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Sensory characterisation of Petite Arvine wines

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Introduction

Petite Arvine is an autochthonous grape cultivar used for wines unique to the Canton of Valais in Switzerland. This wine has become very popular, the acreage increased considerably from 1960 to 2000 and the production more than quintupled, to approximately 700 tons in 2003 (1). The flavour of Petite Arvine is described as fruity and floral (grapefruit, exotic fruit, rhubarb, wisteria, etc.), however, the compounds responsible for the characteristic flavour are mostly unknown. The knowledge of these compounds would allow the study of the biogenesis of the wine aroma during the vinification and the ability to enhance the formation of typical flavour compounds, and to prevent the formation of off-flavours.

Sensory evaluation of wines has been used for several purposes. On one hand sensory studies have been carried out to explore the typical flavour of specific cultivars, e.g. Chardonnay (2–4). On the other hand, sensory evaluation has been used to evaluate the influence of different steps in wine making (5), and the influence of malolactic fermentation on the wine aroma (6, 7). It has further been used to discriminate wines regarding their origin, site, vintage and quality (4, 8).

Many factors can influence wine attributes and therefore the sensory evaluation of wine. Even by using a trained panel and a strict procedure, it is necessary to develop a precise terminology in order to correctly describe the samples. Noble and co-workers (9, 10) developed the “wine aroma wheel”, where the terms are hierarchically structured in three levels. For every descriptor of the third level, containing the most detailed terms, a reference made of a neutral wine and a piece of fruit or spice was created in order to train the panellists and to establish wine description analyses.

Prior to this study, no scientific sensorial evaluation has been carried out on Petite Arvine wines. Reliable results on the typicality of a Petite Arvine wine and the intensities of certain descriptors were needed to assist in the identification of the flavour impact compounds of this wine cultivar.

Experimental

Selection of experimental wines

The Petite Arvine wines (vintage 2000) were collected all over the Canton of Valais from different producers producing a minimum of 1500 litres. The grape must of the samples had an average content of 23.3 °Brix (sd 0.9) at harvest. These prerequisites helped to avoid outliers due to too low production volumes, specific viticultural conditions or simply too low or too high sugar content. None of the wines was stored in wooden barrels because the woody notes might have been too dominant and may have masked the typical flavours of Petite Arvine wines.

For the first sensory session (February/March 2001), the young wines were taken directly from the storage tanks of the producers, transferred to bottles under argon and stored at 12 °C. For the second sensory session (March/April 2002), bottled wines were purchased at the wine cellars. The bottled wines were 100% Petite Arvine, not blended with other wines. Eventually some tanks of the same cellar were mixed before bottling.

Sensory analysis

Panels

Sensory evaluations were carried out with two panels. The main panel consisted of a dozen local wine experts (local oenologists and wine producers). The wine experts were experienced tasters due to their daily work with the vinification of Petite Arvine and their regular participation in official wine tasting. Their ages were between 35–65 years, mainly male, only three females participated.

The second panel consisted of 15 students of oenology at the University of Applied Science in Changins (ages around 25 years). The second panel was only employed once, to verify the found descriptors by the first panel.

Tasting conditions

All wines were tasted at a temperature of 12 °C and were evaluated by sniffing and tasting. The sessions took place in a specially designed room for sensory evaluation, making communication between the tasters impossible, white light was used. A volume of 40 ml of wine was presented in clear, tulip shaped tasting glasses. The wines were presented in random order, coded with three digit numbers. The tasting took place on different days to prevent fatigue of the panellists.

Creation of a list of descriptors

In the first session, taking place in spring 2001, the panellists described the wines without any given guidelines. After elimination of imprecise and hedonic terms, the panellists had to agree on a list of descriptors to describe Petite Arvine wines. The list of the descriptors was verified by a second panel of 15 panellists who were asked to describe the same samples of Petite Arvine, without being informed about the nature of the samples or the aims of the sensory experiment. A total of 11 wines were tasted; whereof one of the samples was eliminated because of an estery off-flavour that made the tasting impossible.

Attribute intensities to typicality

In the second session, taking place in spring 2002, the list of descriptors was shortened to the 12 descriptors showing the highest intensities in the samples tasted in the first session. A total of 7 wines were tasted, whereof one of the samples was eliminated because of a sulphurous off-flavour that made the tasting impossible.

Wine standards according to *Noble et al.* (9, 10) were used to facilitate an agreement between the panellists. The proposed standard references were either adjusted or newly developed for the purpose of being perfectly adapted to the tasting of Petite Arvine wines. In contrast to the references described by *Noble et al.* (9, 10), only fresh fruit or peel and no juice or canned fruit were used. The results with juice and canned fruit were unsatisfactory due to the "cooked" flavour of pasteurised (juice) or sterilised food (canned fruit).

The references were smelled by the panellists prior to wine evaluation. The recipes for the preparation of the odour reference standards are described in Table 1. The standards were freshly prepared on the days of the sensory evaluation (1–2 h before tasting).

Table 1
Recipes for the preparation of odour reference standards for the Petite Arvine wine descriptive analysis

<i>Descriptor</i>	<i>Recipe</i>
Cooked rhubarb	1 teaspoon of warm rhubarb compote
Fresh rhubarb	slice of 1 cm of fresh fruit, cut up into 5 pieces
Grapefruit	piece of peel of yellow grapefruit (2 cm ²)
Honey	1 teaspoon, dissolved
Lemon	piece of peel of lemon (1 cm ²)
Mango	10 g fresh fruit, cut up into small pieces
Passion fruit	6 pips of fresh fruit
Pear William's	5 g of fresh fruit, cut up into small pieces
Pineapple	5 g of fresh pineapple, cut up into small pieces
Violet	1 ml of a solution of essential oil (1 drop/l)
These references were prepared in 40 ml of white wine (Vin blanc, Provins, Sion, Switzerland) and served in wine tasting glasses.	
Box tree	crushed leaves of fresh plant
Quince	quince jelly
These references were served in small bowls.	

Categories

In both sensory sessions (spring 2001 and 2002), the panellists classified the wines according to their typicality into 7 categories (between 0 for no typicality and 6 for high typicality). The typicality was defined as the ease of identification of a sample as being a Petite Arvine wine. Wines, which could not be assigned to this variety, were considered as untypical.

The intensities of the descriptors were quantified on a non-structured scale (10 cm, divided into 100 units for interpretation) with a (-) and a (+) on the ends, indicating the minimum and maximum of intensity. Only the data of the second session were used as results.

Data analysis

The collected data were analysed by the calculation program Excel (Office 2000 for Windows/Microsoft), and were tested by an analysis of variance ANOVA (two-factor without replication). Further, the least square difference (LSD) was calculated in order to be able to compare the samples. A confidence level of $p < 0.05$ was chosen (11).

The correlations of two variables were calculated by linear least-squares regression.

Results and Discussion

Creation of the list of descriptors

The objective of the first session was to establish a list with the appropriate descriptors for Petite Arvine wines. The panellists described the wines, and the hereby-used terms were grouped into "families" and "subfamilies".

The tasting experiment with the uninformed panellists confirmed the descriptors introduced by the experts and added only a few new ones. The descriptors are listed in Table 2. All these terms were found to be useful to describe the tasted Petite Arvine wine samples.

The results of the classification of the wines according to their typicality and of the intensities of the descriptors (see table 2) were not satisfactory at the early stage of wine making. The results from the tasting of the 5–6 month old wines revealed no significant differences among the wines in scoring neither typicality nor the intensities of descriptors. The typicality of the wines and intensities of most of the descriptors were low (data not shown). Apparently the wines were too young and the estery flavours masked the typical flavours. This was in agreement with the experience of wine experts who recommend drinking Petite Arvine wine no earlier than one year after vintage. Esters formed during the fermentation process are subject to hydrolysis during wine maturation, thus diminishing their concentration (12).

Table 2
 Descriptors for Petite Arvine wine grouped into "families" and "subfamilies"

<i>Box tree like</i>	<i>Flowers</i>	<i>Rhubarb</i>
Blackcurrant leafs	Wisteria	Fresh rhubarb
Cat urine	Rose	Cooked rhubarb
Box tree	Lime tree blossom	
	Violet	
<i>Citrus</i>	<i>"Heavy" fruits</i>	<i>Roast-flavors</i>
Grapefruit	Blackberries	Toasted bread
Lemon	Blackcurrant	Roasted meat
Lime	Elderberries	Woody
Lemon peel		
Tangerine		
<i>Ester</i>	<i>Honey</i>	
Apple		
Quince		
Pear (William's variety)		
Banana		
<i>Exotic fruits</i>	<i>Red fruits</i>	
Pineapple	Strawberry	
Passion fruit	Raspberry	
Melon	Cherry	
Lychee		

The descriptor families "heavy" fruits, red fruits and roast flavours seemed to be unnecessary, since the intensities of these descriptors were very low. Also some sub-families were obviously less important.

Correlation of typicality and intensity of descriptors

Using the results of the first session, the list of the descriptors to taste was shortened. All descriptors with low intensities in the tasting during the first session were eliminated. The final choice was discussed with the panellist in order to assure that no important descriptor was eliminated. The descriptors used in the second session were (in alphabetic order): box tree, grapefruit, honey, lemon, mango, passion fruit, pear, pineapple, quince, rhubarb (cooked/fresh), and violet. The results are shown in table 3.

Table 3

Results of the sensory evaluation of Petite Arvine wine, mean values of the tasted descriptors of each wine; ANOVA of the results of the sensorial evaluation of Petite Arvine wine; confidence level and least square difference (LSD)

	Vétroz	Sion	Sierre	Leytron	Sion	Sierre	p-value	LSD
Box tree	27.44	29.00	21.44	46.56	33.56	6.33	0.038	23.4
Grapefruit	8.25	43.25	16.00	52.00	29.50	42.25	0.014	26.7
Honey	12.33	20.00	32.22	30.22	33.11	19.44	0.364*	–
Lemon	13.11	46.00	21.78	30.33	16.67	51.11	0.002	20.7
Mango	15.89	19.33	20.89	12.89	14.00	26.67	0.728*	–
Passion Fruit	23.11	27.44	34.22	28.22	32.33	17.44	0.782*	–
Pear (William's variety)	15.41	31.52	22.47	34.40	25.37	29.16	0.152*	–
Pineapple	31.25	19.13	69.38	36.75	29.00	27.125	0.022	28.9
Quince fruit	8.11	22.56	38.67	43.33	17.78	40.00	0.014	22.6
Rhubarb cooked	3.50	34.50	39.38	47.00	27.00	36.50	0.038	26.6
Rhubarb fresh	13.86	34.29	16.43	70.00	26.29	18.14	0.013	29.8
Violet	25.00	35.67	31.44	33.78	21.89	34.56	0.801*	–
Typicality	2.1	4	4.2	5.3	3.3	3.5	0.0002	1.07

* $p > 0.05$, results statistically non confident (the taster did not find any difference between the intensities of that descriptor), and therefore no LSD could be calculated. Range 0–100 for the descriptors and 0–6 for the typicality.

The results of the descriptors honey, mango, passion fruit, pear Williams, and violet were not statistically reliable and could therefore not be taken into consideration. For illustration, the most and the least typical wines are compared in Figure 1.

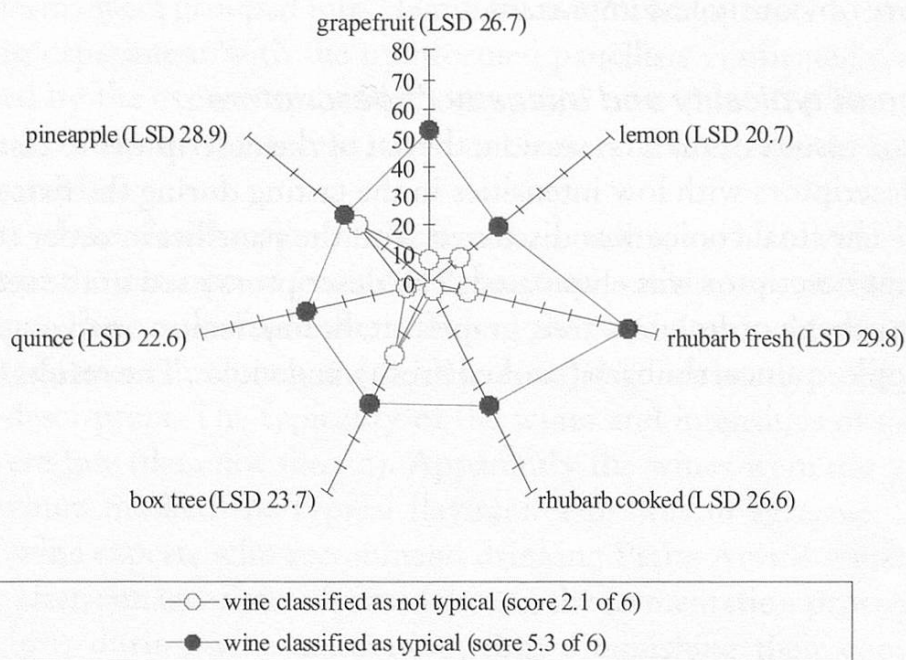


Figure 1 Descriptive analysis aroma profile of a typical and an untypical Petite Arvine wine

The most and the least typical wines had significantly different intensities in grapefruit, fresh and cooked rhubarb, as well as quince aroma, where the typical wine had higher intensities. These facts were affirmed by the correlation coefficients of the correlation between the intensities of the descriptors and the typicality. In our case (six samples tasted) the r-value had to exceed 0.811 to statistically confirm a correlation between the variables with a confidence level of 0.95 ($p=0.05$), or $r=0.729$ with a confidence level of 0.90 ($p=0.10$) (11). The descriptors showing high correlations are highlighted in Table 4.

Table 4
Correlations between the typicality and the intensities of the descriptors $p=0.05$ (dark) and $p=0.10$ (light)

<i>Descriptor</i>	<i>Correlation coefficient (r)</i>
Rhubarb cooked	0.925
Rhubarb fresh	0.820
Grapefruit	0.769
Quince	0.769
Box tree	0.443
Lemon	0.410
Pineapple	0.161

The intensities of fresh and cooked rhubarb, grapefruit and quince correlated well with the typicality of the Petite Arvine wine. The wine was considered as typical if it showed high intensities in these descriptors. The typicality of Petite Arvine wine was less dependent upon the intensity of the descriptors lemon and box tree and independent on the intensity of pineapple, even if this descriptor was often mentioned as an important flavour for Petite Arvine. The correlations between the single descriptors were also calculated. The correlation coefficients are shown in Table 5; the descriptors showing high correlations are highlighted.

Table 5
Dependences (correlation coefficient r) between the seven tasted descriptors of Petite Arvine wines. Significant correlations are highlighted, $p=0.05$ (dark) and $p=0.10$ (light)

	<i>Grapefruit</i>					
Lemon	0.723	<i>Lemon</i>				
Fresh rhubarb	0.743	0.16	<i>Fresh rhubarb</i>			
Cooked rhubarb	0.733	0.529	0.578	<i>Cooked rhubarb</i>		
Box tree	0.232	0.428	0.771	0.12	<i>Box tree</i>	
Quince	0.571	0.496	0.439	0.898	0.0099	<i>Quince</i>
Pineapple	0.446	0.404	0.156	0.082	0.059	0.407

The intensities of certain descriptors were highly correlated. The wines that were intense in grapefruit were also intense in lemon, fresh rhubarb and cooked rhubarb. Box tree is correlated with fresh rhubarb and quince with cooked rhubarb.

Two possible reasons for the correlation of two descriptors can be accounted for. One possibility is that the panellists were not able to distinguish properly between two of them. This effect was tried to be minimized by using the wine references and a trained panel. The other possibility is more likely: The correlated aromas are caused by the same or by chemically related compounds. The compounds responsible for the descriptors in Petite Arvine wine are still partly unknown. Some of the compounds in the aroma of Petite Arvine have been identified by gaschromatography and olfactometry (14); however, the study of the volatile compounds of Petite Arvine wine has to be the subject of further studies.

Conclusions

The present study showed that Petite Arvine wines considered as typical show high intensities in rhubarb, grapefruit and quince aroma.

The sensory evaluation revealed that the wines of Petite Arvine could not be tasted and classified before an age of 12 month since the estery notes resulting from the alcoholic fermentation mask the typical flavours.

The use of reference standards has proofed to be an effective tool to improve the reliability of descriptive sensorial analyses.

The flavour of Petite Arvine is often described as flowery. However, in this sensorial evaluation, the data of the flowery compounds were statistically not interpretable. In a further session, these aspects should be studied in detail. For this reason, a panel specially trained on flowery aromas, should be considered.

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Summary

The wine of Petite Arvine is a local white wine specialty of the Canton of Valais/Switzerland. The characteristic aroma of Petite Arvine wine is described as fruity and flowery. Up to now, no scientific sensorial evaluation has been performed on this wine. In this study, a descriptive sensorial analysis was carried out. The intensities of the descriptors were correlated to the typicality of the wine samples. The descriptors "cooked rhubarb", "fresh rhubarb", "grapefruit" and "quince" are correlated positively and can be considered as important for the characteristic flavour for this wine variety.

Zusammenfassung

Petite Arvine ist eine autochthone Traubensorte aus dem Kanton Wallis/Schweiz. Das typische Aroma des Weines wird als fruchtig und blumig beschrieben.

Bis jetzt fehlte eine wissenschaftliche sensorische Analyse dieses Weines. In der vorliegenden Arbeit wurde eine beschreibende sensorische Analyse durchgeführt. Dabei wurden die Intensitäten der einzelnen Deskriptoren mit der Typizität der Weinproben korreliert. Die Deskriptoren «gekochte Rhabarber», «rohe Rhabarber», «Grapefruit» und «Quitte» korrelierten positiv mit der Typizität und können deshalb als charakteristisch für das Aroma der Petite Arvine betrachtet werden.

Résumé

La Petite Arvine est un cépage autochtone du canton du Valais/Suisse. L'arôme typique est décrit par les oenologues comme fruité et floral, mais une analyse sensorielle scientifique manquait encore. Nous avons donc effectué une analyse sensorielle descriptive qui a permis de mettre en évidence les intensités des descripteurs liés à la typicité des échantillons. D'après cette analyse, les descripteurs «rhubarbe cuite», «rhubarbe fraîche», «pamplemousse» et «coing» sont corrélés positivement avec la typicité de la Petite Arvine et doivent donc être considérés comme caractéristiques pour le bouquet de ce cépage.

Key words

Petite Arvine, sensorial analysis, typicality, aroma, wine

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