FACES OF MASS SPECTROMETRY / Erin Baker

Kristin Elise Phillips, Health and Science writer at the University of Texas at Austin

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A Passion for Developing New Technologies

*When **Erin Baker** speaks about her research, her rapid cadence is peppered with laughter, informality and an infectious excitement. Listening to Baker is like delving into her personal history.*

Baker, who grew up on a ranch in Montana, chose chemistry as her subject. Both her bachelor's degree from Montana State University and her doctorate from The University of California, Santa Barbara are in chemistry. She spent the last dozen years working at the Department of Energy's Pacific Northwest National Laboratory (PNNL) where her publication record is prolific. Her research - combining ion mobility spectrometry (IMS) and mass spectrometry (MS)—has increased the ability to detect disease and environmental pollutants at the molecular level.

Baker likes to say that she is still having fun, and the fun is paying off. Last year she received a Rising Star award from the American Chemical Society.

What keeps you so inspired about your research?

I like creating new techniques for better analyses than are currently available. This is one of the reasons I joined PNNL after my Ph.D., since National Labs are known for developing novel technologies and techniques. At PNNL, we analyze molecules by combining IMS with MS to get two-dimensional measurements of each molecule's structure and mass. We've been working on making IMS-MS studies (Ibrahim et al., *Int. J. Mass Spectrom.*, **377**, 655-662 (2015)) really, really sensitive and really, really fast. We've also made our instrument commercially available to the scientific community so that everyone can perform similar measurements.

What is the impact of your IMS-MS technology?

The IMS-MS system we created at PNNL was commercialized by Agilent Technologies as their 6560 IM-QTOF MS. We worked with Agilent for about eight years to help develop this instrument by sending them schematics and results from novel applications. The instrument was finally released to the scientific community in 2014. It's really exciting to track all of the papers using this instrument. People are using it to characterize waste water, check for contaminants in laser cartridge ink, and perform health-based studies. It seems like the sky's the limit and there are probably studies taking place that I cannot even imagine.

How did your interest in chemistry start?

Everybody always laughs because they say they don't know many mass spectrometrists from Montana. But I grew up there on a cattle ranch and farm. My mom and I got very interested in understanding molecules and chemical reactions when a nearby gold mine started polluting our ranch. Unfortunately, arsenic and cyanide came down through water and sediments, killing several of our animals in addition to other local wildlife. This experience prompted my interest in chemistry, which just kept growing as I went through school.

How do you see your research trajectory?

When I began at PNNL, proteomics was a very hot area. In my proteomic studies, I have analyzed both environmental samples such as soils, and biological samples. In my human-based studies, I have characterized liver fibrosis, tuberculosis and a few different cancer types. About seven years ago, I also became interested

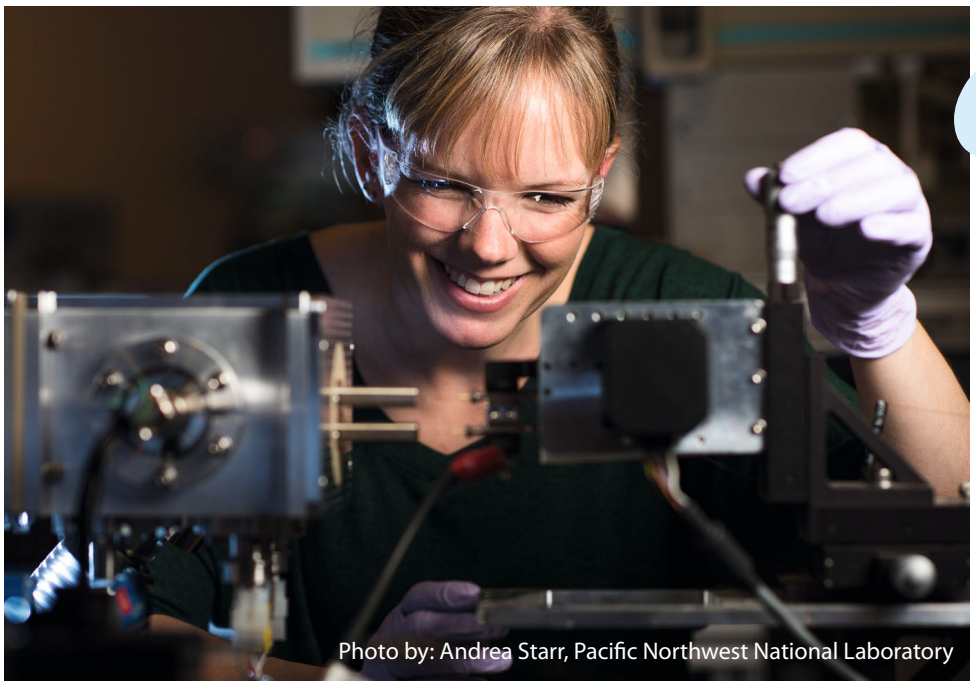

Photo by: Andrea Starr, Pacific Northwest National Laboratory

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in small molecule (metabolomic) analyses. Over the last six years, I have used IMS-MS to rapidly screen hundreds of patients and look for both endogenous molecules normally present in the body, and exogenous molecules such as those obtained through cosmetics, foods and environmental pollutants. By analyzing all of these different molecules, we can perform proteomic (Burnum-Johnson et al., *Mol. Cell. Prot.*, **15**, 3694-3705 (2016)), lipidomic, metabolomic, glycomic, and exposomic measurements to get a systems-overview of someone with a disease. We laugh that we are the omics people, but this gives us the ability to ask certain questions: are pollutants higher in the disease group or how do the xenobiotics effect endogenous proteins and metabolites?

What's next in exposomic research?

While we began our research by rapidly screening large patient populations, we've had to take a step back. In these studies, we detected thousands of features but were unable to identify the molecules that these features correlated with. So, for the last two years, we've been making libraries of every small molecule we can get a standard for that might be important for our studies. We recently published our first database of more than 500 molecules (Zheng et al., *Chem. Sci.*, **8**, 7724-7736 (2017)). This library is transferable to the scientific community, and anyone with an IMS-MS instrument can use it to evaluate whether these molecules are present in their samples.

Any other research you are excited about?

We have some really exciting work right now, but people will have to wait until ASMS to hear about it ☺. One of my favorite studies was evaluating patients following a liver transplant to understand why some livers fail while others do not (Baker et al., *Mol. Cell. Prot.*, 13, 1119-1127 (2014)). In this study, we discovered a panel of 63 different protein markers that clinicians can monitor for signs of liver failure. The ultimate goal would be to develop a drug that can be used whenever these markers are evident. This would allow the patients to be treated before their new liver fails and they die.

We recently did another interesting study that required analysis of over 3500 patients. In this study, the disease sarcopenia was investigated. Sarcopenia is a degenerative disease that hits men around the age of 55. Because the molecular changes are similar to other diseases, we had to run a lot of samples in order to find statically significant results. Our technique allowed us to increase the throughput of sample analyses and detect certain protein markers that were indicative of mortality in this disease.

This research is exciting, but can be all-consuming. What balance do you find outside of work?

My husband and I like to go white water rafting in areas where there is no cell phone service. It is so wonderful to unplug. Last summer, we went down the middle fork of the Salmon River in Idaho—100 miles in the middle of nowhere for six days. We fished, kayaked, rode horses and camped near natural hot springs that you could hike up to and sit in with a beer. It was so much fun and a great way to refresh.