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Italian Study Finds Sequential Yeast Fermentation Sharpens Fruit Aromas in Wine

Researchers said Torulaspora delbrueckii changed the aroma and taste of Verdeca and Nero di Troia rosé most when added before standard wine yeast

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Researchers in Italy reported new evidence that a nontraditional yeast could help wineries shape the aroma and taste of white and rosé wines through the way fermentation is managed.

The study, published Monday in OENO One, tested a newly isolated strain of Torulaspora delbrueckii, a non-Saccharomyces yeast, alongside a commercial Saccharomyces cerevisiae strain in pilot-scale fermentations of two Apulian wines: Verdeca, a white wine, and Nero di Troia, made as a rosé. The researchers found that the strongest changes came when the two yeasts were used in sequence rather than added at the same time.

In the trial, the team compared three approaches in 50-liter stainless steel tanks: fermentation with S. cerevisiae alone, co-inoculation with both yeasts at the same time, and sequential inoculation, in which T. delbrueckii started fermentation and S. cerevisiae was added four days later. Each treatment was replicated three times and carried out at 17°C.

According to the paper, sequential fermentation produced a slower and more gradual sugar consumption pattern, especially in Verdeca, while keeping volatile acidity low. The main differences appeared in the wines' volatile compounds, which are closely tied to aroma. In Verdeca, the sequential method nearly doubled total ethyl esters and quadrupled acetate esters compared with the control fermentation based only on S. cerevisiae. In Nero di Troia rosé, the same strategy sharply increased grape-derived terpenes and norisoprenoids, including citronellol and damascenone.

The sensory results moved in the same direction. Using a Rate-All-That-Apply test with a semi-trained panel of 10 assessors, the researchers found that wines made with sequential inoculation received significantly higher scores for fruity descriptors. In Verdeca, those notes included orange-like fruit character. In Nero di Troia rosé, the wines showed stronger cherry and red-berry impressions.

The work adds to growing interest in using non-Saccharomyces yeasts not simply as alternatives to standard wine yeast but as tools to steer style. The authors said the effect of T. delbrueckii was dependent on grape variety, but across both wines it increased aromatic complexity. Their analysis also suggested that different families of

compounds drove those changes depending on the cultivar: fermentation-derived esters were central in Verdeca, while a combination of aliphatic esters and free monoterpenes shaped the rosé's fruit profile.

The research was carried out by scientists from Italian institutions including the University of Basilicata and collaborators in Apulia. The T. delbrueckii strain used in the study, identified as LC 2-1, had been isolated from a spontaneous fermentation of Cococciola grapes and previously characterized for traits such as tolerance to high ethanol and sugar levels, β-glycosidase activity and resistance to oxidative stress.

Apulia has become an important region for Italian wine exports and domestic sales as producers put more emphasis on native grapes and regional identity. That market context helps explain why researchers are focusing on fermentation methods that can alter aroma without changing grape origin. For wineries, especially those working with local varieties, the findings point to a possible way to differentiate white and rosé wines through yeast management rather than through more visible changes in viticulture or oak use.

That matters for the beverage sector because producers are under pressure to offer wines with clearer identity and stronger sensory distinction in crowded markets. If similar results hold at commercial scale, sequential inoculation with Torulaspora could give winemakers another practical option to modulate a wine's volatilome and sensory response, particularly when they want more fruit-forward styles without raising volatile acidity.

The study was based on pilot-scale vinification rather than full industrial production, and the researchers noted that microbiological monitoring of yeast population dynamics during fermentation was outside its scope. Even so, the design went beyond bench-top trials by using real musts from two established Apulian cultivars and by combining chemical analysis with sensory evaluation.

To map aroma compounds, the team used comprehensive two-dimensional gas chromatography coupled with mass spectrometry. That allowed them to identify broad shifts in both free and bound volatile fractions after fermentation. The paper said these chemical patterns aligned with what tasters perceived in the glass, strengthening the

case that inoculation timing can materially affect finished wine character.

The findings also fit into a broader line of research showing that T. delbrueckii does not behave uniformly across all grapes or all cellar conditions. Earlier studies cited by the authors have reported mixed outcomes for fruity aromas depending on cultivar and fermentation setup. In some wines it has increased complexity or boosted certain varietal compounds; in others its sensory impact has been limited or less favorable. That variability is one reason this new work may draw attention from winemakers interested in cultivar-specific protocols rather than one-size-fits-all yeast programs.

For producers of Verdeca and Nero di Troia rosé, the paper offers one of the clearest recent examples of how sequential inoculation can shift both chemistry and perception in tandem. For other wineries, it provides further support for testing non-Saccharomyces yeasts as part of targeted fermentation design instead of treating them as niche additives.

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