The production area of Gewürztraminer in Sella di Termeno (Bz), site where the tests were done

Improving the typicity of Gewürztraminer using specific inactivated yeasts in the vineyard

DUILIO PORRO,
FABRIZIO BATTISTA

In the last thirty years, significant climatic changes have taken place that are characterized by an increase in average, minimum and maximum temperatures and a changing distribution of rainfall. Rainfall distribution is increasingly concentrated between autumn and spring, with prolonged dry periods during the summer which are, at times, interrupted by short but very intense rainy phenomena.

As a result of these changes, the time gap between technological maturation and aromatic / phenolic ripening has widened, resulting in high levels of sugars, low total acidity and high pH, whilst aromatic compounds or their precursors located in the skin have not yet reached adequate maturity. For red grapes, it is becoming increasingly evident, at the time of technological ripeness, the tannins are still astringent and herbaceous and the anthocyanins have not reached a good level of concentration and extraction capacity. High temperatures are also responsible for a decrease in the accumulation of aromatic precursors in the berry skin.

Winemakers are constantly seeking agronomic practices to counter the effects of the above-mentioned climate conditions. However, many agronomic practices do not have a selective effect that can reduce the time gap between the two maturations. Practices such as leaf stripping or canopy thinning facilitate the accumulation of secondary metabolites but at the same time lead to an excessive increase in sugar and a very rapid deterioration of the acidity. It is therefore necessary to intervene more and more selectively and specifically to preserve the balance in berry composition. In response to these problems, the Edmund Mach Foundation of San Michele all'Adige has been testing an innovative

Details of treated plots (left) and untreated plots (right).

foliar application product for two consecutive years (2017 and 2018). It is a natural formulation based on inactivated yeasts, designed by Lallemand to improve the quality of wine from the vineyard. The product called LalVigne Aroma™, is already used in many Italian and worldwide viticultural regions and acts as an elicitor in the plant, stimulating the secondary metabolism and promoting a greater accumulation of aromatic precursors typical of the particular grape variety. In previous scientific trials, the effects of LalVigne AROMA™ have been investigated on aromatic varieties such as Sauvignon Blanc (Šuklje et al., 2016) and on varieties with a more neutral aromatic profile such as Glera, Garganega and Pinot Grigio (Tomasi et al., 2016). In addition to the effect on the accumulation of aromatic precursors in the grape, the treatment with this specific inactive yeast derivative also causes an increase in the synthesis of reduced glutathione, an important antioxidant compound. Reduced glutathione helps to preserve the aromatic profile during the winemaking process. For this reason, wines made from grapes treated with LalVigne AROMA™ also showed a lower susceptibility to browning and "pinking" phenomena. From an organoleptic viewpoint, the wines made from vines treated with LalVigne AROMA™ demonstrated a greater aromatic definition and longevity, more body and volume, coupled with a decrease in greenness and bitterness sensations in the mouth.

This trial has been conducted on a Gewürztraminer vineyard in "High-Adige" (photo 1). The trial was conducted over two years. The product LalVigne Aroma™ was used, according to the manufacturer's instructions, which required two 3kg/ha foliar treatments, the first spray at the beginning of veraison and the second ten days later. A control of no spray was also conducted (photo 2). After the treatment of the vines, grape samples were taken to measure the impact on the measurable parameters.

In addition to the analysis of the 'usual' parameters which outline "classical" technological maturation (such as pH, TA, Baume etc.), analysis of the main

Parameter	2017		2018	
	Control	Treated	Control	Treated
Number of shoots / plants	9.3	9.2	9.4	9.5
Number of bunches / plants	12.9	13.0	13.8	13.3
Production (kg / plant)	1.41	1.52	2.16	2.03
Fertility of the bud	1.41	1,41	1.49	1.41
Average weight of the bunch (g)	108.9	118.5	158.4	154.4
Sugars (° Brix)	24.27	24.15	23.02	25.25
Total acidity (g / L)	6.33	6.60	5.95	5.98
pH	3.67	3.64	3.27	3.34
Malic acid (g / L)	1.17 b	1,50 a	1.03	0.99
Tartaric acid (g / L	6.18	6.18	5.03	5.40
Potassium (K +) (g / L)	1.98	2.12	1.61	1.66
APA (mg / L)	122 b	160 a	116	118

Table 1 - Data on the production and composition of grapes at the time of harvest in the two vintages studied. Comparison between the control modality (CONTROL) and the treatment modality (TREATED) with the LalVigne Aroma product.
Different letters indicate significant differences with values of $p < 0.001$

Parameter (µg/L)	2017		2018	
	Control	Treated	Control	Treated
1-hexanol	918.5	1082.5	608.3	585.8
Trans-3-hexen-1ol	17.6	23.6	11.9	11.5
Cis-3-hexen-1ol	9.7	9.9	4.4	4.7
Beta-citronellol	2.4	2.7	1.6 b	3.5 a
Nerol	12.7 b	18.4 a	14.1 b	28.9 a
geraniol	51.7	60.2	46.6	69.7
Geraniol acid	13.6	18.5	10.3 b	23.0 a
Benzyl alcohol	14.9 b	18.0 a	9.7 b	19.6 a
Benzaldehyde	0.9	0.9	7.1	6.7
Total free forms	1042.0	1234.6	714	753.4

Table 2 - Comparison of Free Aromatic Content in Grapes: treated and control with LalVigne Aroma. Different letters indicate significant differences with values of p <0.001

Parameter (µg/L)	2017		2018	
	Control	Treated	Control	Treated
1-hexanol	28.4	32.8	45.3 b	58.4 a
Trans-3-hexen-1olo	0.8	1.0	1.9 b	2.8 a
Cis-3-hesen-1olo	2.2	2.1	5.0 b	6.6 a
Linalol A oxidized	2.0	2.3	25.6	29.2
Oxidized Linalol B	1.5 b	2.1 a	21.3	22.9
linalool	1.5	1.8	7.1	6.6
α-terpineol	0.8	1.0	3.7	3.9
Terpinen-4ol	0.9	0.9	3.9	3.8
Beta-citronellol	7.6	11.7	17.6	21.3
Nerol	89.0 b	104.9a	101.9 b	137.9 a
Geraniol	187.9	210.3	312.4 b	411.0 a
Geraniol acid	70.7	85.3	79.7 b	129.7 a
Rose Oxide I	0.8	0.7	1.7	2.0
Rose Oxide II	0.8	0.8	2.1	2.4
Benzyl alcohol	184.9 b	212.2 a	557.1 b	706.9 a
Benzaldehyde	0.9	0.9	3.6	3.5
Methyl salicylate	0.7 b	1.3 a	0.7 b	1.2 a
Total bound forms	581.6	672.4	1190.6 b	1550.1 a

Table 3 - Comparison of the content of glycosylated aromatic compounds present in grapes treated and control with LalVigne Aroma.
Different letters indicate significant differences with values of p <0.001

aromatic precursors accumulated in the grapes were also undertaken. Moreover, during the 2017 harvest, comparative micro-vinifications were carried out, in triplicate, to understand the organoleptic impact on the finished product.

Results of the experiment.

This trial was conducted in a commercial vineyard of more than 10 years of age, using a fully randomized experimental design with three replicates per modality. In this trial there was no significant effect on the sugar content, acidity and pH (Table 1) between the treatment and control grapes, a result also supported by previous trials. In 2017, there was a slight increase in the malic acid and APA content in the treated modality, an effect not observed in 2018 and therefore was deemed a result not attributable to the treatment of the tested product. Analysis of the free aromatic compounds (Table 2) in the treated modality showed higher values of nerol (about 45% more than the two years) and benzyl alcohol, belonging respectively to the family of terpenes and benzenoids. Among the terpenes, the values of beta-citronellol, geraniol and geranic acid were on average higher for the Lal LalVigne AROMA™ grapes. In general, the sum of the free forms showed higher values in the musts obtained with the grapes of the treated vines compared to the grapes of the untreated vines. This result indicates that the effect of the treatments with these specific inactive yeasts lead to an increase in free forms of aromatic compounds, particularly benzyl alcohol and thiol-sulfur compounds, as observed on Glera and Sauvignon Blanc (Tomasi et al., 2016; Šuklje et al., 2016). The results from the analysis of aromatic compounds in bound form (Table 3) were congruent with what has been observed for free forms. In particular, compounds of the terpenes family such as nerol, geraniol, geranic acid and linalol oxides have increased considerably in the treated modality. Such compounds can generally contribute to the aromatic complexity, enhancing the floral aromas. In addition, the content of benzenes, and benzyl alcohol, increased as a result of the treatment; these compounds give complexity by providing notes of dried fruits. The total content of glycosylated aromatic compounds is therefore increased with the treatment. The values of thiols present in bound form in the modality treated are significantly higher than those of the control modality (Figure 1), showing notable increases for Cys-3-MH and for G-3-MH. This result, compared to the precursors of the thiol compound 3MH, makes it possible to postulate an increase in the aromatic typicity of Gewürztraminer wines (Román et al., 2016). Organoleptic evaluation of the micro-vinification wines of 2017,undertaken by a panel of tasters, matched the compositional analysis results. A triangular test confirmed that the two wines were different with a statistical probability of $p < 0.05$. The sensory profiles of both modalities (Figure 2) are particularly different in terms of notes of tropical fruits and floral aromas (rose), which led the tasters to define the organoleptic profile of wines treated with LalVigne AROMA™ as more typical of Gewürztraminer.

Conclusions

The data obtained from this trial confirm that the application of LalVigne AROMA™ resulted wines a greater typicity, highlighting the characteristics of this particular Gewürztraminer vineyard. This trial demonstrated that LalVigne AROMA™ can be used for aroma management in the vineyard. Improving the varietal expression of a vineyard can be achieved using foliar treatments based on inactivated specific yeasts, which act mainly on the secondary metabolism of the plant, increasing varietal aromatic precursors. The current trial results are supported by other similar trials (Tomasi et al., 2016, Šuklje et al., 2016, Tosi et al., 2017).

It should be noted that the effect of the treatments must be considered against the climatic conditions of the vintages. In the trials, average temperatures in 2017 were above average and precipitation was lower, resulting in an accelerated vegetative cycle; the 2018 vintage, on the other hand, was characterized by particularly abundant spring rains (40% more than the previous year), with a colder climate and thus a longer vegetative cycle. The treatment, without changing the parameters related to sugar accumulation and the pH of the grapes, is a useful tool to reduce the time gap between aromatic ripening and technological maturation, which is more and more common during warmer years (such as vintage 2017). At the same time, in colder climatic conditions, as in 2018, the treatment improved the organoleptic varietal profile and helped the plant to reach full aromatic maturity. ■

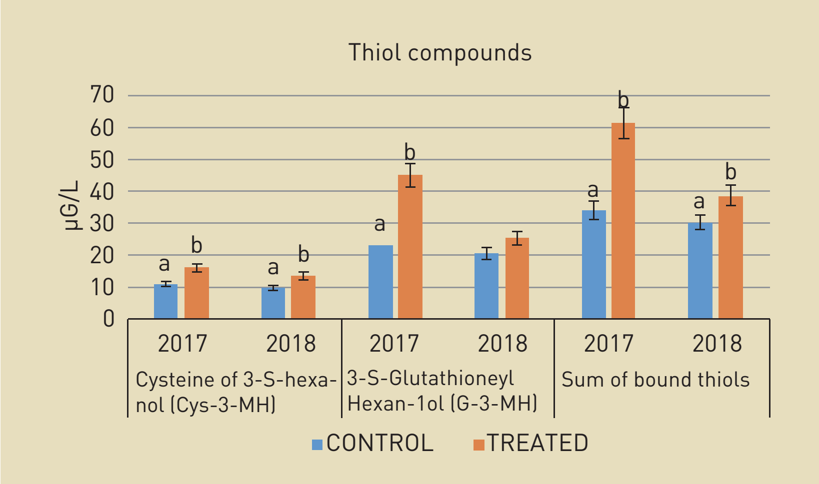

Figure 1 - Comparison of bound thiol compounds present in grapes treated and untreated with LalVigne Aroma. Different letters indicate significant differences with values of $p < 0.001$.

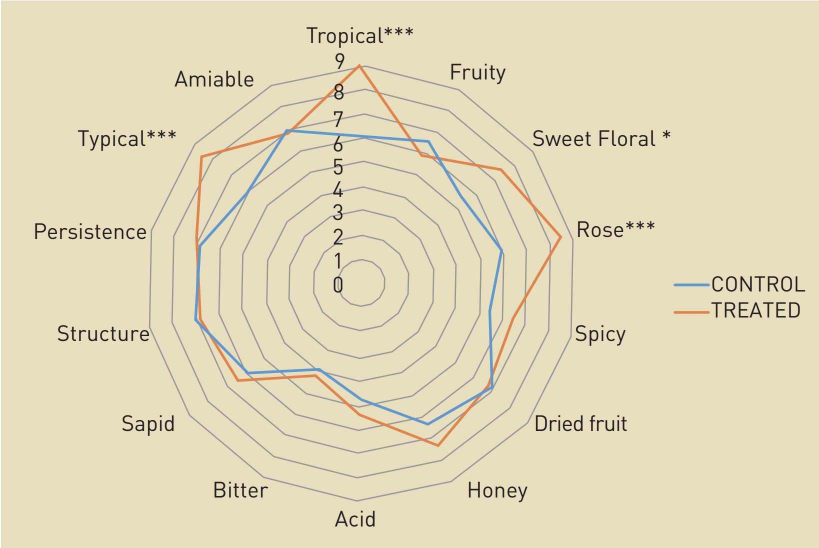

Figure 2 - Sensory profile of Gewürztraminer wines in both modalities (control and treated).
(* indicates an organoleptic difference with $p < 0.05$, while *** is $p < 0.001$).

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