

PROFILE IN BUSINESS

## LEPRINO CHEESE By Beth Lipscomb

**ROB YEMM** was raised in Illinois, and attended the University of Iowa. There, he received bachelor's and master's degrees in biology. After graduation, with two job offers pending in the Midwest, Yemm and his wife decided they would prefer to live in the Front Range of Colorado. So they relocated, with hopes of finding work. Yemm's gamble paid off with a research position in the Animal Sciences department at Colorado State University in 1986. He remained in that role for 19 years.

"Throughout my career at CSU, we were doing research on growth mechanisms in livestock," Yemm says. "And as my career progressed, I got the opportunity to become more cross-functional, too. So I learned about food quality and meat safety, along with doing research on the topic of dairy."

The well-rounded research he'd conducted gave Yemm the knowledge he needed to later work in the food industry. Today, he is the director of analytical services for Leprino Foods. There, he oversees all operations of the company's laboratory — including food chemistry testing and food microbiology. His team is made up of 14 chemists and 16 microbiologists.

Yemm is also responsible for hiring, and says that he often recruits CSU graduates. "CSU puts out hardworking, well-rounded graduates that have the work ethic and academic knowledge that we need here," he says. And with the new Fermentation Science and Technology major, Yemm anticipates that the targeted knowledge will be an asset to companies like his.

He also hopes to build partnerships between the University and his current employer in the future. "I still have great connections at CSU. We have relationships that are growing and being actively pursued. Leprino is a great private resource, and there are many avenues for interaction between us and CSU," he says.



**Rob Yemm**  
Faculty Research Associate  
1986 - 2005

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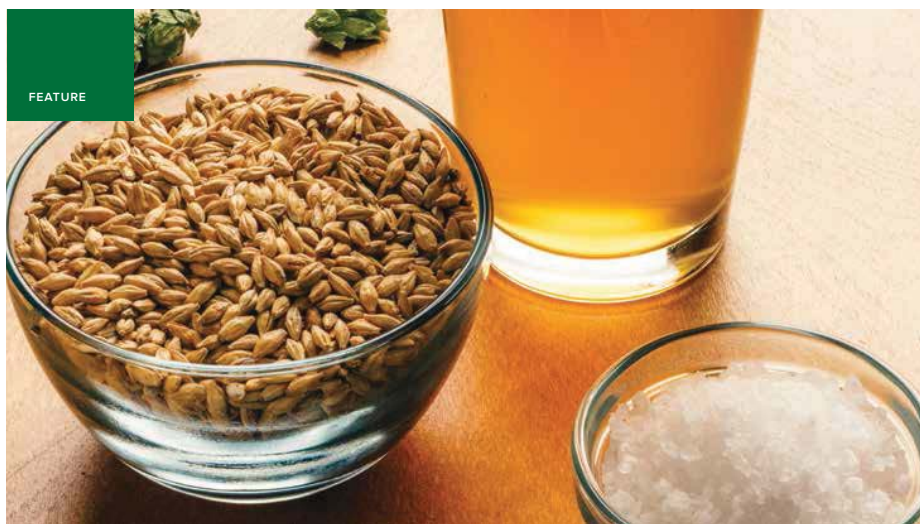
FEATURE

## SCIENCE of BREWING By Sandra Hume

WHEN ADAM HEUBERGER GOES TO EVENTS AND PARTIES IN HIS NATIVE CHICAGO, SOMETHING FEELS OFF. OH, RIGHT... WHERE'S THE BEER? "IT'S THE FIRST THING I NOTICE," SAYS THE ASSISTANT PROFESSOR IN THE CSU DEPARTMENT OF HORTICULTURE AND LANDSCAPE ARCHITECTURE, WHO IS MORE LIKELY TO BE OFFERED WINE OR OTHER BEVERAGES BACK HOME. "BEER IS SO

MUCH PART OF THE CULTURE IN FORT COLLINS, OF EVERY SOCIAL ACTIVITY. I THINK WE TAKE IT FOR GRANTED."

IT'S EASY TO TAKE BEER FOR GRANTED WHEN IT'S ALSO PART OF YOUR JOB. AS A SCIENTIST. AT A UNIVERSITY. ONLY IN FORT COLLINS, RIGHT? (CONTINUES ON PAGE 24)



## SCIENCE THEN AND NOW

In the beginning, centuries ago, beer was magic. If it tasted great, thanks were given to the gods. If it didn't, sorcery was clearly at play. Today we're a little more informed. We know that while beer brewing may be an art, it is also a very, very precise science. From chemistry to microbiology, the slightest of recipe adjustments can mean the difference between a porter and a pilsner, a sour brew or a fruity one, a fabulous-tasting beverage or one where your only option is to start over. And especially in a craft beer nucleus like Fort Collins, home to a university, the advancements in brewing science just keep coming.

## FLAVOR FIRST

New Belgium Brewing Company houses an entire brewing science team, including chemists, food scientists, biochemists, microbiologists, and sensory scientists to help beer through its brewing journey. Which is, in the simplest terms: Yeast is added to wort (which contains fermentable sugars usually from malted barley as the base source for the starch), kickstarting fermentation, the chemical process that converts fermentable sugars into alcohol. At any step along the way, samples are tested. Temperatures are adjusted. Ingredients are added. Measurements are taken. Yeast, a living organism, is a fickle thing, so it is also carefully monitored, says Dana Sedin, New Belgium's chemistry lab manager. "Yeast has good days and bad days. We treat our yeast very well to make sure it stays healthy."

These mid-brew check-ins help in two main ways, Sedin explains. Beer labels require listing alcohol content. Along with measuring alcohol, the beer's density can reveal its sugar content, so brewing scientists keep tabs on this all through the process to make sure their listed alcohol content is accurate and fermentation went as planned.

Next is flavor, which is a much bigger deal. When you order or open a beer for that "10 minutes of pleasure," in New Belgium parlance, you have certain expectations, Sedin says. "You expect a certain level of foam, or of carbonation. You don't expect to taste any off-notes. The beer you drink today should taste the same as the same beer you drank a few weeks ago." Sensory science is a broad discipline used across any industry whose products or services engage the senses. In the brewing milieu, New Belgium's sensory scientists are responsible for ensuring that all the beer they put out is "true to brand"—it tastes exactly like it's supposed to.

As a large craft brewery, New Belgium has plenty of instruments in their lab to analyze beer. The sensory science team also manages human instruments — a group of individuals (primarily New Belgium employees) who have gone through weekly training to prove they can taste and identify very specific flavors in beer. (A nice gig, but it takes at least a year of training, usually two, for a panelist's tasting data to be good enough to use for analysis.) The scientists use specialized software to write specific questions for this "sensory panel" and then analyze the resulting data to determine if the beer is true to brand. For example, panelists are trained to detect an off-note not uncommon in beer brewing that resembles butterscotch. If a statistically significant portion of the panel detects this off-note flavor, the scientists know they've got an excess of a compound known as VDK, and they'll "fail" the beer.

## BRINGING BEER INTO THE UNIVERSITY LAB

Across town at CSU, Jessica Prenni, PhD, leads the Proteomics and Metabolomics Core Facility. Metabolomics is a white-hot area of science, less than 20 years old. Using a device known as a mass spectrometer, scientists like Prenni and Heuberger can analyze the entire spectrum of molecules within a tissue sample. "Metabolomics is a discovery platform," explains Heuberger, "a new, different way of approaching data. It's the idea of trying to measure everything I can see, whether I know what it is or not."

Usually it's biological fluids — urine, blood — that are run through the mass spectrometer for disease research. A few years ago, Prenni and her team wanted to measure something decidedly more fun. This was Fort Collins, after all. What better way to showcase their half-a-million-dollar machine than running a sample of Fat Tire through it?

They decided to focus on three styles of beer: IPA, stout, and amber ale. A microliter — there are 473,176 of these in one pint — of each from New Belgium, Fort Collins Brewery, and Odell Brewing Co. was run through the mass spectrometer and analyzed. The results surprised them: The chemical fingerprint of each beer was specific to the brewery where it was brewed at — not the type of beer it actually was. This was new.

## ALL SUGARED UP

To the west on the CSU Foothills campus, in the University's Research Innovation Center, Dale Willard is watching his carbs. His company, Carbo Analytics, has developed a credit-card-sized microchip that uses electrochemical technology to measure individual sugar levels in a liquid sample.

The more beer that flows from a brewery's taps, the more important sugar — a vital component of the flavor profile — is to the brewing process. When a starchy carb like malted barley breaks down in a process known as wort formation, to prepare for fermentation, sugar becomes more accessible to yeast. Because yeast can only live off simple sugars, measuring sugar at this critical juncture — just before the yeast is added — often dictates the next step.

Typically sugars are tested throughout the brew cycle, from malt composition all the way through to bottling, by sending a sample of beer out to a lab. Results are usually a trade off: high-quality lab work with a wait of hours to days, or quicker and simpler methods but with results that are less reliable or robust. Carbo Analytics aims to eliminate that time-consuming step entirely, using their microchip to manipulate brewing samples to separate out and measure individual sugars right on the production line, so any response to results can be proactive and immediate rather than passive and delayed.

This "lab-on-a-chip" technology, as it's known, was initially developed within a larger company and for more widespread use. Willard, a chemist who earned his Ph.D. at CSU, spun off that segment into Carbo Analytics, and soon it became clear that breweries would end up one of the major markets for the technology.

"We can get real-time data versus having to take a sample to a lab and wait for results. You could have another batch of beer by then," says Sedin, who has witnessed the technology at its prototype stage. "A lot of the adjustments we'd make at that point, like temperature, can be done in real time. And you don't end up with wasted raw materials" — a win-win for all, including the environment.

Although the company is still at the prototype stage, it anticipates its first commercial sale this summer in the high-fructose corn syrup market. In the brewing industry, the idea is that ultimately breweries could wall-mount a unit right on the production line

that a chemist can check, and address, in real-time. "If they don't have to wait for results, they'll have the capability to change the course."

## BEER AGING

Back at the metabolomics core facility, the team was encouraged by the results of their first beer analysis. They looked for another brewing project to sink their mass spectrometer's teeth into. Was there a known problem in the industry they could help solve? They settled on beer aging. "The expiration date of beer is very important to the industry," says Heuberger. "Once it's past that date, it no longer tastes the way it should." Improving shelf life — keeping beer as fresh as possible for as long as possible — is a perpetual goal.

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So, they asked, what can a metabolomic analysis tell us about the chemical reactions that occur in beer over time that affect the big three of aging: appearance, aroma, and flavor? A lot, it turns out. Working with New Belgium, the team sampled Fat Tire at three stages: fresh, stored at room temperature, and refrigerated. In the process they were able to isolate an entirely new class of compounds that are sensitive to temperature and time within beer: purines.

This was a breakthrough. When a brewery runs beer through sensory analysis for an aging experiment, it has to be done real-time. That's usually about six months. Now, with these new chemical markers identified, the future looks promising for breweries to run accelerated experiments in a fraction of the time, moving toward increasing beer stability over a longer time. To date the facility has run several more accelerated analyses alongside the brewery's real-time experiments, "and so far," says Heuberger with a smile, "our data and theirs have matched up nicely." Just what a scientist wants to hear.

The facility is delving into research with mass-market brewing companies as well. With Anheuser-Busch InBev, they're working with barley breeders to see how the chemical profile of barley might affect its malting quality. Identifying chemical markers early on could potentially shave years off what is now a 12-year breeding process. Similarly, they've just begun a yearlong study with New Belgium to identify which chemical qualities in barley — identified through metabolomics — correspond to flavor differences. In a world where a suspicion that barley contributes to flavor has not been shown through scientific research, this is cutting-edge stuff.

The science of beer is complicated and precise and, for the scientists, fun. There's plenty still to learn. Says New Belgium's chemist Sedin, "We're not saving the world, we're just making beer a little better."