White meat or dark meat? Serving up big data to decipher Thanksgiving dinner

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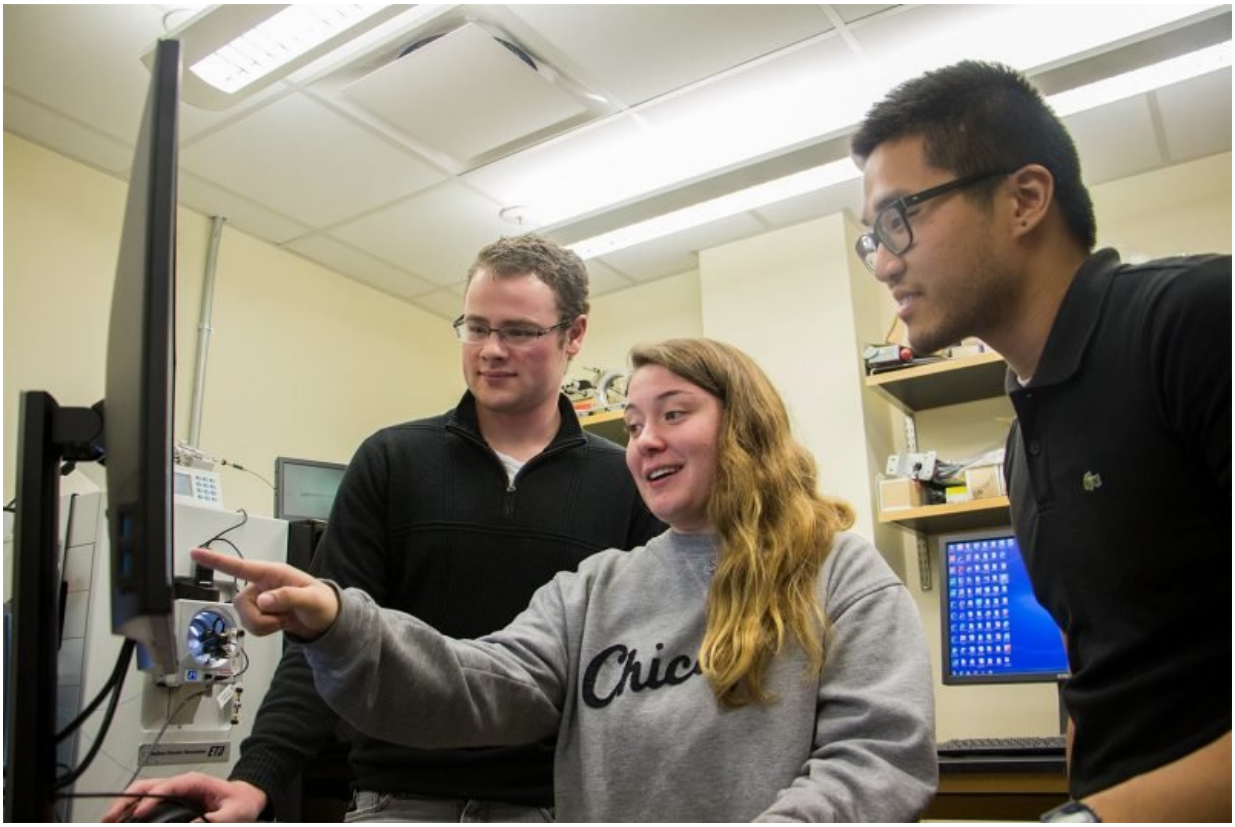

Will Stone, Cat Hayes, and Duke Nguyen talk turkey as they review data from the mass spectrometer. Credit: Virginia Tech

For Virginia Tech biochemistry majors Cat Hayes, Duke Nguyen, and Will Stone, turkey has taken on a whole new meaning.

The three, along with their General Biochemistry classmates, were challenged by Richard Helm, an associate professor in the College of Agriculture and Life Sciences' Department of Biochemistry, to consider the science behind Thanksgiving.

The professor gave his students the opportunity to dig into the experiment by analyzing large data sets and spending time in the lab with state-of-the-art instruments. Taking the HokieBird as inspiration, the students conducted a protein analysis of turkey, looking at leg, thigh, and breast meat. They were asked to investigate the difference between white and dark meat by analyzing the proteins that give turkey its color.

"You can sink a lot of time into data sets," said Helm. "You can get more questions than answers. But this is something many students are not challenged to do. I wanted them to examine real data from a real experiment where they had the first shot at the analysis."

The students looked at the most essential proteins, exploring high-quality protein identifications. They also learned how to pinpoint contaminants in the turkey samples to see how clean the tissue was. In order to understand the numerical difference between breast, thigh, and leg tissue proteins, the students analyzed spreadsheets with thousands of fields—a daunting task. They then developed their own formulas, color coding, filters, and other methods to allow them to see differences and evaluate statistical significance.

"I was both scared and excited," said Stone, a junior from Springfield, Virginia. "After staring at the data on my computer for at least an hour, I just jumped in the water to figure out how to sort it all."

Nguyen also used a whiteboard to plot out information, along with Venn diagrams.

The turkey testers were also able to get some high-tech help courtesy of a mass spectrometer coupled to a liquid chromatography unit. This newly acquired instrumentation is able to conduct highly sophisticated assays, showing the young investigators the relative abundance of various turkey proteins. Although the Helm Laboratory members operated the machine, the students were able to learn how to read data provided by the instrument. The machine also helped them validate their results.

The researchers discovered that enzymes involved in glycolysis, the metabolic pathway that converts glucose into energy, were similar in the turkey thigh and leg, and different in the breast. The concentrations of glycolysis proteins in breast were higher because this muscle is used for flight in birds, a process that relies heavily on glycolysis.

The thigh and leg meat contained relatively less glycolysis protein and more proteins associated with mitochondria because these tissues receive greater levels of oxygen, and these muscles are used more frequently when the turkey is standing or moving.

Although their focus was on proteins, the students also analyzed lipids in the three turkey tissues and found that thigh meat lipids oxidized faster than breast or leg meat. This, according to Helm, could drive further turkey research comparing frozen versus fresh, wild versus domestic, organic versus traditional, and so forth.

"It was a lot of fun," said Hayes, a junior from Plainfield, Illinois. All three of the students learned that they can conquer intimidating data sets as well as apply their biochemical knowledge to real data. They are also eager to see what other research may be inspired by their work.

Just in time for Thanksgiving, a subset of the students' findings will be published in BioRxiv, a free online archive and distribution service for unpublished preprints in the life sciences.

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