

The microbes make the sake brewery

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A sake brewery has its own microbial terroir, meaning the microbial populations found on surfaces in the facility resemble those found in the product, creating the final flavor according to research published ahead of print in the journal *Applied and Environmental Microbiology*. This is the first time investigators have taken a microbial census of a sake brewery.

Many sake makers inoculate with both bacteria and yeast, says corresponding author David A. Mills of the University of California, Davis, but he and his colleagues investigated a sake brewery where inoculation is restricted to a single species, *Aspergillus oryzae*, at the first of three stages of [fermentation](#).

"The purpose was to be able to ask the question, 'do the environmental surfaces have microbiota that are similar to those that normally are added to ferment the product?'" says Mills.

And despite the single stage one inoculation, the microbial populations change dramatically at each fermentation stage—koji, moto, and moromi.

"The kojii fermentation is dominated by an inoculated fungus, *Aspergillus oryzae*, which helps process the rice into smaller, more available sugars," says Mills. "The Kojii is then diluted with steamed rice and water to form the seed mash or moto. In this stage the alcoholic fermentation commences with yeast and various lactic acid-producing bacteria populations expanding."

That, says Mills, is followed by the major fermentation in sake. "Yeast perform the alcoholic fermentation, while a range of other bacteria—*Bacillus*, *Staphylococcus*, *Lactobacillus*—consume available nutrients and stabilize the product."

"At each stage, most of these organisms—with the exception of the added *A. oryzae*—could also be found on the equipment surfaces, suggesting the house microbiome provides the necessary microbes to carry out the fermentation," says Mills. "Thus, the environmental conditions are important for controlling these fermentations."

The results echo those of studies Mills and collaborators have done on other food facilities: an artisanal cheese maker, and wine facilities, he says. He adds that this line of research is currently at the natural history stage where census is taken, and that ecological understanding, the kind of understanding that will enable predictive product improvement, will come later. But he expects this kind of facility monitoring to become the norm.

"Understanding the microbial interface between food facilities and food products in a global way will be important for controlling the safety and quality of many different foods and beverages," says Mills.

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