The environmental adaptability of clones: Influence of the yeast strains and must clarifying in the modification of wine quality.

Die Adaptadation von Klonen: Einfluß des Hefestammes und der Mostklärung auf Veränderungen der Weinqualität

A. Cavazza, F. Iacono, M. Stefanini, G. Nicolini and F. Romano.
Istituto Agrario di S. Michele. I-38010 S. Michele all'Adige (Trento) Italy.

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Abstract

In a series of experiments with different Chardonnay clones planted on two sites and three yeast strains for fermentation as well as three methods of clarification, the final wine quality was evaluated with a sensory panel.

It was found out viticultural practices as well as clones and geographical site strongly influenced „green apple" flavors. The fermentative flavor is interactively influenced from site and yeast strain. Global flavor persistance and grassy flavor seems to be more influenced from yeast strain. Technological operations caused a decrease in some fruity flavors.

Key Words: Sensory evaluation, site, clone, clarification, factor analysis

1. Introduction

This work is the result of a multi-disciplinary approach in viticulturural and enological research using the tool of sensory analysis. The wine complexity, consisting of its composition and sensory, is indeed the integral result of many parameters, which can be studied and also optimized with different research issues. The use of sensory analysis enabled different groups of researchers working in our Institute to characterize successfully wines: sparkling base wines coming from grapes grown in different Trentino areas (Iacono et al., 1990) or from grapes harvested at different times (Versini et al., 1989) or from musts fermented with different yeast strains (Cavazza, 1990). Far from being complete, it was indeed possible to correlate some sensorial notes to the chemical composition of wines (Romano et al., 1987; Iacono et al., 1990). In this work we combined some viticultural, microbiological and technological parameters in the same experiment, and evaluated the results using a sensory analysis approach. The first ones, the viticultural variables, were different sites and Chardonnay clones, the microbiological ones were yeast strains for fermentation, and the technological ones were different types of clarifying the must.

2. Materials and Methods

Experimental plan:

A cross-comparison of all the considered variables would have lead to a grat number of variants which is nearly impossible to handle in microvinification. So, for each one of the tested variable, we arbitrarily chose three intensity levels; the intermediate was chosen as a control. Two sites were tested: Latina (50 km South from Rome) represented the hot climate, and S. Michele all'Adige (in the Alps near Trento) the cool one.

Three Chardonnay clones were tested: # 130 (control), # 78, and # 116. The latter are known to be different in aromatic intensity (Scienza, 1987). The yeast strains, belonging to our Institute's collection, were Ch 101 strain (control), Sy 612, which produces many fruity flavoured compounds, and Gtr 304, which delivers neutral wines (Cavazza, 1990).

The grape must clarification was done at two intensities. Control treatment was cold settling. First goal was to ferment a juice which was slightly cleared, and to omit fermentation of cloudy musts. The first level of clarification was made to add 40 g/hL bentonite, and the second (strongest) one by addition of 80 g/hL bentonite and 80 g/hL of K-Caseinate.

Comparisons of effects was achieved by varying one set of variables and taking all the others at the reference level or varying only one of the others. For example the yeast strains comparisons were made on two series: the first one on samples which had all other parameters at the reference level and the second on a different Chardonnay clone.

Vinifications:

Each trial was made from a 100 kg grape sample.

Grapes were crushed and pressed in a pneumatic press, 50 mg/L SO_2 were added. The juice was stored for settling 36 hours at 5 °C in a stainless steel tank and then racked.

When the must temperature exceeded 15 °C inoculation was done with a 5% (v/v) yeast suspension grown in the same must, collected as an aliquot during crushing, and which was actively fermenting. Fermentation temperature in the stainless steel tanks, was controlled at 20-22 °C. At the end of fermentation the wines were racked and cold-stabilized. Then they were clarified with 30 g/hL bentonite, filter-sterilized and bottled with a final SO_2 content of 90 mg/L.

Tastings and data processing:

Wine tastings were made by the Institute's Sensory Analysis Group, using the non-parametric card shown in Fig. 1, which was focused to differentiate Chardonnay wines. Each descriptor in the card was taken as a variable, whose value represented the perception intensity. Data were then standardized by tasters, giving them 0 as the mean value and 1 as Standard Deviation.

Variables transformed in this way underwent analysis of variance, using the SAS statistics package; as sources of variations, we took the viticulture-, microbiology- and enology-origin variables. Data were additionally analyzed with a factor analysis.

3. Results and Discussion

The first model considered the two sources of variation: Site and Clone (Tab. 1). Significant differences were found for green apple flavour ($p < 5\%$): differences between clones were significant at $p < 2\%$.

Other descriptors means did not show any difference whose significance was higher than 95%.

Considering the two sites, no significant differences could be detected. In order to get a view on the sensory characteristics of wines data were plotted, previously transformed as described, and connected with the variables means values, to obtain a sensory profile. This

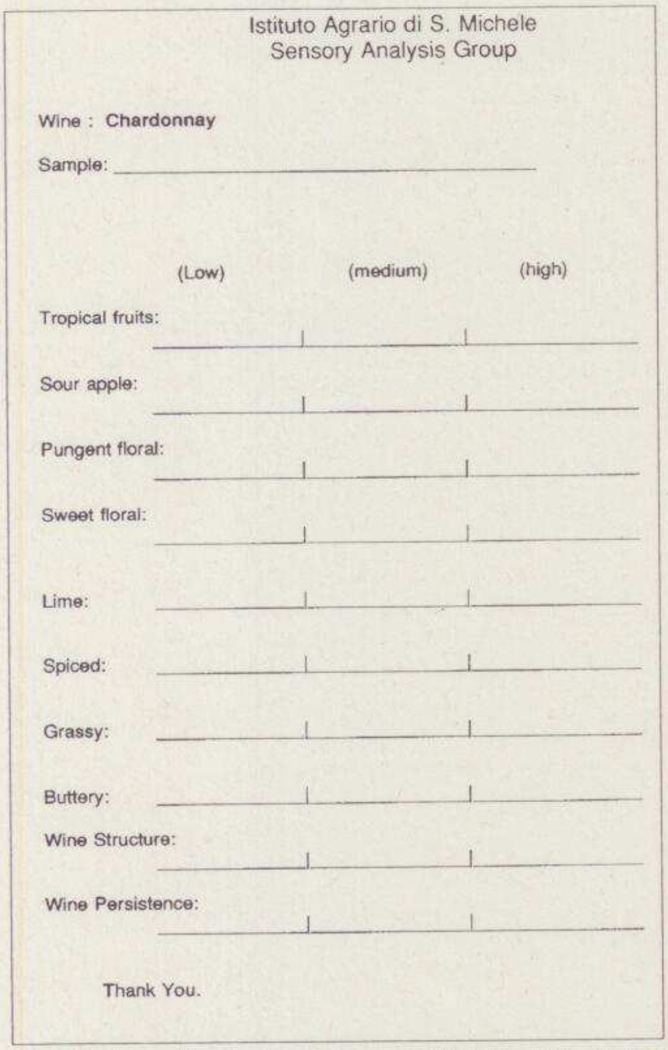

Fig. 1: Tasting card for Chardonnay wines: each line is an intensity scale of a sensorial note

Table 1: Analysis of variance applied to green/sour apple flavour sensorial note. Means of wines coming from different geographic sites and grape clones.

Dependent Variable: GREEN/SOUR APPLE FLAVOUR

Source	DF	Sum of Squares	F value	Pr > F
Model	3	6.48	2.86	0.0458
Error	52	39.32		
Corrected Total	55	45.81		
Source	DF	Type I SS	F value	Pr > F
Site	1	0.02	0.02	0.8755
Clone	2	6.46	4.27	0.0191

Means:

Site	Mean	Std Dev
S. Michele	-0.110	0.888
Latina	-0.067	1.016

procedure was applied to all the means arising by different sources of variations.

The sensory profiles of wines coming from S. Michele have higher intensities of many of the descriptors (Fig. 2) although their means are not all significantly different. The sensory profiles of tested clones are less clear (fig. 3).

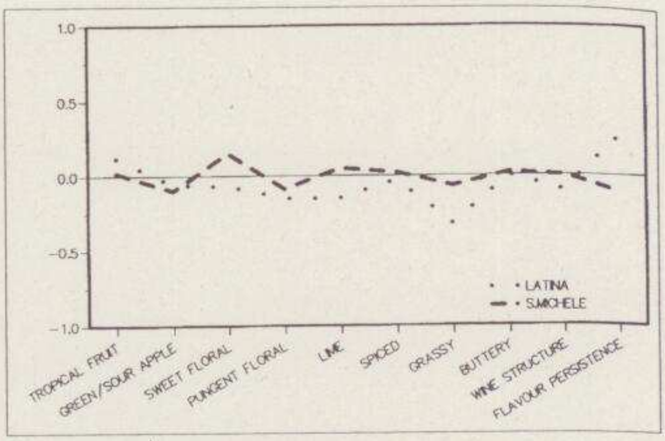

Fig. 2: Organoleptic profile of wines coming from different sites. The sensory profiles of tested clones are less clear (Fig. 3).

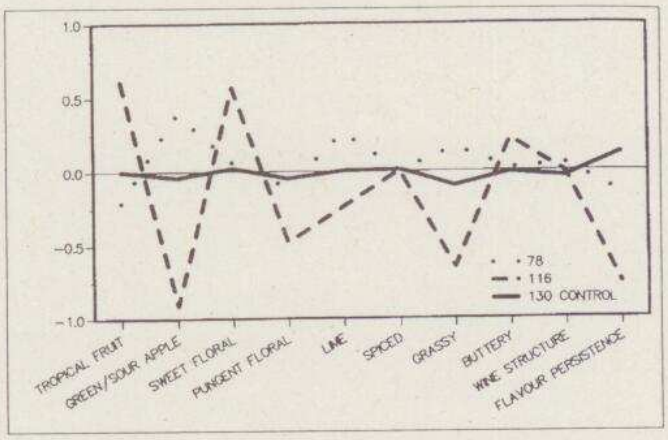

Fig. 3: Organoleptic profile of wines coming from different clones.

They showed similar behaviours regarding green apple, lime and grassy flavours, and opposite regarding fruity and floral flavours; we can also see that the control clone has a medium intensity of green apple flavour, the 78 clone ranks higher and the 116 one lower. In Table 2 and in Table 3 we can observe significant differences in Microbiological variables regarding grassy flavours (95.71%) and global flavour persistence (99.98%).

Table 2: Analysis of variance applied to grassy flavour sensorial note. Means of wines fermented with different yeast strains.

Dependent Variable: GRASSY FLAVOUR

Source	DF	Sum of Squares	F value	Pr > F
Model (Yeast strains)	2	5.55	3.36	0.0429
Error	50	41.33		
Corrected Total	52	46.87		

Means:

Yeast Strains	Mean	Std Dev
Ch 101 (control)	-0.433	0.741
Gtr 304	0.193	0.873
Sy 612	0.259	1.124

Table 3: Analysis of variance applied to flavor sensorial persistence. Means of wines fermented with different yeast strains.

Dependent Variable: FLAVOUR PERSISTENCE

Source	DF	Sum of Squares	F value	Pr > F
Model (Yeast strains)	2	14.57	9.89	0.0002
Error	50	36.83		
Corrected Total	52	51.41		

Means:

Yeast Strains	Mean	Std Dev
Ch 101 (control)	-0.078	1.024
Gtr 304	-0.752	0.434
Sy 612	0.597	0.933

The average flavour profiles of wines fermented with the different yeast strains are shown in fig 4.

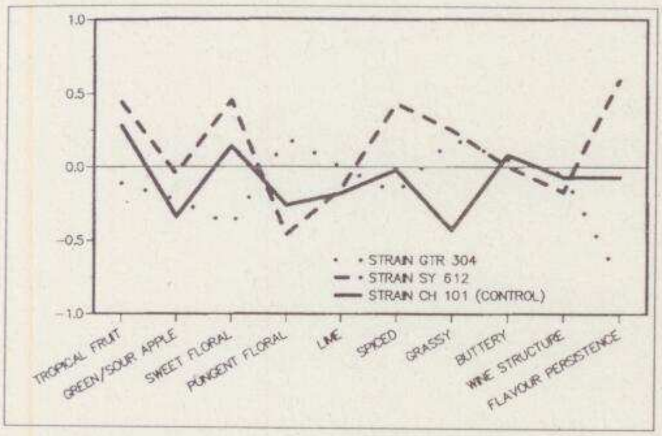

Fig. 4: Organoleptic profile of wines fermented with three yeast strains

Sy 612 strain gives wines rich in fermentative flavours (fruity and sweet floral), spiced and grassy, and fairly more persistent.

Technological parameters did not seem to influence significantly the wines. Examining the sensory profiles of wines (Fig. 5) a decrease of tropical fruits and sweet floral flavours, coupled with an increase of green apple and pungent floral flavours happened when stronger clarification procedures were applied.

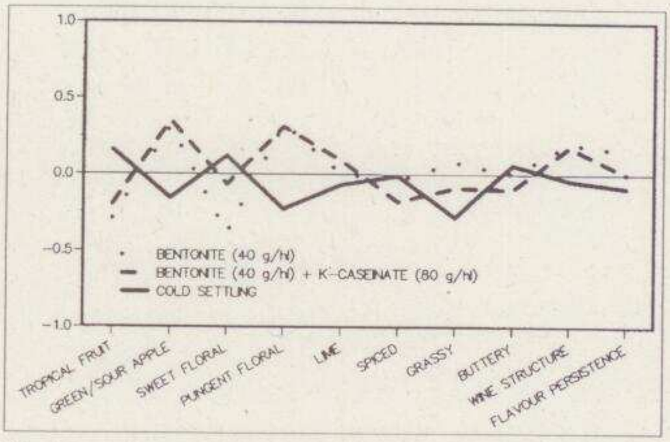

Fig. 5: Organoleptic profile of wines obtained with different methods of must clarification.

In order to better understand the interactions between the Viticultural, Microbiological and Enological origin variations, a Factor analysis was made (Varimax Rotation Method) to reduce the number of variables (Pages et al., 1987). The five calculated factors (Tab. 4) were then considered as new variables which underwent further elaborations.

The first calculated factor is well correlated to the fruity (tropical) and sweet floral flavours, namely the typical fermentative ones.

The second factor is linked to grassy and spiced flavours, the third one to green apple and lime flavours, the fourth to buttery flavour.

The fifth was well correlated with flavour persistence and, inversely, with wine structure.

The analysis of variance, applied to these 5 factors, firstly confirmed the previous mentioned results, demonstrating that this procedure was correctly applied. In fact, yeast data (Tab. 5) showed significant differences ($p < 2\%$) in factor 1 (fruity flavours) between means, and also in factor 5 (persistence/structure) with $p < 1\%$. By coupling the parameters it was possible to see interactions between their groups. Coupling Microbiological with Viticultural parameters (Tab. 6), the significance in site mean differences and an interaction between yeast strain and site emerged for the Factor 1, and this fact proves that the same yeast strain has a different bahaviour on the same clone if the site is changed .

Regarding the flavour persistence, which is yeast dependant in our trials, it did not show any interaction with site (Tab 7). Technological

Table 4: Rotated factor pattern for sensorial variables in tasted wines. Bold numbers emphasize relations between factors and sensorial pattern. (Varimax Rotation)

Rotated Factor Pattern	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
Tropical fruit	**0.70481**	0.25531	-0.34541	0.01573	0.04075
Sour Apple	0.00165	-0.17324	0.58302	0.48222	0.36465
Sweet floral	**0.81462**	0.05261	0.12640	0.01892	0.09992
Pungent floral	-0.49905	0.35480	-0.10667	0.46889	0.02424
Lime	-0.00065	0.13539	**0.83672**	-0.01046	-0.06534
Spiced	0.27404	**0.70724**	0.09772	-0.18420	0.02012
Grassy	-0.03798	**0.77780**	0.01951	0.03360	0.07039
Buttery	0.03175	-0.11253	0.05398	**0.86813**	-0.07088
Wine structure	0.13677	-0.21191	-0.35992	0.06360	**-0.62736**
Flavour persistence	0.25371	-0.02611	-0.20061	0.00762	**0.80479**

Table 5 a: Analysis of variance applied to factor 1. Means of wines fermented with different yeast strains.

Dependent Variable: FACTOR 1 (FRUITY-FLORALFLAVOURS)

Source	DF	Sum of Squares	F value	Pr > F
Model (Yeast strains)	2	10.75	4.25	0.0198
Error	50	63.23		
Corrected Total	52	73.97		

Means:

Yeast Strains	Mean	Std Dev
Ch 101 (control)	0.307	1.190
Gtr 304	-0.465	1.254
Sy 612	0.664	0.869

Table 5 b: Analysis of variance applied to factor 5. Means of wines fermented with different yeast strains.

Dependent Variable: FACTOR 5 (PERSISTENCE/STRUCTURE)

Source	DF	Sum of Squares	F value	Pr > F
Model (Yeast strains)	2	8.93	5.59	0.0065
Error	50	39.96		
Corrected Total	52	48.89		

Means:

Yead Strains	Mean	Std Dev
Ch 101 (control)	-0.104	1.066
Gtr 304	-0.558	0.610
Sy 612	0.495	0.882

Table 6: Analysis of variance applied to means of wines fermented with different yeast strains and coming from different sites (Factor 1).

Dependent Variable: FACTOR 1 (FERMENTATIVEFLAVOURS)

Source	DF	Sum of Squares	F value	Pr > F
Model	5	20.29	4.26	0.0017
Error	84	79.96		
Corrected Total	55	100.25		
Source	DF	Type I SS	F value	Pr > F
Yeast	2	8.58	4.51	0.0138
Site	1	3.79	3.98	0.0492
Yeast x Site	2	7.92	4.16	0.0190

Means:

Site	Yeast strain	Mean	Std Dev
S. Michele	Ch 101 (Control)	0.142	0.993
	Gtr 304	0.482	1.072
	SY 612	0.704	0.898
Latina	Ch 101 (Control)	0.069	1.016
	Gtr 304	-1.168	0.827
	Sy612	0.531	0.887

parameters (clarifications and yeast strains) confirmed the decrease of fruity flavours induced by the clarifications and by one of the yeast strains (gtr 304), while the sy 612 on contrary enhanced them (Tab. 8).

Table 7: Analysis of variance applied to means of wines fermented by different yeast strains and coming from different sites (Factor 5).

Dependent Variable: FACTOR 5 (PERSISTENCE/STRUCTURE)

Source	DF	Sum of Squares	F value	Pr > F
Model	5	10.37	2.61	0.0303
Error	84	66.71		
Corrected Total	55	77.08		
Source	DF	Type I SS	F value	Pr > F
Yeast	2	6.68	4.21	0.0182
Site	1	0.47	0.60	0.4416
Yeast x Site	2	3.21	2.02	0.1387

Means:

Site	Yeast strain	Mean	Std Dev
S. Michele	Ch 101 (Control)	-0.145	0.921
	Gtr 304	-0.118	0.783
	SY 612	0.313	1.006
Latina	Ch 101 (Control)	0.280	0.954
	Gtr 304	-0.717	0.694
	Sy 612	0.568	0.782

Table 8: Analysis of variance applied to factor 1 means

Analysis of variance

Dependent Variable: Factor 1 (FRUITY FLAVOURS)

Source	DF	Sum of Squares	F value	Pr > F
Model	4	13.68	3.72	0.0068
Error	118	108.32		
Corrected Total	122	122.00		

Means:

Variable	Mean	Std Dev
Gtr 304	-0.392	1.251
Sy 612	0.612	0.868
Control	0.123	0.996
Clarification	-0.434	0.734
Heavy clarification	-0.219	0.732

Conclusions

It can be stated that the observed differences between variables, in the observed populations, did not have the same weight varying the source of variations.

Viticulture linked sources of variations, such geographic site and particularly the clones, influenced the green apple flavours.

The fermentative flavours are probably dependant even on interactions between the yeast strain and site. This fact depicts that the effect and the weight of each one must be considered when evaluating the other. It give also an explanation why different yeast strains are used in different production areas.

Global flavour persistence and grassy flavours seemed to be linked to the yeast strain.

The technological origin sources of variation lowered some fruity flavours. Tastings were made only on a one year experiment, and the variables linked to viticulture, microbiology, and expecially wine technology are considerably changing, but we wonder to know wether their effect on wine sensory characteristics were of comparable intensity or one of them were much more important than the others: for this series of experiments it can be stated that they were of comparable intensity.

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