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To What Extent Do Particle Film Applications on Grapes Affect Yeast Populations During Alcoholic Fermentation?

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1. Introduction

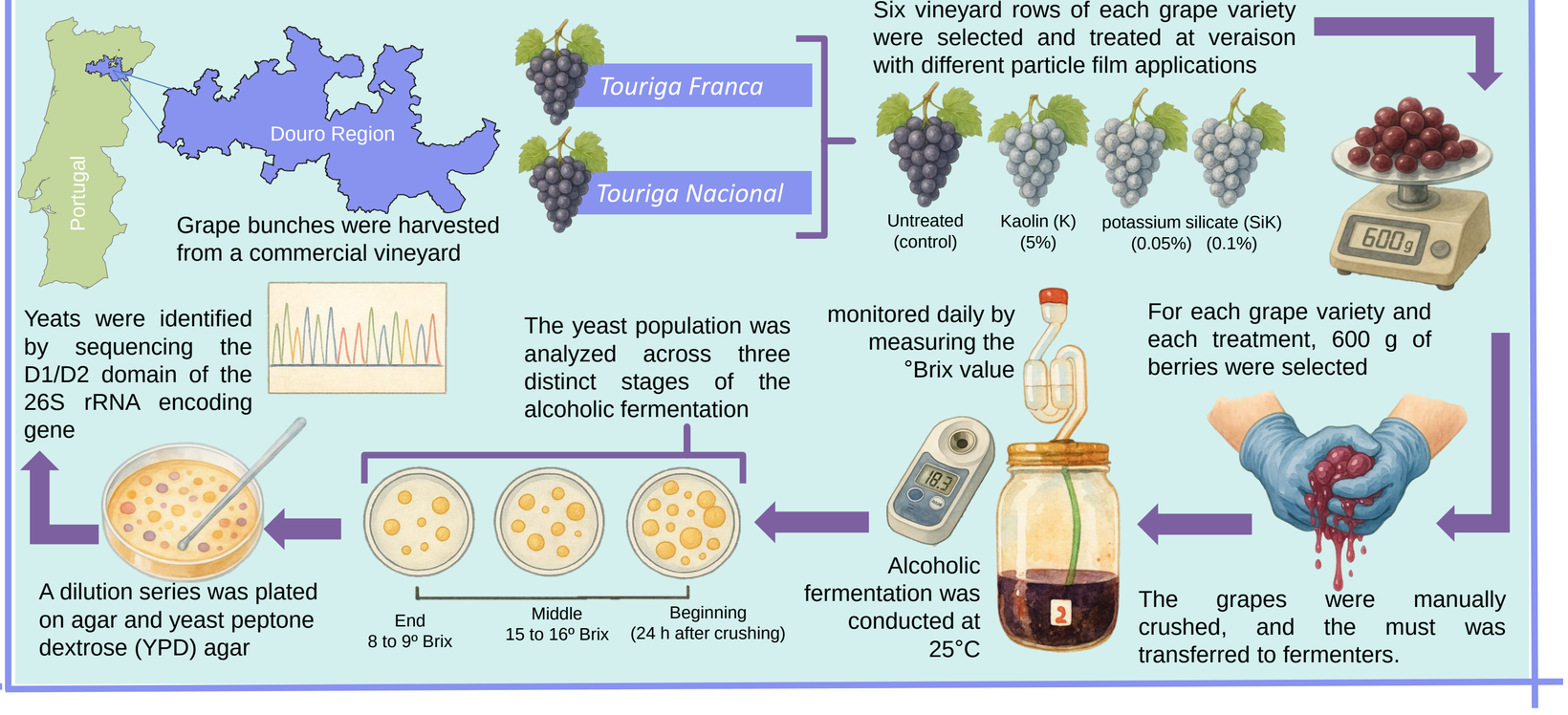
Particle films, such as **Kaolin** and **Potassium silicate**, have been widely studied in viticulture for their protective effects against biotic and abiotic stresses.

However, their impact on vineyard microbial communities, especially on **yeast populations** involved in **fermentation**, remains insufficiently explored

Objectives

This study investigates the extent to which pre-harvest applications of **kaolin** and **potassium silicate affect yeast community dynamics** during the **alcoholic fermentation** of grape musts from two Vitis vinifera varieties: **“Touriga Nacional”** and **“Touriga Franca”**

2. Materials and Methods



3. Results & Discussion

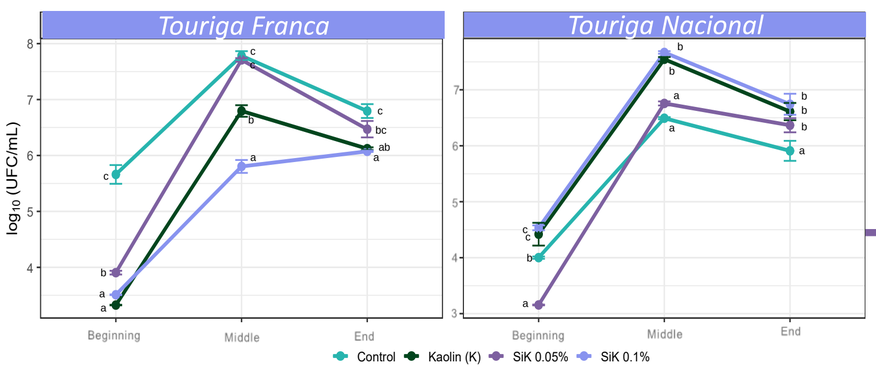


Fig. 1 Total abundance (mean ± SD) of yeast communities at different stages of alcoholic fermentation of Touriga Franca and Touriga Nacional musts, following pre-harvest applications of different treatments: control, kaolin (5%), and potassium silicate (SiK) at concentrations of 0.1% and 0.05%.

Table 1. Results of the Analysis of Variance (ANOVA) for the Generalized Linear Model (GLM), aiming to assess the main effects and interactions between the factors variety, treatment, and fermentation phase on the response variable.

	Sum Sq	Df	F value	p-value
(Intercept)	128.2	1	3041.1	< 0.0001
variety	5.5	1	130.7	< 0.0001
treatment	13.7	3	108.3	< 0.0001
fermentation phase	9.0	2	107.0	< 0.0001
variety:treatment	11.1	3	87.7	< 0.0001
variety:fermentation phase	0.6	2	7.1	< 0.0001
treatment:fermentation phase	6.9	6	27.2	< 0.0001
variety:treatment:fermentation phase	3.1	6	12.4	< 0.0001
Residuals	3.0	72		

- Yeast abundance in the must was significantly affected by the interaction between variety, treatment, and fermentation time (Fig. 1 and Table 2).
- In general, the highest yeast abundance was observed in the middle of the fermentation process (Fig 1).
- Species richness and diversity declined as fermentation progressed, due to increasing ethanol concentrations (Fig. 2).
- The yeast community varied significantly among varieties, treatments, and fermentation phases (Fig.3 and Table 2).
- In “Touriga Nacional”, the 0.05% potassium silicate treatment led to early dominance of *S. cerevisiae*, whereas this species was absent at the same stage in the “Touriga Franca” (Fig 4).

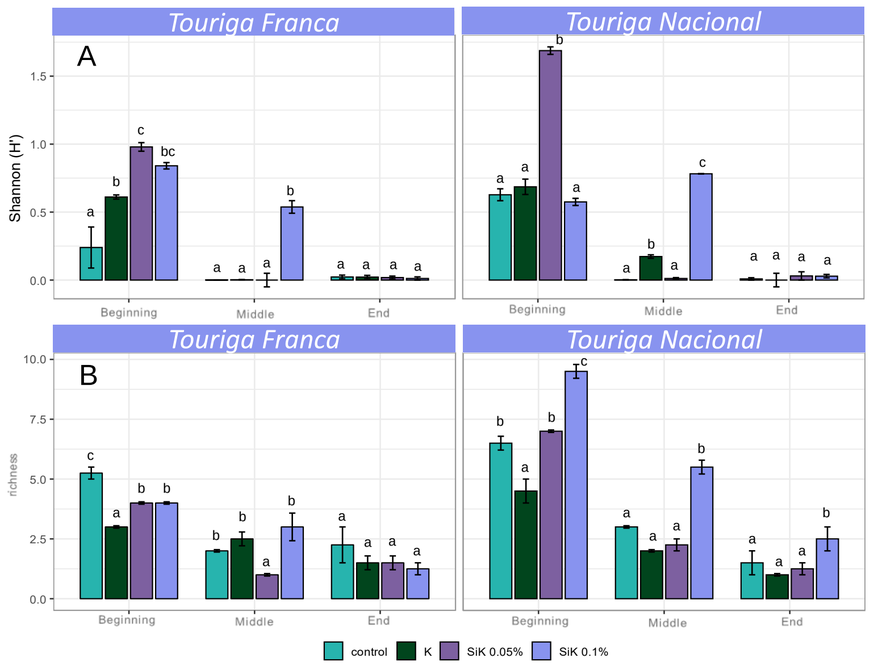


Fig. 2 (A) Shannon diversity index and **(B)** Species richness of yeast at different stages of alcoholic fermentation of Touriga Franca and Touriga Nacional musts, following pre-harvest applications of different treatments: control, kaolin (5%), and potassium silicate (SiK) at concentrations of 0.1% and 0.05%.

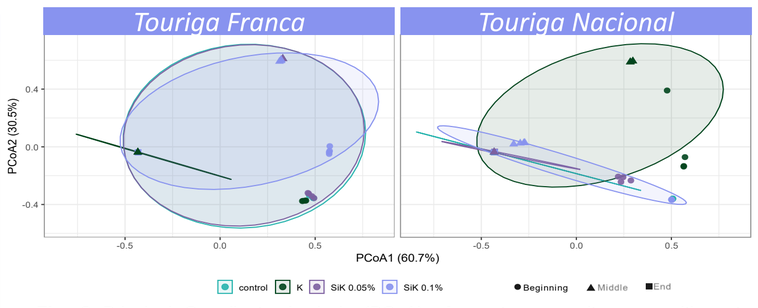


Fig. 3 Principal Coordinate Analysis (PCoA) of yeast community composition at different stages of alcoholic fermentation of Touriga Franca and Touriga Nacional musts, following pre-harvest applications of different treatments: control, kaolin (5%), and potassium silicate (SiK) at concentrations of 0.1% and 0.05%.

Table 2. Results of the permutational multivariate analysis of variance (PERMANOVA) assessing the effects of variety, treatment, and fermentation phase, as well as their interactions, on the yeast community composition.

	Sum Sq	Df	R2	F	p-value
variety	0.68	1	0.02	163	0.001
treatment	0.59	3	0.02	47	0.001
fermentation phase	18.07	2	0.64	2160	0.001
variety:treatment	2.99	3	0.11	238	0.001
variety:fermentation phase	1.31	2	0.05	156	0.001
treatment:fermentation phase	1.08	6	0.04	43	0.001
variety:treatment:fermentation phase	3.34	6	0.12	133	0.001
Residuals	0.30	72	0.01		
Total	28.37	95	1.00		

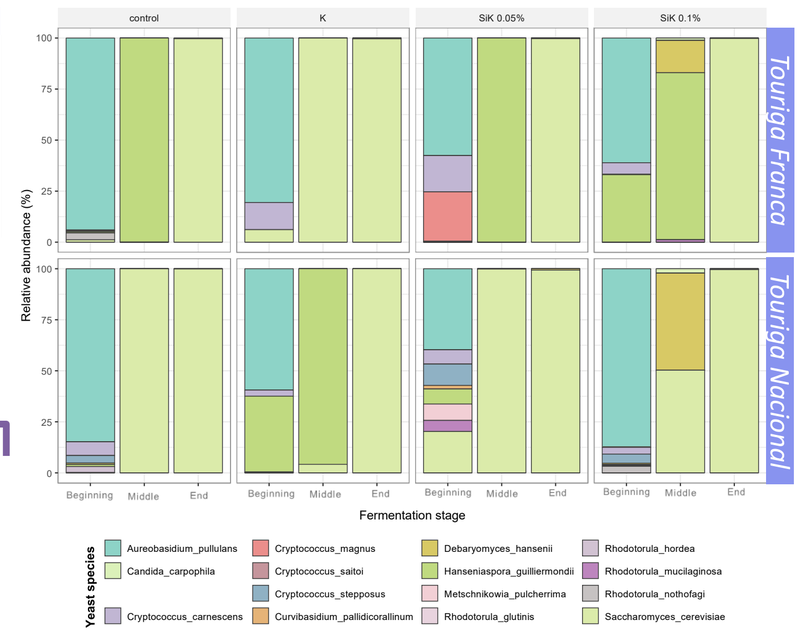


Fig. 4 Relative frequency of yeast species isolated at different stages of alcoholic fermentation of Touriga Franca and Touriga Nacional musts, following pre-harvest applications of different treatments: control, kaolin (5%), and potassium silicate (SiK) at concentrations of 0.1% and 0.05%.

4. Conclusion

Particle films modify yeast community structure during fermentation.
The impact varies with grape variety and treatment type.
Potassium silicate (0.05%) promoted earlier dominance of *S. cerevisiae* in Touriga Nacional.
Particle films should be considered not only for vineyard protection but also for their potential influence on wine microbiota.

Acknowledgements

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