

Sensory Evaluation of Wines as a part of Certification of Protected Designation of Origin in Greece and the EU

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Abstract

According to EU legislation, wines of Protected Designation of Origin (PDO) are products whose names are protected under this particular designation and must be produced, processed and prepared within a particular geographical environment and must have qualities or characteristics exclusive to that area with its inherent natural and human factors. PDO wine certification schemes are a crucial part of control for these “qualities or characteristics” and especially the wine’s organoleptic profile. This is also the key point of consumer perception and preference, as well as, one of the bases of product communication and marketing for the wine sector. Due to the importance of the wines sensory profile, scientists have continuously advanced sensory testing by refining, formalizing, structuring, and codifying both new and old methods, as a mean of quality control, product development and recently, product certification.

This paper will focus on the current use of, sensory techniques in wine research and of PDO wine evaluation, characterization and certification. An analysis of the EU and Greek legislation is presented, in comparison with that of other countries, and their standards regarding: test room installation, product and panel conditions and glasses; general basic vocabulary; general methodology of sensory evaluation; selection, training and monitoring of skilled wine testers; and organoleptic assessment of PDO wines.

In anticipation of the new OIV regulations and the Greek system for PDO wine certification, this work proposes a variety of sensory analysis methodologies which can be used in that context.

INTRODUCTION

In the European Union winemaking tradition and legislation, as well as, the place of origin of a wine plays a significant role for its quality and characteristics. Grape cultivation, wine production and commercialization are in part based on the system of Appellations of Origin (French AOC). Through centuries of practice a combination of grape varieties, soils, climates, viti-vinicultural practices and other factors have been identified as critically important for high quality wine production, resulting in what is called “terroir effect”.

Through the recent wine Common Agricultural Policy (CAP) and the European Commission Regulations (EC Reg. 479/2008) a new system has been put in place for the recognition and certification of the Protected Designations of Origin (PDO). In that regulation, as well as, those that came after (EC Reg. 491/2009, incorporated in EC Reg. 1234/2007) “designation of origin” means the name of a region, a specific place (or in exceptional cases a country) used to describe a wine that complies with the following requirements: a) its quality and characteristics are essentially or exclusively due to a particular geographical environment with its inherent natural and human factors, b) the grapes from which it is produced come exclusively from this geographical area, c) its production takes place in this geographical

area, d) it is obtained from vine varieties belonging to *Vitis vinifera*. The applications for protection of names as designations of origin includes a technical file containing, the name to be protected, the name and address of the applicant, product specifications and link to the region. The specifications contain a description of the wine, its principal analytical and organoleptic characteristics, where applicable, the specific oenological practices used to make the wine, as well as, the relevant restrictions on making the wine, the demarcation of the geographical area concerned, the maximum yields per hectare, an indication of the wine grape variety or varieties the wine is obtained from, the details bearing out the link mentioned in point a) above, other applicable requirements laid down in Community or national provisions or, where foreseen by Member States, by an organization which manages the protected designation of origin, having regard to the fact that such requirements shall be objective and nondiscriminatory and compatible with Community law and the name and address of the authorities or bodies verifying compliance with the provisions of the product specification and their specific tasks. The final decision for the approval rests in the hands of the EU Commission (EC).

As before, within this new system, the annual verification of compliance/certification of PDO wines is being conducted in three steps: a) administrative verification (grape provenance, varieties, yields, place of vinification, viticultural and oenological practices, etc), b) analytical verification of PDO wines, c) organoleptic verification of PDO wines. Many EU countries have already adjusted their national legislation to reflect the EU regulation (France, Spain, etc). In these countries significant changes were made as in certain PDO's national authorities relinquished part of their mandates to new sector organization, who took most of the roles of the State Organizations.

Greece is in the process of drafting a new law for the implementation of the new system. There lies the opportunity to improve on the previous systems and get benefits for the sector and the consumers.

The purpose of the annual verification of compliance/certification of PDO wines, is to assess and confirm the absence of faults and the "typicity" of the wine (Casabianca *et al.*, 2005). Typicity is one of the most important attributes defining a PDO wine and it is defined as the specific and distinct properties that can be identified/described by a human group who is a reference. These properties are the technical, cultural, social and other properties including the sensory typicity of a PDO, also called sensory "typicality". (Maître *et al.*, 2012). "Typicality" is the level of representativeness of an item in a category. Wines of a specific PDO are not all the same, but they share (or must share) certain common sensory characteristics. Thus, the sensory typicality of a given wine can be measured by the perceived distance between a reference (prototype) wine and the given wine. Based on the previous definitions, the establishment of these sensory characteristics and of the sensory evaluation methods for the wine typicity, must be based on the agreement of the opinion of a human reference group. This group consists of professionals of the sector that must be experts in sensory evaluation. (Nicod 2006) and must have a clear understanding of what the "prototype" is.

When deciding on how to organize the organoleptic certification of PDO wines there is a number of questions that need to be answered. Sensory typicality can be assessed either by a) evaluation, b) characterization, c) accreditation. For each one of these approaches we must define:

- i) Who is going to do it? Which is the human reference group, as well as their number, composition and training and what is the consensus on the typicality of the specific PDO?
- ii) What are samples?
- iii) What methodology are we going to use?

Concerning the samples, PDO regulations clearly state that all PDO wines must pass the organoleptic analysis to be granted PDO status. A question that rises is, if the group, can not only find the specific sensory properties of the PDO, in wines produced according to the technical files, but also if they are able to exclude other wines (not of the PDO) tasted as mock samples in the same sessions.

Concerning the human reference group, the accepted composition is achieved by the use of wine professional, with the majority being oenologists. The previous system in Greece used 3 assessors, which is considered an inadequate number. The French system uses 7, who are chosen from a pool of assessors, previously controlled and trained. A larger number of assessors provide more confidence, minimizing errors regarding potential physiological and mental state problems of assessors on the day of the test, as well as, peer or sector pressure not to eliminate wines. At the same time it enhances statistical results and can also provide additional information on the samples, or the PDO as a whole.

Prior to the formation of the group of assessors, selection procedures for assessors should also include: a) Tests to detect inabilities, b) Tests to determine sensory awareness (detect a stimulus, discriminate between intensity levels of a stimulus), c) Participation in inter-laboratory tests.

Once the assessors have been selected and a panel has formed, they should undergo training and continuous development. One of the objectives is to optimise the technical knowledge of experts by training them and developing their sensory potential. Training should include a variety of testing methods (theoretical and practical) and checking assessors' performance (repeatability, reproducibility, discriminatory power). Training should also be provided in the olfactory and taste evaluation of wine defects, which is one the main reasons for a wine failing a sensory analysis PDO certification. Monitoring assessors' performance can be achieved by a) Odour description tests, b) Identification of defects in wine using solutions, c) Identification of the most common defects in wine, d) Tasting of different types of tannins or other substances giving similar but slightly different stimuli. The International Organization for Vine & Wine (OIV) is currently developing a number of useful resolutions for this purpose (OENO-SCMA 11-475, 11-440, 12-508), which are based on the relative ISO standards.

It is certain that professionals who work in the PDO region, have high experience, however in light of the previous mentioned problem (peer/sector pressure, monitoring performance, etc) the question is if the group should also have a number of professionals not related to the region. The professional must have an extensive experience not only, in winemaking and especially in sensory analysis in general, but also, they must have an extensive experience of the specific PDO wine in question. However, this alone is not enough. They must have also built a consensus as a group of what the "prototype" is? Although, the technical files for each PDO wine describe their basic sensory characteristics, randomly selected assessors, even experts, may have a different understanding of them. Consensus can be achieved only by training of the group as a whole. Thus, training should be provided on the positive distinct properties generally attributed to the specific PDO wines (olfactory, taste and tactile) and/or with a variety of the specific PDO wines, as well as, positive distinct properties generally not attributed to the specific PDO wines.

The above laborious and time consuming training for proficient wine quality/sensory analysis is necessary because as it has been shown (Kwan and Kowalski, 1980; Gawel, 1999; Scaman *et al.*, 2001; Francis *et al.*, 2004), random wine judges' panels do not always have the required consistency. In a survey of 65 wine judging panels (2005-2008), only 30 panels had results close to similar, while most exhibited variations attributed to judge inconsistency and/or lack of concordance (Hodgson 2008). An analysis of variance showed that only about 50% of the panels presented awards based solely on wine quality. As shown by Gawel and Godden (2008) the ability of experienced wine tasters during Australian competitions to

consistently rate wines for overall quality varied greatly between individuals and was generally better for red wines than white.

Concerning the methodology for typicality assessment over the last 10 years, oenology and sensory science researchers have been experimenting with a number of different sensory analysis tests and their adaptation for PDO wine certification. In this work we have explored the use of a number of these methodologies (Pérez *et al.*, 2007).

METHODOLOGIES & RESULTS

Sixteen PDO Santorini dry white wines (vintage years 2012 and 2013), free of technical faults, were assessed for typicality of varietal/terroir character, to determine if each wine exhibits the predominant character of a wine produced mainly from the Assyrtiko grape variety (at least 75%) and the distinct Santorini terroir. A number of non-Santorini Assyrtiko wines, as well as, non Assyrtiko dry white wines were also used for discrimination purposes. The Panel consisted of 12 previously trained and monitored, experienced enologists, winemakers and sensory analysis experts. A panel of 8 wine experts without specific previous training in PDO Santorini wines was also used. Facilities, conditions and glasses used, were conforming to OIV resolutions. Sensory evaluation was repeated twice, and panelist repeatability/reproducibility/discrimination, was checked with replicates, both in the same and different sessions.

The sensory analysis methodologies used for assessing typicality are listed below in groups:
Typicality evaluation may be assessed by:

- a) A simple question of typicality (Ballester & al 2005) on a free scale line and Monadic sequential presentation without repetition. This is an easy and simple test based on a question like: "Do you think this wine is a good example or bad example of Santorini PDO dry white wine?"

Additional information can be obtained using the free scale (diagram 1), after statistical analysis such as mean values, standard deviation and other.

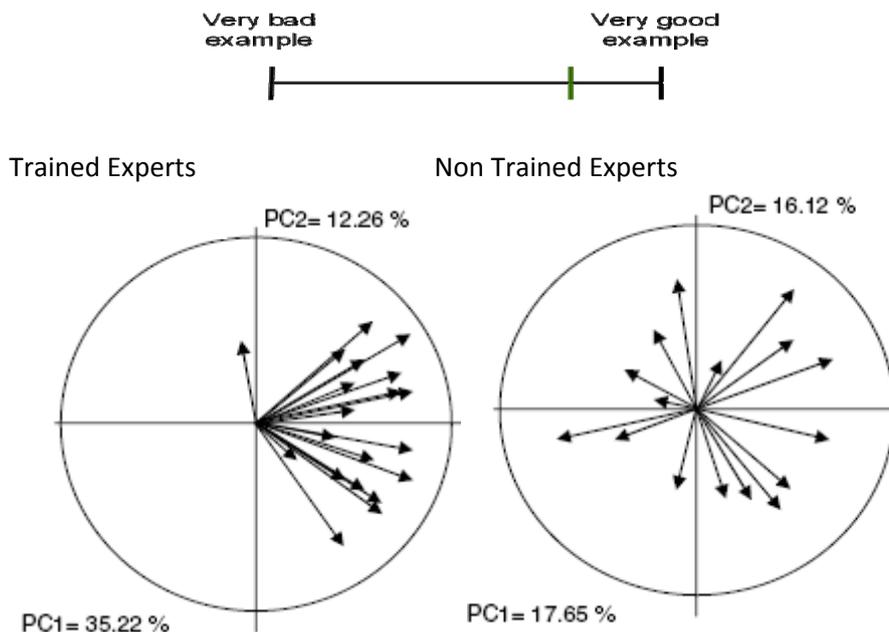


Diagram 1. Free scale line and PCA analysis examples for trained experts (agreement) and non trained expert panel (non agreement)

This method relies heavily on the expertise of the assessors and their ability to have the common prototype (specific PDO) memorized, but for such a group it results in significant consensus (diagram 1 – trained experts). On the other hand if the panel does not have a clear understanding of the specific PDO wine, then it cannot be used for typicality evaluation.

b) Sorting tasks, like Free sorting tasks (Ballester & al, 2008, Parr *et al.*, 2010) and Projective mapping like Napping® (diagram 3) (Perrin & al, 2008), either linked or not to a typicality rating. These methods can be performed without using language or completed by a sensory description. They could be used in discriminating specific PDO wines from other wines of the same variety, or other wines of similar varieties. Free sorting tasks consist of tasting and smelling the wines and grouping them according to their similarities (diagram 2). Other methods include sorting with an imposed group, with predefined categories or hierarchical sorting. They can be performed by trained or untrained assessors (about 20) with a large number of products (up to 20), in a relative short time, compared to other methods and without the need for replication. Replicated samples can be used to check the assessors. Experiments using sorting tasks are generally analyzed using multidimensional scaling (MDS) or sometimes multiple correspondence analysis or variations of these methods. Additional methods have been developed (Abdi *et al.*, 2005) in order to get valuable information on individual assessors and on the consensus between assessors when individual assessor matrices are analyzed.

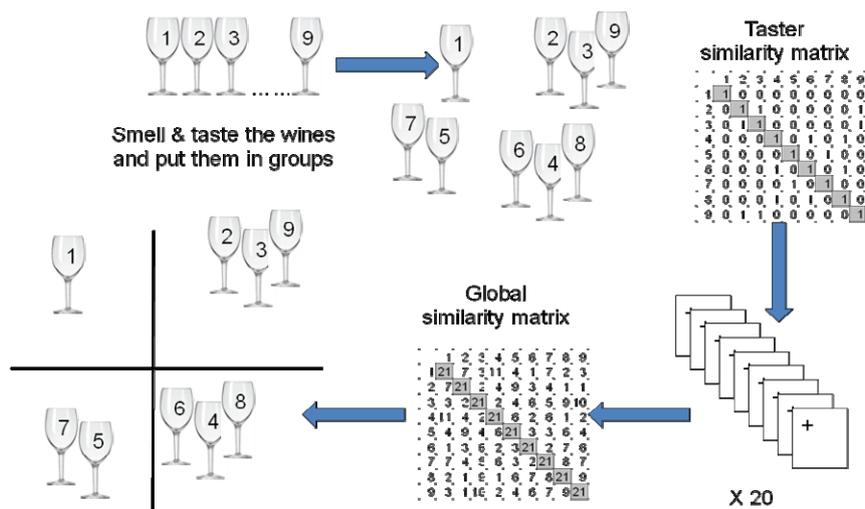


Diagram 2. Example of Free sorting tasks

Napping® is a variation on sorting tasks. Samples are positioned on a piece of paper (40x60 cm) so that similar samples are close together and different samples are far from each other. Distance depends on the similarities/differences. The recorded coordinates of each sample are taken from each assessor's paper for all assessors. They can be performed by trained or untrained assessors (about 20) with a large number of products (up to 15), without need for repetition, Statistical analysis of the results can be performed by Multiple Factorial analysis or Hierarchical analysis & PCA.

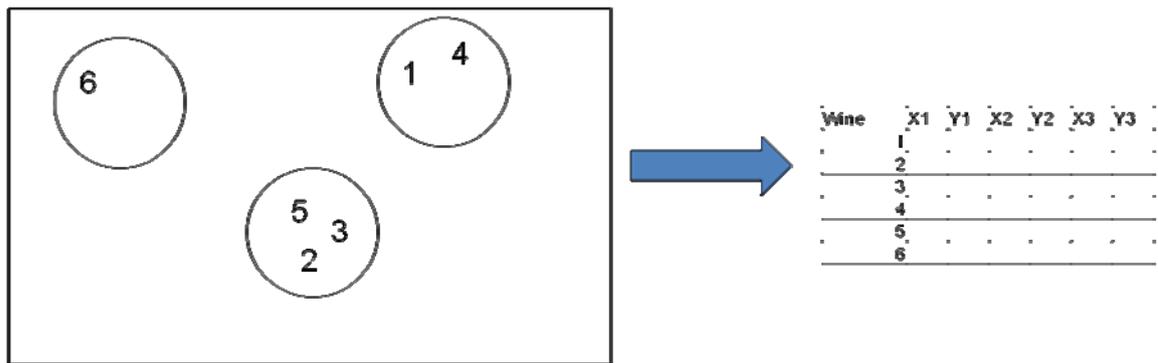


Diagram 3. Example of Napping®

For free sorting tasks, expert assessors trained in PDO Santorini wines had 100% success in wine typicality identification. In cases of wine experts without PDO Santorini training, some non-Santorini Assyrtiko wine were scored above average.

This is an easy test which can be performed by untrained experts. However it presents a difficulty for the assessors, when all wine characteristics, for taste and odour, have to be taken in account simultaneously, as in some cases individual assessors group either by taste or odours. Results showed more than one group existed for PDO Santorini Assyrtiko wines and in some cases a non Santorini Assyrtiko wine was included in such a group.

Napping® performed after free sorting tasks gave interesting results, but suffered the same problems mentioned before (taste/odour grouping), as shown by the results of a typicality rating which differed from the first (above) and the sensory description of the groups. It is obvious that additional panel training is needed for these methods in order to obtain higher assessor performance.

All these tests can be used to distinguish products belonging or not to the specific PDO. They are also very useful in assessing the ability of the panel members to exclude wines that are not of the specific PDO. Since they are often used in consumer tests they can give valuable insight to the producers on how their products are perceived by consumers.

As we mentioned before, the EU legislation approves the specific requirement regarding each PDO wines. These requirements are in the technical file, which describes also the analytical and sensory properties of these wines that have to be found by the panel during the sensory analysis for the PDO certification. For example the requirement regarding the PDO Santorini dry white wines are the following: Varieties: Assyrtiko (minimum 75%), Aidani, Athiri. Analytical characteristics: Alcohol >12 % vol, residuals sugars <4 g/L, total acidity (as tartaric acid) >5,5 g/L, Sensory characteristics: Appearance - bright green-yellow color, Odor - complex nose with aromas of yellow fruits, notes of lemon and orange peel and a characteristic minerality in the background. Taste - rich taste with balancing acidity giving structure, providing fresh aftertaste. This is the description of the reference (prototype) wine and those are the sensory characteristics that have to be present during the sensory analysis for the PDO certification. As anyone can understand a theoretical knowledge of those characteristics is not enough for someone to be able to positively identify PDO Santorini dry white wines, as many of the attributes are found in other wines. It is thus necessary for the panel members to have an extensive first hand sensory knowledge of the PDO wines themselves. This is even more important as different PDO wines have varying intensities of these attributes, depending on the vineyard, the microclimate, the time of vintage, the oenological practices, etc. However, using language to describe these wines can be performed with a number of methods.

The use of classic wine quality evaluation methods using score cards (Davis 20 points scale, OIV competition scorecards, etc) are not specific enough to differentiate between PDO

wines. Moreover, some of the parameters like “balance”, “harmony”, etc, are not defined enough and scoring criteria are not specified enough, leading to scores that are influenced by the opinion, formation and personal experience of each expert.

The use of language to describe the typicality of a specific PDO wine is what gave as the attributes contained in the PDO technical files and is what permits the communication of the wine characteristics. The terminology used in this description is based on the common experience, of the professionals of each viticultural area, which has been developed though the years after multiple group wine tastings.

Typicality characterization can be assessed by panel of trained experts with a variety of methods such as:

- Choice of attributes, (Esti, 2010) and free descriptive analysis
- Classical profile (Perrin et al, 2008) and free classic sensory profile with quantification of fixed terms
- Free methodologies
 - a. Citation frequency, (Campo 2010)
 - b. Free choice profiling, flash profiling (Perrin, 2008) descriptive analysis
- **Mixed choice profile** Sensory characteristics and attributes are assessed using a mixed profile questionnaire and evaluation was performed using five grading categories

Choice of attributes is a method that permits to tackle the first challenge of using language, which is the choice of sensory attributes which are truly characteristic of a specific PDO wine, from a statistical point of view. As seen in diagram 4, after assembling a list of 113 descriptors related to wine sensory analysis, we submitted 16 PDO Santorini dry white wines to a panel of 12 experts. The experts were asked to use as many descriptors they needed to describe each one of the 16 wines. After analysis of the results, we found that 53 descriptors were used by more than 50 % of the experts and 15 descriptors were common to all samples.



Diagram 4. Results using Choice of attributes methodology.

These descriptors included the ones in the technical file, but also more terms related to aroma, taste and mouth feel. These descriptors could also be used as a short list for the quantification of the typicality.

A classical profile with with quantification of fixed terms was also used to characterize typicality. Results (diagram 5) show that all PDO Santorini dry white wines give similar profiles with score between the two blue lines. Other wines (non PDO Santorini had scores outside the blue lines. When using expert related to Santorin, panel performance consistent, and the appellation effect was evident. This is because normally professionals from the same geographical area have common experience/knowledge and language/vocabulary.

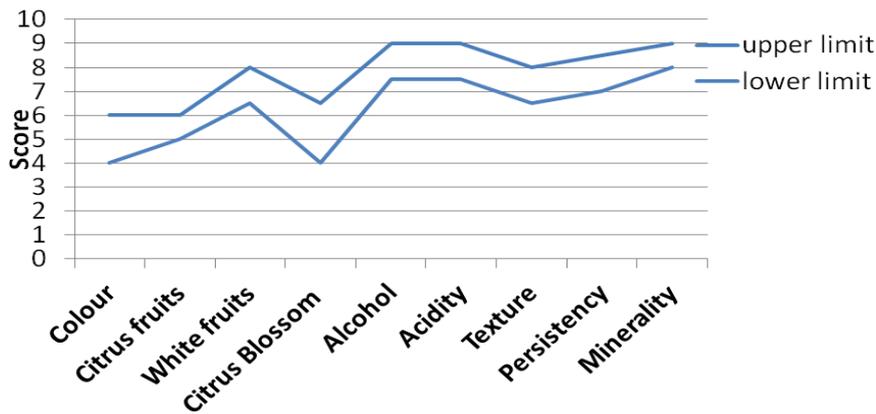


Diagram 5. Classical profile of PDO Santorini white wine with quantification of fixed terms

Free methodologies like citation frequency and free choice profiling or flash profiling can also be used by trained experts, but present less precision and more difficulties for statistical evaluation. However, when a large number of trained professional is used, because of their expertise they are able to give new, unexpected additional information. The disadvantages of free methodologies can be minimized by using a mixed profile methodology (Lawrence *et al.*, 2012), this includes a short defined and imposed list of attributes and the possibility for the taster to add more descriptors in order to completely describe the product. Diagram 5 shows the results of the fixed part of the profile while diagram 6 shows the free part. Some experts gave new terms like grapefruit, apple and dried fruits for the aftertaste. Others scored honey and wet wool/acacia blossom, terms that are related to untypical ageing and the presence of 2-aminoacetophenone.

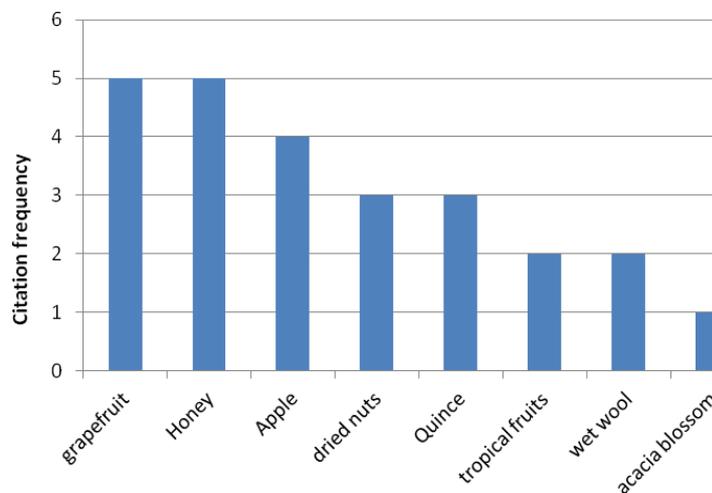


Diagram 6. Citation frequency example for PDO Santorini

It should not be forgotten that the evaluation and accreditation of wine typicality has a dual role, on one hand it is necessary for checking if the wine has the main attributes of the PDO in question and on the other hand to have a consistency sought by the consumer for whom sensory analysis is a basic tool of information as well as one of the producers main tools of communication (Prigent-Simonin *et al.*, 2005).

In the last few years a number of studies have been conducted for typicality evaluation and accreditation with methods that need trained experts and are time consuming, but have the benefit of providing accuracy.

- The Just About Right (Cadot 2012) method uses a scale (structured or unstructured) ranging from much too little to just about right to much too much, in order to check the attributed of the wine in comparison to the expected attributes of the PDO. It is also an excellent tool for the wine producers who can see which attributes of his wine differ or how much and tackle the root causes in order to improve the quality.
- Accreditation cards (Etaio *et al.*, 2010) are based on results obtained from all the previous methods and can be developed after a large number of rigorous tasting sessions, starting with term generation, direct wine description, statistical analysis for the selection of important appropriate attributes, non appropriate attributes and faults and development of a decision tree and a quality scale adapted to the specific PDO (Esti *et al.*, 2010). The concise decision tree and the limited and clear scale makes accreditation cards one of the most specialized tool for sensory certification of PDO wines.

CONCLUSIONS

It is obvious that the development of the EU legislation presents a challenge and an opportunity for the wine sector. Given the efforts of the OIV to present new resolutions to facilitate the improvement of industry standards for sensory analysis and the numerous scientific results from the application of sensory methods for PDO wines, it is time to change the old bureaucratic certification system. The task is not an easy one, as each method has a different purpose and presents advantages and disadvantages. Each PDO managing organization must decide on the level of standards needed and set up a new scientific, accurate and robust system. Thus, benefits for the consumer can be increased and the wine sector can set the basis for quality improvement, generating new results and help better communicate and promote the sensory properties of the PDO wines.

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