

Fermented coffee's fruity aromas demystified

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Identifying the compounds that give fermented coffee, pictured brewing here, its unique flavor and aroma could allow more people to enjoy it. Credit: Samo Smrke

Specialty coffees are gaining traction in coffeehouses around the world—and now a fermented version could bring a fruity taste to your

morning cup of joe. This new kind of beverage has a raspberry-like taste and aroma, but what causes these sensations has been a mystery. Today, scientists report six compounds that contribute to the fermented coffee experience. The work could help increase production of the drink and make it more readily available for everyone to enjoy.

The researchers will present their results at the spring meeting of the American Chemical Society (ACS). ACS Spring 2023 is a hybrid meeting being held virtually and in-person March 26–30.

"There are now flavors that people are creating that no one would have ever associated with coffee in the past," says Chahan Yeretzian, Ph.D., the project's principal investigator. "The flavors in fermented coffee, for example, are often more akin to fruit juices."

This unusual type of beverage provides a unique flavor experience for consumers, and the growing demand for it means that fermented coffee beans can fetch a high price, potentially benefiting farmers. And the process by which the beans are prepared requires much less water than traditional methods, making it a more environmentally friendly alternative to a standard cup of coffee.

But despite this drink's growing popularity, the compounds that cause its distinctive flavor were unknown. And with fermented coffee becoming more popular in competitive events, some people have been concerned that the lack of knowledge about fermented coffee may make it difficult to distinguish between the genuine product and regular joe that has been illicitly adulterated. So, Yeretzian and colleagues from the Coffee Excellence Center at Zurich University of Applied Sciences sought to identify the compounds that are responsible for these new and exciting flavors. And because flavor and smell are intimately linked, studying the beverages' scents could help the team gain a better understanding of how fermented coffee's complex flavor is created.

To single out the compounds unique to fermented coffee's aromas, researchers took arabica beans and divided them into three groups. One was prepared using a wash process, which is likely how the average afternoon pick-me-up brew is made. Here, a gelatinous substance known as mucilage is stripped from the coffee bean, which is washed with water before being dried.

The researchers prepared the second group using the pulped natural process—another common approach—in which the skin is removed from the bean, but the mucilage is left intact.

Finally, the team fermented beans in the third group using carbonic maceration, a process often used in winemaking. This method was first introduced to the specialty coffee world in 2015, when the winning contestant in the World Barista Championship used it to prepare their entry. With this process, whole coffee fruits are fermented in stainless steel tanks and infused with carbon dioxide to lower the pH of the fermentation. Unlike the other brews, the coffee made with fermented beans was described as smelling intense, like raspberries with a hint of rose.

Next, the researchers brewed coffee using each type of bean and analyzed the samples with [gas chromatography](#) (GC) sniffing, also called GC olfactometry. First, the GC instrument separated individual components in the air above each sample. Then, as the compounds left the instrument, they went to a mass spectrometer for identification, and to someone sitting at the outlet to describe what they smelled.

"Because the [chemical signature](#) doesn't tell us how a compound smells, we have to rely on the human nose to detect the scent as each compound comes out of the chromatography instrument individually," says Yeretzian. This methodology can be tricky because there is a subjective element to it. "We're using people to detect scents, and everybody

perceives flavors a little differently," says Samo Smrke, Ph.D., a research associate in the lab who is presenting the results. "But in this case, the panel was very consistent in the smells they described. So, what is traditionally considered a challenge was actually not an issue because the aromas were so clear."

There is one major advantage to GC sniffing. The [human nose](#) can sometimes detect scents from compounds that are at such a low concentration, they're unable to be picked up by mass spectrometry. In this case, although six compounds appeared to contribute to the intense fruity flavor and the raspberry scent of the fermented coffee, the team was only able to identify three of them: 2-methylpropanal, 3-methylbutanal and ethyl 3-methylbutanoate.

In the future, the researchers hope to identify the remaining compounds, as well as judge the intensity of different flavors and scents. Additionally, the researchers would like to know more about how these unique compounds form. Potential factors include farming practices, the variety of coffee beans, the microclimate of specific farms and the microbes present during fermentation.

"There's still quite a lot of unknowns surrounding this process," says Smrke. A better understanding of the sources of these [compounds](#) could help the team standardize production methods, making it easier to produce fermented [coffee](#) at larger scales and allowing even more people to enjoy this distinctive [flavor](#).

More information: ACS Spring 2023: Exploring unique coffee flavours of fermented high-end specialty coffee: Towards the fourth wave coffee, www.acs.org/meetings/acs-meetings/spring-2023.html

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