Murali Krishna Temburni

Department of Biology
Delaware State University
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Education:

Ph.D. Life Sciences (1998)
Centre for Cellular and Molecular Biology
Jawaharlal Nehru University, Hyderabad, India
Dissertation: Cloning and Characterization of Tumor Specific Antigens
Advisor: Dr. Ashok Khar

M.Sc. Biochemistry (1990)
G.B. Pant University of Agriculture and Technology, Pantnagar, India
Master's Thesis: Characterization of Sporulation Genes of *Bacillus brevis*
Advisor: Prof. Govind K. Garg

B.Sc. Microbiology, Zoology, and Chemistry
Osmania University, Hyderabad, India (1987)

Positions held:

Associate Professor of Biology (2016 onwards)
Delaware State University
Dover, DE

Assistant Professor of Biology (2012 to 2016)
Delaware State University
Dover, DE

Assistant Professor of Biology (2008 to 2012)
Georgian Court University
Lakewood, NJ

Visiting Assistant Professor (2007 to 2008)
Department of Biology
Washington College
Chestertown, MD

Research Associate (2004 to 2007)
Dept. of Chemistry and Dept. of Biology
University of Delaware
Newark, DE

Research Associate (2000 to 2004)
Post doctoral Fellow (1997 to 2000)
Neuroscience Department
Tufts University School of Medicine
Boston, MA

Fellowships and Awards

- Continuous Improvement Award - course release time, Georgian Court University (2012)
- Senior Research Fellowship, University Grants Commission, India (1993-1995)
- Junior Research Fellowship, University Grants Commission, India (1990-1992)
- Teaching Assistantship during M.S. (1988-1990)

Publications

1. Sanchez, K. R., Harrington, M.A., Madadi, K., Dezayas, G., Chitra, S.P. and Temburni M.K. (2018). Astrocytes are required for development of synchronous activity of vertebrate neurons in culture. *Manuscript in preparation.*
2. Sanchez, K.R., Mersha, M.D., Dhillon, H.S., Temburni, M.K. (2018). Assessment of the Effects of Endocrine Disrupting Compounds on the Development of Vertebrate Neural Network Function Using Multi-electrode Arrays. J. Vis. Exp. (134), e56300, doi:10.3791/56300.
3. Mersha, M. D., Sanchez, K. R., Temburni, M. K., Dhillon, H. S. (2018). Long-term Behavioral and Reproductive Consequences of Embryonic Exposure to Low-dose Toxicants. J. Vis. Exp. (133), e56771, doi:10.3791/56771.
4. Mohanan, V., Temburni, M. K., Kappes, J. C., & Galileo, D. S. (2013). L1CAM stimulates glioma cell motility and proliferation through the fibroblast growth factor receptor. Clinical & experimental metastasis. 30(4): 507-520.
5. Sauers DJ, **Temburni, MK**, Biggins JB, Ceo LM, Galileo DS, and Koh JT. 2010. Light-Activated Gene Expression Directs Segregation of Co-cultured Cells in Vitro. *ACS Chemical Biology*. 53: 313-320.
6. Yang M, Adla S, **Temburni MK**, Patel VP, Lagow EL, Brady OA, Tian J, Boulos MI, Galileo DS. 2009. Stimulation of glioma cell motility by expression, proteolysis, and release of the L1 neural cell recognition molecule. *Cancer Cell Int.* 29(1):27.
7. Rosenberg, M, Fang, Y, Giovanni, M, Mohn, J, **Temburni, MK** and Jacob, MH. 2008. Adenomatous polyposis coli plays a key role, in vivo, in coordinating assembly of the neuronal nicotinic postsynaptic complex Molecular and Cellular Neuroscience. 38(2): 138-52.
8. Fotos, JS, Patel, VP, Karin, NJ, **Temburni, MK**, Koh, JT, Galileo, DS. 2006. Automated time-lapse microscopy and high-resolution tracking of cell migration. *Cytotechnology*. 51(1):7-19.
9. **Temburni, MK**, Madelaine Rosenberg, Narendra Pathak and Michele H. Jacob. 2004. Neuronal nicotinic synapse assembly requires the adenomatous polyposis coli tumor

suppressor protein. *Journal of Neuroscience.* 24(30):6776-84. (***Selected by Faculty of 1000 as a recommended paper***).

10. **Temburni, MK** and Michele H Jacob. 2001. New functions for glia in the brain. *Proceedings of the National Academy of Sciences*. 98:3631-3632.
11. **Temburni, MK**, Blitzblau, R.C. and Jacob, M.H. 2000. Receptor targeting and heterogeneity at interneuronal nicotinic cholinergic synapses in vivo. *The Journal of Physiology.* 525(1):21-29.
12. Williams, Brian M., **Temburni, MK**, Levey MS, Bertrand S, Bertrand D and Jacob MH. 1999. The long cytoplasmic loop of the α3 subunit targets specific nAChR subtypes to synapses on neurons in vivo. *Annals of the New York Academy of Sciences*. 868:640-644.
13. Williams, BM, **Temburni, MK**, Levey MS, Bertrand S, Bertrand D and Jacob MH. 1998. The long internal loop of the α3 subunit targets nAChR subtypes to microdomains within individual synapses *in vivo. Nature Neuroscience.* 1(7): 557-562.
14. **T. Murali Krishna**, Begum Z, Swamy Ch.V.B. and Khar A. 1998. Molecular cloning and characterization of a tumor rejection antigen from rat histiocytoma, AK-5. *DNA and Cell Biology*. 17(7): 603-612.

Grants obtained since joining DSU

August 2018 to July 2021
NSF IOS Neural Systems Cluster
Title: Molecular Mechanisms of Astrocyte Neuron Interactions in the Development of Neuronal Synchrony
Budget: $753,000 for 3 years
In collaboration with Dr. Rhonda Dzakpasu, Georgetown University
My role: PI
Status: Funded and current

September 2015-August 2020
NIH R25 Research Education Project
Title: A Neuroscience-Focused Undergraduate Research Program at an HBCU"
Budget: $536,030 for 5 years
Date Submitted: April 2, 2015
My role: Co-PI (Melissa Harrington, PI)
Status: Funded

June 2015 to December 2018
NSF- HBCU-UP RIA Research Initiation Award
Title: Role of Astrocytes in the Development of Synchronized Bursting Behavior in Neuronal Networks
Budget: $ 200,000
My role: PI
Status: funded

April 2013 to March 2015
COBRE Pilot Proposal

Title: The role of glia in the development of synchronized bursting behavior in neuronal networks in culture.
Budget: 50,000/year for two years
My role: PI
Status: funded

February 2013 to July 2013
Proposal submitted to the CIBER-EPSCoR seed grant in collaboration with Dr. Harb Dhillon
Title: Long-term biological consequences of embryonic exposure to Bisphenol-A (BPA) and Bisphenol-S (BPS)
Budget: $30,000
My role: PI
Status: funded

NSF HBCU-UP SMILE Award
$4000 + full year of stipend support for one undergraduate student
The role of glia in the development of synchronized bursting behavior in neuronal networks in culture
Budget: $4000 + full year of stipend support for one undergraduate student
My Role: PI
Status: funded

Grants obtained at Georgian Court University

April 2009: GCU Summer Research Grant.

December 2010: Merck Undergraduate Science Endeavors (MUSE) summer research grant to train one undergraduate student awarded by the Independent College Fund of New Jersey (ICFNJ).

September 2011: MUSE grant renewed.

Graduate Undergraduate and High School Students Trained:

Name of Student	Current Position	Undergrad Institution	Accomplishments
Karla Sanchez	Graduate Student	University of Maryland Eastern Shore	Invited to Gordon Research Conference, 2015
Krittika Madadi	MD student (St. Georges University, Grenada, West Indies)	University of Delaware	1st Prize poster presentation, ABRCMS 2014
Kasey Cosden	Undergraduate researcher, Temburni lab	Delaware State University	MARC scholar
Nkoli Agbazue	Undergraduate researcher, Temburni lab	Delaware State University	SMILE researcher
Famatta Perry	Undergraduate researcher, Temburni lab	Delaware State University	SMILE researcher,CIBER Scholar
Mercedes Howard	Undergraduate researcher, Temburni lab	Delaware State University	

Geraldine DeZayas	Undergraduate researcher, Temburni lab	Delaware State University	
Kyrhee Powell	High School Student researcher, Smyrna High School	Delaware State University	Poster presentation, DSU Undergraduate Symposium
Destiny King	High School Student researcher, ECHS, DSU		Supported by NSF-RIA
Gihane Rachid	High School Student researcher, ECHS, DSU		Supported by NSF-RIA

Summary of Current Research

The chicken embryo is an excellent model system for training undergraduate researchers as it is amenable to experimental manipulation *in ovo*, very inexpensive, and we can address fundamental questions regarding early neuronal development and synapse formation. My research highlights using this model system include identification of novel organizer molecules that function in neurotransmitter receptor targeting (publication cited by *Faculty of 1000* as recommended reading) and demonstration for the first time that the alpha3 subunit is required for targeting nicotinic acetylcholine receptors (nAChRs) to synaptic sites (http://www.f1000biology.com/article/15282282/evaluation).

Synchronous activity in neuronal networks: role of astrocytes

Synchronous oscillatory activity is thought to play a fundamental role in the establishment of functional networks in the developing nervous system, yet the mechanisms underlying the emergence of synchronized patterns of activity in the developing brain are not fully understood. Recent evidence shows that glia, particularly astrocytes, guide synapse formation and take part in synaptic transmission. Astrocytes communicate among themselves via Ca^{++} waves and astrocytic gap junctions, and with neurons by releasing gliotransmitters such as glutamate, ATP and D-serine. Astrocytes are also known to modulate synchronous activity in neuronal networks *in vivo*, but their role in the emergence of these synchronous oscillations is unknown. Unraveling the role of astrocytes in the development of synchronous activity is essential for understanding the formation of functional neuronal networks and for developing meaningful models of network function.

We are investigating the role of astrocyte Ca^{++} signaling and gliotransmission in guiding and supporting the development of recurrent networks and population bursting in cultures of embryonic neurons. Synchronous activity is recorded on MED64 multi-electrode arrays in the presence and absence of astrocytes.

We are **targeting three GPCR pathways within astrocytes** that have been demonstrated to be crucial for communication with neurons: a) Metabotropic gluamate receptor (mGluR), b) Purinergic receptor (P2Y1) receptor and c) $GABA_B$ receptor. The common feature in these three pathways is a rise in intracellular Ca^{++} release via coupling to G-proteins. In order to specifically disrupt these pathways in cultured astrocytes we will use a **dominant negative** approach - by over-expressing peptides or truncated subunits to disrupt interactions with the downstream proteins.

Role of APCand its binding partners in axon outgrowth and Synapse formation

My proposed research project is a continuation of my current research which is focused on addressing the roles of microtubule binding proteins in synapse formation and axonal path finding in vertebrates using the developing chicken brain as a model system. Specifically, this project is aimed at understanding the role of the adenomatous polyposis coli (APC) protein and its binding partners in axon outgrowth and synaptogenesis. My strategies include modulating protein function by over-expression, RNA interference, and dominant negative peptides using retroviral and

lentiviral vectors and analyzing the effects by immuno-fluorescence and live imaging by Time-Lapse video microscopy. I will be collaborating with Dr. Michele Jacob at Tufts University Medical School and Dr. Deni Galileo at the Universiy of Delaware on this project.

APC:EB1 interactions

Axon outgrowth: APC captures microtubules at the cell periphery by binding to the EB1 protein on microtubule plus ends. I had earlier demonstrated that this interaction is necessary for insertion of nAChRs into the post-synaptic density in chicken ciliary ganglion (CG) neurons. Recently, both APC and a number of its binding partners including EB1 have been shown to localize to the axonal growth cone. This project will explore the possibility that APC-EB1 interactions are necessary for axonal outgrowth by expressing dominant negative peptides that interfere with APC-EB1 binding in CG neurons.

Pre-synaptic assembly: APC and EB1 are also expressed in the pre-synaptic terminals of mature synapses which suggests their role in pre-synaptic assembly. I propose to test this hypothesis by expression of dominant negative APC:EB1 construct in CG neurons and assaying synapse formation in co-cultures of CG neurons and ciliary muscle tissue or in differentially labeled CG neuron cultures.

APC: IQGAP interactions

The IQ domain containing GTPase IQGAP is known to localize to the axonal growth cone and regulates actin dynamics. It interacts with APC in epithelial cells and we recently showed that APC recruits IQGAP to the postsynaptic density in CG neurons. IQGAP is also localized to the xonal growth cone. This project aims to disrupt APC: IQGAP interactions and analyze its effects on axon outgrowth.

APC: PSD93 interactions

The PSD93 (Post Synaptic Density) protein is a member of the synapse associated MAGUK family of proteins is expressed in CG neurons. We showed that it interacts with APC in CG neurons but this interaction is not essential for assembling the post-synaptic density. PSD93 is expressed in the initial axonal segment and APC is necessary for neurite specification into the axon. This projects tests the novel idea that APC:PSD93 interactions are necessary for axon specification by expressing dominant negative constructs in CG neurons in culture. Preliminary results from my lab suggest that this interaction is needed for axon specification.

CAM and FGFR interactions in neuronal development

This project is a collaboration with Dr. Deni Galileo at the University of Delaware. We are testing the hypothesis that direct interactions between neuronal cell adhesion molecules like L1 and the fibroblast growth factor receptor are responsible for various aspects of neuronal development like proliferation, migration and axon outgrowth. We are using the developing chick optic tectum and the peripheral CG and DRG (dorsal root ganglia) as *in vivo* model systems as well as *in vitro* explant and neuronal cultures along with Time-Lapse imaging and analysis.

Teaching Experience

Delaware State University (2012 to present): As an Assistant Professor in the Biology Department, I am teaching the following courses:

Fall 2012 BIOL315:
Behavior (lecture and lab)

Fall 2013
BI310 Molecular Biology (lecture and lab)

Fall 2014
BIOL311 Neuroscience (lecture and lab)

Fall 2015
BIOL520 Cell Biology

Fall 2016
BIOL650 Biological Mechanisms

Spring 2013
BI422 Biochemical Mechanisms (lecture and lab)
BI192 University Seminar
BI194 Intro to Bio Professions

Spring 2014
BI422 Biochemical Mechanisms (lecture and lab)

Spring 2015
BIOL422 Biochemical Mechanisms (lecture and lab)

Georgian Court University (2008 to 2012):

Undergraduate:
BI407 Neurobiology
BI322 Molecular Genetics
BI427 Immunology
BI319 Microbiology

Graduate:
BI503 Molecular Neuroscience
BI504 Advanced Immunology
BI490/511 Developmental Biology

Washington College (2007): In my previous position as Visiting Assistant Professor, I taught BIO203 Microbiology with lab and BIO 111 General Biology in the fall. In the spring semester of 2008, my teaching responsibilities included **BIO 394 Neurobiology with lab (a new course I developed)** and BIO 404 Immunology.

University of Delaware (Part Time teaching, 2004 to 2007): Developmental Neurobiology, BISC 439-010/639-010. This course was developed for undergraduate as well as for graduate students by Dr. Deni Galileo in the Biological Sciences department at the University of Delaware. My responsibilities included lectures in synapse formation and axonal path-finding as well as coordinating and evaluating student presentations and literature review.

Graduate Teaching Assistantship (1987 to 1990): I taught General Biochemistry (BPC-360) and Elementary Biochemistry (BPC-260) in the Department of Biochemistry, G.B. Pant University, India, during my Masters' program. My duties included preparing and conducting labs.

Other Teaching experience: Summer Neurobiology Course at Marine Biological Laboratories, Woods Hole, MA. I assisted Prof. Michele Jacob in teaching the molecular neurobiology course in the summer of 2002 and 2003. In my position as a post-doctoral fellow, I have trained graduate students and supervised technicians both at Tufts University Medical School and at the University of Delaware. I tutor high school students for the AP Biology and SAT II biology exams in my free time.