

CAROTENOID COMPOUNDS FOUND IN GRAPES AND THEIR RELATIONSHIP TO PLANT WATER STATUS

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INTRODUCTION

The presence of carotenoids in grapes is well established (1, 2). Cultivar, viticulture region, exposure to sunlight and ripening stage affect carotenoid concentrations in grapes (3, 4). Carotenoids are known as precursors of aroma-active substances responsible for the typical aroma of same grape varieties. Their degradation can lead to the formation of C13 – norisoprenoids compounds (5, 6). These molecules have all been identified in grapes and wines and are associated with some sensory attributes. The effect of irrigation on changes in berry composition, colour and weight (g/berry) has been reported by many authors (7, 8). The aim of this work was to study the relationship between carotenoid content in grapevine berries and the plant water status. For this purpose a black grapevine variety *Vitis vinifera* L. cv. Touriga Nacional was studied during the two weeks before veraison until maturity stage.

MATERIAL AND METHODS

Plant materials and treatments

Grapes from *Vitis vinifera* L. cv. Touriga Nacional variety were studied during the two weeks before veraison until maturity stage (four sampling dates). The experiments were carried out in Douro vineyards, with plants of the same age, in two different water retention soils. A higher water retention capacity soil, soil A, and a lower water retention capacity soil, soil B, both in a 1.2 m deep silt-loam schist derived soil. The training system was the vertical double cordon. A first range was not irrigated (NI) and a second one was irrigated (I) (60% of the Etp). For soil B a 30% of Etp treatment was also applied. The plant water status was estimated by predawn leaf water potential.

Extraction and determination of carotenoids

Carotenoids were quantified by HPLC/DAD (9). Identification was performed by comparison with commercially available standards or array spectra available in literature (figure 1).

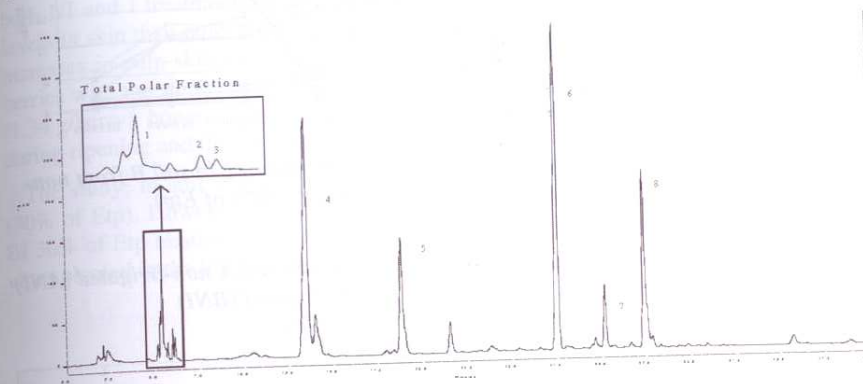


Figure 1: HPLC chromatogram of carotenoids of Touriga Nacional from non-irrigated treatment grapes, in soil B, at harvest time

DO = 447 nm; (1) Neoxanthin; (2) violaxanthin; (3) luteoxanthin; (4) lutein; (5) internal standard; (6) unknown; (7) chlorophyll; (8) β -carotene.

RESULTS AND DISCUSSION

Results showed that carotenoids content decreased during the time of study with concomitant increase of °Brix, independent of the treatment (NI or I) or soil water retention capacity (A or B) (figures 2 and 3). The highest decreases were observed for an unknown compound, lutein and β -carotene. The total polar fraction peaks 1, 2 and 3 (figure 1) as well as chlorophyll have also decreased over the same period, whereas, violaxanthin and luteoxanthin appeared only in the second sampling time. The levels of carotenoids founded for NI and I grapes in the higher water retention capacity soil (ANI and AI 60% of Etp) were similar (figure 2), while, carotenoids contents in the irrigated grapes in the lower water retention soil (BI 60% of Etp) were approximately 50% that of the non-irrigated grapes (BNI), with higher decreases in levels until harvest time (figure 3). Irrigated treatments contributed to higher sugar concentrations in both soils.

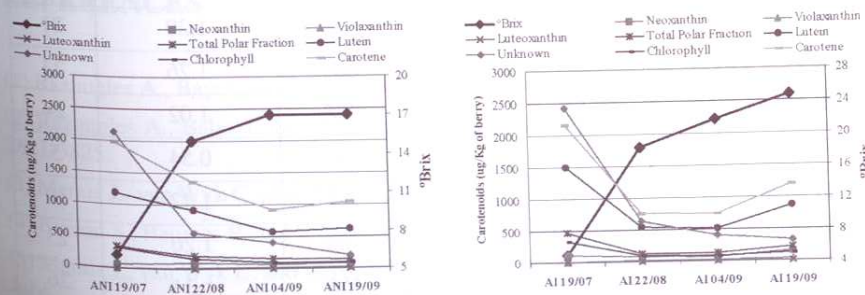


Figure 2: Changes in carotenoids content during grape ripening in soil A from non-irrigated (ANI) and irrigated (AI) treatments (60% of Etp)

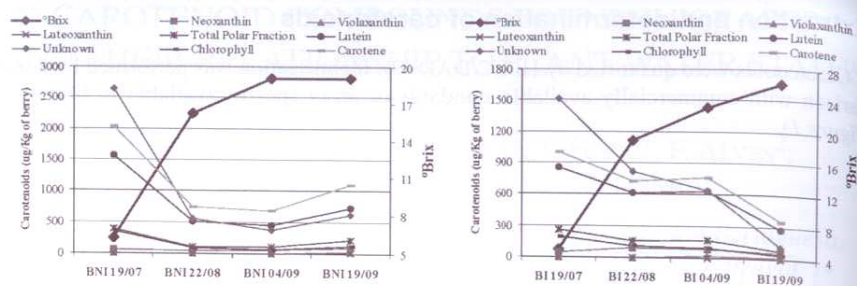


Figure 3: Changes in carotenoids content during grape ripening in soil B from non-irrigated (BNI) and irrigated (BI) treatments (60% of Etp)

Table I: Values for carotenoids content and berry growth in soil A non-irrigated (ANI) and irrigated (AI 60%) and soil B non-irrigated (BNI) and irrigated (BI 30% and BI 60%)

Soil/treatment/time	Total Polar Fraction	Lutein	Carotene	Weight/Berry	°Brix
ANI 19/07	347	1183	1981	0.48	6
ANI 22/08	196	929	1363	0.88	15
ANI 04/09	152	571	918	0.90	17
ANI 19/09	147	624	1046	0.89	17
AI 60% 19/07	462	1499	2153	0.56	5
AI 60% 22/08	132	548	764	1.56	18
AI 160% 04/09	126	519	746	1.52	22
AI 160% 19/09	222	874	1204	1.36	25
BNI 19/07	386	1563	2018	0.50	6
BNI 22/08	109	514	739	0.94	16
BNI 04/09	109	452	677	0.95	19
BNI 19/09	222	728	1102	0.94	19
BI 30% 19/07	222	881	1198	0.57	6
BI 30% 22/08	78	340	448	1.39	21
BI 30% 04/09	71	260	369	1.26	23
BI 30% 19/09	47	152	238	1.02	24
BI 60% 19/07	258	855	999	0.54	5
BI 60% 22/08	156	615	721	1.42	19
BI 60% 04/09	167	629	762	1.20	23
BI 60% 19/09	78	282	356	1.34	26

Total Polar Fraction is expressed in equivalents of lutein; lutein and carotene ($\mu\text{g}/\text{kg}$ of berry). Berry weight in grams.

For vines planted in a soil A results showed that berries exposed to NI treatment had a lower weight, 0.89 g/berry, versus 1.36 g/berry for I treatment, at harvest time, however, irrigated treatment contributed to a higher sugar concentration (table I). This fact could be related to a higher vegetative growth resulting in higher pruning weights where irrigated vines are not exposed to heat stress (8). The total carotenoid content was similar for both NI and I treatments, with regard to soil A. Since carotenoids are in much higher levels in skin than pulp (9), this non-variation could be explained by the fact of observed increases in pulp-skin ratios, with irrigated treatment. Vines planted in soil A produced berries with the same weight (1.36 g/berry), at harvest date, than those planted in soil B (1.34 g/berry), however, with regard to soil B, levels of sugars were progressively higher during ripening and the carotenoid contents were approximately 50% lower (table I).

The study, in soil B, was complemented with a medium regime of water irrigation (30% of Etp). However, differences due to the soil water retention were also observed. BI 30% of Etp treatment was the one that had the lowest carotenoid levels (table I) with vines planted in the lower water retention capacity soil.

CONCLUSION

Results showed that carotenoids content decreased during the study period with concomitant increase of °Brix, independent of the treatment (NI or I) or soil water retention capacity (A or B). The irrigated treatment contributed to a higher sugar concentration. However, the total carotenoid content was similar for both NI and I treatments. It seems to be possible to produce higher weight berries (with higher sugar levels) together with the same carotenoid contents. On the other hand, soil characteristics had a larger influence than irrigation on the concentration of carotenoids in grapes, resulting in an important viticulture parameter to take into account in aroma precursor formation. Further results are needed to confirm these preliminary results.

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