Bioprotective co-inoculation strategies for the optimisation of Nocellara del Belice table olive fermentation

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Background.

Green split table olives from the Nocellara del Belice cultivar are a traditional Sicilian product, typically undergoing spontaneous fermented driven by indigenous microbiota. However, this natural process is microbiologically uncontrolled and often leads to inconsistent product quality, including pulp softening, browning, and the development of off-flavours; these factors compromise both safety and marketability. These issues are particularly pronounced in small-scale artisanal productions, where standardisation is limited. Recent studies have shown that using selected microbial starters, particularly lactic acid bacteria (LAB) and yeasts, can improve fermentation by enhancing microbial control, sensory attributes, and overall product stability (https://doi.org/10.1016/j.fm.2020.103497). Co-inoculation strategies involving LAB and yeasts have demonstrated potential in modulating fermentation dynamics and inhibiting spoilage organisms. Employing defined starter cultures also promotes reproducibility and adherence to food safety standards.

Methods.

To optimise the fermentation process for Nocellara del Belice green split olives, three experimental treatments were tested under controlled conditions. The first treatment (SO1) used the commercial LAB strain *Lactiplantibacillus pentosus* OM13 as a control. The second (SO2) and third (SO3) treatments involved co-inoculation of *L. pentosus* OM13 with *Candida boidinii* LC1 and *Candida norvegica* OC10, respectively. Fermentation was carried out over 90 days in 8% NaCl brine. Several parameters such as pH, salinity, and microbial population dynamics were monitored throughout the transformation process. Randomly amplified polymorphic DNA (RAPD-PCR) was used to assess the dominance of inoculated strains. At the end of fermentation, olives were evaluated for colour (CIELab), pulp hardness, and sensory attributes, with a trained panel of 16 tasters following International Olive Council protocols.

Results.

All inoculated strains successfully dominated the fermentation, with over 80% prevalence. In the co-inoculated tretments (SO2 and SO3), acidification occurred more gradually, reaching

pH < 4.5 after 75 days, compared to 21 days in the control. Despite the slower acidification, co-inoculation effectively suppressed spoilage microorganisms, including *Enterobacteriaceae*, coliforms, and pseudomonads. Pulp hardness was significantly higher in SO2 and SO3, likely due to the absence of polysaccharolytic activity in the selected yeasts. Colour differences were minimal, though SO3 exhibited a more desirable yellow hue. Sensory analysis evaluation confirmed these findings, with SO3 receiving the highest scores for flavour, texture, and overall appreciation. No off-flavours or defects were detected in any treatment, confirming the effectiveness of the selected strains in guided fermentation.

Conclusions.

The co-inoculation of *L. pentosus* OM13 with selected yeast strains (*C. boidinii* LC1 and *C. norvegica* OC10) presents a promising strategy to enhance the quality and safety of Nocellara del Belice green split table olives. This approach improves microbial control, preserves texture, and enhances sensory quality. Although acidification was slower in co-inoculated trials, the bioprotective effects of the yeasts effectively limited the growth of undesirable microorganisms. These findings support the use of LAB–yeast consortia in standardised fermentation protocols, offering artisanal producers a practical solution for achieving consistent, high-quality, naturally fermented table olives.

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