

Descriptive analysis of *Sangiovese* and *Cabernet Sauvignon* wines from different terroirs in D.O.C. Bolgheri (Tuscany)

M. BOGONI, G. MELÀ

Istituto di Colture Arboree, Università degli Studi di Milano
Via Celoria 2, 20133 Milano, Italy

ABSTRACT

Different terroirs have been identified in Bolgheri area (a viticultural appellation in the Tirrenian coast of Tuscany) by the aid of pedological, landscape and agronomic observations in 1993. Numerous preliminary observations suggested that wines obtained from these different terroirs were unique.

To confirm these observations sixty kilograms of *Sangiovese* and *Cabernet Sauvignon* grapes were harvested at the same maturation degree in homogeneous vineyards within each presumed terroir in 1993, 1994 and 1995 vintages. Grapes were later vinified according to a standardised scheme and bottled after malolactic fermentation in May.

To assess the role played by soil type and its immediate ambience over wine sensory properties, for each soil type two wines were obtained from two different vineyards located in the same environmental conditions.

Wines were firstly evaluated by standard chemical analyses.

The technique of descriptive analyses, combined with univariate and multivariate statistics, has been used to profile wine flavour and taste. Judges were trained in the use of specific descriptive terms, the intensities of which were consequently rated across the wines. In this study, the technique of descriptive analysis was successfully applied to define the sensory properties of different presumed terroirs in Bolgheri appellation.

INTRODUCTION

Different presumed *terroirs* have been identified in Bolgheri area (by the aid of pedological, landscape and agronomic observations carried on in 1993-1994), as "landscape units" homogeneous zones as concern soil type, plant available water, land morphology. The influence of landscape units on crop level, vine vegetative growth, grape composition and wine quality was the result of the combination of mesoclimatic conditions, soil characteristics, soil water and mineral nutrient availability (Bogoni *et al.*, 1996). Numerous preliminary observations, suggested that wines obtained from these different *terroirs* were unique (Scienza *et al.*, 1996).

MATERIAL AND METHODS

Microvinification.

In all "cultivar (*Sangiovese*, *Cabernet Sauvignon*) x landscape unit" combinations, experimental plots (replicated groups of vines) were chosen in homogeneous vineyards, single cordon trained (about 3300-4500 vines/hectare). Grape maturation was studied by weekly samples of berries from veraison to vintage in the three years period. At harvest, from the plots representative of landscape unit variation, sixty kilograms of grapes were vinified in San Michele Institute (S.Michele all'Adige, Trento) experimental cellar according to a standardised

scheme. Whenever possible, replications of the same landscape units were made to estimate variation in wines due to vineyard characteristics and management systems (Tab. 1-2).

Wines were bottled 6 months after vintage. Chemical analysis of wines were performed according to European Union official methods : alcohol (% on volume), reducing sugar (Feehling, g/l), total and volatile acidity (as g/l of tartaric and acetic acid, respectively), pH, free and bound SO₂ (mg/l), dry extract (g/l).

Panel.

Sensory analyses were performed partially by a trained panel of 10 judges in our Institute.

Preliminary discriminant sensory tests ascertained the significant differences existing among wines from different landscape units (not reported data).

Selection of descriptive terms.

At bottling and 8 months later 1993 Sangiovese wines were tasted to identify descriptive terms according to a standard reference list (Noble *et al.*, 1987) from individual evaluation of wines. In a third session, upon discussion of the wines, a consensus was reached on a final set of 11 aroma (fresh berry, jam berry, cherry, spicy, floral, vegetative dried, dried fruity, gamy, chemical, honey, woody burned) and 9 flavour by mouth terms (sourness, body, salty, alcohol, softness, bitterness, astringency, aroma persistence, overall appreciation). For Cabernet Sauvignon wines, according to this technique, a set of 10 aroma (fresh berry, jam berry, cherry, vegetative fresh, spicy, floral, vegetative dried, balsam, leather, phenols) and 9 flavour by mouth terms (the same of Sangiovese) was obtained. Attributes were summarised in two descriptive lists.

Table 1. Identification and characteristics of the 20 Sangiovese and 19 Cabernet Sauvignon wines.

Sangiovese					Cabernet Sauvignon				
Code	Vintage	Farm	Soil code	Origin (landscape unit)	Code	Vintage	Farm	Soil code	Origin (landscape unit)
1	1993	A	G	<i>Greppi cupi</i>	21	1993	A	G	<i>Greppi cupi</i>
2	1993	B	Cs	<i>Castagneto</i>	22	1993	G	G	<i>Greppi cupi</i>
3	1993	B	As	<i>Grascete</i>	23	1993	A	Ls	<i>Le Contessine</i>
4	1993	B	As	<i>Grascete</i>	24	1993	A	Cs	<i>Castagneto</i>
5	1993	C	G	<i>Greppi cupi</i>	25	1993	F	S	<i>Segalari</i>
6	1993	D	F	<i>Accattapane</i>	26	1994	A	G	<i>Greppi cupi</i>
7	1993	D	Fs	<i>Accattapane</i>	27	1994	A	G	<i>Greppi cupi</i>
8	1993	F	S	<i>Segalari</i>	28	1994	I	G	<i>Greppi cupi</i>
9	1994	G	G	<i>Greppi cupi</i>	29	1994	H	As	<i>Sassicaia</i>
10	1994	B	Cs	<i>Castagneto</i>	30	1994	I	As	<i>Sassicaia</i>
11	1994	B	As	<i>Grascete</i>	31	1994	I	As	<i>Sassicaia</i>
14	1994	D	F	<i>Accattapane</i>	32	1994	F	S	<i>Segalari</i>
13	1994	E	Cf	<i>Castagneto</i>	33	1994	I	Cs	<i>Castagneto</i>
12	1994	E	As	<i>Grascete</i>	34	1994	I	I	<i>Ornellaia</i>
15	1994	F	S	<i>Segalari</i>	38	1994	H	As	<i>Sassicaia</i>
16	1995	A	Ga	<i>Cerreta</i>	35	1995	A	G	<i>Greppi cupi</i>
17	1995	F	S	<i>Segalari</i>	36	1995	I	Cs	<i>Castagneto</i>
18	1995	B	As	<i>Grascete</i>	37	1995	F	S	<i>Segalari</i>
19	1995	B	C	<i>Castagneto</i>	39	1995	H	A	<i>Sassicaia</i>

Sensory analysis procedures.

Each taster, 9 months after bottling for each vintage, was requested to describe wines using terms reported in the two lists according to a structured nominal scale (perceptible=1, low=2, average=3, strong=4 and very strong=5). Results, as frequencies of use of an attribute (Gerbi and Zeppa, 1993), or as mean ratings were treated according to Quantitative Descriptive Analysis (QDA) techniques (Sauvageot, 1980). Sensory evaluation was completed by the evaluation of flavour by mouth attributes (fig. 4) on a structured scales (Iacono et al., 1994). Results concerning taste evaluation by unstructured scales are not reported in this paper.

Data analysis.

All statistical analyses were performed using Statistical Analysis System (SAS) (1988). The mean ratings of the 20 Sangiovese and 17 Cabernet Sauvignon wines for the aroma and taste by mouth attributes were then analysed by principal component analysis (PCA) (Guignard and Cliff, 1987). PCA was also performed on the chemical data across the 20 and 17 wines.

RESULTS

Chemical analyses of wines.

In Analysis of variance, Sangiovese wines obtained in different landscape units were significantly different as concern ethanol, total acidity, pH, volatile acidity. Replications of wines from each unit in the same or different years were not a significant source of variation except for dry extract. Cabernet Sauvignon wines obtained in different landscape units were significantly different as concern total acidity, pH, volatile acidity. Replications of wines from each unit in the same or different years were a significant source of variation except for total acidity, pH, volatile acidity.

Sangiovese wines from *Segalari* unit resulted of average ethanol content, had the highest acidity and extract, the lowest pH and volatile acidity (tabl. 2). *Accattapanè* wines had low ethanol content, low acidity and average pH. *Castagneto* wines had the highest ethanol, low acidity and high pH and volatile acidity. *Greppi cupi* and *Grascete* wines were positioned together due to their average ethanol, pH and acidity.

Segalari Cabernet had high acidity, low pH, the highest extract and average ethanol (tabl. 3). *Ornellaia* unit Cabernet had the highest alcohol content, high acidity, low pH and a good extract. *Sassicaia* Cabernet had average ethanol, acidity and pH. *Castagneto*, *Contessine* and *Greppi cupi*, units on very sandy soils, were grouped due to their high pH (over 3.7), average ethanol (but high in *Contessine* wines) and low acidity.

Table 2. Average alcohol, titratable acidity, pH, volatile acidity and dry extract for Sangiovese and Cabernet Sauvignon wines from different landscape units in 1993 and 1994.

Landscape Unit	Cultivar	Number of cases	alcohol %	titratable acidity g/l	pH	volat. acidit. g/l	dry extract g/l
Greppi Cupi	Sangiovese	3	11.86 ab	5.48 b	3.32 a	0.43 b	25.23 b
Grascete	Sangiovese	4	12.81 a	5.70 b	3.23 ab	0.41 b	25.46 b
Accattapanè	Sangiovese	3	10.84 b	5.14 b	3.23 ab	0.46 b	23.23b
Castagneto	Sangiovese	4	13.27 a	5.34 b	3.52 a	0.70a	25.39 b
Segalari	Sangiovese	2	11.81 ab	8.89 a	2.94 b	0.37 b	34.45 a
Greppi cupi	Cabernet S.	5	11.44 a	4.82 b	3.75 ab	0.78 a	27.95 b
Sassicaia	Cabernet S.	4	11.71 a	5.14 ab	3.59 abc	0.64 a	27.56 b
Castagneto	Cabernet S.	2	11.29 a	4.53 b	3.74 ab	0.74 a	27.42 b
Segalari	Cabernet S.	2	12.29 a	6.75 a	3.37 c	0.67 a	33.85 a
Contessine	Cabernet S.	1	12.51 a	4.05 b	3.92 a	0.81 a	28.80 b
Ornellaia	Cabernet S.	1	12.72 a	5.77 ab	3.50 bc	0.84 a	29.05 b

Alcohol as % on volume ; sugar as Feehling ; total and volatile acidity as g/l of tartaric and acetic acid, respectively ; total anthocyanins as mg/l of malvidin diglucoside.

Means with the same letter do not differ significantly at $p < 0.05$.

Sensory analyses of wines.

Sensory data obtained by the use of the descriptive lists of attributes were represented according to QDA techniques (fig. 1). On radiuses the percent of tasters which detected the corresponding sensory note was reported, according to Gerbi and Zeppa (1993).

The correlation matrix generated from the mean ratings of each wine across the different aroma and flavour by mouth terms was analysed by Principal Component Analysis.

As for Sangiovese, the first three "significant" principal components (PC), accounted for 38%, 28% and 14% of the variance, respectively. In Figure 2, the 20 Sangiovese wines from the three vintages are separated along the first PC according to the intensity of their fresh berry, spicy and floral aromas and flavour by mouth softness and alcohol. The position of wines on the second PC is determined by the intensity of their red colour and structure and by berry jam and gamy aromas.

In the plane formed by the first two Pcs (Fig.2), *Segalari*, *Accattapane* (except wine 14), *Castagneto* and, to a lesser extent, *Grascete* Sangiovese wines are clustered. Furthermore, *Segalari* and *Accattapane* clusters are separated from *Grascete* and *Castagneto* wines. *Greppi cupi* wines are not grouped together.

As for Cabernet Sauvignon, the first three "significant" principal components, explained 38%, 26 and 12% of the variance, respectively. In Figure 3, the 17 Cabernet wines are separated along the first PC according to the intensity of their fresh berry and spicy aromas and flavour by mouth structure, persistence and overall appreciation. On the second PC wines are reported according to the intensity of their alcohol and berry jam and leather aromas.

In the plane formed by the first two Pcs (fig.3), *Segalari*, *Greppi cupi* (except wine 21), and *Sassicaia* Cabernet wines are clustered. The three *Castagneto* wines are not clustered together : this landscape unit do not seem to induce a stability in Cabernet wines over different years. The wine from *Ornellaia* unit is clustered with *Sassicaia* wines.

CONCLUSIONS

The technique of descriptive analysis was successfully applied to define the sensory properties of different presumed terroirs in Bolgheri appellation.

Discriminant and descriptive sensory tests assessed the significant variability induced on Sangiovese and Cabernet Sauvignon wines by "landscape units", i.e. areas with homogeneous environmental conditions as concern soil, mesoclimate and landscape morphology, within Bolgheri D.O.C. territory. Furthermore, distinction among different "terroirs" was also achieved by standard chemical data.

The uniqueness of Sangiovese and Cabernet Sauvignon wines produced in some of these "terroirs" may be partially related to the high variation existing among sites and soil within Bolgheri Appellation (Bogoni *et al.*, 1996).

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ACKNOWLEDGEMENTS

Authors wish to express their grateful thanks to the *WINE SENSORY PANEL* in Istituto di Coltivazioni Arboree, Università degli Studi di Milano.

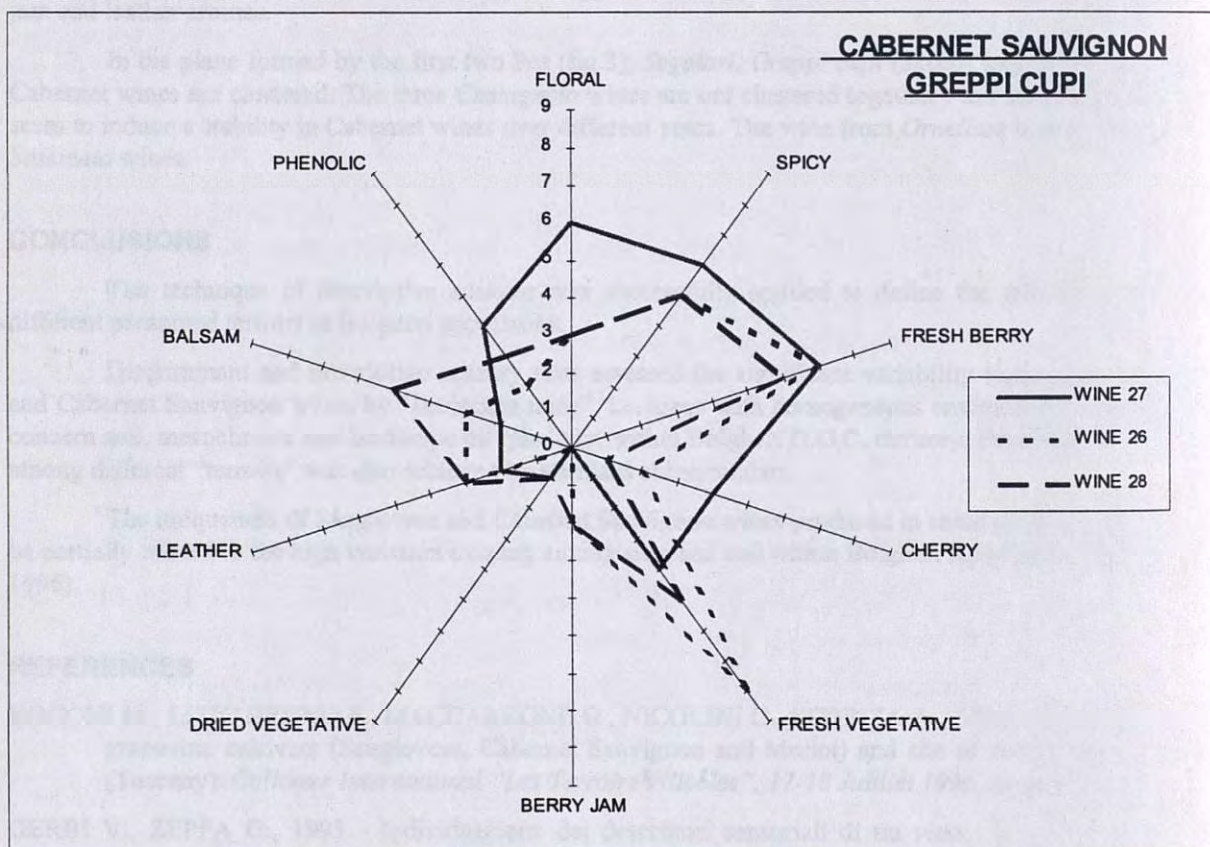
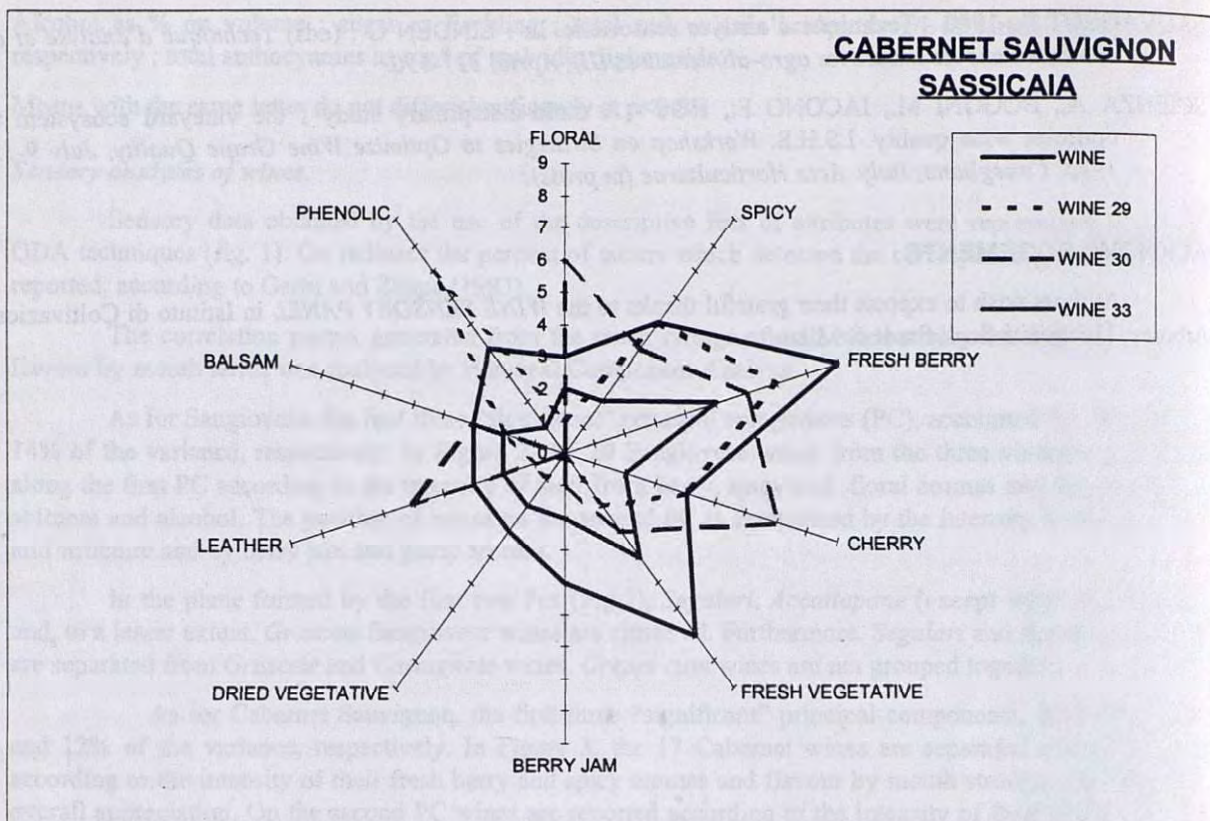


Figure 1. Quantitative descriptive analysis sensory profiles of Cabernet Sauvignon wines from 1994 vintage obtained in landscape unit *Sassicaia* (above) and *Greppi cupi* (below). On radiuses the percent of tasters which detected the corresponding sensory note was reported.

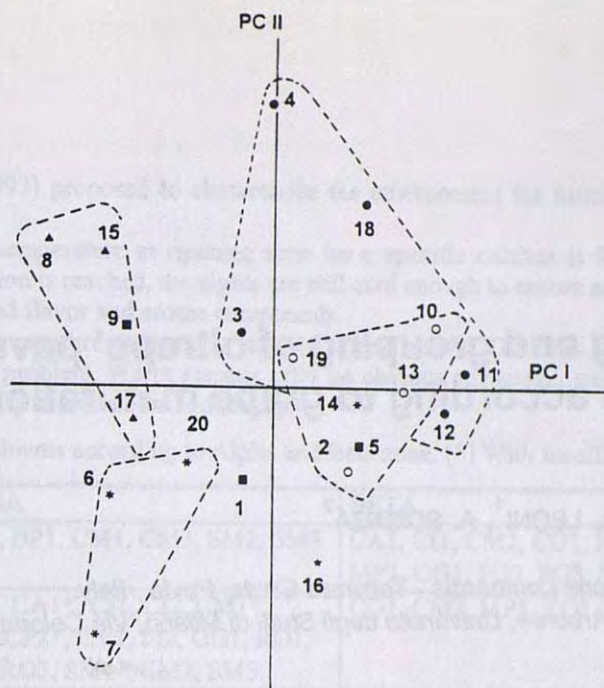


Figure 2. Principal component analysis of the mean ratings of the 20 Sangiovese wines from 1993, 1994 and 1995 vintages. The first two principal components are shown.

Sangiovese wines from the three vintages are separated along the first PC (38% of the variance) according to the intensity of their fresh berry, spicy and floral aromas and flavour by mouth softness and alcohol. The position of the wines on the second PC (28% of the variance) is determined by the intensity of their red colour and structure and by berry jam and gamy aromas.

Wine codes and origin, i.e., *Greppi cupi* (■), *Segalari* (Δ), *Grascete* (●), *Castagneto* (○), *Cerreta* (★) and *Accattapane* (★) are plotted.

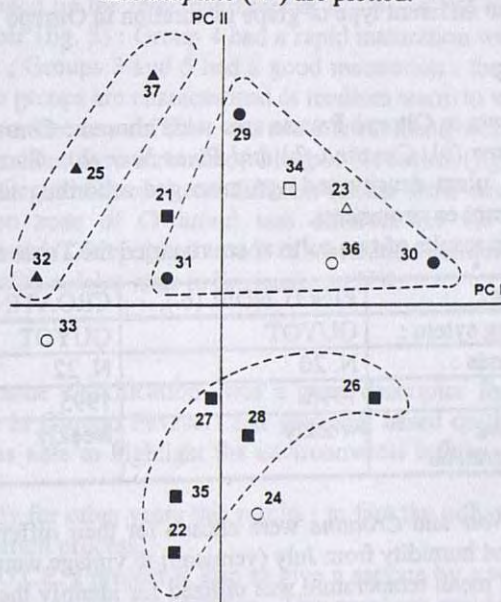


Figure 3. Principal component analysis of the mean ratings of the 17 Cabernet Sauvignon wines from 1993, 1994 and 1995 vintages. The first two principal components are shown.

Cabernet wines are separated along the first PC (38% of the variance) according to the intensity of their fresh berry and spicy aromas and flavour by mouth structure, persistence and overall appreciation. On the second PC (26% of the variance) wines are reported according to the intensity of their alcohol and berry jam and leather aromas.

Wine codes and origin, i.e., *Greppi cupi* (■), *Segalari* (Δ), *Sassicaia* (●), *Castagneto* (○), *Ornellaia* (○) and *Contessine* (Δ), are plotted.