Dr. Krishnendu Ganguly, PhD

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PERSONAL STATEMENT:

I have a broad spectrum of research background in the fields of "Gastro biology and Neurobiology". As a Doctoral scholar, I studied the **"Studies on extracellular matrix remodelling and angiogenesis in nonsteroidal anti-inflammatory drug induced gastric ulcer: Effect of Melatonin"**. I won a prestigious research grant **(Homing Plus)** as a Post-Doctoral fellow in Poland, where I discovered "Transcriptional regulation of MMP-9 gene during fear learning in mammalian brain". In future, I have a fascination to conduct research on following research areas: **(1) Molecular Characterization of Engram cells during specific behavior at three-dimensional space in Mice (2) The molecular encryption of Memory in Peri-Neuronal NET in Mice. (3) Molecular basis of MMP-based synaptic plasticity during various Physiological and Pathological condition. (4) Therapeutic interventions of various diseases including Cancer and Neuropshyiatric Disorders by MMP-Based Nano-Tools**.

In a nutshell, I have 13.5 years (6 years of PhD + 7.5 years of Post-Doctoral) of research experience at Institute level and 3 years of teaching experience at University College level. Beyond my research successes (including 13 research articles, 1 book chapter), I have been fortunate to obtain a wide range of technical aptitudes. My teaching roles included teaching assistant, instructor and mentor of the school, undergraduate and graduate students. Apart from my doctoral and post-doctoral research, I have also trained several junior fellows about various research techniques and helped them during preparation of their manuscripts and project reports. This altruistic behaviour of my character kept great impressions amongst them and motivated them to carry out their professional life as devoted group researchers in the field of Bioscience. I have strong motivation and faith upon myself, and hence, I wish to carry on my carrier further as a devoted Scientist/ Academician. I believe that implementation of fruitful research, apart from the academic classes and seminars in your esteemed institution will not only provide my basic skill development in recent scientific techniques but also provide the recognition of your organizations glory in global arena.

ACADEMIC APPOINMENTS:

Sept, 2018-March, 2021: **Research Associate**, Department of Zoology, BHU, Varanasi, India.
Aug, 2016- Dec, 2016: **Guest Lecturer**, TDB College Raniganj, Raniganj, India.
Nov, 2015- Mar, 2016: **Post-Doctoral Scholar**, CCRC, University of Georgia, USA.
Feb, 2015- June, 2015: **Post-Doctoral Scholar**, SJTU, Shanghai, China.
Aug, 2014- Jan, 2015: **Visiting Scientist**, DBS, TIFR, India.
Sept, 2009-Jun, 2013: **Adjunct Assistant Professor**, Nencki Institute, Warsaw, Poland.
Jan, 2004-August, 2009: **Doctoral Scholar**, IICB, Kolkata, India.
Sept, 2001-Dec, 2003: **Guest Lecturer**, TDB College and Raniganj Girl`s College, India.

EDUCATION:

2009	**PhD in Gastric Ulcer Biology (Biochemistry)**, Indian Institute of Chemical Biology, affiliated by Jadavpur University, Kolkata, India
2003	**B. Ed in Life Sciences,** Department of Education, Burdwan University, India.
2001	**M. Sc in Zoology (Genetics Special Paper)**, Department of Zoology, Banaras Hindu University, Varanasi, India
1999	**B. Sc in Zoology**, Department of Zoology, TDB College Raniganj, Raniganj, India.

FELLOWSHIPS & GRANTS:

National:

- National Scholarship for M. Sc course (Securing 6th position in B. Sc. Honors): 1999.
- Qualified GATE Exam in life sciences, Percentile - 91.40; All India Rank: 222: 2002.
- Qualified CSIR-UGC NET Exam, UGC JRF: December, 2002.
- Qualified CSIR-UGC NET Exam, CSIR JRF: June & December, 2003.
- CSIR- JRF & SRF for PhD: 2004 – 2008.

International:

- IBRO Travel Award: International Conference, Wierzba, Poland; 2009.
- ISN research fellowship: Work in Nencki Institute, Warsaw, Poland; Sept-Oct, 2009.
- Post- Doctoral Fellowship: Nencki Institute, Warsaw, Poland: Jan, 2010-June, 2013.
- FNP-Programme Homing plus research grant: Nencki Institute, Warsaw, Poland: 2010 - 2012.
- ECMNET-COST Fellowship for Workshop: LIN, Magdaburg, Germany: December 2012.
- ISN-ASN Travel Award: ISN-ASN Neuroscience meeting, Coba & Cancun, Mexico: April 2013.
- FENS travel grant for attending the SFN Neuroscience meeting, San Diego: November 2013.

PUBLICATIONS:

Preparing for Communication:

1. Modulation of Adult Neurogenesis during Neurodevelopmental and Neurodegenerative disorder. **Ganguly K**, Mullick D and Trigun SK: 2022.

2. Painting Memory Engram by Biologically Active Messengers –The molecular Time Travel for the Search of Memory. **Ganguly K** and Trigun SK: 2022.

Published: (13 PAPERS + 1 BOOK CHAPTER; 24 CONFRENCES):

B. Ed. (2002-2003):
1. Chatterjee, S. K., **Ganguly, K**. Predation efficiency of some biological agents on mosquito larvae. Environment and Ecology. 22(3); 562-564; (2004).

PhD (2004-2009):
2. Swarnakar, S., **Ganguly, K.**, Kundu, P., Banerjee, A., Maity, P. and Sharma, A.V. Curcumin regulates expression and activity of matrix metalloproteinases -9 and -2 during prevention and healing of indomethacin induced gastric ulcer. J. Biol. Chem. 280(10); 9409-9415; (2005). **Citation: 295.**
3. Ganguly, K., Maity, P., Reiter R.J. and Swarnakar, S. Effect of melatonin on secreted and induced matrix metalloproteinase-9 and -2 activity during prevention of indomethacin induced gastric ulcer. J. Pineal. Res. 39; 307-315; (2005). **Citation: 65.**
4. Ganguly, K., Kundu, P., Banerjee, A., Reiter, R.J. and Swarnakar, S. Hydrogen peroxide mediated down regulation of matrix metalloprotease-2 in indomethacin-induced acute gastric ulceration is blocked by melatonin and other antioxidants. Free Rad. Biol. Med. 41; 911-925; (2006). **Citation: 104.**
5. Swarnakar, S., Mishra, A., **Ganguly, K**. and Sharma, A. V. Matrix metalloproteinase-9 activity and expression is reduced by melatonin during prevention of ethanol-induced gastric ulcer in mice. J Pineal Res. 43; 56-64; (2007). **Citation: 67.**
6. Singh, L. P., Kundu, P., **Ganguly, K.**, Mishra, A and Swarnakar, S. A novel role of famotidine in downregulation of matrix metalloproteinase-9 during protection of ethanol-induced acute gastric ulcer. Free Rad. Biol. Med. 43; 289-299; (2007). **Citation: 50.**
7. Ganguly, K., and Swarnakar, S. Induction of matrix metalloproteinase-9 and 3 activities during NSAID-induced acute gastric ulcer: role of melatonin. J Pineal Res. 47; 43-55; (2009). **Citation: 63.**
8. Ganguly, K., Sharma, A.V., Reiter, R.J., Swarnakar, S. Melatonin promotes angiogenesis during protection and healing of indomethacin-induced gastric ulcer: role of matrix metaloproteinase-2. J Pineal Res. 49(2); 130-140; (2010). **Citation: 76.**
9. Sharma, AV., **Ganguly, K.**, Paul S, Maulik N, Swarnakar, S. Curcumin heals indomethacin induced gastric ulceration by stimulation of angiogenesis and restitution of collagen fibers via VEGF and MMP-2 mediated signaling. Antioxid Redox Signal. 16(4); 351-362; (2012). **Citation: 52.**

Post-Doctoral (2010-2021):
10. Ganguly K, Rejmak E, Poleszak K, Mikosz M, Nikolaev E, Nikolajew T, Knapska E, Kaczmarek L. Matrix metalloproteinase (MMP) 9 transcription in mouse brain induced by fear learning. J Biolo Chem. 288 (29), 20978-20991, **Citation: 81.**

11. van der Kooij MA, Fantin M, Rejmak E, Grosse J, Zanoletti O, Fournier C, **Ganguly K**, Kalita K, Kaczmarek L, Sandi C. Role for MMP-9 in stress-induced downregulation of nectin-3 in hippocampal CA1 and associated behavioural alterations. Nat Commun. Sep 18;5: 4995 (2014). **Citation: 95.**
12. Mapping connectome in mammalian brain: a novel approach by bioengineering neuro-glia specific vectors. **Ganguly K** and Trigun SK., J Theor Biol 496:110244 (2020)**.**

Book Chapter:
13. Swarnakar, S., **Ganguly, K.**, and Paul S. Regulating Functions of Angiogenesis in Prevention and Therapy of Gastric Ulcer. Nova Science Publishers, NY, USA, www.novapublishers.com (2013).

Scientific Productivity: Number of citations: 948; h-index: 10 (as per 14-01-2022).

CONFERENCES & WORKSHOPS:

National:

- International Symposium on Avian Endocrinology; Department of Zoology, BHU, Varanasi, India: 1999-2000.
- International Symposium on "Aging-A challenge in the New Millennium"; Department of Zoology, BHU, Varanasi, India: 2000-2001.
- 73rd SBC meeting held at Pantnagar University, Uttaranchal, India: 21st - 24th November 2004.
- International Symposium on Teaching, Research and Exploration in Biochemistry; Department of Biochemistry, University of Calcutta, Kolkata, India: 6th - 8th January, 2006.
- The International conference on developmental biology"; Department of Zoology, Kalyani University, Kolkata, India. 8th - 10th July 2006.
- The International conference on Frontier Researchers in Integrative Physiology (ICFRIP)"; Department of Physiology, University of Calcutta, Kolkata, India: 8th - 10th January 2007 and got the **best poster award**.
- International conference on Perspectives of cell signaling and molecular medicine. Department of Biochemistry, University of Calcutta, Kolkata, India. 27th -29th November, 2008 and got the **best poster award.**
- International conference on Neuroscience & XXXVI Annual Meeting on Indian Academy of Neurosciences; Centre of Advanced Study, Department of Zoology, Banaras Hindu University, Varanasi, India. 29th-31st October, 2018.
- Symposium on Frontiers of Sciences (Present & Future)-Life Sciences; Mahamana Seminar Complex, Institute of Science, BHU, Varanasi, India. 13th-14th March, 2019.
- International conference on Neuroscience & XXXVII Annual Meeting on Indian Academy of Neurosciences; AIIMS, India. 29th-31st October, 2019.
- International conference on Current Perspectives of Biochemistry in Health and Diseases; Biochemistry Unit, Department of Zoology, Institute of Science, Banaras Hindu University, Varanasi. 11th-12st January, 2020.

International:

- The International conference entitled "Molecular view of a synapse and its proteolytic remodeling in neuronal plasticity". Wierzba, Poland. September 1st -6th, 2009.
- Participated in the "First FENS featured regional meeting of 9th International congress of the Polish Neuroscience Society" from September 9-12, 2009 at Warsaw, Poland.
- VIII Parnas conference. Warsaw, Poland. August 27st-31st, 2011.
- The 2nd Polish Congress of Biochemistry and Cell Biology. Krakow, Poland September 5th - 9th, 2011.
- ECMNET-COST satellite symposium, Barcelona, Spain. July 11th-13th, 2012.
- 8th FENS forum of Neuroscience, Barcelona, Spain. July 14th-18th, 2012.
- Participated in the Nobel Lecture in Physiology of Medicine, 2012 and in first "Nobel Dialogue week: The Genetic Revolution and its Impact on Society" on 7th-9th of December 2012 in Stockholm, Sweden
- ECMNET-COST training school: A Cell Biologist´s View on Active Synapses and the Perisynaptic Extracellular Matrix, LIN, Magdaburg, Germany. December 12th-18th. 2012.
- Participated in the Nobel Lecture in Physiology of Medicine, 2012 and in first "Nobel Dialogue week: The Genetic Revolution and its Impact on Society" on 7th-9th of December 2012 in Stockholm, Sweden.
- Neurochemistry of Glia Neuron Interaction: April 16th-20th, Chichén Itzá, Yucatán, Mexico 2013.
- ISN-ASN Neuroscience meeting: April 20th-24th, Cancun, Mexico 2013.
- Synapse satellite symposium: April 25th-28th, Plya de Carmen, Mexico. 2013.
- SFN Neuroscience meeting: November 8th-13th, San Diego, California 2013.

SCINTIFIC CONTRIBUTIONS:

PhD:

During the beginning of my doctoral research, it was already known from the previous discoveries that causative factors of stress, alcohol, *Helicobacter pylori* or NSAID-induced gastric ulceration was mainly attributed with deregulation of various antioxidant enzymes and growth factors, abnormal secretion of acids and release of reactive oxygen species (ROS). However, it was almost unknown about the inflammatory mediators of ulcerogens during extracellular matrix (ECM) remodeling and the effect of matrix metalloproteinase's (MMPs) during non-steroidal-anti-inflammatory drug (NSAID)-induced gastric ulceration and consequent healing process. During first two years of my research, I discovered that (NSAID)-induced acute and chronic gastric ulceration was manifested upon regulation of both MMP-9 and -3 enzymes where inflammatory stimulus governs a phase wise remodeling of ECM in gastric tissues by transcriptions and activations of MMPs. The immunofluorescence studies of present research prove that the localization of both MMP-9 and -3 were confined especially to gastric mucosal cells at injured sites during the onset of ulceration (acute phase) and, their secretion were increased in gastric ECM during the resolution phase (chronic phase). This study for the first time revealed that the up regulation of MMP-9 and -3 were significantly dependent upon the duration of gastric inflammation and the increased expressions of TNF-α, IL-1β, IL-8, NF-kB and AP-1. Herein, the secondary goal of my doctoral research was to decipher the effect of melatonin, during gastric ulcer prevention and healing where I discovered that during NSAID-induced gastro-protection and healing, melatonin attenuated the inflammation by suppression of NF-κβ and AP-1 (ERK-1/2 and JNK based) mediated signaling pathways therefore prevented the up regulation of MMPs. Present study also proves that, ROS production during ulceration were significantly governed a phase wise regulation of MMP-2 expression and activity which was primarily based upon the redox-state of ulcer milieu and secondarily on AP-2-mediated differential transcription. Melatonin and other antioxidants blocked H2O2-mediated suppression of MMP-2 during acute phase while up-regulated the MMP-2 activity by AP-2 mediated transcription during chronic phase. Additionally, my doctoral research also proves that the activity of MMP-2 was dependent upon the inverse expression of TIMP-2 and parallel expression of MT1-MMP *in vivo*. The last goal of my doctoral work was to furnish melatonin as a pro-angiogenic molecule during gastro protection and healing. Herein, I invented that melatonin offered significant angiogenic potential either independently or in presence anti-angiogenic molecule indomethacin. With an increasing angiogenic index, melatonin enhanced the expressions of VEGF, eNOS and pro- and active MMP-2 activities which are nothing but angiogenic modulators in various inter-specific model systems i.e., in rat cornea, chick chorioallantoic membrane and gastric injury model in mouse and rat. Preceding with the above approach of my doctoral research it is possible to come up with the great therapeutic strategy in the treatment of gastric ulcer diseases in near future by melatonin and other antioxidants.

Post Docs:

1. Memory formation requires learning based molecular and structural changes in neurons, whereas matrix metalloproteinase (MMP)-9 is involved in the synaptic plasticity by cleaving extracellular matrix proteins and thus is associated with learning processes in the mammalian brain. As the mechanisms of MMP-9 transcription in the brain are poorly understood, this study aimed at elucidating regulation of MMP-9 gene expression in the mouse brain after fear learning. I show herein that contextual fear conditioning markedly increases MMP-9 transcription, followed by enhanced enzymatic levels in the three major brain structures implicated in fear learning, i.e., the amygdala, hippocampus and prefrontal cortex. To reveal the role of AP-1 transcription factor in MMP-9 gene expression, I have used reporter gene constructs with specifically mutated AP-1 gene promoter sites. The constructs Ire introduced into the medial prefrontal cortex of neonatal mouse pups by electroporation, and the regulation of MMP-9 transcription was studied after contextual fear conditioning in the adult animals. Specifically, -42/-50 and - 478/-486 bp AP-1 binding motifs of mouse MMP-9 promoter sequence have been found to play a major role in MMP-9 gene activation. Furthermore, increases in MMP-9 gene promoter binding by the AP-1 transcription factor proteins c-Fos and c-Jun have been demonstrated in all three brain structures under investigation. Hence, my results suggest that AP-1 acts as a positive regulator of MMP-9 transcription in the brain following fear learning.

2. Chronic stress is a risk factor for the development of psychopathologies characterized by cognitive dysfunction and deregulated social behaviors. Emerging evidence suggests a role for cell adhesion molecules, including nectin-3, in the mechanisms that underlie the behavioral effects of stress. We tested the hypothesis that proteolytic processing of nectins by matrix metalloproteinases (MMPs), an enzyme family that degrades numerous substrates, including cell adhesion molecules, is involved in hippocampal effects induced by chronic restraint stress. A reduction in nectin-3 in the perisynaptic CA1, but not in the CA3, compartment is observed following chronic stress and is implicated in the effects of stress in social exploration, social recognition and a CA1-dependent cognitive task. Increased MMP-9-related gelatinase activity, involving N-methyl-D-aspartate receptor, is specifically found in the CA1 and involved in nectin-3 cleavage and chronic stress-induced social and

cognitive alterations. Thus, MMP-9 proteolytic processing emerges as an important mediator of stress effects in brain function and behaviour.

3. Moderate hepatic encephalopathy promotes enhanced astrocytosis in compensation to the evident neuronal loss in hippocampus, however with compromised generation of new neurons. A significant deficit in spatial reference memory, hippocampal memory coinciding with declined motor coordination functions in those Control rats thereby providing evidence for a significant neuropsychiatric complications matching well with the category of moderate grade HE in those rats.

TECHNIQUES KNOWN:

Postdoctoral Research: Behaviors (Fear Conditioning, Radial Arm Maze, Novel Object, Rota Rod); Embryonic and Primary neuronal culture from rat or mice brain; In-situ Zymography of gelatinase; Immunostaining; Confocal; Cloning, mutagenesis; recombination; *In vivo* and *in utero* electroporation in rats and mice; Luciferase, Lac Z and GFP promoter specific assays; EMSA super shift assay; Virus preparation and transfection.

PhD: Animal experiments: Oral feeding, IP injections; Angiogenic assays in rat cornea and in chick embryo. Biochemical techniques: Extraction of proteins; Partial purification of matrix metalloproteinases; Spectrophotometric enzymatic assay, Redox responsive assays; ABTS assay for antioxidant activity. Molecular Biology Techniques: Genomic DNA and RNA extraction from rat/mouse; RT-PCR, Real-time-PCR; Electrophoretic mobility shift assay (EMSA); Agarose gel electrophoresis for the analysis of PCR products. Protein Chemistry Techniques: SDS-PAGE, Native PAGE, Gelatin and Casein zymography; Gradient gel electrophoresis and expression patterns of different types of collagen (Type III and IV); Western Blotting. Immunohistochemistry; In vitro assays of oxidative modification of MMPs and prevention by antioxidants; In vitro assays of collagen degradation by different types of MMPs. Microscopy: Light Microscopy; Fluorescence and Phase Contrast Microscopy.

Masters: Short term culture of whole blood and preparation of Metaphase Chromosomes; G and C-banding of Metaphase chromosomes and karyotyping; Fluorescence in situ hybridization (FISH) of Polytene Chromosome in Drosophila; Transformation of E. coli with Recombinant plasmid vector and rapid isolation of plasmid DNA; Extraction of genomic DNA from Bacteria and Human Blood; Restriction digestion of genomic and plasmid DNA; Southern blotting and hybridization; SDS-PAGE analysis of histone proteins; Chromatin isolation and identification; Micrococcus Nuclease digestion of Human DNA; Analysis of polymorphism in LDH and G6PD enzyme by PAGE.

Bachelors: Micro and macro dissection of organ systems of vertebrates and invertebrates; Histology and Histochemistry from different vertebrate tissues; Preparation of slides from chick embryo at different developmental stages; Enzyme (LDH, G6PD) kinetics studies.

REFEREES:

1. Dr Snehasikta Swarnakar, PhD, FNASC, FASCT; Indian Institute of Chemical Biology; CSIR; Principal Scientist; 4, Raja S. C. Mullick Road, Kolkata, West Bengal, India, Pin: 700032 Tel: 033-2499-5759-824/904, Fax: 033-2473-5197; Mobile: 9831499093; Email: sikta@iicb.res.in; Web: http://iicb.res.in

2. Professor Surendra Kumar Trigun, PhD; Laboratory of Biochemistry and Molecular Biology, Department of Zoology; Banaras Hindu University; Varanasi: Pin: 221005, India Mobile: +919415811962, Phone 91 542 6702523, Fax:+91 542-2368174; E-mail: sktrigun@gmail.com, sktrigun@bhu.ac.in; Web: http://www.bhu.ac.in/science/zoology/sktrigun.php

3. Professor Sukala Prasad, Ph D; Laboratory of Gerontology and Emotion Biology, Department of Zoology; Banaras Hindu University; Varanasi: Pin: 221005 Phone: +915422575842, Fax:+91-542-2368174 Email Id:s.sprasadbhu@gmail.com Web: http://www.bhu.ac.in/science/zoology/sprasad.php