



Never Stop Learning

When **Candice Ulmer** discusses analytical chemistry, her formidable acumen and sense of strategy are as clear as the permanent smile that shines through her voice. Her conversation is as structured as the map that she has planned for her life, from carefully cultivating a series of mentors to excelling during her National Research Council (NRC) post-doctoral fellowship at the National Institute of Standards and Technology (NIST) to landing a research chemist position at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia less than two years after completing her doctorate.

She is always looking ahead and never wants to stop learning.

“At this moment, I am preparing for the American Board of Clinical Chemistry (ABCC) certification. As an early-career scientist, I want to further develop my skillsets and become a more well-rounded person. I see myself transitioning into a director role of a clinical laboratory in the future.”

Ulmer obtained a doctorate in analytical chemistry with a focus on mass spectrometry from the University of Florida in 2016—where she was a McKnight Doctoral Fellow—after completing her undergraduate work in chemistry and biochemistry at the College of Charleston in 2012. She is an elected second-term member of the Early-Career Members

Network (EMN) Committee of the Metabolomics Society, a network devoted to providing scientific and career support for early-career members, and recently received awards for her abstract and oral presentation at the 13th Annual Conference of the Metabolomics Conference in Brisbane, Australia.

What was your path into mass spectrometry?

It’s really funny—and most people don’t believe me—but I have been practicing chemistry since I was 12 years old. I come from a family of educators, and my parents began cultivating my interest in math and science as early as the 7th grade through my participation in summer research programs at local universities in South Carolina. As I shadowed graduate students and used instrumentation that I’d never been introduced to before, I fell in love with chemistry.

I began employing mass spectrometry (MS) during college when I joined my mentor’s, Wendy Cory, research group to monitor the photodegradation of nonsteroidal anti-inflammatory drugs (NSAIDs) like ibuprofen and naproxen. Whenever these pharmaceuticals are excreted and exposed to light or certain compounds in the soil, chemical transformation occurs to generate a structural analog that is more toxic to humans and aquatic animals [Vulava, *et al.* *The Science of the Total Environment*. **565**, 1063-1070 (2016)]. Wastewater treatment companies have found the removal of these compounds challenging, further emphasizing the need to monitor this environmental exposure.

What did you research for your Ph.D.?

My doctoral research, under the direction of Richard Yost at the University of Florida, involved the use of mass spectrometry with various modes of ionization to profile small molecule biomarkers (amino acids, sugars, nucleotides, and lipids) for the early disease diagnosis of Type 1 Diabetes and melanoma skin cancer. I designed sample preparation protocols for multi-omics applications involving various matrices (e.g., suspension mammalian cells, plasma, and tissue) [Ulmer *et al.* *Methods. Mol. Biol.* **1609**, 91-106 (2017)]. In addition, I collaborated with the Southeast Center for Integrated Metabolomics Center (SECIM) to develop a technique using ambient ionization and traditional chromatography techniques to analyze clinical patient skin lesions and mammalian melanoma cell cultures for putative biomarkers of melanoma skin cancer.



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What challenges have you faced in your career?

Throughout my tenure, I have encountered unwelcomed reminders of my status as a woman and a minority in science. It is very challenging to remain motivated and confident in settings where you are the only person that looks like you. Very early into my career, I sought out mentors who could understand these challenges and provide advice, suggestions, and words of encouragement. I have also aligned myself with organizations and committees that share my core values and moral basis. I am forever indebted to my mentors, and I feel honored to serve as a mentor to others.

What research are you known for?

During my NRC post-doctoral fellowship at NIST under the direction of John Bowden, I was heavily involved with the first Interlaboratory Lipidomics Comparison Exercise [Bowden *et al. J. Lipid. Res.* **58**, 2275-2288 (2017)]. Lipidomics is an emerging field with no standardized guidelines/practices. This study was designed as a means to harmonize lipid measurement. After sending five materials (SRM 1950, SRM 2378 levels 1, 2, and 3, as well as a custom-made bovine liver lipid extract) to 30 participating labs, over 1500 unique lipids were reported and 339 consensus mean values across 19 lipid classes were generated for SRM 1950. We created a visualization tool, LipidQC [Ulmer *et al. Anal. Chem.* **89**, 13069-13073 (2017)], to compare experimental SRM 1950 data, independent of the instrument platform, to these consensus mean values. We discovered that no one laboratory implemented the same lipidomics workflow. As a result, naming inconsistencies lead to the development of a comprehensive user-generated exact mass template, LipidPioneer [Ulmer *et al. J. Am. Soc. Mass*

Spectrom. **28**, 562-565 (2017)], used to calculate the exact mass of over 60 lipid classes. To engage a larger cross-section of the lipidomics community, 125 individuals completed a 54-question survey that highlighted challenges encountered within the field [Bowden *et al. Metabolomics.* **14**, 53 (2018)].

What are you working on right now?

After my NRC post-doctoral fellowship, I started working as a research chemist at the CDC in a clinical chemistry laboratory. We are focusing on standardization efforts and providing the accurate measurement of chronic disease biomarkers such as parathyroid hormone (PTH). PTH is a key biomarker in patient diagnosis and treatment of Chronic Kidney Disease-Mineral and Bone Disorder (CKD-MBD), as well as hypo- and hyperparathyroidism. Unfortunately, PTH immunoassays demonstrate significant variability. I find myself implementing many techniques learned in graduate school and during my post-doctoral fellowship to resolve these issues that could potentially lead to inconsistent measurements and misdiagnoses.

What do you enjoy outside of the lab?

I have taken a love to running and am participating in a summer half marathon here in Atlanta. I also have a Yorkie named Copper, named after my favorite element, who yearns for most of my attention. I enjoy spending quality time with family and friends, and do a fair bit of traveling. However, I am most passionate about STEM outreach. As a member of the national chemistry fraternity, Alpha Chi Sigma, I was awarded all four Wyvern pins for over 80 hours of service, including volunteering as a local science fair judge, serving on research panels, and providing test prep for high school and undergraduate students. .