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Study Finds Native Grape Microbes Shape Flavor Differences Among Wines From the Same Vineyard

Across six varieties in one vineyard, researchers tied distinct grape skin microbiomes to fermentation pathways and wine aromas.

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A study published in the International Journal of Food Microbiology found that native microbial communities on grapes can help drive clear flavor differences between wines made from different grape varieties grown in the same vineyard.

The research examined six grape varieties cultivated side by side at a single vineyard across two harvests. The authors tracked the microbes present on grape skins at the start of production and followed how those communities changed during fermentation. They paired microbiome sequencing with chemical analysis of the finished wines to test whether the vineyard's indigenous microorganisms were linked to differences in aroma and taste.

The study adds detail to a question that has become increasingly important in wine science: why wines from the same place can still develop distinct sensory profiles. Grape variety and growing region have long been treated as the main drivers of wine character. In recent years, researchers have also focused on the role of the vineyard microbiota, the bacteria and fungi that live on grape surfaces and enter the fermenting juice, as a possible contributor to terroir.

According to the study, the microbial populations present on the grapes at the beginning of the process were shaped mainly by grape variety, even though all the fruit came from the same vineyard environment. That means each variety appeared to host its own starting microbial community before fermentation began.

The work also found that harvest year influenced how those microbial communities changed over time. In other words, the vintage did not erase the varietal signal, but it did affect microbial succession during fermentation and the buildup of volatile compounds that contribute to aroma. That finding suggests two forces were at work at once: the variety of grape influenced which microbes were present first, while the conditions of a given year helped shape how fermentation unfolded.

The authors reported that these microbial differences were associated with different patterns of volatile aroma compounds in the wines. Those compounds are important because they help determine notes that drinkers perceive in the glass, including fruit, floral, spice and fermentation-related characteristics. The researchers also linked microbial variation to differences in sensory traits, indicating that the native microbiota

may contribute not only to chemistry but also to the way wines are experienced by smell and taste.

Because the grapes were grown in one vineyard rather than across different regions, the study was designed to reduce the effect of location and isolate the influence of grape variety and microbial ecology. That setup strengthens the case that indigenous microbes can help create divergent wine styles even when fruit is produced under the same broad site conditions.

The findings do not mean microbes alone determine wine flavor. Wine character still depends on a combination of factors that includes grape genetics, weather, ripeness, vineyard management and cellar practices. But the results support the idea that native microorganisms are an active part of that system rather than passive bystanders.

For the beverage industry, the work could have practical value beyond academic debate over terroir. If native microbiota help preserve or amplify varietal identity, wineries may be able to use that information to guide fermentation choices in ways that protect a grape’s typical character, even when several varieties are grown in the same vineyard. The same research could also support more targeted decisions about whether to encourage spontaneous fermentation, manage microbial populations more carefully, or select production methods that maintain desired local traits.

That could be especially relevant for producers looking to differentiate wines from a single estate without relying only on blending, oak treatment or other post-harvest interventions. A better understanding of how microbial communities vary from one grape variety to another may also help wineries predict how wines will develop across different vintages, when weather can shift fermentation behavior and aroma formation.

The study reflects a broader trend in food and beverage science, where microbial ecology is being studied as a factor in flavor development and product identity. In wine, that interest has centered on whether a place’s microbial signature can be considered part of terroir in the same way as soil, climate and topography. By showing varietal differences in native microbes within one vineyard, and linking those differences to volatile compounds and sensory attributes, the new research offers further evidence that the biological environment on the grape itself may be part of what makes one wine

distinct from another.

The authors said the work opens new possibilities for winemaking strategies aimed either at preserving indigenous microbiota or shaping them for specific flavor outcomes, an area likely to draw continued interest as producers seek more precise ways to influence style at the intersection of agriculture, fermentation and local identity.