**The impact of vine microclimate on the evolution of carotenoids in cv. Nebbiolo.**

# The impact of vine microclimate on the evolution of carotenoids in cv. Nebbiolo

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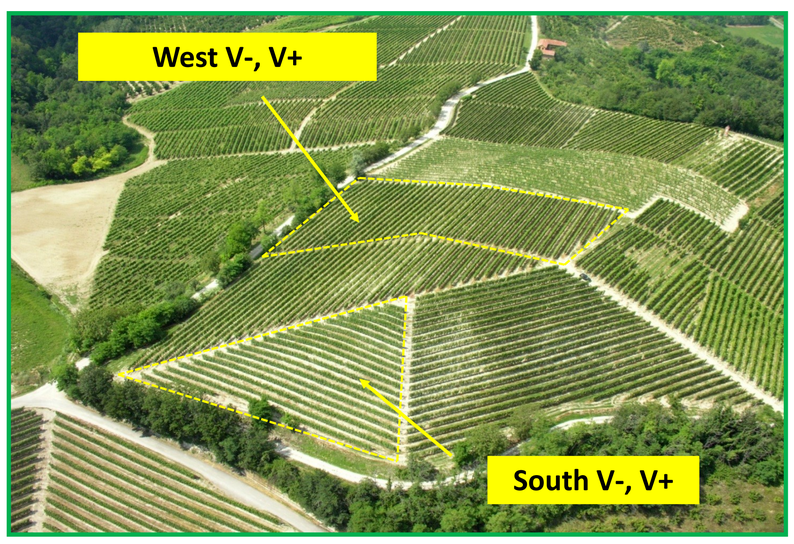
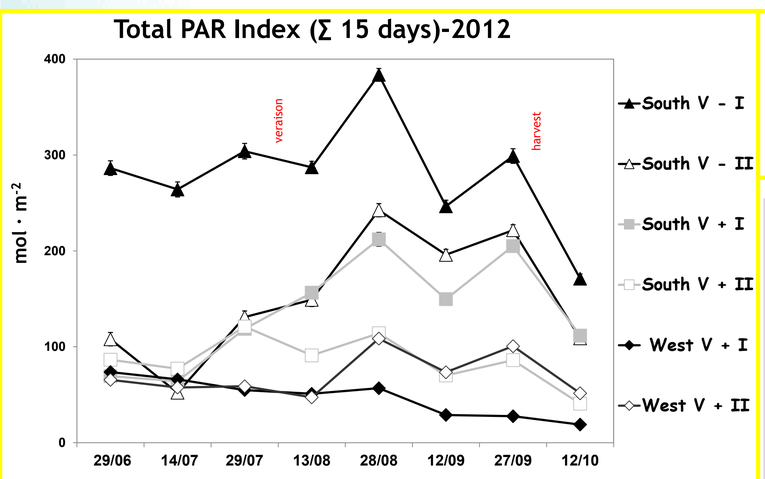
Grape carotenoids are precursors of low threshold aroma compounds in wine such as the $C_{13}$-norisoprenoids and their evolution during ripening may be consider an indicator of grapes aromatic potential (Winterhalter & Ebeler, 2013). Environmental conditions, such as climate, light exposure of bunches and soil water deficit may influence the carotenoid content in grape berries, although their concentration has also been shown to differ between cultivars (Oliveira *et. al.*, 2014).

The influence exerted by bunch microclimate on the rate of synthesis/degradation of some relevant carotenoids, was investigated for the first time in Nebbiolo grapes, an Italian variety of high interest for local and international wine market.




The data were collected, during two consecutive seasons, in two nearby Nebbiolo planted vineyards (North-West Italy), characterized by high vigour heterogeneity and by a different aspect (**South** or **West**). Each vineyard parcel was sorted in 2 vine vigour classes (**V- the less vigorous parcel** and **V+ the more vigorous**) (Asproudi *et al.*, 2016). Berry samplings were collected from 15 days after flowering until harvest.
Photosynthetically Active Radiation (PAR) and air temperature (T, °C) inside the bunch zone were measured *in continuous* from pea size stage to harvest time.

## Microclimate characterization




In both seasons, the **TPARI** value was the highest in the South V- and higher in the South, rather than the West vineyards. In addition, in 2012, the index was higher than in 2013, especially for the South blocks (not reported).

Temperature Index **(TI)** depends on both the value and the duration of the temperature level. TI values above the threshold of 35 °C, were registered mainly during the post veraison period for all treatments and the most notable differences between the West parcels (milder microclimate) and the South ones (warmer microclimate) were observed in 2013 season.

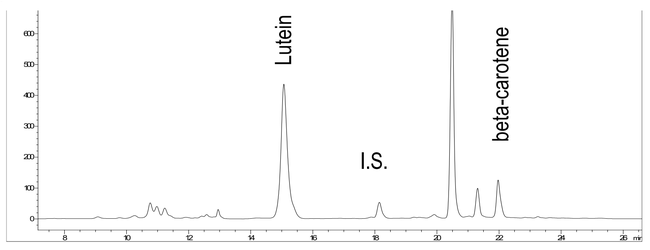
**TI [number of hours]**

| Class of T | Aspect | Class of vigour | 2012 periods 30/06 29/07 | 2012 periods 30/07 28/08 | 2012 periods 29/08 12/10 | 2012 total | 2012 average | 2013 periods 30/06 29/07 | 2013 periods 30/07 28/08 | 2013 periods 29/08 12/10 | 2013 total | 2013 average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T < 25 °C | South | V - | 417 | 373 | 907 | 1697 | 1713 | 421 | 438 | 832 | 1691 | 1727 |
| | | V+ | 428 | 382 | 919 | 1729 | | 439 | 445 | 879 | 1763 | |
| | West | V - | 436 | 404 | 965 | 1805 | 1806 | 440 | 466 | 913 | 1819 | 1826 |
| | | V+ | 437 | 403 | 966 | 1806 | | 442 | 468 | 922 | 1832 | |
| 25 °C ≤ T < 35 °C | South | V - | 269 | 215 | 147 | 631 | 618 | 246 | 128 | 157 | 531 | 565 |
| | | V+ | 243 | 210 | 152 | 605 | | 267 | 176 | 156 | 599 | |
| | West | V - | 222 | 218 | 108 | 548 | 582 | 272 | 233 | 161 | 666 | 645 |
| | | V+ | 267 | 238 | 110 | 615 | | 267 | 218 | 138 | 623 | |
| T ≥ 35 °C | South | V - | 34 | 132 | 26 | 192 | **189** | 53 | **154** | **91** | **298** | **228** |
| | | V+ | 49 | 128 | 9 | 186 | | 14 | 99 | 45 | 158 | |
| | West | V - | 62 | 98 | 7 | 167 | **133** | 8 | 21 | 6 | 35 | **50** |
| | | V+ | 16 | 79 | 4 | 99 | | 11 | 34 | 20 | 65 | |

The South plot has always registered higher PAR and temperature values compared to the West exposure in both 2012 and 2013 vintage years, particularly in the post veraison period.

## Carotenoid extraction and determination

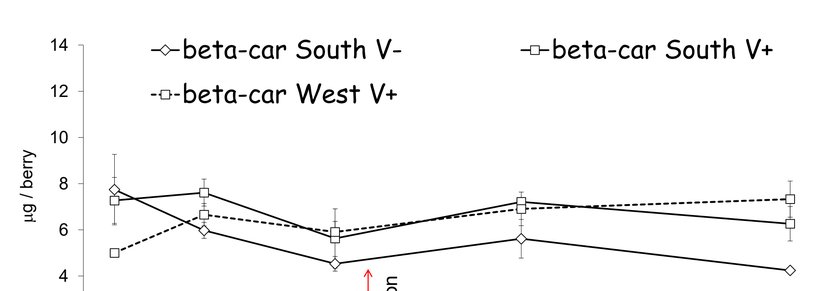
A liquid-liquid extraction was carried out under both, low temperature and dim yellow light, to minimize degradation, light-induced isomerization and oxidation of carotenoids.
A subsequent H.P.L.C. determination was carried out.




## RESULTS

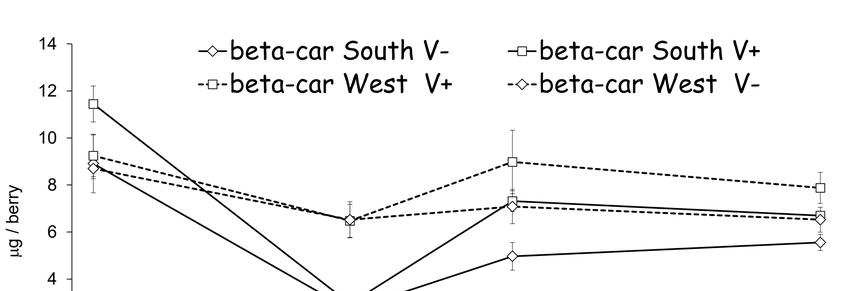
### 2012




### 2013




- A lutein content peak proportional to the vine vigour was noticed in the post-veraison period;
- A major photodegradation than synthesis of lutein probably occurred in the less vigorous and warmer parcel (South V-);
- Final lutein contents were proportional to the vine vigour: grapes less protected from direct radiation had the lowest lutein content.

- A costant and similar trend was highlighted for β-carotene, in all vigour conditions during 2012;
- A near veraison significant decline of β-carotene in the warmer South parcels was registered in 2013, season when the TI differences (>35°C) between the two aspects were more notable.

**Conclusions**: High carotenoid contents were found in Nebbiolo berries; the most abundant compounds were lutein and β-carotene. Synthesis and degradation of these carotenoids, were influenced by vine microclimate variability as a consequence of both vigour and aspect. Moreover, a variety effect can be presumed as regards the evolution trend of lutein since the post veraison peak noticed for Nebbiolo grapes was noticed only for few other cultivars in literature, such as Touriga Franca and Merlot (Oliveira *et. al.*, 2014; Kamffer *et. al.*, 2010).

REFERENCES
Winterhalter, P. & Ebeler, S. In *Carotenoid Cleavage Products* **2013**, *1134*, 3-9 (ACS); Oliveira, C. *et. al.* Journal of Agricultural and Food Chemistry **2004**, *52* (13), 4178-4184; Asproudi *et. al.*, Food Chemistry **2016**, *211*, 947-956; Kamffer, Z. *et. al.* Journal of Agricultural and Food Chemistry **2010**, *58* (11), 6578-6586.