

INTRODUCTION

The pursuit of sustainable, allergen-free solutions in winemaking has increased interest in plant-based fining agents.

Traditionally, clarification relied on animal proteins such as casein and albumin, but regulatory constraints and consumer demand are driving a shift toward alternatives.

Pea (*Pisum sativum*) and potato (*Solanum tuberosum*) proteins have shown strong enological potential, offering clarification, oxidation and astringency reduction, and improved colloidal stability. Unlike animal proteins, they are only partially soluble, with both soluble and suspended fractions contributing to reactivity.

Process variables (pH, temperature), hydrolysis degree, and dosage affect their behavior. Pea proteins, rich in globulins (legumin, vicilin), are effective against oxidation and iron. Potato proteins strongly bind tannins, reducing astringency. This study presents data on their molecular behavior and performance in wine, supporting their role in sustainable, quality production.

MATERIALS AND METHODS

Plant Proteins:

Commercial pea and potato isolates produced through dry milling, liquid-phase extraction, and isoelectric precipitation.

Samples Used:

White wines
(Trebbianco, Sauvignon Blanc, Zibibbo, Verdicchio, Gewürztraminer)

Red wines
(Sagrantino, Nebbiolo, Sangiovese)

Dosages:

10 g/hL for clarification trials;
5 g/hL for flotation.

Analyses Performed:

- Protein solubility across pH range
- SDS-PAGE to profile protein fragments
- Clarification effectiveness (turbidity/NTU)
- Oxidative stability (OD at 420 nm, iron reduction)
- Astringency reduction (sensory panel scoring)
- Heat test (Δ NTU) for protein/colloid stability
- GC for aromatic compound retention
- Sensory analysis for aroma intensity, cleanliness, and pleasantness

RESULTS AND INTERPRETATION

CLARIFICATION CAPACITY

Graph 1 - Turbidity values 48 h after adding the products. Carried out on white wine (Trebbianco, pH 3.22) and red wine (Sagrantino, pH 3.45).

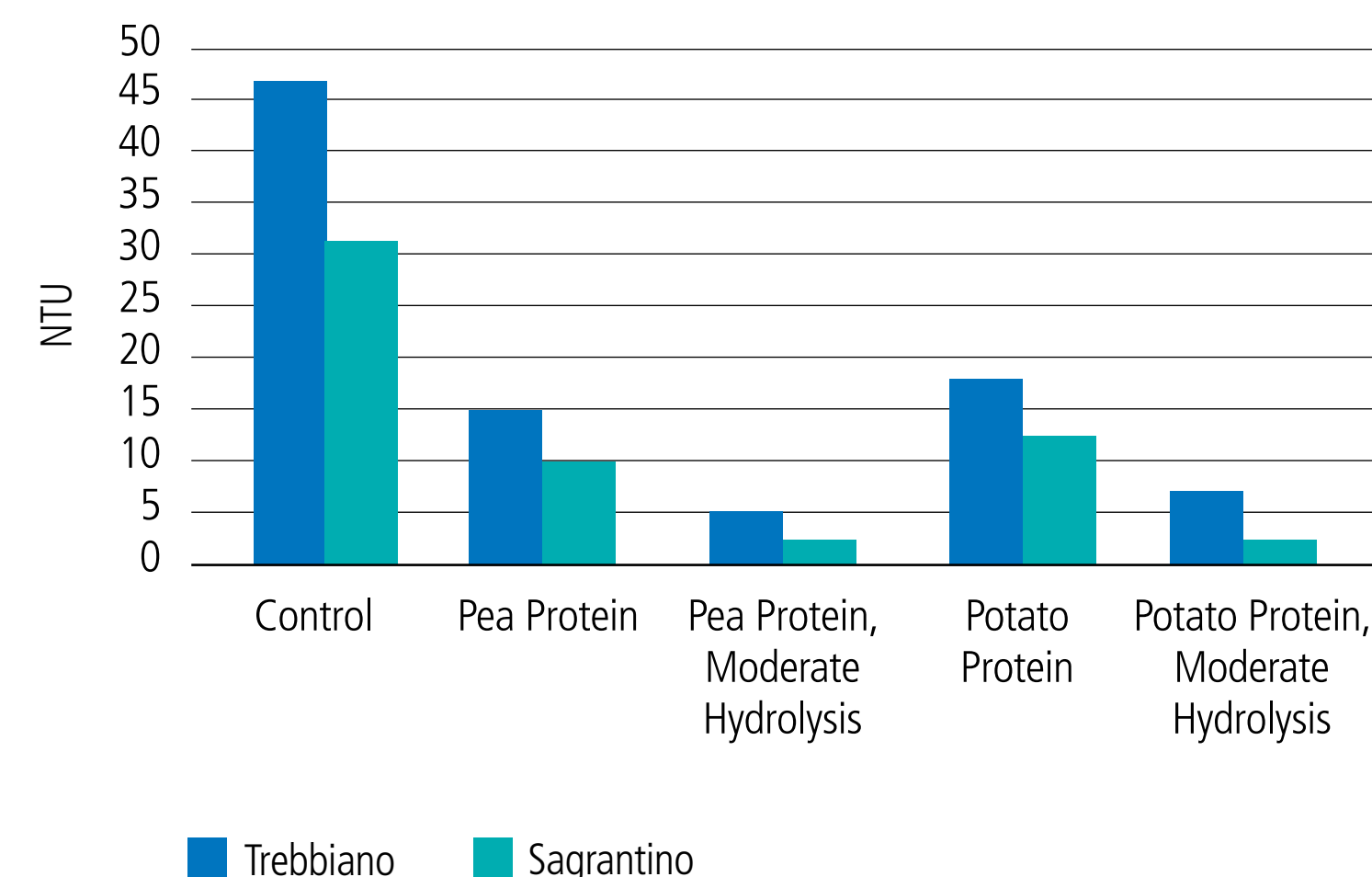
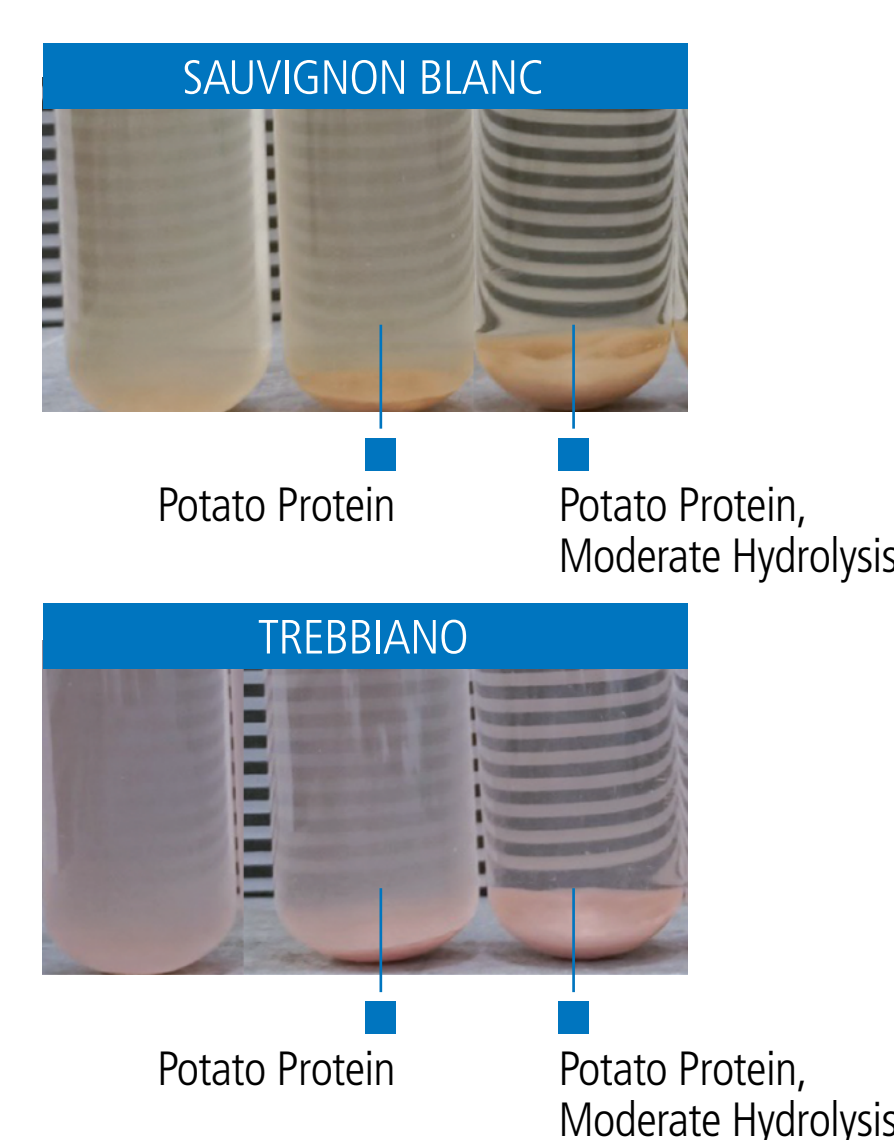
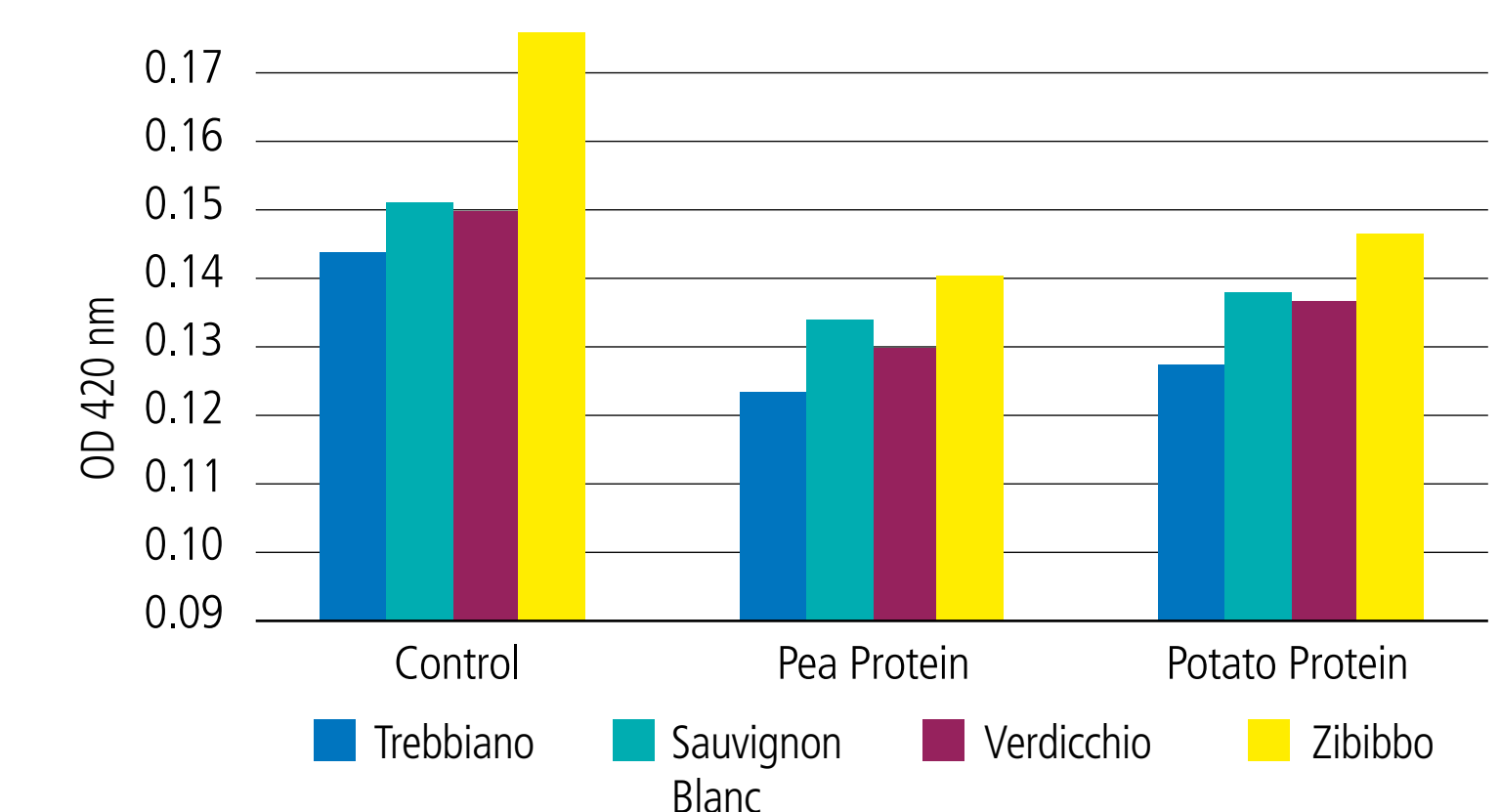


Fig. 1 - Clarification tests. Turbidity 48 h after addition to Sauvignon Blanc wine with pH 3.30 and Trebbianco wine with pH 3.22.

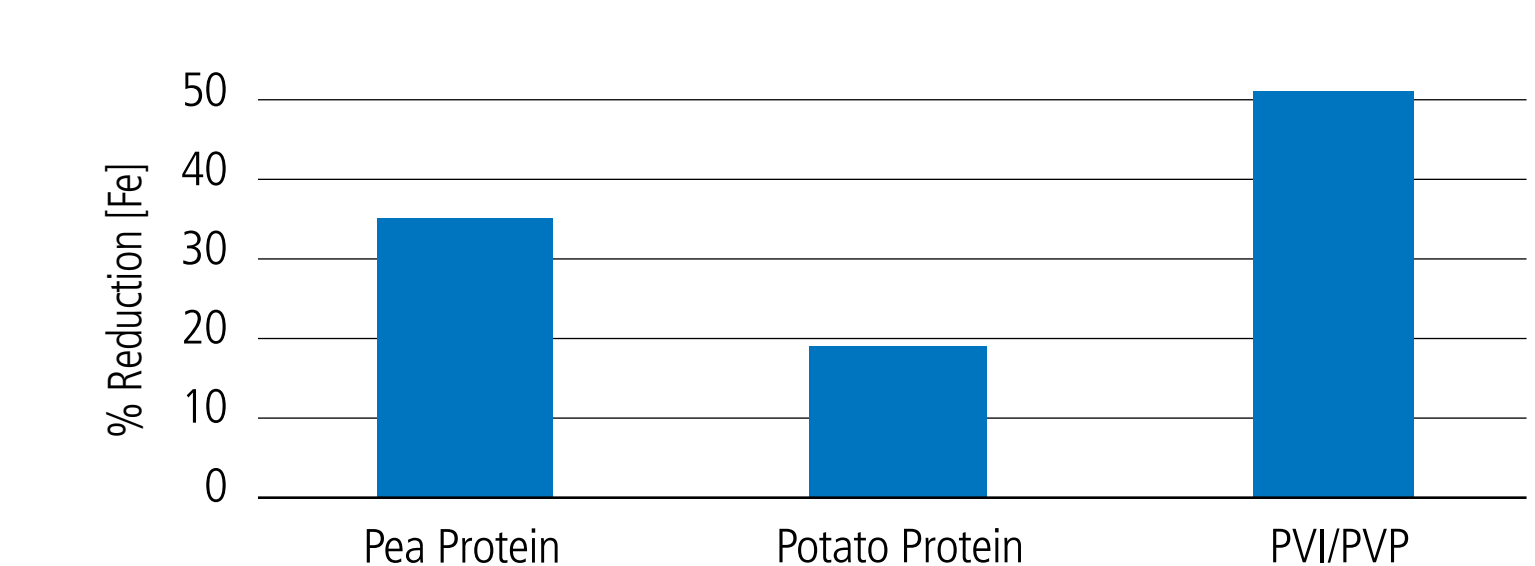


OXIDATION MANAGEMENT

Graph 2 - Average optical density reading at 420 nm after clarification with plant-based proteins. Results show that pea proteins reduce browning (OD 420 nm) better than other agents.

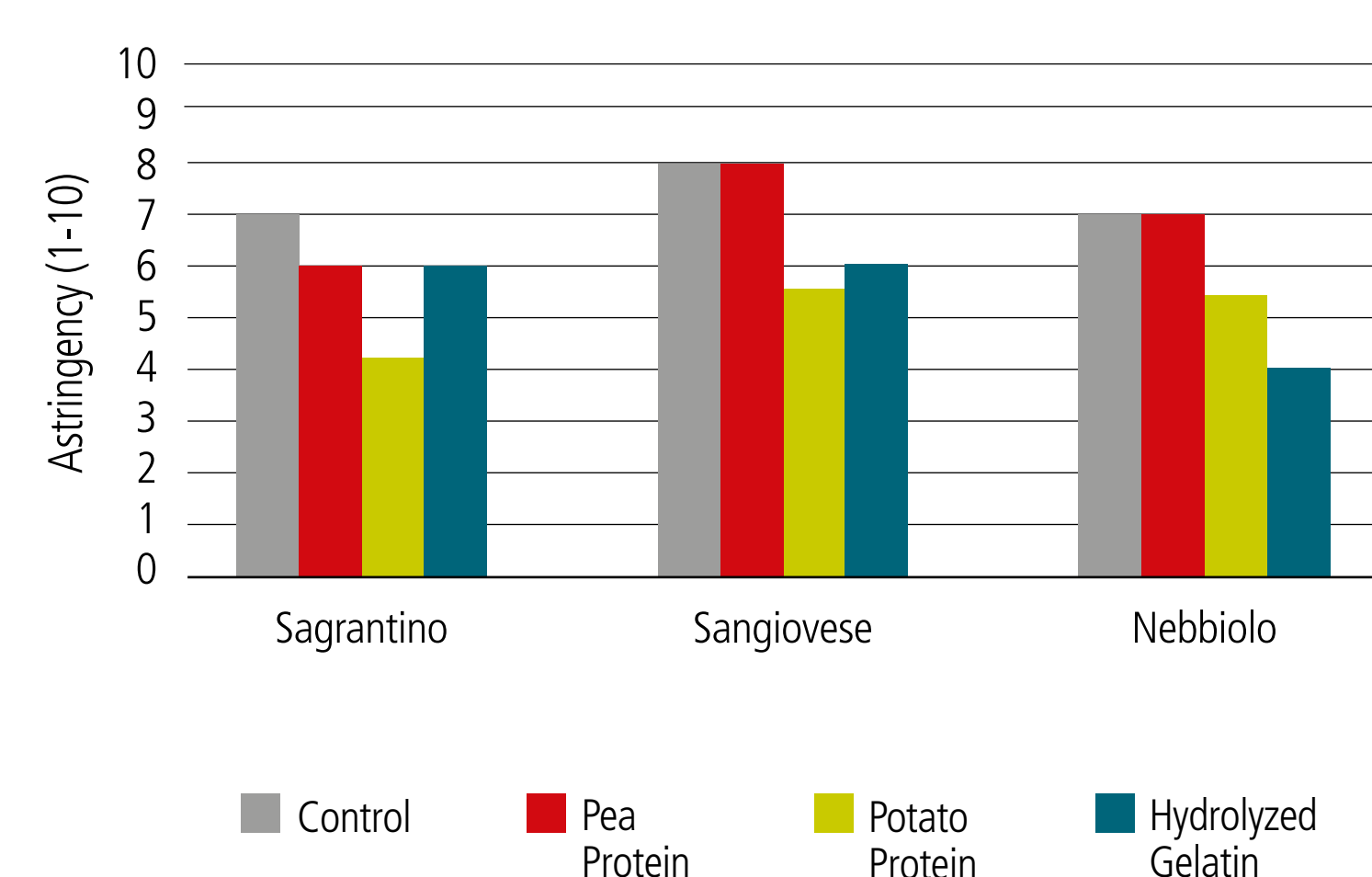


Graph 3 - Average % reduction in iron concentration obtained by clarification of different types of wines with plant-based proteins. Results show that pea proteins reduce iron concentration better than other agents, and it is comparable or superior to agents such as PVI/PVP.



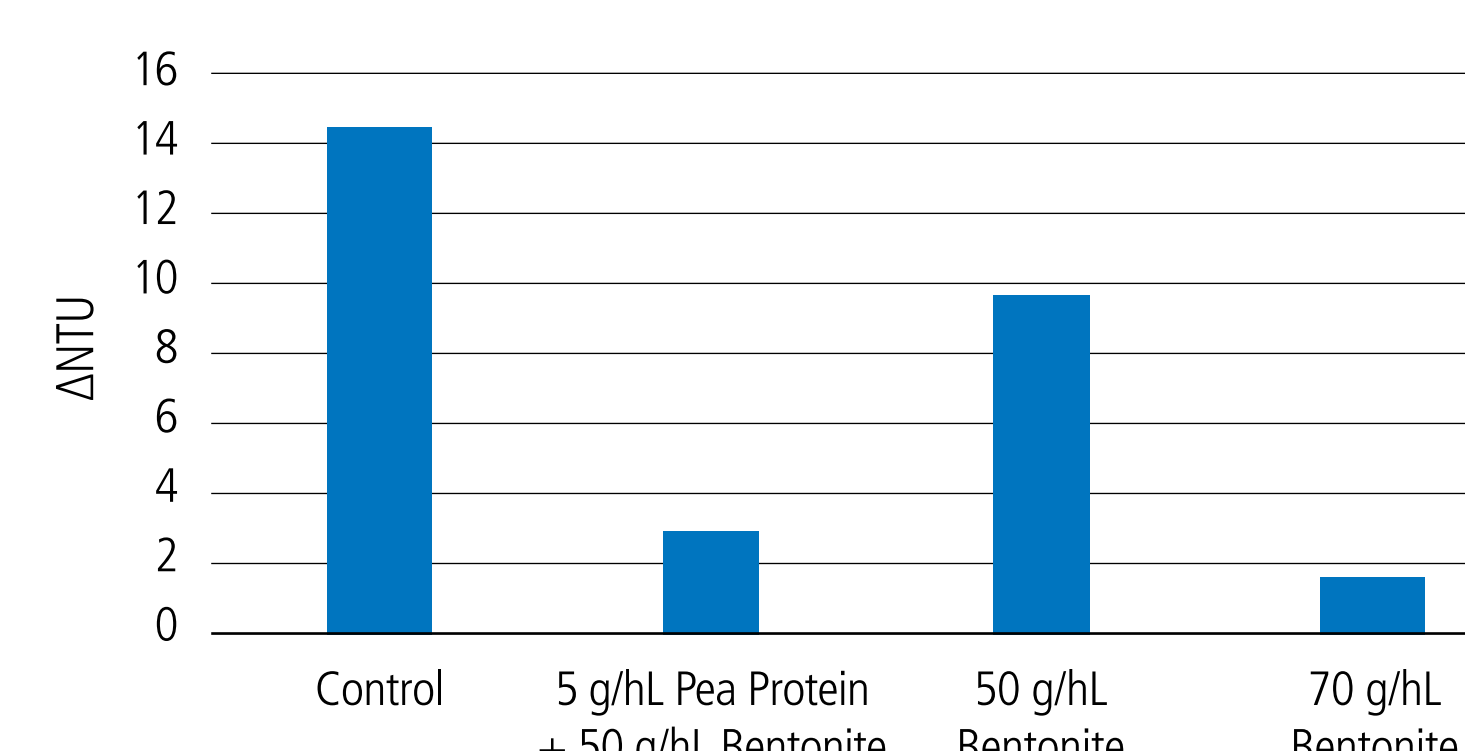
ASTRINGENCY REDUCTION

Graph 4 - Astringency values of wines clarified with plant-based proteins and hydrolyzed gelatin. The results show that potato proteins are more reactive with tannins.



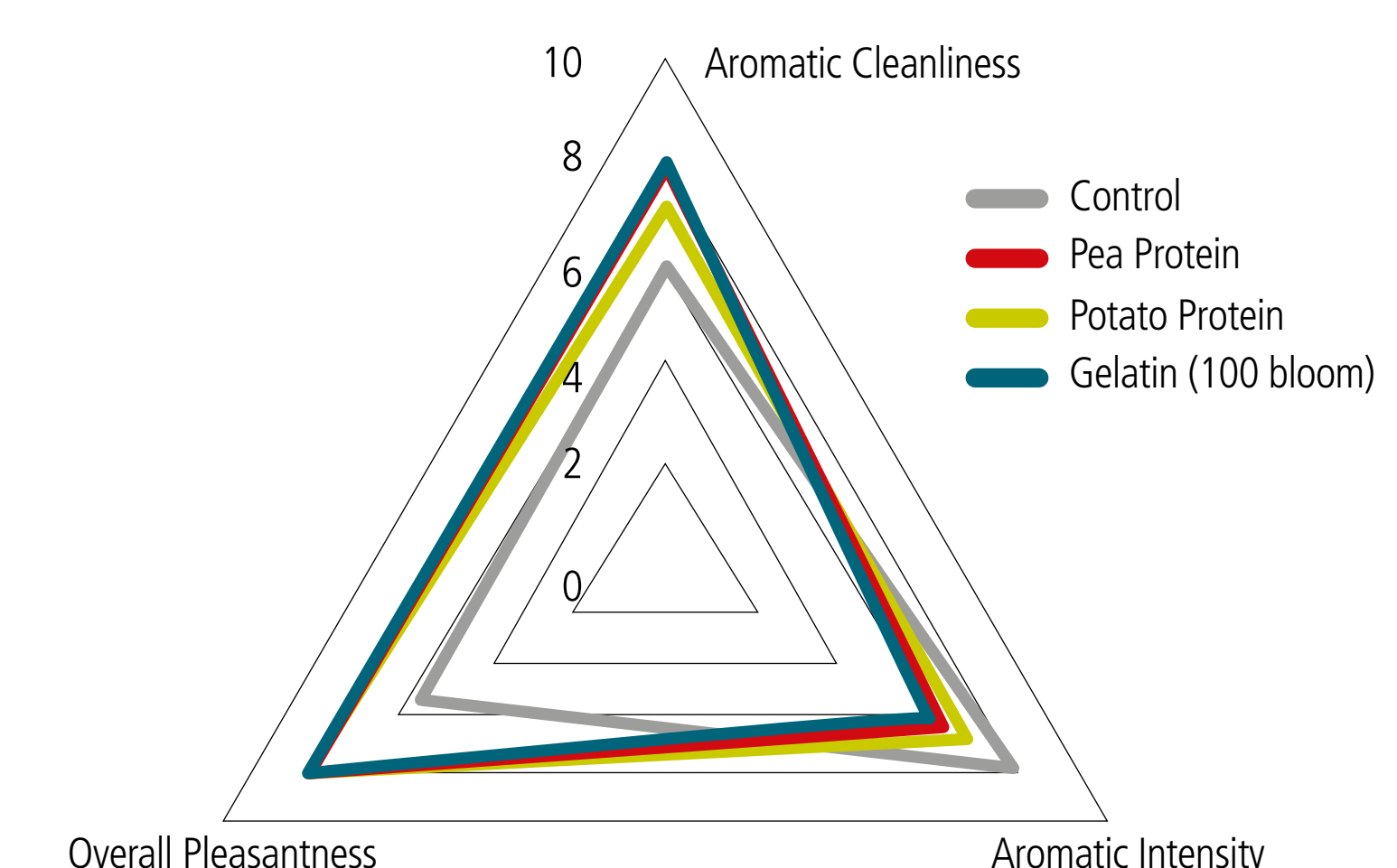
COLLOIDAL STABILITY

Graph 5 - Heat test Δ NTU values (30 min at 80°C) on Gewürztraminer wine. Wines treated with plant proteins showed reduced Δ NTU in heat tests, showing stabilization with less bentonite.



SENSORY EVALUATION

Graph 6 - Average tasting scores of Nebbiolo wine treated with various plant-based proteins, with gelatin included for comparison. No significant loss of aromatic compounds detected. Wines clarified with plant proteins were generally perceived as cleaner and more pleasant.



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CONCLUSIONS

Pea and potato proteins are proven to be more effective, sustainable alternatives to traditional animal-based fining agents. Their enological behaviors differ: pea proteins enhance oxidative stability, while potato proteins effectively reduce astringency. Both exhibit strong clarification potential, especially when hydrolyzed to increase surface reactivity. Experimental trials confirmed their ability to preserve aromatic profiles and enhance sensory quality when used at optimal dosages. Additionally, their impact on colloidal stability suggests value in protein stabilizing wines with decreased bentonite requirements. These findings underscore the technological relevance of plant-based proteins and support their adoption as strategic tools in modern, sustainable winemaking, aligned with both regulatory standards and consumer expectations.