IECPS 2020
1st International Electronic Conference on Plant Science
01–15 DECEMBER 2020 | ONLINE
plants MDPI

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 deseases (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.

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Results and Discussion

Syrah variety	Total Soluble Solids (ºBrix)	
	Mean	SE
Control	13.10c	± 0.31
OZn30	16.83ab	± 0.36
OZn60	16.33ab	± 0.07
SZn30	15.13b	± 0.22
SZn60	18.10a	± 0.48

Zn (ppm_{Dw})	
Mean	SE
13.460b	± 0.876
18.843ab	± 1.799
21.400a	± 0.892
19.287a	± 1.487
19.580a	±0.800

Grapes flesh Zn (ppm_{Dw})		Seeds Zn (ppm)	
Mean	SE	Mean	SE
13.3b	± 0.66	8.74b	± 0.44
33.4a	± 1.67	14.8ab	± 0.74
32.1a	± 1.61	15,4a	± 0.77
28,0a	± 1,40	17,1a	± 0,85
31,5a	± 1,58	19,1a	± 0,95

Zn contentes in wine ($\mu g\ L^{-1}$)	
Mean	SE
0.730b	± 0.088
1.398a	± 0.153
1.074ab	± 0.135
1.289a	± 0.041
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 $ZnSO_4$ 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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Acknowledgments

The authors thanks to Engenier Luís Silva (Adega Cooperativa de Palmela-Casa Agrícola Nunes Oliveira da Silva Lda) for technical assistance to project PDR2020-101-030727 – for the financial support. We also thanks to the Research centres (GeoBioTec) UIDB/04035/2020. This work was further supported in part by the research center Grant Nº. UID/FIS/04559/2013 to LIBPhys-UNL, from the FCT/MCTES/PIDDAC and by the project PDR2020-101-030727.

PROGRAMA DE DESENVOLVIMENTO RURAL 2014·2020

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