

The yeast is rising

Makers of beer, wine and cheese need microbiologists to keep fermented products at their peak. Kendall Powell gets a taste of the career offerings.

Every student who has ever crossed paths with *Saccharomyces cerevisiae*, the academic version of brewer's yeast, has pondered getting a job at the local brewery. Cody Reif is living the dream. As a microbiologist at the New Belgium Brewing Company in Fort Collins, Colorado, Reif and his colleagues start each day by tasting the latest batches of the company's eight brews. He says that the group's taste-test gives better statistics for determining if a batch is up to company standards. Yeah, sure, statistics.

"Is working here as much fun as people think? Yes, it is," Reif says. The daily sampling illustrates a criterion for working with fermented food products not usually highlighted in a basic microbiology degree: critical sensory skills. It reflects the fact that the bottom line is not the science behind making fermented products, but rather the flavour and appeal of a product.

Careers focusing on the microbiological processes that go into making beer, wine and dairy products demand solid backgrounds in microbiology and biochemistry, but they also incorporate special expertise in food science and sensory training. Research projects in this small but diverse field range from troubleshooting contaminants that might spoil a vat of wine to designing probiotic microbial cultures for 'functional foods' that aim to improve the immune system.

An understanding of how fermenting microbes behave, and how their metabolites change the properties of foods and beverages, can be picked up in specialist degree programmes or through on-the-job

experience. Reif, who has a microbiology degree, brags: "I can probably identify four or five different strains of yeast or bacteria just by smell."

One place a microbiologist might seek work is in a microbrewery — a small regional enterprise. There, says Reif, it is necessary to know the ins and outs of the entire beer-making process because any microbial problems could bleed into the next phase. Also, scientists at smaller companies handle most analyses on site, from quality control and yeast propagation to monitoring for 'critical beer spoilers' — bugs that can crash the keg party.

This holds true at smaller wineries, too, says Lars

Bjorkman, an enologist at Flora Springs Winery in St Helena, California. His bachelor's degree in viticulture and enology from the University of California, Davis, combines classic microbiology, biochemistry and food science with sensory classes for the tailored enology half of the degree. These allow him to analyse his winery's varieties through each stage of production. Bjorkman says that a large part of his job is to ask each day, "What is growing in this wine?", and to find out if it is advantageous or a troublemaker.



Tread carefully: winemakers are looking for experienced microbiologists.

A STRANGE BREW

Larger enterprises such as Miller Brewing Company in Milwaukee, Wisconsin, and E. & J. Gallo Winery in Modesto, California, have their own research and development departments that employ scientists at bachelor's, master's and PhD levels. Tom Pugh, director of enology research at Gallo, says that the company does both applied research, to optimize fermentation conditions, and basic research that strives to identify the microbial characteristics that affect a wine's feel, flavour and aroma.

His research group looks at the way genetic differences between strains affect metabolism throughout the fermentation. Gallo also takes on microbiologists with degrees slanted towards wine-making as winemakers, he says, overseeing a wine's production from grape to bottle.

Similarly, David Ryder, chief brewmaster at Miller, says that microbiologists may want to become brewmasters at individual breweries. There's also a small group of microbiologists doing R&D at the corporate headquarters in Milwaukee. These, says Ryder, track yeast physiology and use DNA

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Gut feeling for health

Developing probiotics — microbial cultures added to foods to convey an added health benefit, such as improved immune function — is one of the biggest growth areas in food science research. Probiotic cultures of bacteria normally found in foods are thought to colonize the gut and aid both digestion and immunity. But companies are still looking for the definitive study that links their consumption to good health. Experts say the most marketable background for work on probiotics would be a microbiology degree coupled with courses in human nutrition and immunology or with experience of running clinical trials.

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Say cheese: an understanding of fermentation — and how microbes affect taste and texture — is crucial in the dairy industry.

microarrays to find out if the yeast strains are ‘happy’. Happy yeast are healthy yeast that grow fast in a variety of environments and efficiently convert sugars to alcohol. Like Pugh, Ryder stresses that he looks for employees who are passionate about both the science and the product.

CHEESE WHIZZES

And what goes better after a fine wine than a nice hard cheese to cleanse the palate? Makers of cheese (and yoghurt) face an equally complex, though different, fermentation process. Microbiologists working on the dairy side of the fence also hunt for the microbes that bring the desired texture, flavour and aroma to fermented milk. Understanding how microbes will react under the different stresses of the cheese-making process is a key component not necessarily gleaned from working in an academic microbiology lab. This is where the practical side of a food-science degree comes in, says Kayla Polzin, a senior scientist and microbiologist at the Land O’Lakes dairy company’s labs in Arden Hills, Minnesota.

Polzin says that, in her job, a deep understanding of microbiology and metabolism is just as important as a broad understanding of the many microbes that can crop up in dairy cultures. She is one of two PhD-level microbiologists at Land O’Lakes, but many more dairy-food microbiologists are employed by the companies that provide the starter cultures. As well as developing cultures that are resistant to bacteriophages and viruses, or that work more efficiently, these scientists track down microbe characteristics responsible for specific flavours and textures sought by their customers.

“Pizza companies can be very, very demanding as to what the cheese looks like on their pizza. It has to brown, stretch and melt just the right way,” says Dennis

Romero, a molecular microbiologist at the starter-culture company Rhodia in Madison, Wisconsin. He is one of about two dozen research scientists at Rhodia, but he notes that most of its competitors are based in Europe and are ten times as large.

Romero stresses that researchers at starter-culture companies must do science that is practical at all times. The best way for microbiology students to gain this applied viewpoint of research, he says, is to work on an industry-funded collaboration. Starter-culture companies tend to ‘outsource’ the most basic research by setting up joint projects with an academic lab.

Christian Hansen, a food-ingredient company based in Hoersholm, Denmark, employs about 80 scientists in its central research laboratories. Chief science officer Peter Olesen says that — because the company deals in colours, flavours and enzymes as well as cultures — it employs protein chemists, chemical engineers and scientists with medical and veterinary degrees.

One of their recent basic microbiology research projects developed what Olesen calls a “revolution in lactic acid bacteria” — a strain engineered so that it can grow under aerobic conditions (with oxygen), resulting in cultures that ferment faster.

All areas of food microbiology value knowledge of food processes and fermentations more than a narrow focus on molecular mechanisms of organisms. For that reason, most of the opportunities in this field do not require postdoctoral training. Industry-related experience is rated highly — whether an internship, working on a wine harvest or an industrial collaboration.

Reif says that, all beer-drinking benefits aside, he gets job satisfaction from the critical thinking required in troubleshooting: “When problems come up it’s an opportunity to use your head.”

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