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

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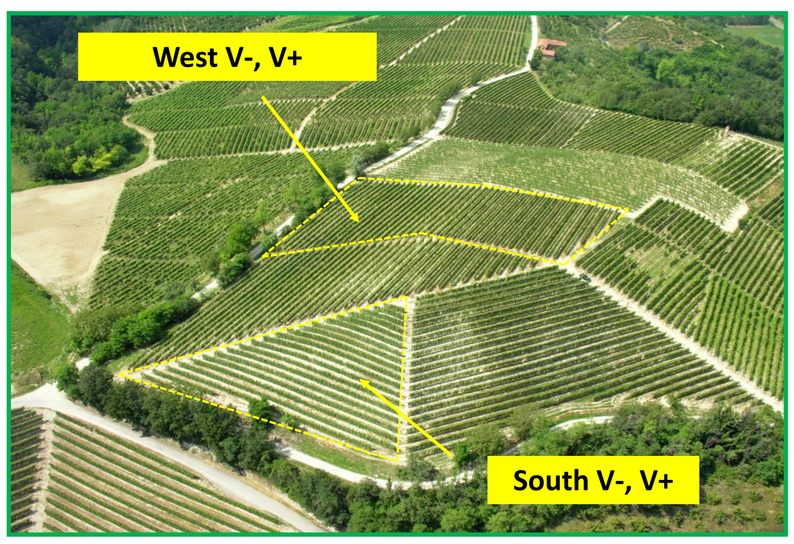
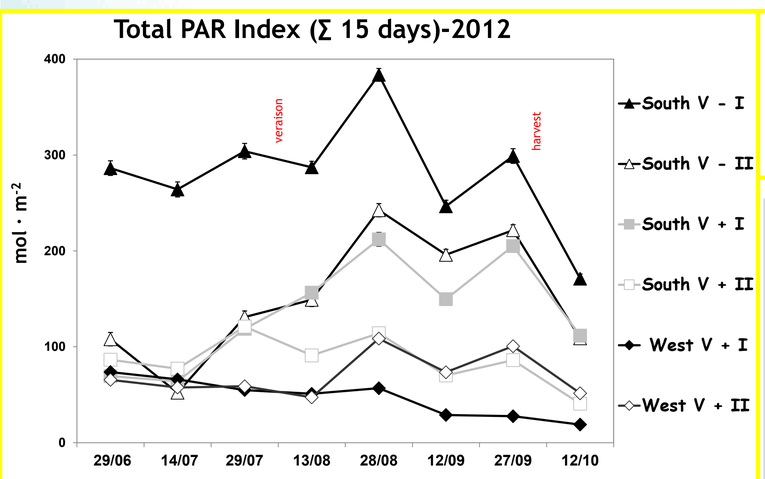
Grape carotenoids are precursors of low threshold aroma compounds in wine such as the C_{13}-norisoprenoids and their evolution during ripening may be consider an indicator of grapes aromatic potential (Winterhalter & Ebeler, 2013). Environmental conditions, such as climate, light exposure of bunches 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.

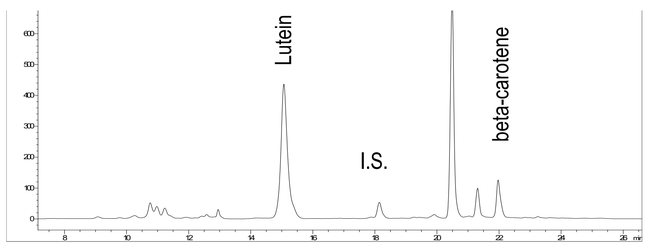
TI [number of hours]

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.

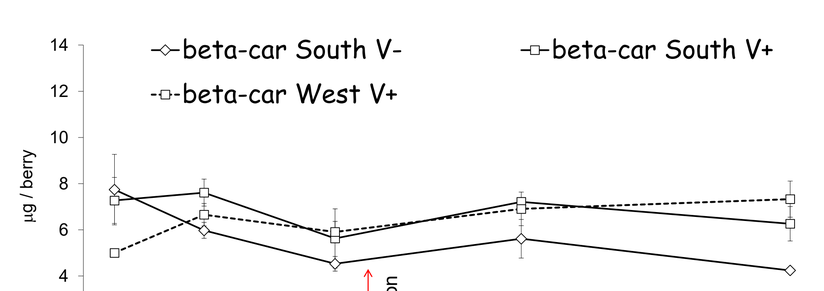
Carotenoid extraction and determination

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.

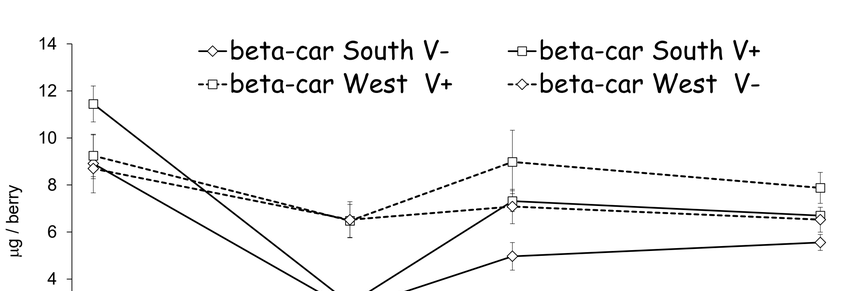


RESULTS

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.