VOLATILE COMPOSITION OF RED BASE SPARKLING WINE: EFFECT OF AGEING ON ULTRASOUND-TREATED LEES

Raúl Moyano[1,*], Coro Blanco Huerta[2], Encarnación Fernández Fernández[2], Josefina Vila Crespo[1], Violeta Ruipérez Prádanos[1], José M. Rodríguez Nogales[2]

[1] Área de Microbiología, ETS de Ingenierías Agrarias, Universidad de Valladolid. Avda. Madrid 50, 34004 Palencia, España..
[2] Dpto. Ingeniería Agrícola y Forestal, Área de Tecnología de Alimentos. Universidad de Valladolid, Campus de Palencia. ETS de Ingenierías Agrarias. Avda. Madrid 50, 34004 Palencia, España
*e-mail: raul.moyano@uva.es

Abstract

Ageing on lees can be a good technique to enhance the quality of red sparkling base wines. Ultrasound treatment of the lees, prior to addition to the wine, can improve the releasing of their components into the wine. This study carries out a four-month ageing on lees of a red sparkling base wine by the addition of ultrasound-treated yeasts at different amplitude levels (30%, 60% and 90% for 10 min) and heat-treated yeasts. Sonicated lees at an amplitude of 90% enhanced the concentration of some volatile compounds in the wine, mainly acetates, esters and terpenes with floral and fruity aromatic notes. This trend was also found for some fused alcohols, contributing to the aromatic complexity of wines, as well as for 2-phenylethanol, an alcohol with a rose-like aroma, and also for C6-alcohols with a green-herbaceous aroma.

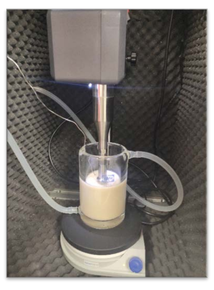
Introduction

Base wines for high quality sparkling red wines must have a moderate alcoholic strength and an optimum level of acidity and pH. To this purpose, base wines must be elaborated with grapes harvested before reaching their optimum phenolic and aromatic ripeness. These wines show astringent, bitter and green notes, as well as a deficient structure in the mouth.

Ageing on lees can be an appropriate technique to improve these wines. One of the strategies that can be used to enhance this process is the treatment of the lees with ultrasounds before the ageing on lees. The **aim** of this work was to study the effect of ageing on lees with ultrasound-treated and heat-treated yeasts on the volatile composition of red base sparkling wine.

Materials and methods

Preparation of Lees of Yeasts by Ultrasound (US)



- UP4005 US processor (400 W, 24 Khz).
- 30 %, 60 % and 90 % of amplitude (10 min).
- 0.8 g/L of yeast (*Saccharomyces cerevisiae,* Lalvin EC1118, Lallemand).

Preparation of Lees of Yeasts by Heat Treatment

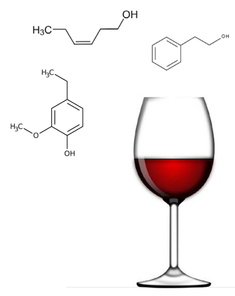
- Thermal treatment (0.8 g/L of yeast, 30 °C, 100 rpm, 64 h).
- *S. cerevisiae* (Lalvin EC1118, Lallemand).
- Centrifugation (4000 rpm, 15 min).

Ageing on Lees of Red Base Wine

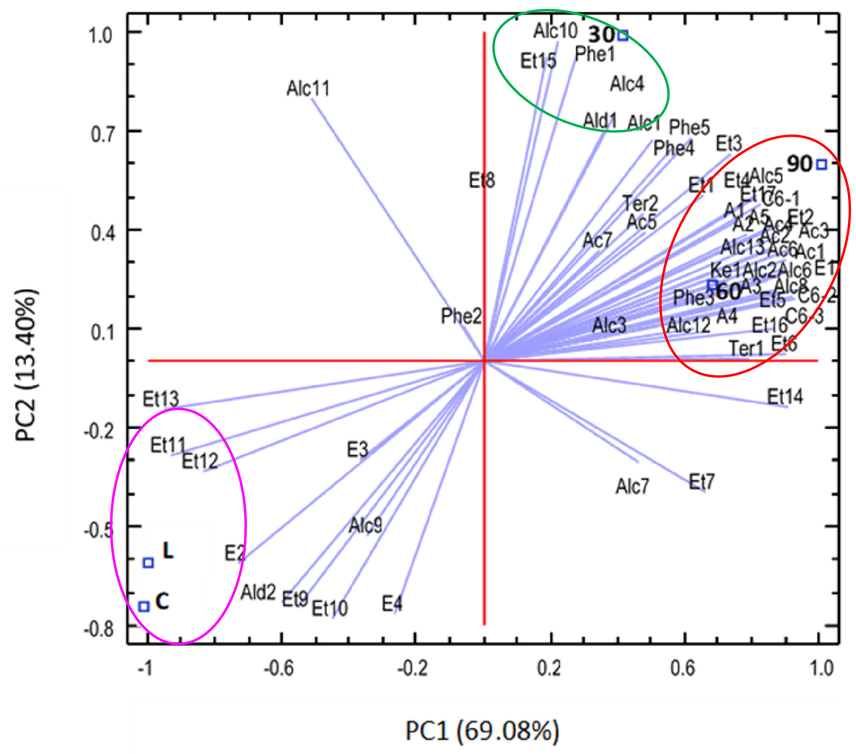
Samples	Codes
Control wine without lees	C
Wine with heat-treated lees	L
Wines with ultrasound-treated lees at 30%, 60%, and 90% of amplitude	30, 60 and 90

- Tempranillo red base wine (2021 vintage).
- 20 L stainless steel tanks in duplicate.
- 0.8 g/L of dry lees.
- 4 months of ageing on lees.
- Stirring for 1 min, one time per week.

Quantification of Volatile Organic Compounds of Wine (HS-SPME-GC-MS)
Blanco et al., (2023)



Results



Code	Parameters
A1	Ethyl acetate
A2	3-methylbutyl acetate
A3	Hexyl acetate
A4	Ethyl 2-phenylacetate
A5	2-phenylethyl acetate
E1	Pentyl 2-hydroxypropanoate
E2	3-methylbutyl octanoate
E3	Methyl decanoate
E4	3-methylbutyl decanoate
Et1	Ethyl butanoate
Et2	Diethyl butanedioate
Et3	Ethyl 2-hydroxypropanoate
Et4	Ethyl 4-hydroxybutanoate
Et5	Ethyl hexanoate
Et6	Ethyl heptanoate
Et7	Ethyl octanoate
Et8	Ethyl nonanoate
Et9	Ethyl decanoate
Et10	Ethyl dodecanoate
Et11	Ethyl tetradecanoate
Et12	Ethyl pentadecanoate
Et13	Ethyl hexadecanoate
Et14	Ethyl (E)-hexadec-9-enoate
Et15	Ethyl octadecanoate
Et16	Ethyl benzoate
Et17	Ethyl furan-2-carboxylate
C6-1	Hexan-1-ol
C6-2	(E)-hex-3-en-1-ol
C6-3	(Z)-hex-3-en-1-ol
Alc1	Propan-1-ol
Alc2	2-methylpropan-1-ol
Alc3	3-methylsulfanylpropan-1-ol
Alc4	Butan-1-ol
Alc5	3-methylbutan-1-ol
Alc6	3-methylpentan-1-ol
Alc7	Heptan-1-ol
Alc8	Octan-1-ol
Alc9	Nonan-1-ol
Alc10	Decan-1-ol
Alc11	Dodecan-1-ol
Alc12	Phenylmethanol
Alc13	2-phenylethanol
Ac1	2-methylpropanoic acid
Ac2	Butanoic acid
Ac3	3-methylbutanoic acid
Ac4	Octanoic acid
Ac5	Nonanoic acid
Ac6	Hexanoic acid
Ac7	Decanoic acid
Ter1	3,7-dimethylocta-1,6-dien-3-ol
Ter2	3,7-dimethyloct-6-en-1-ol
Phe1	Phenol
Phe2	4-ethylphenol
Phe3	4-ethyl-2-methoxyphenol
Phe4	2,4-ditert-butylphenol
Phe5	1,1'-biphenyl
Ald1	Acetaldehyde
Ald2	Nonanal
Ke1	Octan-2-one

Figure 1, Principal component analysis of wines and volatile organic compounds. Symbols. C: control; L: heat-treated yeast; 30, 60, 90: ultrasound-treated at an amplitude level of 30%, 60%, and 90%, respectively.

- Similar volatile composition was found between the wine aged on heat-treated lees (L) and the control wine (C) (Figure 1).
- Wines aged with lees treated at 60% and 90% of amplitude (sample 60 and 90) showed high values for acetates, short-medium chain esters and terpenes with fruity and floral notes, and for C6-alcohols with herbaceous and vegetal notes.
- The treatment of the lees with ultrasound at the highest amplitude (90%) increased the concentration of some fused alcohols, such as 2-methylpropan-1-ol, 3-methylbutan-1-ol, 3-methylpentan-1-ol and octan-1-ol in wine, and for 2-phenylethanol with a rose-like aroma.
- Higher concentration of 2-methylpropanoic, butanoic, 3-methylbutanoic, octanoic and hexanoic acids was found in the wines aged on ultrasound-treated lees at an amplitude of 60% and 90%.

Conclusions

- The ageing on sonicated lees at the highest amplitude enhanced the concentration of most of the volatile compounds in the wine, mainly acetates, esters and terpenes with floral and fruity aromatic notes.
- The application of ultrasound-treated lees from *S. cerevisiae* during the ageing of the wines could be a promising alternative to enhance the aromatic quality of red sparkling base wines.
- Further research is needed to confirm these results, either using other red grape varieties or non-*Saccharomyces* yeast lees.

References

Blanco-Huerta, C.; Fernández-Fernández, E.; Vila-Crespo, J.; Ruipérez, V.; Moyano, R.; Rodríguez-Nogales, J.M. Impact of Ageing on Ultrasound-Treated Lees on Volatile Composition and Sensory Properties of Red Sparkling Base Wine. *Beverages* **2023**, *9*, 23. https://doi.org/10.3390/beverages9010023

Acknowledgments: We are very grateful to Isabel Navarro Hernández and Sara de Domingo García for their contribution to the analytical work of this study. We also thank PROCEREALtech Group of the University of Valladolid for the ultrasound equipment and Lallemand BIO S.L. for its donation of oenological products