

Benjamin Wolfe on Molds and Cheese



Benjamin Wolfe is an assistant professor of microbiology in the Department of Biology at Tufts University. His lab uses food microbial communities to address fundamental questions in microbial ecology and evolution.

How did you get into studying mold?

I did my PhD on fungal diversity, ecology, and evolution at Harvard and I was studying mushroom farming fungi. If you've ever played Mario Brothers, you've probably seen that red mushroom with the white dots on the top of it. That's a real thing called *Amanita*. I became fascinated with fungi and for my postdoc, I had the amazing opportunity to work with the microbial diversity of cheese. I now have my own lab at Tufts University, where we're doing a lot more work with food molds in particular.

Most of us aren't familiar with mold other than, "Oh, that peach has gone moldy, let me throw it away." Can you describe molds to a layperson?

Fungi live by decomposing stuff. They break down the environment that they live in and use that decomposed stuff as a way to make energy to grow. A log rotting in a forest or the bread sitting on your counter rots via mold. The mold produces enzymes that break down things in the environment to take in glucose and other sugars that they get from decomposition. All fungi have a compound called *chitin* that they use to build their cells, and all fungi have a network of cells called a *mycelium*. When you're looking at a piece of bread that is moldy, that big fluffy cloud that's spreading across the bread is a whole bunch of fungal cells all united together.

Which came first, the log or the mold?

One group of molds and fungi that people never really see are living in the soil, breaking down things in the soil, and they connect up with roots underground, and deliver nitrogen, phosphorus, and other compounds to the plants and in return the plants give that fungi carbon. It actually feeds them sugars from photosynthesis. What happened is that these fungi evolved first and allowed plants to colonize barren land that existed many millions of years ago and so, we do think actually the fungi came first and then came the plants. The log came after the fungi.

On the flip side, is there stuff about mold that's dangerous?

Absolutely. They can wipe out entire crops; they can wipe out animals and infect humans. They produce compounds called mycotoxins, which can be very dangerous, and these compounds are produced for reasons we don't totally understand. We think they produce mycotoxins to fight with other microbes, as these toxins can sometimes kill off neighboring microbes.

In the 1950s and '60s, there were some big outbreaks of molds. In Europe, a bunch of feed given to turkeys was contaminated by a particular fungus-producing mycotoxin. All these turkeys started dying because of an *Aspergillus* disease, which is caused by mold. After that discovery, we realized that there are a lot of different types of places where molds can grow and produce mycotoxins. Often peanuts are screened for a mycotoxin called *aflatoxins*. These are pretty potent carcinogens that we need to monitor in our food systems.

How do I avoid mycotoxins at home?

Most high-risk foods we know are prone to mycotoxins are generally screened as per requirements by the US FDA. Peanut-based products in the US require regular screening for aflatoxins; they're really the highest-risk product. There is research going on right now to try to evaluate coffee and chocolate, which both can get pretty moldy. But in general, if you're eating food that's been produced in a clean, safe way—which most of the things in the US are produced as such—you don't have to worry about mycotoxins.

If you're making your own cheese or salami, you have to be careful that you're inoculating with beneficial molds that don't produce mycotoxins. The whole idea of color being an indicator of the safety of molds is really not a safe thing to be using for the home fermenter. Leave fancy moldy cheese and salami production to the people who are experts.

Cheeses, salami, and you mentioned coffee and chocolate... You're mentioning some of my favorite things!

And they're all dependent on mold! My favorite mold in food is *Aspergillus oryzae*, which brings you sake and miso and soy sauce and all those wonderful Asian fermented foods.

In cheese and in salami, we also have wonderful molds. Camemberts and bries have that thick white sweater on their outside. That is a mold called *Penicillium camemberti*. The fungus is slowly decomposing the cheese curd that is on the inside of the cheese. It breaks down the proteins and the fats, which releases various flavors. It also makes it nice and creamy. When you look at aged salami, it's also white and dusty on the outside because of *Penicillium nalgiovense*. This is another mold that is inoculated. In this case it's more for keeping other molds off of the surface and creating this beautiful pure white product; it doesn't add a whole lot of flavor.

Coffee and chocolate go through what is called *heap fermentation*. You just pile up all the cacao pods and let them rot for a little bit of time. People largely attribute the downstream flavors of things like chocolate to the yeast and

bacteria that are fermenting those products.

Foods like salami and miso and cheeses are clearly fungal-dominated, and the fungi play huge roles in the flavor production of those foods.

Should you eat the rind on cheeses that have visibly moldy outsides?

If it's a cheese that's supposed to be moldy, then you're probably fine. Camembert and brie are definitely supposed to have mold on the outside. In fact, they encourage you to eat it because often the flavors of the cheese are partly in the rind. Then there are cheeses where the surface is crusty and has a weird texture, very crunchy and dry and really unpleasant. I don't recommend eating the rinds on those cheeses, but on mold-ripened cheeses, they're called "mold-ripened" because you're supposed to eat the mold.

If you are eating plastic-wrapped cheddar and eventually it gets moldy, be careful because you don't know what that particular mold is. While it may appear to be only on the surface, it's often unclear exactly how far in it's grown, and it's unclear if it's producing any kind of toxins. If it's not supposed to be moldy, I wouldn't eat it.

Any tips for managing good molds? How we store these things must impact whether the beneficial mold is doing the right thing.

People know from watching their bread go bad that there are molds everywhere. We breathe in spores of mold all the time. You just have to create a really clean environment where you minimize all those spores that are coming down onto your product.

It's also a seasonal thing. In the spring there's a lot more growth in temperate regions, so there's a higher risk of contamination then. In the fall, we get a lot of moldy "Frankencheeses," as I like to call them, sent to our lab to be analyzed, because in the fall you have a lot of leaves dropping to the ground, there's a lot of wind blowing spores around, and you end up getting a lot more colonization of bad molds at that time of the year as well.

What other unexpected things have you come across with mold?

Wherever you have a moldy food, you will have mites, tiny little insects that freak a lot of people out. So you've probably heard of cheese mites that really should be called "mold mites" because they're not really there for the cheese. They're there to eat the molds, but they're also disturbing your cheese or salami surface.

A lot of cheese makers will either go through with a big vacuum cleaner or leaf blowers and blow the mites off of their cheese. It's so ridiculous how much time and money is spent on cheese mites in the industry. I have a video that I think is adorable of a cheese mite eating mold. I think it's great!

See <http://cookingforgeeks.com/book/cheesemites/> for a video of cheese mites.

