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The Influence of Lysed Biomass of Wine Yeast on the Preservation of Aromatic Substances of Grapes during Alcoholic Fermentation

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Annotation: This study investigates the effect of lysed wine yeast biomass on the preservation of grape aromatic compounds during alcoholic fermentation. The aim was to assess how the addition of enzymatically lysed yeast biomass influences the physiological activity of pure yeast cultures. The research was conducted using Rkatsiteli grape must, lysed yeast biomass, and the resulting wine material. Gas chromatography analysis demonstrated that fermentation in experimental wines was more complete compared to control samples.

Keywords: yeast, lysed biomass,

grape must, aromatic compounds, alcoholic fermentation.

Introduction

The aromatic complexity and sensory quality of wine are significantly influenced by the metabolic activity of yeasts during alcoholic fermentation. Beyond ethanol and carbon dioxide production, yeast metabolism leads to the formation of a wide range of volatile compounds, including esters, higher alcohols, aldehydes, and volatile acids, which are essential for the organoleptic profile of wine. Recent technological developments have highlighted the role of yeast derivatives, such as inactive dry yeast and lysed yeast biomass, in modulating fermentation kinetics and enhancing aroma compound retention.

Lysed yeast biomass contains a range of biologically active components, including amino acids, peptides, nucleotides, polysaccharides (notably mannoproteins), and enzymes. These compounds can act as nutrients for fermenting yeast cells, improve fermentation performance, and interact with aroma precursors to reduce their volatilization or degradation. This strategy is increasingly being explored to improve wine quality, especially in grape varieties sensitive to aromatic loss during fermentation. In this study, we investigate how the addition of lysed yeast biomass affects fermentation efficiency and the aromatic profile of wine produced from Rkatsiteli grapes.

Aim of the Study

The objective of this study was to investigate the influence of enzymatically lysed wine yeast biomass on the physiological performance of pure yeast cultures and to determine the optimal biomass dosage for preserving grape varietal aromatic compounds.

Specifically, the research aimed to explore how lysed yeast biomass—rich in amino acids, peptides, mannoproteins, and enzymes—could stimulate the metabolic activity of Saccharomyces cerevisiae during alcoholic fermentation. The study also sought to assess whether the addition of this biomass could enhance the retention and expression of grape-derived aroma compounds, particularly esters, aldehydes, and higher alcohols, which are known to be critical for the sensory quality of wine.

By applying varying concentrations of lysed yeast biomass to Rkatsiteli grape must and comparing fermentation kinetics, chemical composition, and sensory attributes with a control group, this study attempted to establish both the technological and organoleptic advantages of using yeast derivatives as fermentation adjuvants. The results of this work are expected to contribute to the development of more efficient and aroma-preserving winemaking practices, especially for grape varieties with delicate aromatic profiles. the influence of enzymatically lysed wine yeast biomass on the physiological performance of pure yeast cultures and to determine the optimal biomass dosage for preserving grape varietal aromatic compounds.

Materials and Methods

The study was carried out using must from Rkatsiteli grapes harvested at optimal technological maturity from the Kakheti region of Georgia. The grape must was clarified and divided into two main groups: a control sample and an experimental group.

The experimental group was further subdivided into six treatment subgroups, each receiving a different concentration (0.25%, 0.5%, 0.75%, 1.0%, 1.25%, and 1.5%) of enzymatically lysed wine yeast biomass prior to the initiation of fermentation. The lysed yeast biomass was prepared from a commercial Saccharomyces cerevisiae strain via enzymatic hydrolysis, followed by thermal inactivation and freeze-drying. The composition of the biomass was characterized by its protein and mannoprotein content.

All samples were inoculated with the same strain of active dry wine yeast (S. cerevisiae) at a standard dosage. Fermentation was conducted at 18–20°C in stainless steel fermenters. Fermentation kinetics were monitored daily by measuring the decrease in sugar concentration and temperature.

Upon completion of alcoholic fermentation, the following analyses were conducted:

Measurement of residual sugar, alcohol content, volatile acidity, total nitrogen, and aldehyde levels by standard OIV methods;

Sensory evaluation performed by a panel of five trained enologists, using a 20-point scale;

Gas chromatography analysis for volatile aroma compounds, including esters, higher alcohols, aldehydes, and acetals. Chromatographic conditions were standardized using a flame ionization detector (FID) and DB-WAX column.

Each experimental and control sample was analyzed in triplicate to ensure the reliability and reproducibility of the results.

Results and Discussion

The results of the study clearly demonstrated the positive impact of enzymatically lysed wine yeast biomass on the alcoholic fermentation process and the resulting wine quality. The optimal dosage of lysed biomass was determined to be 1 g/L, based on fermentation kinetics, chemical composition, and sensory evaluation. Wines fermented with this dosage showed significantly improved parameters compared to the control.

Fermentation was completed five days earlier in the test samples compared to the controls, indicating enhanced yeast metabolic activity. The diagrams below provide a visual comparison of fermentation dynamics and major chemical attributes between control and experimental wines.

Figure 1. Fermentation Duration by Sample

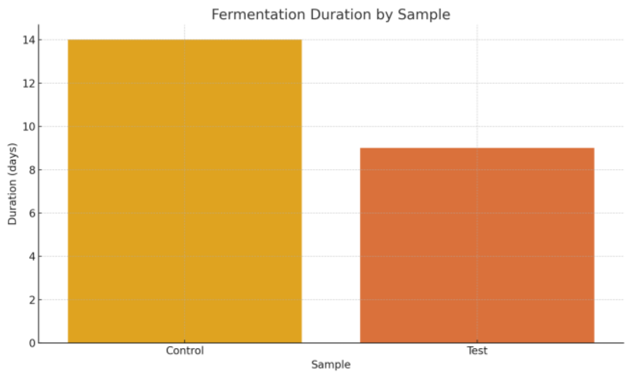
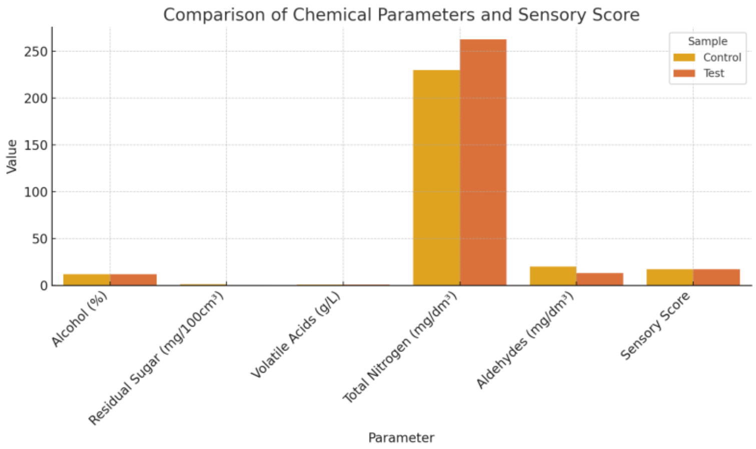


Figure 2. Comparison of Chemical Parameters and Sensory Score

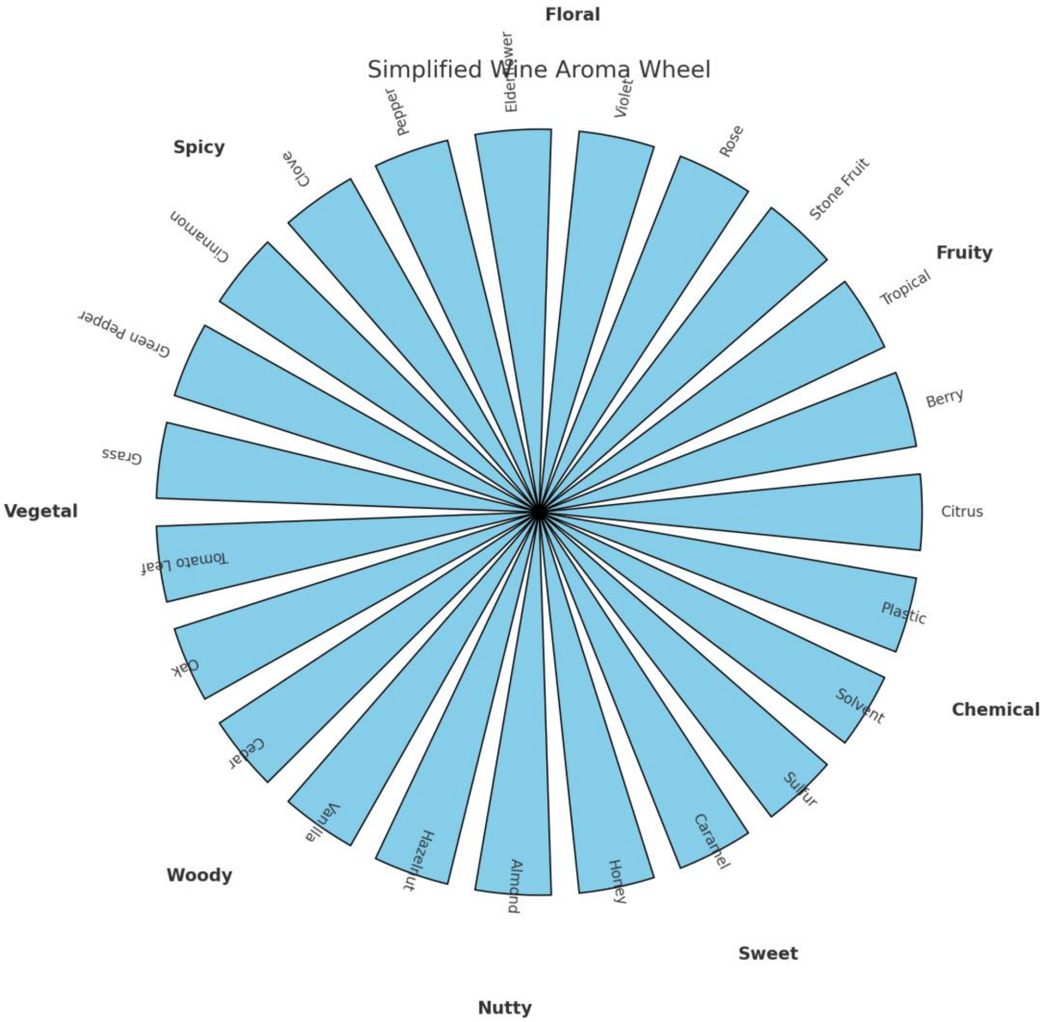


As illustrated, the experimental wine exhibited increased fermentation efficiency, evidenced by 0.7 mg/100 cm^3 higher sugar consumption and a corresponding 0.15% increase in alcohol content. Additional benefits included a 33 mg/dm^3 rise in total nitrogen, a 7 mg/dm^3 decrease in aldehydes, and reduced volatile acidity. These modifications translated into a 0.15-point improvement in the sensory evaluation.

The vigorous fermentation in the test samples, without alcohol loss, suggests a stimulatory effect of lysed yeast enzymes on yeast metabolism. The enriched medium, containing peptides, amino acids, and mannoproteins, likely facilitated yeast growth and enzymatic activity, accelerating sugar conversion while maintaining balance in redox potential and minimizing oxidative degradation.

Further investigation focused on aroma-related compounds. Gas chromatography analysis revealed that the test wines had significantly elevated concentrations of aldehydes and volatile acetals—approximately 1.5 times higher than those in the control. These compounds contribute to enhanced aromatic complexity. The experimental wines also contained higher levels of glycerol and 2,3-butylene glycol, known to improve texture and mouthfeel.

Figure 3. Simplified Wine Aroma Wheel



The test wines exhibited significantly higher levels of aldehydes and volatile acetals—approximately 1.5 times more than the controls. These compounds are known to enhance wine aroma and complexity. Additionally, the experimental wines showed increased levels of glycerol and 2,3-butylene glycol, contributing to a smoother mouthfeel.

These findings are consistent with previous studies showing that yeast derivatives can influence wine aroma by providing additional precursors and stabilizing volatile compounds (Pozo-Bayón et al., 2009; Pinheiro et al., 2025). The presence of mannoproteins from lysed biomass likely contributed to the improved mouthfeel and colloidal stability, while amino acids and peptides enhanced the formation of aromatic esters via yeast metabolism.

It is also notable that the use of lysed biomass reduced aldehyde content, which can be associated with oxidation and undesirable aroma notes. This suggests an additional antioxidant or redox-buffering role for the yeast derivatives. In line with work by the Oeno-One Research Group (2023), the re-utilization of wine yeast lees as nutrient sources has clear potential not only for improving wine quality but also for contributing to more sustainable winemaking practices. In conclusion, the results support the hypothesis that lysed yeast biomass acts both as a nutritional supplement and as a modulator of aroma compound formation and retention. Future research may focus on evaluating the long-term stability of these wines during bottle aging and exploring the application of lysed yeast derivatives in different grape varieties and wine styles.

Conclusions

- The addition of lysed wine yeast biomass during alcoholic fermentation enhances yeast activity, shortens fermentation time, and improves wine quality.
- A novel protocol for the preparation and application of enzymatically lysed yeast lees has been developed and tested.
- Wines produced using this method from Rkatsiteli grapes showed superior aromatic profiles and sensory ratings.

References

1. Moyano-Gracia, R., Vila-Crespo, J., Ruipérez, V., Rodríguez-Nogales, J. M., & Fernández-Fernández, E. (2023). Effect of yeast derivatives and β-glucanases on ageing over lees process of Tempranillo red sparkling wine. Fermentation, 9(12), 1012. https://doi.org/10.3390/fermentation9121012
2. Pozo-Bayón, M. A., Andújar-Ortiz, I., & Moreno-Arribas, M. V. (2009). Effect of yeast derivative products on aroma-compound retention in wine. Food Research International, 42(7), 754–761.
3. Pinheiro, S. S., Campos, F., Cabrita, M. J., & Silva, M. G. D. (2025). Exploring the aroma profile of traditional sparkling wines: A review on yeast selection in second fermentation, aging, closures, and analytical strategies. Molecules, 30(13), 2825. https://doi.org/10.3390/molecules30132825
4. Castillo, F., et al. (2021). Impact of industrial yeast derivative products on the modification of fermentative aroma in wine. Food Chemistry, Article ID pending.
5. Oeno-One Research Group. (2023). Enhancing fermentation performance through reutilisation of wine yeast lees as nutrient supplement. Oeno-One, Volume(Issue), Pages.
6. Álvarez-Rodríguez, V., et al. (2020). Microbial contribution to wine aroma and its intended use for wine quality improvement. Microorganisms, 8(9), Article ID.
7. Moyano-Gracia, R., Vila-Crespo, J., Ruipérez, V., Rodríguez-Nogales, J. M., & Fernández-Fernández, E. (2023). Fermentation of Tempranillo red sparkling wine with yeast derivatives and β-glucanases. Fermentation, 9(12), 1012.