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Descriptive Sensory analysis of Monovarietal Spanish Young Red Wines. A Comparison between Trained and Untrained Panels

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Abstract

In the wine industry, wine is often characterized by professional tasters. Methods commonly used in descriptive sensory analysis, as "conventional profiling," require intensive, experiment-specific training and thus cannot be applied by a panel of untrained tasters, even if they are wine professionals. Some spontaneous methods such as free profiling do not require time-intensive training sessions. This study compares wine sensory characterization obtained with a panel of trained judges and other with a panel of untrained judges using the free choice profiling in both case. Data were analyzed by generalized procrustes analysis. Representations provided by the two methods are broadly similar, but reveal some disparities, although both panels are valid to evaluate the sensory characteristics of wines. Free profiling may be a good compromise to obtain meaningful results from untrained but knowledgeable wine professionals.

Keywords: Minority red grapes; Free choice profiling; Untrained panel; Trained panel; GPA.

Introduction

Knowing the sensory characteristics of food products among their competitive universe is a key priority in the food industry. To reach this objective, quantitative descriptive analysis is used to specify the nature and the intensity of the sensory characteristics perceived when a product is evaluated [1]. In industry, it represents the ideal methodology since it is known to provide detailed information and reliable and consistent results [2]. However, the use of this technique raises several questions.

Descriptive analysis is a primary tool of food sensory scientists which involves the evaluation of both the qualitative and quantitative sensory characteristics of products by a trained panel. Sensory scientists from academia and food industry have developed several descriptive methods, some of them trademarked, reflecting various philosophies of descriptive analysis. They include the Flavor Profile [3], the Texture Profile [4], Quantitative Descriptive Analysis TM [1], Sensory SpectrumTM [5], Free Choice Profiling [6], Quantitative Flavor Profiling [7] and Flash profile [8]. However, the most widely used profile technique – based on ISO NORM [9]-combines different aspects from the above mentioned methods and is generally named conventional descriptive analysis (DA).

In order to provide qualitative as well as quantitative measures of a wine's properties, descriptive analysis has been widely used [10-20].

Free Choice Profiling (FCP), initially applied to port [6], is an interesting tool for evaluating sensory properties of foods from the consumer's point of view [21,22]. As regards sensory descriptions, the language of a consumer is more global, not analytical and less accurate than the language of experts, which differs because of the exhaustive definition of the sensory attributes of a particular product [23]. FCP can easily be performed with consumers, who

develop an individual vocabulary in their own, non-scientific language during judging a set of products, and who score the products by using this vocabulary; it is further assumed that the sensory character of a product is perceived similarly by the panelists, who use an idiosyncratic vocabulary [24]. As both the descriptors between individuals and the number of descriptors per assessor may differ largely, it is necessary to refer to special multivariate methods to compare different data matrices [25]. After deriving a consensus product space by Generalized Procrustes Analysis (GPA) [26], it is possible to gain information on the way how consumers differentiate between the items under study [27].

The aim of this paper was to compare the descriptive profiles generated by trained panel and by untrained panel in Spanish monovarietal young red wines.

Materials and Methods

Wines

Red wines from six cultivars grown in La Mancha region middle-southeast of Spain, harvested in their optimal ripening stage (23–24 °Brix; pH 3.4–3.6) and in good sanitary conditions, were used for winemaking. Three batches of grapes (20 kg each) of the cultivars, Rojal, Tortosí, Merlot, Moravia Agria, Moravia Dulce and Bobal, were elaborated in vats of 10 l, with skin maceration until the alcoholic fermentation finished. Winemaking conditions were: addition of 100 ppm of SO₂, as K₂S₂O₇, after stemming and crushing, inoculation with *Saccharomyces cerevisiae cerevisiae* selected yeasts (UCLM S325, Fould-Springer), and fermentation temperature kept at 24°C. Manual punching down was done twice a day. Separation of the wines from solids was performed when relative density reached a constant value. Subsequently, the malolactic fermentation was induced by inoculation with *Oenococcus oeni* lactic acid bacteria (Lactobacter SP1; Laffort); this second fermentation finished in 2–3 weeks, as confirmed by TLC, and then the wines were racked. After 1 month, the wines were racked again, filtered through 1.2 µm membranes (Millipore, Bedford, MA, USA), bottled, and stored in a conditioned room kept at 16–18°C.

Assessors

Untrained: A number of students from Food Science and Technology (University of Castilla-La Mancha) were selected. Selection criteria were availability for the assessments, interest to participate in the study, the absence of aversions, allergies or intolerance against wine, normal perception abilities, and no wine craving. After 10 sessions of 1 h a group of 11 assessors was formed (5 female, 6 male). None of the panellists had a specific training in sensory evaluation of wine, nor previous experience with FCP.

Trained: The assessors of trained panel were members of department of Food Technology of University of Castilla-La Mancha. Eight persons (5 female, 3 male) contributed to trained panel. All members had a long experience in wine sensory analysis.

Free-choice profiling

In the first of two sensory sessions, the assessors were given brief introduction into the methodology and the procedure of FCP [28]. In single sessions, they were then

confronted with the seven encoded wine samples at once, asked to taste the samples and to use their individual vocabulary for describing sensory characteristics and key features related with the aroma of wines. The participants were also instructed to refer only to objective attributes and not to use hedonic terminology. Based on the descriptors used by the panelists in the preliminary session, individual score cards were prepared. These score cards were sheets of paper, labeled with the name of the assessor, with the particular descriptor, and line marking scale of a length of 10 cm [29]. Endpoints were labeled with the attributes “not perceptible” (not at all) and “clearly perceptible” (extremely). In this session (on average, 3–4 days after session 1), the samples were served monadically, and the serving order of the six samples was randomized (Fizz software).

During judgement, it was up to the assessors to eliminate the one or other descriptor if it came to their mind that it had become irrelevant, or to join two descriptors into a new one.

Statistical analysis

The data from Free Choice Profiling, i.e., the intensities of each attribute as evaluated by the assessors, were analyzed using the GPA tool in the Senstools V.3.0.11 software (OP & P Product Research BV, Utrecht, The Netherlands).

Results and Discussion

Generation of descriptors

Table 1 showed the summary of the selected descriptors produced by the assessors. The total number of different descriptors generated was higher with the untrained panel than with the trained one. According to Moskowitz [30] the experienced panellists use fewer descriptors than the novices, because it seems that the effort expended in accurate description replaces the effort used to capture all attributes however in this study the total number of descriptors used by trained panel was higher than untrained panel.

Table 1. Summary of the selected descriptors produced by the assessors.

Odour descriptors							
Untrained panel				Trained panel			
Assessors	Initial	Selected	%	Assessors	Initial	Selected	%
1	17	8	47.1	1	15	14	93.3
2	13	5	38.5	2	14	12	85.7
3	18	10	55.5	3	16	12	75.0
4	14	5	35.7	4	15	12	80.0
5	12	5	41.7	5	15	13	86.6
6	12	5	41.7	6	14	10	71.4
7	13	7	53.8	7	15	11	73.3
8	10	5	50.0	8	16	13	81.3
9	6	0	0				
10	7	1	14.3				
11	11	4	36.4				
Panel average	12.1	5.18	42.8	Panel average	15	12.1	80.7
Total*	55	16	30.0	Total*	35	16	46.0

Descriptors were selected when they were individually discriminant ($p < 0.15$) and used by at least.

*Total number of different descriptors generated by the group of assessors.

In this study the mean individual total number of different descriptors generated was similar for both panels. The higher total number of different descriptors generated by the untrained panel may be due to the higher number of assessors and their lower level of agreement and not to a greater ability in the generation of valid descriptors. In fact, the mean individual number of selected descriptors using the expert panel was more than double that of the untrained panel. The selected descriptors by expert panel were individually discriminated ($P < 0.15$), such as those of the untrained panel. These results were according to the observed by [31] using the same methodology with almond.

An increase in the percentage of selected descriptors (effectiveness) represents a saving in work and time for the assessor and the analyst. The mean individual value of this percentage was higher for the expert panel than for the untrained one. The untrained assessors generally tend to use a limited, inconsistent and relatively nonspecific vocabulary to describe their perceptions [32]. This could explain the loss of effectiveness.

Tables 2 and 3 show the selected descriptors by assessor of each panel and the frequency of use.

The untrained assessors generally use easier but more redundant descriptors. The level of agreement among these assessors tends to be low. They presented a lower mean frequency of descriptor use, 0.31, compared to that of the expert assessors, 0.81, who after several years of joint evaluations and discussions have a higher descriptive homogeneity.

Table 2. Frequency of the use of selected descriptors by the untrained assessors.

Descriptors	Assessors untrained panel											Total
	1	2	3	4	5	6	7	8	9	10	11	
Sweet	*	*		*		*	*	*		*		7
Apple		*	*									2
Alcohol	*		*	*	*		*					5
Red fruit	*		*		*		*	*		*		6
Wood	*		*	*								3
Fresh		*				*						2
Vanilla		*	*									2
Acetaldehyde	*		*							*		3
Licorice		*	*									2
Floral	*					*	*	*		*		5
Spices	*				*							2
Tobacco	*		*									2
Coffee			*				*	*		*		4
Fruit				*	*	*	*	*				5
Grass			*			*	*					3
Smoke				*	*							2
Total	8	5	10	5	5	5	7	5	0	1	4	55

*Descriptor used by assessor "N".

The similarities and differences in descriptors between the panels can be seen in attributes listed in tables 2 and 3. The descriptors "Sweet", "Vanilla" and "Spices" from the untrained panel could be considered respectively synonymous to the expert panel descriptors: "Sweet spices"; the former being more comprehensible to the consumers. These results show the utility of profiles generated by inexperienced panels [27].

Table 3. Frequency of the use of selected descriptors by the trained assessors.

Descriptors	Assessors trained panel								Total
	1	2	3	4	5	6	7	8	
Red fruit	*	*	*	*	*	*	*	*	8
Alcohol	*	*	*		*	*		*	6
Violet	*	*	*	*	*	*	*	*	8
Pepper	*			*	*		*	*	5
Coffee	*	*	*	*	*	*	*	*	8
Tobacco	*	*		*	*	*			5
Wood	*	*	*				*	*	5
Sweet spices	*		*		*		*	*	5
Fresh	*	*	*		*	*	*	*	7
Floral	*	*			*		*	*	5
Ripe fruit	*	*	*	*	*	*	*	*	8
Clove		*	*		*	*		*	5
Licorice			*	*	*	*	*	*	6
Fresh fruit	*	*	*	*	*	*	*	*	8
Green	*	*	*	*	*	*	*	*	8
Leather	*		*	*	*		*	*	6
Total	14	12	13	10	15	11	13	15	103

*Descriptor used by assessor "N".

The Descriptive Profile of the untrained Assessors

The residual Procrustes statistics by assessor and sample are shown in Table 4. The values represent the sum of square distances between individual configuration of each subject or product and the consensus configuration after Procrustes Analysis [33]. The lower the value the higher the agreement with the consensus. Only assessors 9 and 10 showed an important difference with respect to the rest of the panel. According to [34,35] this may be due to their low number of attributes (6 and 7 descriptors respectively).

Table 4. Residual Procrustes statistics by untrained assessors and sample.

Assessor	Residual	Product
1	1.68	BO
2	2.36	CFA
3	1.22	MD
4	2.38	RO
5	2.57	MA
6	2.45	TOR
7	2.03	Total
8	2.52	
9	23.4	
10	14.1	
11	2.99	
Total	57.7	

The distribution of the samples in the consensus space (Figure 1) is indicative of the differences between wines. The first two dimensions explained most of the variance among the samples, with the remaining dimensions explaining only a small proportion of the variance (<6%). Dimension 1 explained 30.12% of the total variance, while dimension 2 explained 26.25%. According to these Bobal and Merlot wines were the most different, and the wines made with the rest grape varieties were grouped in two different groups, one formed by Moravia Agria and Tortosí wines and the other one by Moravia Dulce and Rojal wines.

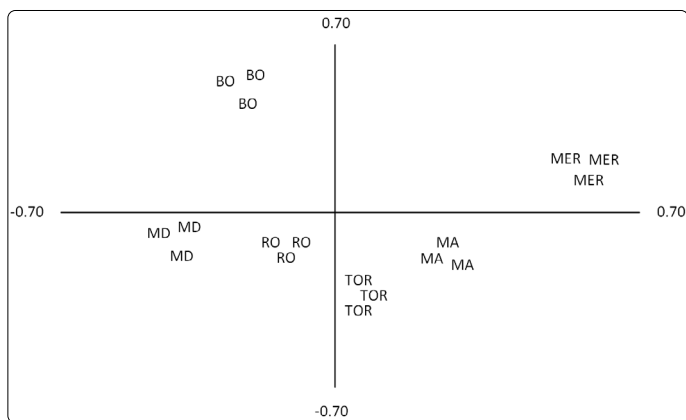


Figure 1. GPA group average of untrained Panel: Dimension 1 (x axis) vs dimension 2 (y axis).

The descriptors of dimension 1 are floral, alcohol and fresh in the positive direction and sweet and coffee located in the negative direction and. The attributes more correlated with the dimension 2 are red fruit and fruity in the positive direction.

The aroma of Bobal wines were characterised by red fruit, coffee and fruity odour with sweet notes. Aroma profile of Merlot wines showed high intensity of alcohol, floral and fresh with red fruit and fruit notes. Floral, fresh and alcohol were the most important descriptor for the aroma of Moravia Agria and Tortosi wines and the aroma of Moravia Dulce and Rojal wines presented sweet and coffee notes.

Descriptive Profile of trained panel

The distribution of the samples in the consensus space (Figure 2) of trained panel is indicative of the differences between wines. The first two dimensions explained most of the variance among the samples, with the remaining dimensions explaining only a small proportion of the variance (<3%). Dimension 1 explained 31.60 %of the total variance, while dimension 2 explained 23.09%.

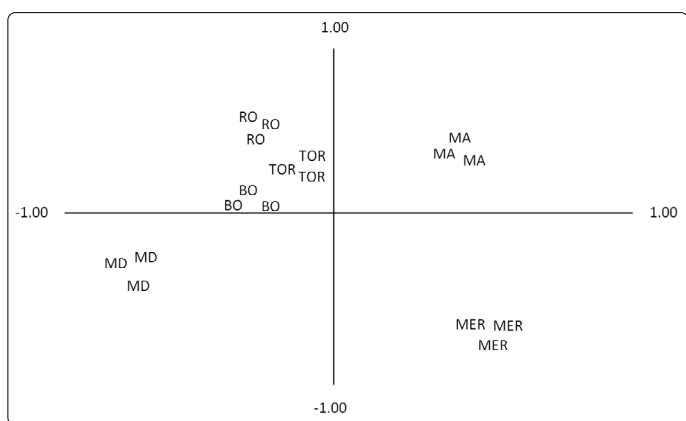


Figure 2. GPA group average of trained Panel: Dimension 1 (x axis) vs dimension 2 (y axis).

These two dimensions may be interpreted according to the content of table 5, which list the descriptors most closely correlated with both dimensions.

Moravia Agria and Merlot wines were grouped according with dimension 1 by floral and violet notes. Rojal, Tortosí, Moravia Dulce and Bobal wines were judged as red fruit, fresh, with liquorice, tobacco, coffee and sweet spice notes.

Dimension 2 explains a low percentage of variance; according to this dimension, Moravia Dulce and Merlot wines presented higher ripe fruit, wood aroma and pepper notes than the rest wines.

In descriptive profile analyses the samples are normally very different in order to allow for the generation of a high number of descriptors [36,37]. The product by assessor interaction was not significant ($P > 0.05$) in any descriptor [38], which indicates a high level of agreement among the assessors [1]. The assessor and session effects were not significant either ($P > 0.05$).

Table 5. Descriptors most closely correlated (>0.7) with the first two GPA dimensions and mean data of the loading

Dimension 1	Dimension 2
Floral (0.98)	Ripe Fruit (-0.81)
Violet (0.82)	Wood (-0.79)
Red fruit (-0.98)	
Licorice (-0.86)	
Sweet spices (-0.85)	
Fresh (-0.78)	
Tobacco (-0.76)	
Coffee (-0.70)	

Only those descriptors with absolute correlation coefficients greater than 0.70 have been included.

Conclusion

The Free Choice Profiling with untrained assessors reduces the main problems associated with the QDA analysis in reference to the time consumption in training and adjustment of an expert panel, and produces descriptors which are simple and easy to understand, and can be used to describe the characteristics of a product with several complexity as wine. Untrained assessors are capable to generate a similar number of descriptors to the expert assessors, though they showed a lower efficacy in the generation of descriptors. In general the untrained assessors used less specific and sometimes redundant descriptors. Profiles obtained by both panels are similar in an overall sense when the samples are clearly different, though only the expert assessors are able to discriminate.

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