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Application of Turbiscan Lab® to study the mechanism of red wine fining with a specific yeast protein extract

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Wine fining with proteins is a key winemaking process for clarifying, stabilising, and improving wine sensory quality. Here, the fining mechanism of a specific yeast protein extract (YPE) was studied. The specific YPE preserves wine structure through a more moderate tannin precipitation compared to gelatine. This work revealed the unique ability of the specific YPE to trap particles and promote wine clarification, even in the absence of tannins in the medium, enabling effective fining of red wines, as well as of low tannin content matrices such as rosé and white wines.

Context

Wine clarification using proteins to enhance wine clarity, stability, and sensory quality[1 2 3] is common in oenology. Gelatine is widely used, but demand for non-animal products has led to alternatives being sought, like yeast protein extracts (YPE), which were approved by the OIV in 2012. It has been shown that YPE interacts with tannins, promoting aggregation and precipitation[4], but the mechanisms that promote the clarification of suspended particles remain under-explored. This study evaluated a specific YPE's ability to interact with polyphenols and particles for clarification. Interactions with YPE and gelatine were compared using static multiple light scattering (SMLS) with the Turbiscan Lab® apparatus. The Turbiscan Lab® offers a more precise evaluation of aggregation phenomena by scanning the entire sample height and measuring scattered light at two angles (0° and 135°), unlike conventional turbidity measurements. Particle interactions were also studied microscopically, and the impact on polyphenols was assessed using spectrophotometry and the BSA test for astringency.

Experimental design

The specific YPE (Finely™) was derived from *Saccharomyces cerevisiae*, produced industrially and spray-dried. The gelatine was a liquid product (100 g/L) derived from pork (Inocolle™), provided by IOC (Epernay). A Portan red wine (turbidity 3159 NTU) was produced at INRAE Pech Rouge, Gruissan, and underwent two centrifugation steps: 1,000 g (3 min, 15 °C) to remove large particles, and 8,000 g (15 min, 15 °C) to isolate small particles for fining studies.

In the experiments, crude wine and particles were suspended in model wine with 10 g/hL YPE or gelatine. Samples were analysed using the Turbiscan Lab® at 25 °C to monitor aggregation and sedimentation.

After analysis, the samples were centrifuged (15,000 g, 15 min), and the Total Polyphenol Index (TPI, 280 nm) and Total Red Pigments Index (TRPI, 520 nm) were determined by spectrophotometry. The influence of tannins and pigments on astringency was assessed via a bovine serum albumin (BSA) precipitation assay. Microscope observations of particles with or without fining agents in the model wine were conducted after 1 h of stirring for any interactions.

Impact on wine clarification

The impact of YPE and gelatine on red wine clarification was assessed (Figure 1) by comparing the Transmission (T) and backscattering (BS) spectra of wine, treated or not with fining agents. They showed three distinct tube regions: bottom (1–4 mm), middle (5–37 mm) and top (38–48 mm). In untreated wine, initial T was near 0 % (opaque, 3159 NTU). Over 7 h, the sedimentation increased the BS at the bottom, while T gradually increased in the middle and at the top, showing natural clarification.

Both YPE and gelatine enhanced clarification. In the middle and top zones, T (%) increased to 50 % and 60 % respectively, with particle aggregation visible in the form of distorted curves (Figure 1). BS (%) increased at the bottom, indicating sediment formation. Destabilisation kinetics, measured by turbiscan stability index (TSI), revealed faster aggregation with gelatine (TSI ≈ 55 within 7 h); however, both fining products exhibited similar performance in terms of clarification (mean value delta transmission) and lees density (BS %) after 7 h. Lees height (peak thickness) after 7 h did not exceed 6 % of total wine height in the flask for both fining agents. The denser the lees, the more tightly they were packed, allowing wine racking to be more efficient with minimal wine volume loss.

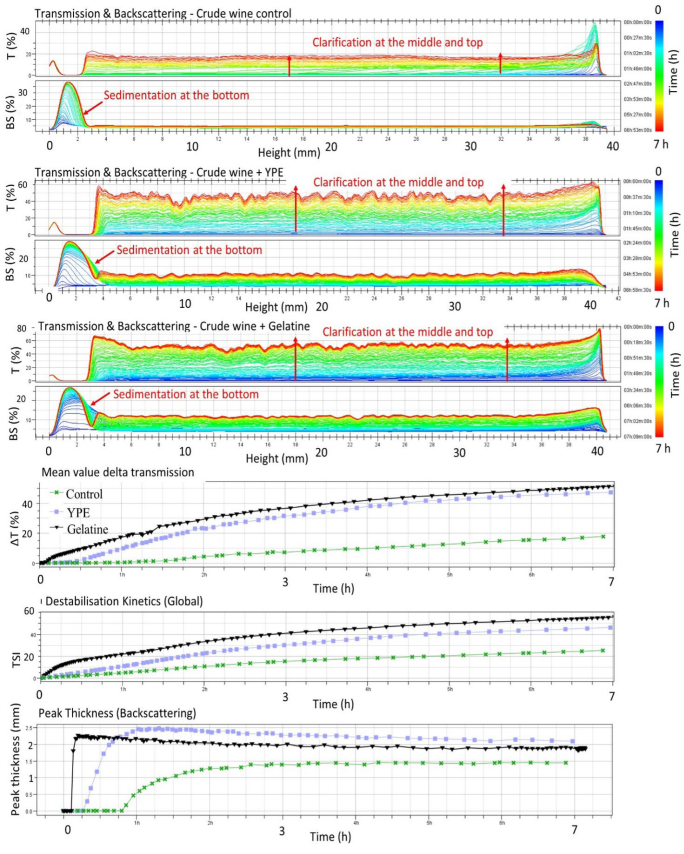


FIGURE 1. Raw data of wine clarification. Transmission (%T) and back scattering (BS %) spectra across the samples.

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Impact on wine colour and astringency

TPI decreased by 12.3 % and 13.3 %, while TRPI dropped by 16.8 % and 19.6 % for YPE and gelatine respectively, indicating less pigment precipitation with YPE (Figure 2). Tannin precipitation, estimated via BSA assay, showed moderate removal of tannins with YPE (25 % for DA 280 and 26 % for DA 520) compared to gelatine (42 % and 40 %). The moderate impact of the YPE is likely to have modulated astringency while preserving wine colour and structure. These findings are consistent with those of other studies in which similar clarification of YPE and gelatine after a couple of hours was found, but with a strong removal of wine colour and tannins with gelatine[5 6].

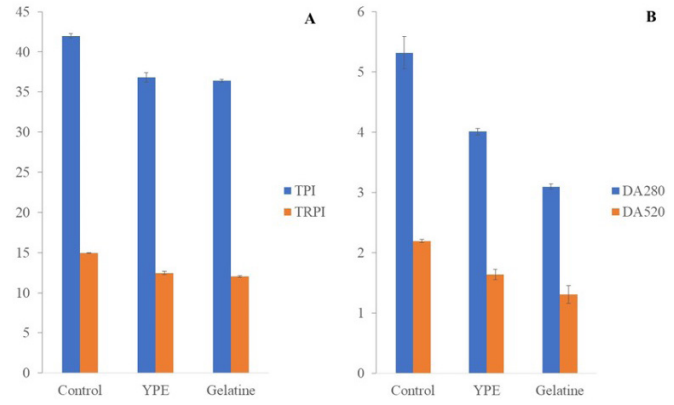


FIGURE 2. Total polyphenol (TPI) and total red pigment (TRPI) (A), tannins (DA 280) and pigments (DA 520) precipitable with BSA (B).

Direct interactions of fining agents with particles

It is also important to consider the potential for fining agents to interact directly with wine particles to promote clarification. In this study, we therefore fractionated the wine to separate the particles from the liquid phase in order to evaluate the protein-particle interactions. The results showed massive aggregation of YPE with the small particles, leading to their sedimentation (Figure 3). This was not the case for gelatine, for which no aggregation or precipitation was observed with optical microscopy (Figure 3). The self-aggregation of YPE in a synthetic wine medium (no aggregation with gelatine) would explain this behaviour with particles. This self-aggregation in the presence of particles led to an encapsulation (trapping) of the latter in a network that grows in sediment. This property of trapping particles in the absence of polyphenols is of great importance for the clarification of matrices that are poor in tannins, such as white and rosé wines. Indeed, in these matrices, the combination of oenological tannins with protein fining agents is often necessary to ensure effective clarification.

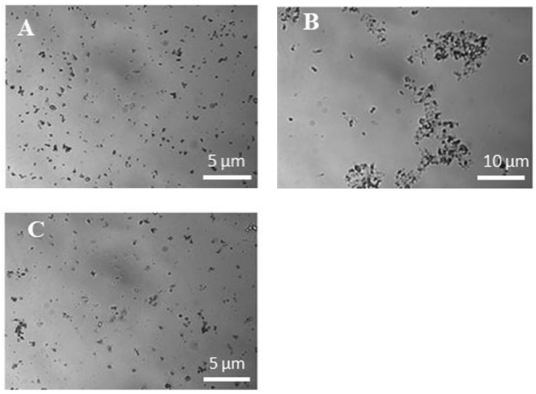


FIGURE 3. Microscope images (objective 40X) of small particles in model wine not treated (A) and treated with YPE (B) and with gelatine (C).

Conclusion

This study investigated the fining mechanisms of a specific YPE, focusing on interactions with polyphenols and suspended particles. Using the Turbiscan Lab®, aggregation and sedimentation kinetics were monitored. Compared to gelatine, YPE showed similar clarification efficiency but different interactions. Both agents promoted aggregation with tannins and sedimentation, modifying wine colour and astringency. Gelatine acted more quickly and removed more tannins and pigments, which reduced astringency but affected colour stability. YPE achieved comparable clarification with moderate polyphenol impact, preserving colour and structure. Unlike gelatine, YPE trapped particles, even without tannins, thus enhancing sedimentation. These properties indicate that the specific YPE studied in this work is a versatile alternative for use in red, rosé and white wine fining.

The specific YPE is commercially available. ■

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