

From childhood, I always dreamt of being a changemaker. Active involvement in initiatives like Shruto Org, which provided audiobooks in Bangla to visually impaired, underprivileged children in Bangladesh, and Doctor4All, which brought telemedicine to remote areas, further shaped my aspirations. However, in 2020, amidst the COVID-19 pandemic, I found myself on an unexpected odyssey when my family became a statistic, grappling with the virus and enduring a grueling 58-day quarantine. The loss of my uncle in that time of fear and uncertainty left a profound mark on my soul. Around the same time, my close peer became an emblematic figure in this narrative when his mother confronted ovarian cancer. Late-night hospital dashes, relentless pursuit of medical assistance, and heart-wrenching moments became part of my lived experience. These experiences ignited my passion for unraveling the complexities of diseases and fueled my decision to pursue research in life sciences. While my childhood dream was to become a neurosurgeon and I was preparing for the medical entrance exam in Bangladesh, my fascination with research led me to make the bold decision to pursue my education at Beloit College and explore research opportunities in the United States.

After arriving in the U.S. as an international student, a different set of challenges emerged—language barriers, cultural adjustments, and financial hardships. Instead of succumbing to these hurdles, I found that being part of the community was key to overcoming them. At Beloit, engaging in cross-cultural communication as an Intern and Admissions Ambassador has enabled me to navigate diverse perspectives. As a Teaching Assistant, I refined my communication skills to foster an inclusive learning environment, while serving as a Residential Assistant equipped me with interpersonal and conflict-resolution skills, allowing me to create a welcoming and inclusive space for residents. Through DEI training and programming in my residential halls, I developed initiatives to address diversity, equity, and inclusion, ensuring underrepresented voices were heard and valued. My active involvement at Beloit extends to serving as an Academic Senator and member of the Beloit Student Government, where I consistently used my voice to represent BIPOC and LGBTQ+ students, advocating for equitable policies and resources. Most recently, my election as a Senior Class Officer reflects my dedication to community engagement and upholding underrepresented perspectives. These experiences have instilled in me a holistic perspective, emphasizing the interconnectedness of research, education, and community service.

Upon arriving at Beloit, I encountered a dearth of research opportunities in the fields I was passionate about. Undeterred, I actively started looking for research opportunities outside Beloit and ultimately found various opportunities that have turned into my strengths. During a conference in Houston, I met Dr. Sonia Villapol, a renowned neuroscientist, and expressed my interest in neuroscience research, which led to my first remote research experience under her guidance at Houston Methodist Research Institute, an affiliated academic medical center of Weill Cornell Medical College. I conducted an independent project under Dr. Sonia's guidance,

performing a literature review that analyzed the relationship between gut microbiota, the brain, and COVID-19. This marked the beginning of my research training.

Moving forward, I joined Dr. Jonathan Sweedler's lab at UIUC in the summer of 2023, which felt like a dream come true. I saw it as my opportunity to prove myself and contribute to cutting-edge research that could impact human lives. After being fully trained in the instruments, peptide extraction processes, sample handling, and more, I was given the chance to contribute intellectually to the projects, starting with investigating alternative peptide extraction methods, as we suspected our standard protocol might be too acidic and harsh, potentially leading to the loss of peptides of interest. Next, I was tasked with developing a Python-based workflow to handle, manipulate, screen, and analyze large and complex IMS-MS data. After weeks of work, I successfully established a protocol that also contributed to our DAACP identification projects. Additionally, I worked on computational modeling, creating a workflow to generate PDB and XYZ files from peptide sequences, add modifications, perform Projection Superposition Approximation, and calculate CCS differences. This helped us better understand how D-amino acid-containing peptides act differently from L-amino acid-containing peptides. These protocols and workflows are still in use today, and I continue to assist with data analysis remotely.

During the Spring of 2024, I spent a study abroad semester at Queen's University, Belfast, where I joined Dr. Haresh Manyar's lab full-time on an ongoing project. The previous student had graduated, leaving the project incomplete, so I stepped in to take it forward. I conducted a literature review, analyzed catalysts, designed 3D-printed microreactors, performed kinetic modeling, and analyzed samples using GC-FID. My efforts brought the photocatalytic oxidation of the Ethyl Benzene project to completion. I also contributed significantly in writing the manuscript which is now in its final stage of review before submission for publication.

After returning from my study abroad program I persisted in finding more opportunities. In the summer of 2024, I had the opportunity to join Dr. Lingjun Li's lab at UW-Madison, an experience that solidified my future research path. My initial project in her lab involved uncovering the neuropeptidomics of the American Lobster through hemolymph analysis, where I played a key role in method development by evaluating buffer systems for optimal peptide extraction. I also performed extensive dissections for a project to study neuropeptide distribution in blue crabs under hypoxic conditions. During this time, a mentor mentioned an R script for Accurate Mass Matching in Mass Spectrometry Imaging data, prompting me to develop a software package with a GUI to automate the process. I also worked on the release of the second version of EndoGenius, a software designed for comprehensive identification and quantitation of endogenous peptides from mass spectrometry data, focusing on adding a post-translational modification (PTM) search function and graphical interface. This required an extensive literature review of existing methods and challenges in PTM identification, sample collection, MS² data acquisition, and PTM identification. Additionally, I benchmarked several mass spectrometry

prediction software for endogenous peptides. These projects are currently being prepared for publication, with several manuscripts in the final stages of review before submission.

I am currently working on a research project under Dr. Rachel Bergstrom at Beloit College, a trained neuroscientist and data scientist who previously developed algorithms for detecting seizures from EEG data. Our focus for this project is to improve our prediction model. While we initially used a scalogram matrix for training, our new goal is to train the model using scalogram images and evaluate its prediction accuracy, which I am currently working on. I am also working on my Senior Thesis, titled *A Comprehensive Guide to Artificial Intelligence Enhanced Neuroimaging for Medical Diagnosis*, under the supervision of Dr. Robin Zebrowski. The research focuses on integrating AI/ML techniques with neuroimaging modalities to improve diagnostic accuracy and patient outcomes, and I am in the process of preparing the manuscript for publication.

Throughout these diverse experiences, I have built a strong foundation in both wet lab techniques and computational skills essential for graduate-level research. My coursework in Biostatistics and Data Structures, coupled with my data analytics major and hands-on experience in Python, MATLAB, and R, has equipped me with the mathematical and computational abilities necessary for tackling complex computational problems. I have also presented my work at prestigious conferences, including those at Washington University in St. Louis, the University of Chicago, the Medical College of Wisconsin, and multiple conferences at Beloit College, and was honored as Best Presenter by the American Chemical Society, which has significantly improved my public speaking, communication, and scientific presentation skills. Also, I am continuing to work remotely with each of these labs, except the Villapol Lab, to finalize the ongoing research and contribute to the preparation and publication of the manuscripts.

Over the past few years of conducting research during my undergraduate studies, I developed a strong interest in bioanalytical chemistry, largely due to the impactful training I received and the immense potential of the field. Mentored by renowned scientists like Dr. Sweedler and Dr. Li, I discovered that mass spectrometry, ion mobility spectrometry, and related analytical techniques are powerful tools for answering critical questions about human proteomics and peptidomics, neuronal function, and disease models. My long-term goal is to become an independent researcher in the field of bioanalytical chemistry, particularly focusing on advancing mass spectrometry techniques to solve complex biological questions, especially in neurochemistry. I envision myself leading a research lab and exploring the intersection of bioanalytical chemistry and neuroscience, to develop innovative tools for disease diagnosis and treatment, particularly for neurodegenerative diseases.