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Research Interests:

My research interests have always involved studying bacterial pathogens. During my graduate studies I identified a novel pathway by which the alternative sigma factor, RpoN, regulates acid resistance and type III secretion systems in Escherichia coli O157:H7. Concurrently, I developed a project exploring how nonsteroidal anti-inflammatory drugs (NSAIDs) increased antibiotic resistance in Staphylococcus aureus. As a postdoctoral fellow I expanded my training and studied pathogenic mechanisms in Mycobacterium tuberculosis (Mtb), which is the causative agent of tuberculosis and the leading cause of human deaths by an infectious disease. Over the last five years my research has focused on identifying mechanisms of how Mtb acquires host iron because it is an essential nutrient for Mtb survival and virulence. For my lead project, I synthesized the toxic heme analog gallium protoporphyrin IX and used it to identify novel outer membrane components in Mtb that are essential for heme iron acquisition. This led to the discovery that the mycobacterial PPE (proline-proline-glutamate) family of proteins can function in nutrient acquisition and that some PPE proteins are channel forming outer membrane proteins. From our studies, we demonstrated that Mtb uses multiple heme uptake pathways for acquiring heme iron. The outer membrane PPE proteins and the inner membrane Dpp transporter constitute one pathway and in a second pathway heme utilization is mediated by albumin. Simultaneously, I developed a drug discovery project and by using a novel whole cell screening approach we identified molecules that inhibit siderophore dependent iron utilization in Mtb. For this project, I collaborated with Southern Research (SR) at Alabama and The GSK Open Lab in Spain and coordinated two whole-cell high throughput screening (HTS) assays and identified molecules which are currently being tested for in vivo efficacy.

One of our long-term objectives is to characterize the molecular components of the different Mtb heme uptake pathways and to eventually develop chemotherapeutic approaches that inhibit heme iron acquisition in Mtb. To this end, we will characterize how novel Mtb proteins allow Mtb to utilize heme from hemoglobin, which is the largest source of iron in the human host. We have exciting preliminary data identifying novel channel proteins and secretion systems that play a role in Mtb heme utilization. Eventually, we want to understand the true relevance of heme iron utilization in Mtb virulence and disease progression.

I have always been committed to research and education at all stages of my career. As an assistant professor at OSU, I intend to bring together a diverse group of individuals who will work together towards obtaining our long-term objectives. At the same time, I will mentor all personnel so that they can develop and pursue their own ideas. Alongside research, I will contribute to the scientific community through teaching at OSU and being part of committees that further research and education in the STEM field

Education:
2020-Present: Assistant Professor in Microbiology, Oklahoma State University, OK
2020: Research Associate in Microbiology, University of Alabama at Birmingham, AL
2014: Cell and Molecular Biology Ph.D., University of South Florida, FL
2008: Biomedical Sciences B.S., University of South Florida, FL

Academic Appointments:
2020-Present: Assistant Professor (PI), Department of Microbiology and Molecular Genetics, Oklahoma State University
2016-2020: Research Associate (PI: Michael Niederweis, PhD), Department of Microbiology, University of Alabama in Birmingham
2014-2016: Postdoctoral Fellow (PI: Michael Niederweis, PhD), Department of Microbiology, University of Alabama in Birmingham
2009-2014: Ph.D. Student (PI: James T. Riordan, PhD), Department of Cell Microbiology Molecular Biology, University of South Florida, FL
2007-2009: Undergraduate Research Volunteer (PI: Lindsey N. Shaw, PhD), Department of Cell Microbiology Molecular Biology, University of South Florida, FL

Awards and Honors:
2018: University of Alabama at Birmingham (UAB), Department of Microbiology Award of Excellence (First Place - Oral)
2017: 6th Southeastern Mycobacteria Meeting (Second Place - Oral)
2016: UAB Department of Microbiology Award of Excellence (First Place - Oral)
2015: UAB Department of Microbiology Award of Excellence (First Place - Poster)
2014: UAB Department of Microbiology Award of Excellence (Second Place - Poster)
2013: Wind River Travel Award 2012 Verocytotoxin Producing Escherichia coli (VTEC) Infections Travel Award
2012: ASM Annual SE Regional Meeting Travel Award
2011: Fred L. and Helen M. Tharp Scholarship Fund Graduate Award
2011: ASM Annual SE Regional Meeting Travel Award
2011: Wind River Travel Award

Research Support:
- 08/17/2020- 08/17/2023: New faculty lab start-up and equipment grant, Oklahoma State University, PI: Avishek Mitra

Selected Publications:

1. Mitra, A., Speer, A., Lin, K., Ehrt, S., and Niederweis, M. (2017). PPE surface proteins are required for heme utilization by Mycobacterium tuberculosis. Mbio. 8(1): e01720 (PMID 28119467)
2. Mitra, A., Ko, Y.H., Cingolani, G., and Niederweis, M. (2019). Heme and hemoglobin utilization by Mycobacterium tuberculosis. Nature Communications. 10(8): 4260 (PMID 31534126)

3. Riordan, J.T. and Mitra A. (2017). Regulation of Escherichia coli pathogenesis by alternative sigma factor N. EcoSal (PMID 28635589)
4. Mitra, A., Fay, P., Vendura, K., Alla, Z., Carroll, R., Shaw, L., and Riordan, J. T. (2014) σ N -dependent control of acid resistance and the locus of enterocyte effacement in enterohemorrhagic Escherichia coli is activated by acetyl phosphate in a manner requiring flagellar regulator FlhDC and the σS antagonist FliZ. MicrobiologyOpen. 3(4): 497 (PMID 24931910)
5. Mitra, A., Fay, P., Morgan, J., Vendura, K., Versaggi, S., and Riordan, J. T. (2012) Sigma factor N, liaison to an ntrC- and rpoS-dependent regulatory pathway controlling acid resistance and LEE expression in enterohemorrhagic Escherichia coli. PLoS One. 7(9): e46288 (PMID 23029465)
6. Neupane, M.S., Abu-Ali, G. S., Mitra, A., Manning, S. D., and Riordan, J. T. (2011) Shiga toxin 2 overexpression in Escherichia coli O157:H7 strains associated with severe human disease. Microb. Pathog. 51(6): 466. (PMID 21864671)
7. Neyrolles, O., Wolschendorf, F., Mitra, A., and Niederweis, M. (2015) Mycobacteria, metals and the macrophage. Immunol. Rev. 264(1): 249 (PMID 25703564)
8. V. Meikle, A. Mossberg, A. Mitra, A. Hakansson, and M. Niederweis (2018). A protein complex from human milk enhances the activity of antibiotics and drugs against Mycobacterium tuberculosis. AAC. 63(2): e01846 (PMID 30420480)