of Biochemistry, University of Calcutta
Thesis work performed in Division of Infectious Diseases and Immunology,
CSIR-Indian Institute of Chemical Biology, Kolkata

Thesis supervisor: Prof. Uday Bandyopadhyay

Thesis title: Studies on the Mechanism of Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)-Induced Mitochondrial Pathology and Altered Dynamics during Gastric Injury.

Master of Science (M.Sc.)

2009-2011

Zoology with specialization in Genetics and Molecular Biology,
University College of Science Technology and Agriculture, University of Calcutta

Bachelor of Science (B.Sc.)

2006-2009

Honors in Zoology,
Maulana Azad College, University of Calcutta

PREVIOUS POSITIONS

- **Experimental Laboratory Manager** **December 2019 – August 2020**
DBT National Genomics Core
National Institute of Biomedical Genomics,
PO: NSS, Kalyani, District Nadia
West Bengal, India 741251
- **Project Coordinator** **November 2018 - December 2019**
Core Technologies Research Initiative (CoTeRI)
National Institute of Biomedical Genomics,
PO: NSS, Kalyani, District Nadia
West Bengal, India 741251
- **Project Assistant Level III** **February 2017 - November 2018**
Division of Infectious Diseases and Immunology
CSIR-Indian Institute of Chemical Biology,
4 Raja S.C. Mullick Road, Jadavpur
Kolkata- 700032, West Bengal, India
- **Guest Lecturer** **August 2017 - November 2018**
Department of Zoology
Sarojini Naidu College for Women
30, Jessore Road, Kolkata – 700028

- **Doctoral Research Scholar**

September 2011 – January 2017

In the laboratory of Prof. Uday Bandyopadhyay
Division of Infectious Diseases and Immunology
CSIR-Indian Institute of Chemical Biology
4 Raja S.C. Mullick Road, Kolkata - 700032

PUBLICATION AND CITATION METRICS SUMMARY

Citation indices as per Google Scholar

Citations 646

h-index 11

i10-index 12

Citation Indices as per *scopus.com*

h-index: 10

Total citations: 456

Google scholar page: <https://scholar.google.co.in/citations?user=UlnhaewAAAAJ&hl=en>

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HONOURS AND AWARDS

- Best Paper Presentation Award in the international conference on ‘**Mechanistic and Therapeutic Approaches in Human and Animal Health**’. Organized by Department of Zoology, Cooch Behar Panchanan Barma University, WB, India; 6-8th December 2021; Title of the Presentation: **Selective scavenging of intra-mitochondrial prooxidants corrects non-steroidal anti-inflammatory drug-induced gastropathy: an acid secretion-independent novel gastroprotective strategy.**
- Doctoral Research Fellowship, Council of Scientific & Industrial Research (CSIR), New Delhi, India.

CURRENT RESEARCH PROJECT

- Major Research Project received as **Start-up Research Grant (SRG)** funded by **Science and Engineering Research Board (SERB), Department of Science and Technology, Govt. of India; Mechanistic studies on mitochondrial quality control during wound healing after nonsteroidal anti-inflammatory drug (NSAID)-induced gastric mucosal injury; Project Allotment of Rs. 25,00,000.00 for 2 years. Status: Ongoing**

TECHNICAL UNDERSTANDING AND EXPERIENCE

- **Genomics-** Human oral cancer tissue dissociation for preparation of viable single cell suspension; preparation of single nuclei suspension from frozen tissue; GEM generation in Chromium Controller from 10X Genomics; single cell RNA 3'-gene expression library preparation from 10X Genomics; DNA and RNA isolation; human whole genome library preparation by TruSeq Nano DNA Library Preparation kit; RNA sequencing library preparation by TruSeq Stranded Total RNA library preparation kit.
- **Cell Biology-** Gastric epithelial cell isolation and purification; single nucleus preparation, neutrophil and peripheral blood mono nuclear cell (PBMC) isolation; *in vitro* cell culture (primary cells and cancer cell lines). TUNEL assay; flow cytometry for mitochondrial transmembrane potential (with JC-1); ROS measurement and apoptosis; immunocytochemistry; subcellular fractionation; isolation of mitochondria from tissue, normal and cancer cells; measurement of mitochondrial respiration by respiratory control ratio analysis.
- **Microscopy-** High resolution live cell confocal imaging for analyzing ER and mitochondrial

structure and estimating mitochondrial fragmentation. Multicolor confocal microscopy. Competent of operating Leica-TCS-SP8 confocal imaging system with STED microscopy; Image processing with Huygens Professional, SVI software; 2D and 3D image deconvolution; Sample preparation for TEM.

- **Molecular Biology-** Isolation and quantification of RNA and DNA, RT-PCR and qPCR, lipofectamine mediated transfection for gene knockdown studies.
- **Biochemistry-** Western blot, Electrophoresis (Agarose and PAGE), Electrophoretic mobility shift assay (EMSA), Co-immunoprecipitation, caspase activity assay, quantification of cellular oxidative stress (lipid peroxidation, protein carbonylation), subcellular fractionation, ETC complex assays using spectrophotometry, cardiolipin oxidation using fluorimetry, fatty acid oxidation using radio labeled fatty acids, mitochondrial respiration by oxygraphic measurement (RCR), measurement of oxygen consumption rate (OCR) by extracellular flux analyzer, MTT assay, cell proliferation assay using [³H]-thymidine incorporation, gastric luminal pepsin measurement.
- **Immunology-** Immunohistochemistry, ELISA, neutrophil isolation, chemotactic assays.
- **Animal Handling-** Generation of experimental gastric ulcer in rats by oral gavaging of non-steroidal anti-inflammatory drugs (NSAIDs), ethanol or by inducing cold restraint stress. Isolation of gastric fluid and quantification of gastric luminal acid content. Intra-peritoneal, sub-cutaneous, intra-muscular injections of drugs. Generation of paw edema in rats by carrageenan and estimation of swelling by plethysmometer.
- **Software-** EndNote, Microscope Imaging software (Application Suite Advanced Fluorescence: Leica Microsystems), Image J, GraphPad Prism, Adobe Photoshop, CorelDraw, MS Office.
- **Other skills-** Writing manuscript, Research Grants and fellowship-proposals writing.

EXPERIENCE OF PROJECT MANAGEMENT

November 2018 -August 2020

Experience in managing scientific projects associated with Next Generation Sequencing and Genotyping. Consultation with scientists to plan the genomics-associated experiments, preparing budgets and finally monitoring and coordinating the smooth running of sanctioned projects in a time bound manner following Good Laboratory Practice guidelines to ensure Quality Assurance of the delivered results in compliance with global standards for a non-clinical national research laboratory. Preparation of standard operating procedures (SOPs), maintenance of laboratory records, inventory management (for lab equipment/consumables), preparation of project reports, preparation of documents for ethical clearance associated with experimentation on human patient-derived samples and laboratory animals, standardization of scientific protocols.

SUMMARY OF RESEARCH EXPERIENCE

Mitochondrial oxidative stress, altered structural dynamics and apoptosis of gastric mucosa

Non-steroidal anti-inflammatory drugs (NSAIDs), popularly known as pain killers, are extensively used to treat multiple inflammatory diseases, pain and they also offer anti-cancer effects against colorectal, prostate and other cancers. In spite of being typical anti-inflammatory agents, the enigmatic activation of proinflammatory signaling specifically in the gastric mucosa, leading to severe gastric injury by these

drugs, poses major limitations in their long-term therapeutic usage along with raising enormous questions about the detailed mode of action and precise subcellular targets. My research specifically deals with elucidation of molecular pathways triggering the gastric mucosal pathogenesis along with identifying novel nontoxic gastroprotective therapeutic strategies. I studied and found that mitochondrial oxidative stress and consequent damage to the organellar structural dynamics and function underlies the clinical complications due to NSAIDs and mitochondrially targeted specific antioxidants like mitoTEMPO can prevent gastric complications by NSAIDs by completely bypassing gastric acid suppression. The finding carries relevance as novel therapeutic strategies targeting mitochondrial pathology hold immense potential as new generation gastroprotective molecules are the need of time that can be used in combination with the NSAIDs. I further studied the effect of NSAIDs on mitochondrial structural dynamics in normal gastric mucosa as well as in gastric cancer cells wherein the crucial role of aberrant mitochondrial dynamics (with excessive fission) in triggering gastric cancer cell death upon NSAID treatment was established. The hyper-fission response activated by NSAID also underlies the pathogenesis of severe gastric mucosal injury triggered by these drugs. This study is the first of its kind which clearly underscores the potency of pain killers to be subjected to anti-neoplastic “drug repurposing”. In addition to pain-killer-induced mitochondrial pathology, I also investigated the involvement of mitochondrial dysfunction in stress-induced mucosal disease which is a very relevant clinical complication arising from acute stress leading to severe gastric mucosal injury and bleeding.

Hepatic oxidative stress and restoration of liver function after malaria

The liver efficiently restores function after damage induced during malarial infection once the parasites are cleared from the blood. However, the molecular events leading to the restoration of liver function after malaria are still obscure. My studies aimed at understanding the process of liver function restoration after malaria. We investigated the role of heme oxygenase 1 (HO-1) in the restoration of liver function (after malaria) because HO-1 normally renders protection against inflammation, oxidative stress, and apoptosis under various pathological conditions and it was found that selective induction of HO-1 in the liver would be beneficial for the restoration of liver function after parasite clearance. The work was published in *Infection and Immunity*, 2014.

Other projects

I was also actively involved in other ongoing projects in the lab wherein the proinflammatory mode of action of human macrophage migration inhibitory factor (MIF) was investigated and Ellagic Acid, a phytopolyphenol was found to inhibit MIF and therefore inflammation. Besides I also worked in identifying the antimalarials activity of a novel small molecule benzothiazole compound that has heme interacting and iron chelation attributes.

COMPLETE LIST OF PUBLICATIONS

➤ Papers in SCI/Scopus indexed international peer reviewed journals

- **Emerging role of mitochondrial DAMPs, aberrant mitochondrial dynamics and anomalous mitophagy in gut mucosal pathogenesis.** *Somnath Mazumder, Samik Bindu, Rudranil De, Subhashis Debsharma, Saikat Pramanik and Uday Bandyopadhyay. (2022) Life Sciences, 120753. doi: 10.1016/j.lfs.2022.120753. PMID: 35787999 <https://pubmed.ncbi.nlm.nih.gov/35787999/>*

- **Sirtuins as endogenous regulators of lung fibrosis: A current perspective.** Somnath Mazumder, Mukta Barman Uday Bandyopadhyay and Samik Bindu (2020) *Life Sciences*, 258:118201. doi: 10.1016/j.lfs.2020.118201 PMID: 32781070
<https://pubmed.ncbi.nlm.nih.gov/32781070/>
- **Non-steroidal anti-inflammatory drugs (NSAIDs) and organ damage: A current perspective.** Samik Bindu, Somnath Mazumder and Uday Bandyopadhyay (2020) *Biochemical Pharmacology*, 180:114147. doi: 10.1016/j.bcp.2020.114147 PMID: 32653589
<https://pubmed.ncbi.nlm.nih.gov/32653589/>
- **Mediators of mitophagy that regulate mitochondrial quality control play crucial role in diverse pathophysiology.** Rudranil De, Somnath Mazumder and Uday Bandyopadhyay (2021) *Cell Biology and Toxicology*, doi: 10.1007/s10565-020-09561-1 PMID: 33067701
<https://pubmed.ncbi.nlm.nih.gov/33067701/>
- **Indomethacin impairs mitochondrial dynamics by activating the PKC ζ -p38-DRP1 pathway and inducing apoptosis in gastric cancer and normal mucosal cells.** Somnath Mazumder, Rudranil De, Subhashis Debsharma, Samik Bindu, Pallab Maity, Souvik Sarkar, Shubhra Jyoti Saha, Asim Azhar Siddiqui, Chinmoy Banerjee, Shiladitya Nag, Debanjan Saha, Saikat Pramanik, Kalyan Mitra, Uday Bandyopadhyay (2019) *The Journal of Biological Chemistry*, 294(20):8238-8258. doi: 10.1074/jbc.RA118.004415 PMID: 30940726
<https://pubmed.ncbi.nlm.nih.gov/30940726/>
- **Selective scavenging of intra-mitochondrial superoxide corrects diclofenac-induced mitochondrial dysfunction and gastric injury: A novel gastroprotective mechanism independent of gastric acid suppression.** Somnath Mazumder, Rudranil De, Souvik Sarkar, Asim Azhar Siddiqui, Shubhra Jyoti Saha, Chinmoy Banerjee, Mohd. Shameel Iqbal, Shiladitya Nag, Subhashis Debsharma, Uday Bandyopadhyay (2016) *Biochemical Pharmacology*, 121:33-51. doi: 10.1016/j.bcp.2016.09.027 PMID: 27693316
<https://pubmed.ncbi.nlm.nih.gov/27693316/>
- **Acute mental stress induces mitochondrial bioenergetic crisis and hyper-fission along with aberrant mitophagy in the gut mucosa in rodent model of stress-related mucosal disease.** Rudranil De, Somnath Mazumder, Souvik Sarkar, Subhashis Debsharma, Asim Azhar Siddiqui, Shubhra Jyoti Saha, Chinmoy Banerjee, Shiladitya Nag, Debanjan Saha and Uday Bandyopadhyay (2017) *Free Radical Biology & Medicine*, 113: 424-438. doi: 10.1016/j.freeradbiomed.2017.10.009 PMID: 28993273
<https://pubmed.ncbi.nlm.nih.gov/28993273/> Work covered in *The Hindu* newspaper
<http://www.thehindu.com/sci-tech/science/iicb-uncovers-molecular-mechanism-of-stress-induced-gastric-ulcer/article22384439.ece>
- **Non-steroidal anti-inflammatory drug induces proinflammatory damage in gastric mucosa through NF- κ B activation and neutrophil infiltration: Antiinflammatory role of heme oxygenase-1 against non-steroidal anti-inflammatory drug.** Samik Bindu, Somnath Mazumder, Sumanta Dey, Chinmay Pal, Manish Goyal, Athar Alam, Mohd. Shameel Iqbal, Souvik Sarkar, Asim Azhar Siddiqui, Chinmoy Banerjee and Uday Bandyopadhyay (2013) *Free Radical Biology & Medicine*, 65:456-467. doi: 10.1016/j.freeradbiomed.2013.07.027

PMID: 23892052 <https://pubmed.ncbi.nlm.nih.gov/23892052/>

- **Association of heme oxygenase 1 with the restoration of liver function after damage in murine malaria by Plasmodium yoelii.** Sumanta Dey*, **Somnath Mazumder***, Asim Azhar Siddiqui, M. Shameel Iqbal, Chinmoy Banerjee, Souvik Sarkar, Rudranil De, Manish Goyal, Samik Bindu and Uday Bandyopadhyay (2014) *Infection and Immunity*, 82(8):3113. doi: 10.1128/IAI.01598-14 PMID: 24818663 *Equal contribution <https://pubmed.ncbi.nlm.nih.gov/24818663/>
- **Macrophage migration inhibitory factor regulates mitochondrial dynamics and cell growth of human cancer cell lines through CD74-NF- κ B signaling.** Rudranil De, Souvik Sarkar, **Somnath Mazumder**, Subhashis Debsharma, Asim Azhar Siddiqui, Shubhra Jyoti Saha, Chinmoy Banerjee, Shiladitya Nag, Debanjan Saha, Saikat Pramanik and Uday Bandyopadhyay. (2018) *The Journal of Biological Chemistry*, 293(51):19740-19760. doi: 10.1074/jbc.RA118.003935 PMID: 30366984 <https://pubmed.ncbi.nlm.nih.gov/30366984/>
- **Management of Inflammation by Natural Polyphenols: A Comprehensive Mechanistic Update.** Souvik Sarkar, **Somnath Mazumder**, Shubhra J. Saha, Uday Bandyopadhyay. (2016) *Current Medicinal Chemistry*, 23(16):1657-95. doi: 10.2174/09298673233666160418115540 PMID: 27087243 <https://pubmed.ncbi.nlm.nih.gov/27087243/>
- **Rab7 of Plasmodium falciparum is involved in its retromer complex assembly near the digestive vacuole.** Asim Azhar Siddiqui, Debanjan Saha, Mohd Shameel Iqbal, Shubhra Jyoti Saha, Souvik Sarkar, Chinmoy Banerjee, Shiladitya Nag, **Somnath Mazumder**, Rudranil De, Saikat Pramanik, Subhashis Debsharma, Uday Bandyopadhyay. (2020) *Biochim. Biophys. Acta General Subjects*, doi: 10.1016/j.bbagen.2020.129656. PMID: 32512169 <https://pubmed.ncbi.nlm.nih.gov/32512169/>
- **Antimalarial Activity of Small-Molecule Benzothiazole Hydrazones.** Souvik Sarkar, Asim A. Siddiqui, Shubhra J. Saha, Rudranil De, **Somnath Mazumder**, Chinmoy Banerjee, Mohd S. Iqbal, Shiladitya Nag, Susanta Adhikari and Uday Bandyopadhyay. (2016) *Antimicrobial Agents and Chemotherapy*, 60(7):4217-28. doi: 10.1128/AAC.01575-15 PMID: 27139466 <https://pubmed.ncbi.nlm.nih.gov/27139466/>
- **Ellagic acid, a dietary polyphenol, inhibits tautomerase activity of human macrophage migration inhibitory factor and its pro-inflammatory responses in human peripheral blood mononuclear cells.** Souvik Sarkar, Asim Azhar Siddiqui, **Somnath Mazumder**, Rudranil De, Shubhra Jyoti Saha, Chinmoy Banerjee, Mohd. Shameel Iqbal, Susanta Adhikari, Athar Alam, Siddhartha Roy and Uday Bandyopadhyay (2015) *Journal of Agricultural & Food Chemistry*, 63 (20), pp 4988–4998. doi: 10.1021/acs.jafc.5b00921 PMID: 25929447 <https://pubmed.ncbi.nlm.nih.gov/25929447/>
- **Hydrazonophenol, a food vacuole targeted and ferriprotoporphyrin IX-interacting chemotype prevents drug resistant malaria.** Shubhra Jyoti Saha, Asim Azhar Siddiqui, Saikat Pramanik, Debanjan Saha, Rudranil De, **Somnath Mazumder**, Subhashis Debsharma,

Shiladitya Nag, Chinmoy Banerjee and Uday Bandyopadhyay. (2018) *ACS Infectious Diseases*, doi: 10.1021/acsinfecdis.8b00178. doi: 10.1021/acsinfecdis.8b00178 PMID: 30472841 <https://pubmed.ncbi.nlm.nih.gov/30472841/>

- **Expression, purification and characterization of Plasmodium falciparum vacuolar protein sorting 29.** Mohd. Shameel Iqbal, Asim Azhar Siddiqui, Athar Alam, Manish Goyal, Chinmoy Banerjee, Souvik Sarkar, **Somnath Mazumder**, Rudranil De, Shiladitya Nag, Shubhra Jyoti Saha and Uday Bandyopadhyay (2016) *Protein Expression and Purification*, 120:7-15. doi: 10.1016/j.pep.2015.12.004 PMID: 26690372 <https://pubmed.ncbi.nlm.nih.gov/26690372/>
- **Detection of retromer assembly in Plasmodium falciparum by immunosensing coupled to surface plasmon resonance.** Mohd. Shameel Iqbal, Asim A Siddiqui, Chinmoy Banerjee, Shiladitya Nag, **Somnath Mazumder**, Rudranil De, Shubhra J. Saha, Suresh K Karri and Uday Bandyopadhyay (2018) *Biochim. Biophys. Acta-Proteins and Proteomics*. 1866(5-6):722-730. doi: 10.1016/j.bbapap.2018.04.005 PMID: 29654975 <https://pubmed.ncbi.nlm.nih.gov/29654975/>
- **Synthesis and biological evaluation of primaquine–chloroquine twin drug: a novel heme-interacting molecule prevents free heme and hydroxyl radical-mediated protein degradation.** Chinmay Pal, Souvik Sarkar, **Somnath Mazumder**, Susanta Adhikari, Uday Bandyopadhyay (2013) *Medicinal Chemistry Communications* 4 (4), 731–736. doi:10.1039/C3MD00019B <https://pubs.rsc.org/en/content/articlelanding/2013/md/c3md00019b>

➤ **Poster/Oral presentation and abstracts in international conference**

1. **Selective scavenging of intra-mitochondrial prooxidants corrects non-steroidal anti-inflammatory drug-induced gastropathy: an acid secretion-independent novel gastroprotective strategy.** **Somnath Mazumder**, Rudranil De, Subhashis Debsharma and Uday Bandyopadhyay. **Mechanistic and Therapeutic Approaches in Human and Animal Health, 2021; 6-8th December 2021**, Dept. of Zoology, Cooch Behar Panchanan Barma University, India
2. **Non-Steroidal Anti-Inflammatory Drugs Induce Mitochondrial Hyperfission and Bioenergetic Crisis to Induce Gastric Cancer Cell Death.** Subhashis Debsharma, **Somnath Mazumder**, Rudranil De, Samik Bindu and Uday Bandyopadhyay (2021), **Frontiers in Cancer Science 2021 (FCS2021)**, 1-3rd November, 2021, Virtual, National university of Singapore, Singapore
3. **Venturing endogenous plant extracts for identification of novel, non-toxic anti-fibrotic formulation: an *in vitro* study.** Mukta Barman, Subhradip Pandit, **Somnath Mazumder**, Chinmay Pal, Subir Chandra Dasgupta, Samik Bindu; **Mechanistic and Therapeutic Approaches in Human and Animal Health, 2021; 6-8th December 2021**, Dept. of Zoology, Cooch Behar Panchanan Barma University, India
4. **Aberrant mitochondrial dynamics: a new therapeutic target for the management of pain killer-induced gastropathy.** Subhashis Debsharma, **Somnath Mazumder**, Rudranil De, and

Uday Bandyopadhyay. **India International Science Festival (IISF) 2020**, 22-24th December 2020, Virtual

5. **Non-steroidal anti-inflammatory drug, Indomethacin, impairs mitochondrial dynamics and cellular respiration to induce death in gastric cancer cells: the central effect targeting cellular metabolic hub.** Somnath Mazumder, Rudranil De, Subhashis Debsharma, Samik Bindu and Uday Bandyopadhyay. **India International Science Festival (IISF) 2019**, 5-8th November 2019, Biswa Bangla Convention Centre & Science City, Kolkata, India
6. **Single Cell Profiling and Identification of Cellular Transitions in Oral Squamous Cell Carcinoma.** Sumitava Roy, Sillarine Kurkalang, **Somnath Mazumder**, Subrata Patra, Shekhar Ghosh, Nidhan K. Biswas, Partha Pratim Majumder, Sandip Ghose, Arindam Maitra; **45th Annual Meeting of the Indian Society of Human Genetics (ISHG) 2020**, 13-15th February 2020, Sri Ramachandra Institute of Higher Education and Research, Chennai, India
7. **Selective scavenging of intra-mitochondrial superoxide and prevention of aberrant mitochondrial fission can serve as novel therapeutic strategies to protect against NSAID-induced gastropathy.** Somnath Mazumder, Rudranil De and Uday Bandyopadhyay; International Conference on Mitochondria in Health and Disease; **6th Annual Conference of Society for Mitochondrial Research and Medicine-India**; 10-11 February, **2017**, Jawaharlal Nehru University
8. **Essential role of macrophage migration inhibitory factor in maintaining mitochondrial integrity and dynamics in gastric adenocarcinoma cells for sustaining proliferation.** Rudranil De, **Somnath Mazumder**, Souvik Sarkar and Uday Bandyopadhyay; **International Conference on Mitochondria in Health and Disease**; 6th Annual Conference of Society for Mitochondrial Research and Medicine-India; 10-11 February, **2017**, Jawaharlal Nehru University
9. **Prevention of mitochondrial pathology and redox imbalance in gastric mucosal cell is a novel therapeutic approach against non steroidal anti-inflammatory drug-induced gastric injury.** Somnath Mazumder and Uday Bandyopadhyay; **3rd International Conference on Perspectives of Cell Signaling and Molecular Medicine**; 8-10 January, **2017**, Bose Institute
10. **Mental stress and mitochondria: mitochondrial dysfunction plays a critical role in the manifestation of gastric injury/ulcer during stress and anxiety.** Rudranil De, **Somnath Mazumder** and Uday Bandyopadhyay; **2nd International Conference on Biotechnology & Biological Sciences, Biospectrum 2018**, University of Engineering & Management (UEM), Kolkata
11. **Bleomycin-induced pulmonary myofibroblast transformation is positively associated with de-stabilization of mitochondrial dynamics due to enhanced fusion and autophagic deregulation.** Samik Bindu, **Somnath Mazumder** and Uday Bandyopadhyay; **INTZOOCON 2018**, 1-3rd February **2018**, University of Calcutta, India.