

Grapes enrichment with zinc for vinification: mineral analysis with atomic absorption spectrophotometry , XRF and tissue analysis

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Abstract: Micronutrient deficiency affects individuals all around the world, being a public health problem. To minimize this problem, several alternatives are being developed, namely agronomic biofortification, to increase the amount of nutrients in food crops. In this context, Zn is one of the most relevant micronutrients for the human body, displaying catalytic, structural and regulatory properties. Considering that Zn deficiency leads to health diseases (namely, neurological disorders, autoimmune, degenerative diseases related to age, Wilson's disease, cardiovascular problems, and diabetes mellitus), a technical itinerary for biofortification was outlined in a field grapes located in Palmela (Portugal), aiming to optimize Zn contents for the Syrah variety. Biofortification was performed with foliar spraying with zinc oxide (ZnO) and zinc sulfate (ZnSO₄) throughout the production cycle (at concentrations of 0%, 30% and 60% - 0, 450 and 900 g ha⁻¹). Zinc biofortification index increased about 59% and 45 %, with OZn60 and SZn60, whereas its deposition in the flesh of the grapes increased 2.41 and 2.37 fold and in the seeds ca.1.76 and 2.19 fold (in OZn60 and SZn60, respectively). After vinification, wine significant increases of Zn contents were also found (1.92 and 1.77 fold) yet, considering the amount of this nutrient in grapes, it is concluded that vinification must also be optimized.

Keywords: Biofortification; Syrah variety; Wine; Zinc oxide; Zinc sulfate.

Results and Discussion

Syrah variety	Total Soluble Solids (°Brix)		Zn (ppm _{Dw})		Grapes flesh Zn (ppm _{Dw})		Seeds Zn (ppm)		Zn contentes in wine (µg L ⁻¹)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Control	13.10c	± 0.31	13.460b	± 0.876	13.3b	± 0.66	8.74b	± 0.44	0.730b	± 0.088
OZn30	16.83ab	± 0.36	18.843ab	± 1.799	33.4a	± 1.67	14.8ab	± 0.74	1.398a	± 0.153
OZn60	16.33ab	± 0.07	21.400a	± 0.892	32.1a	± 1.61	15.4a	± 0.77	1.074ab	± 0.135
SZn30	15.13b	± 0.22	19.287a	± 1.487	28.0a	± 1.40	17.1a	± 0.85	1.289a	± 0.041
SZn60	18.10a	± 0.48	19.580a	± 0.800	31.5a	± 1.58	19.1a	± 0.95	1.295a	± 0.104

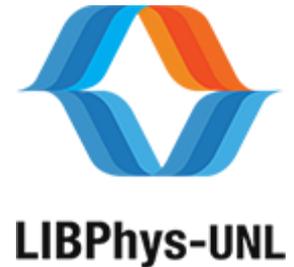
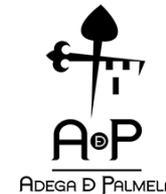
- Total soluble solids in all treatments, showed an increase relatively to the control. Atomic absorption in grapes treated with ZnO and ZnSO₄ showed, relatively to the control, significant increases of Zn. Zn- treated grapes triggered an increasing accumulation of this nutrient in the produced wine.
- Zn accumulation prevailed in the flesh of the grapes, surpassing 30 % above de control, which revealed the effectiveness of the biofortification. Indeed, a higher biofortification index was found

Conclusions

Biofortification with Zn in Syrah grapes increase the total soluble solids, but once the climatic conditions have an influence in the content, more assays must be carried out. OZn has led to better results but, in general, although biofortification has proved to be effective in increasing Zn content of grapes and wine, the vinification process needs to be optimized.

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