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Sulfur dioxide (SO_2) replacement by *p*-coumaric acid: a green alternative in wine industry.

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Introduction & Study Aim

Sulfur dioxide has been traditionally used in winemaking as an effective preservative even though often its negative taste and health related effects to consumers particularly when it used in excess. Furthermore, it can induce both the SO_2-related resistance and the SO_2-related viable but not culturable (VBNC) state of different wine yeast and bacteria species.
Currently, sulfur dioxide replacement by plant-derived compounds, used as food bio-preservatives, has been proposed in winemaking, at laboratory scale, as a green and healthier alternative
The aim of this study was to replace sulfur dioxide by *p*-coumaric acid, a plant-derived phenolic compound, in winemaking at industrial scale in order to produce a safe, natural wine, more sustainable, genuine and healthier.

Materials & Methods

Winemaking of both sulfur dioxide- and *p*-coumaric acid-treated wine was conducted in parallel at winery industrial scale (into two 10,000 L stainless steel tanks) using the same quantity of the same grape variety (10,000 kg of Lemnos island organic white wine grapes Muscat of Alexandria) during the harvest of 2019 and following the same oenological procedures. The influence of *p*-coumaric acid on wine properties and quality has been compared with that of sulfur dioxide under the same conditions, after 3 months of storage in bottle. To this end, several analytical parameters of wine related to oenological, microbiological, antioxidant, sensory and safety properties were determined according to International Standards Organization (ISO) and International Organization of Vine and Wine (OIV) official analytical methods for both wine samples.

Results & Conclusions

Table 1. Oenological & antioxidant profile

PARAMETERS	RESULTS A* / B**	METHOD OF ANALYSIS
Reducing Substances (Glucose + Fructose)	0.63g/L / 0.1g/L	OIV-MA-AS311-01A
Density at 20°C	0.9911g/mL / 0.9908 g/mL	OIV-MA-AS2-01A
Alcoholic Strength by Volume at 20°C	11.39% v/v / 11.08% v/v	OIV-MA-AS312-01A
Total Acidity	5.10g tartaric acid/L / 5.25 g tartaric acid	OIV-MA-AS313-01
Volatile Acidity	0.28g acetic acid/L / 0.52g acetic acid	OIV-MA-AS313-02
Total Sulfur Dioxide	133mg/L / 5.1mg/L	OIV-MA-AS323-04A
Free Sulfur Dioxide	21mg/L / 0,0 mg/L	OIV-MA-AS323-04A
Phenolics' Index	8.7 A / 6.5 A	OE 1001
pH	3,28 pH units / 3,49 pH units	OIV –MA-AS313-15-PH
Lactic acid	1.1g/L / 1.14 g/L	OIV-MA-AS313-04 _UHPLC-MS/MS
Citric acid	0.1g/L / <0.1g/L	OIV-MA-AS313-04 _UHPLC-MS/MS
Tartaric acid	1.6g/L / 2.4 g/L	OIV-MA-AS313-04 _UHPLC-MS/MS
Malic Acid	1,22 g/L / 0,01 g/L	OIV-MA-AS313-11

Figure 1. Stability profile

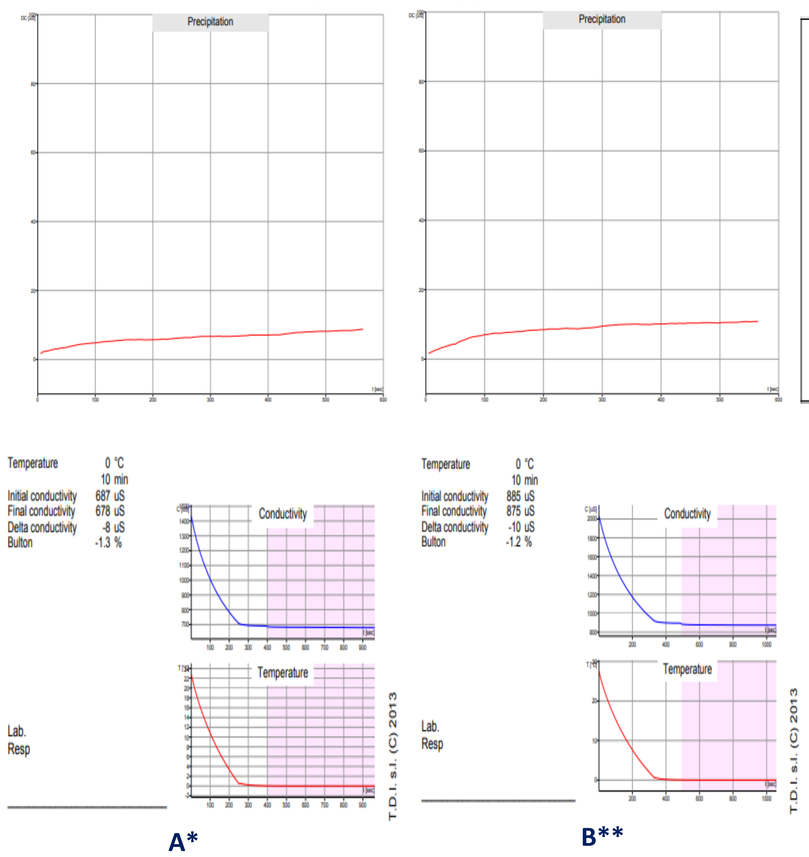

Figure 2. Sensory profile

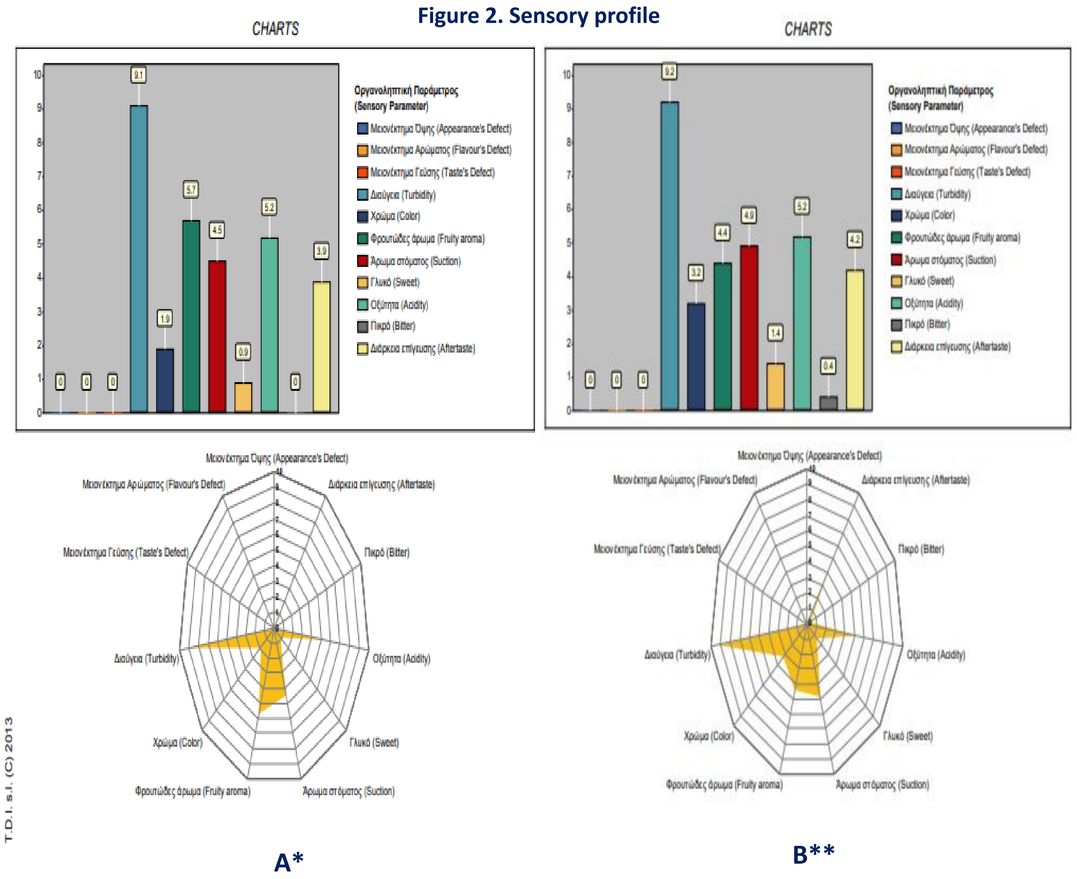

Table 2. Microbiological profile

PARAMETERS	Total Viable Count	Yeasts	Moulds	Lactobacillus spp.
RESULTS A* / B**	8.6E+02cfu/ml / Estimated 65cfu/mL	6.0E+02cfu/mL / Presense (<40) cfu/mL	<10cfu/mL / <100cfu/mL	2.5E+02cfu/mL / Presense (<40) cfu/mL
METHOD OF ANALYSIS	ISO 4833-1:2013	ISO 21527-1:2008	ISO 21527-1:2008	MRs Agar. Incubation: 5 days at 30°C, under CO_2 atm. Confirmation: White colonies, Gram(+), nonspore bacillus, Catalase(-), Oxidase(-).

A* dioxide-treated wine sample
B *p*-coumaric acid-treated wine sample**

In general, there were no significant differences observed in stability, microbiological, antioxidant and oenological profiles due to sulfur dioxide replacement by *p*-coumaric acid while sensory profile was slightly ameliorated.

✓ This replacement technology resulted a suitable green alternative to sulfur dioxide and could be easily applied by wine industries in order to guarantee high quality green products.