Sensory analysis for better quality of virgin olive oil

Abstracts

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ORO-SENSORY PERCEPTION IN HUMANS
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Our evaluation of foods and beverages is largely based upon inputs from three chemosensory systems, taste, olfaction and chemesthesis, integrated with sensory inputs from other physical attributes of foods such as temperature, texture, color, and rheological properties. The chemical activations of taste receptor cells in the oral cavity (which generate the five main taste qualities sour, bitter, sweet, salty, and umami) and olfactory receptor neurons in the upper nasal cavity (which generate myriad odor sensations) are responsible for most of the food flavor. The chemically-stimulated sensations of our epithelia (chemesthesis) also play key roles in the perception of many foods. These include the pungency of olive oils or the sting of alcoholic beverages. These sensory systems are heavily interactive and in fact the perception of flavor is based on our brain’s ability to integrate such disparate and anatomically independent sensory cues as taste, smell, irritation, and touch. Flavor perception can be divided into two broad categories, the analytic (e.g. intensity, quality of a flavour) and its pleasantness or desirability. The pleasantness of a flavour, which modulates ingestion or rejection, is determined by both innate (genetically-programmed) and learned factors. For example, sweet is innately attractive and bitter is innately aversive to humans and many other species. Yet, in the proper context, even innately negative components of flavor can become attractive. Here we describe an example of this: two of the most important sensory traits of high quality olive oils, bitterness and pungency, are innately aversive, yet they can become positive attributes if experienced in the favorable context of fine oils.
Sensory evaluation enables to distinguish the botanical origin of honey and to identify and quantify certain defects (fermentation, impurities, off-odours and flavours). It also plays an important role in defining product standards and in the related controls regarding botanical denominations or other specific labels. Moreover, it is an essential part of consumer preference/aversion studies (Piana L. et al 2004).

This paper focuses on botanical denomination, concentrating on the sensory profiles of five principal unifloral Italian honeys: chestnut honey (Castanea sativa Miller); citrus honey (Citrus spp.); eucalyptus honey (Eucalyptus spp.); black locust honey (Robinia pseudoacacia L.) and honeydew honey. The aim of this study is to suggest an alternative method (“profile method”) appropriate to modern techniques through which are able to demonstrate that a honey conforms to its declared botanical origin. In earlier studies by the sensory group within the IHC (International Honey Commission), a harmonized glossary was developed and two methods of evaluation were suggested: the descriptive semi-quantitative method and the “yes/no” classification method. Such methods are based on the ability of trained assessors to evaluate the correspondence of a declared monofloral honey to a memorized standard. The descriptive semi-quantitative method, in particular, requires an overall assessment which considers all the components perceived and quantifies them on an unstructured 10-centimeters scale in comparison with memorized reference samples. The “yes/no” classification method is a very simple classification system (ISO 6658, 1985) mainly used for quality assessment (absence of defects). Also in this case, assessors give their decision in consideration of memorized reference samples. The alternative method (not yet an official one) which this study is about to suggest takes into consideration the attributes and their intensity. For each unifloral honey type the most significant attributes have been selected and estimated. In this way a typical profile has been produced. Consequently, in unifloral honey assessment if the profile is within the limits of the expected profile it is considered to conform to the botanical declaration of origin. In this research the unifloral honey profile was developed by a panel of specialized expert assessors. The preparation of the samples and the olfactory and olfactory-gustatory characteristics have been performed as described by Piana (Piana L. et al., 2004).

Each taster smelled and tasted a determined honey in order to analyse the olfactory and gustatory characteristics. Twelve attributes were evaluated. Attributes were assessed by marking a 10 cm line scale and quantified by measuring the location of the mark from the origin. The obtained data for the 12 attributes were used to define the sensory profile of each sample through the median values.

The number of samples studied varied between 9 and 11 for each unifloral typology and were to define the unifloral sensory profile which would include not only the best representative unifloral honey, but also the acceptable “commercial” unifloral honey.

Each unifloral profile has highlighted specific characteristics. Principal component analysis (PCA) and linear discriminate analysis (LDA) clearly allow the discrimination of the studied unifloral honey.

References
AN ORGANOLEPTIC ANALYSIS OF FRENCH DESIGNATION OF ORIGIN WINES

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Wine, a processed product made from grapes, is a complex and extremely diverse product. There has always been a close link with wine tasting to check quality. In 1974, French legislation required all wines laying claim to a designation of origin to undergo tasting and analysis to secure the designation each year. The result of this requirement was an undeniable improvement in the wines. In 2008 there was a thorough reform of the Institut National de l'Origine et de la Qualité (INAO) and of how the designations are checked. The procedure for checking wine designations was harmonised with that for agrifood designations, including the products' organoleptic analysis.

The latter requirement of the specification for the designation is based on the legislation which states that ‘The organoleptic analysis to which designations of origin are subjected (...) is carried out by a commission of competent professionals and experts, in conditions guaranteeing an independent and impartial analysis of the products'. The method required at national level has been laid down by INAO in a set of guidelines.

Tasting is now done by sampling the wines as close as possible to when they are released for consumption (after bottling or packing the wine for sale) or as close as possible to when they are transferred (prior to bottling etc.). The organoleptic analysis is intended to check that the wine respects all the specification requirements and complies with its designation. The commission in charge of carrying out this analysis is made up of a least five tasters from a group of people who serve as a reference for the particular wine production, namely: ‘Technicians’, ‘Product memory holders, i.e. people who retain how the product should taste and smell’ and ‘Product Users’. These juries are assessed and trained on the specific characteristics and potential shortcomings of the designation. A list of the negative traits is drawn up by the particular organisation responsible for protecting and managing the designation concerned (the ‘ODG’) on the basis of the national list validated by INAO. The specific characteristics of the designation, as defined in the specification and, where applicable, any negative traits are shown in the assessment sheet used by the tasters when evaluating the wine. Each taster gives their individual appreciation of the acceptability of the wine with regard to its designation. Should they judge the sample to be unacceptable, the taster must identify the shortcomings and indicate how serious they are (low, medium, high). An ODG’s tasting notes demonstrate the importance of having an assessment sheet that is tailored to each specific wine. This sheet must cater for the multiple questions the taster has to answer (the principal stages of the sensorial analysis, the wine assessment criteria based on the characteristics of the particular designation and its negative traits, any particularly intense qualities noted and the wine’s overall acceptability). In the specific case in point, we note that using such a sheet better achieves a harmonised and analytical approach to tasting, even when the qualities of the wine demand a negative assessment.

The Control Organisation confirms or rejects the wine’s designation on the basis of the individual tasting results of each member of the jury. In its guidelines, INAO recommends processing the results statistically in compliance with the binomial rule. By way of example, a wine’s designation will not be confirmed if at least four out of the five tasters have found the sample to be unacceptable. In cases where the sample is rejected, the degree of the organoleptic failing (low, medium, high) is indicated according to its seriousness as observed by the members of the jury.
In practice, the main difficulties are posed by the statistical reliability of the decision taken and the identification of the shortcomings found, which must form the basis of any decision to reject the wine.

We have noted that these difficulties have for the most part been resolved by introducing a more stringent selection and assessment of the tasters and by providing them with specific training on the characteristics of the specific designation and its negative traits, but also on how to fill in the assessment sheet. We also deal with the various measures adopted for certain designations that help the taster reach a decision: simplifying the assessment sheets, providing a reference sample, providing a sample at the lower end of the designation, reaching a consensus as to the negative traits with a commission chair to guide the debate and tasting no more than ten samples per series with a rest period between series, etc. Lastly, increasing the number of tasters per commission and introducing statistical processing in accordance with the binomial rule are important factors for improving the reliability of the decisions taken.

**References**

- Article L.642.27 of the Rural and Maritime Fisheries Code
In 1987 the IOC developed and adopted a method for the organoleptic assessment of virgin olive oil (COI/T.20/Doc. No 15/Rev. 7), which is designed to classify virgin olive oils into one of its four categories. Since then, the method has been updated on several occasions. Four accompanying standards or guides cover aspects dealt with in the method: General basic vocabulary for sensory analysis (COI/T.20/Doc. No 4/Rev. 1); Glass for oil tasting (COI/T.20/Doc. No 5/Rev. 1); Installation of a test room (COI/T.20/Doc. No 6/Rev. 1); Selection, training and monitoring of skilled virgin olive oil tasters (COI/T.20/Doc. No 14); and Guidelines for the accreditation of sensory testing laboratories with particular reference to virgin olive oil according to standard ISO/IEC 17025:2005 (COI/T.28/DOC.1)

The IOC organoleptic assessment method:
- Is aligned with international sensory analysis standards
- Separates the sensory analysis of virgin olive oils from the subsequent classification of the oils based on the analysis of the data obtained
- Uses univariate robust statistics as a tool due to the peculiar distribution of the attribute sensory scores

It is structured into two distinct stages:
- Assessment of the sensory (organoleptic) characteristics
- Statistical analysis of data and classification of the oil

The assessment stage is performed by a sensory testing panel selected, created, trained and qualified in line with the instructions given in the IOC method and guide.

Tasters therefore strictly carry out the sensory assessment of the characteristics required of virgin olive oils (vocabulary of characteristic terms), which can be classified into two sets of descriptors:

A. Defects: non-positive perceptions related to alterations in the product or the raw material
1. Fusty/muddy sediment
2. Winey
3. Musty
4. Rancid
5. Frostbitten olives (wet wood)
6. Others (only those included in the vocabulary)

B. Positive attributes: Perceptions produced by good, healthy, fresh olives
1. Fruity
2. Bitter
3. Pungent
The chosen descriptors are based on the definition of extra virgin olive oil given in the method. The IOC has also developed a method to determine and check the sensory profile of extra virgin olive oils with designation of origin (DO) status (COI/T.20/Doc No 22), which is divided into two distinct parts:

A. Search for the positive sensory characteristics of the specific DO (rules);

B. Evaluation of the consistency between the reference sensory profile (DO) and the sensory profile of the sample analysed.

**Keywords:** virgin olive oil, quality, sensory assessment, testing methods, sensory testing panel, positive attributes, defects
The International Olive Council, or IOC for short, is the intergovernmental organisation mandated to administer the International Agreement on Olive Oil and Table Olives. Its Members produce 98% of the world’s olive oil and 92% of its table olives.

The Council carries out a string of activities. Just two of its top objectives are to improve product quality and to draw up standards for compulsory application by IOC Members in their international trade in olive products.

Under the International Agreement, the Council has been tasked to examine all business concerning the physico–chemical and sensory standards applicable to olive oils and table olives. Its brief is to work in partnership with specialist organisations to gain a better insight into the compositional and quality characteristics of these products.

The Council has long been involved in establishing standards to set product terminology, to define olive oil and table olive categories in step with changing processing methods and international market conditions and to fix admissible limits for each approved analytical parameter and grade in order to guarantee product authenticity and quality while bearing in mind the realities of production and testing methods.

Through these standards and testing methods the Council looks to ensure quality control and fair international trading, and to protect consumer rights and prevent fraud. To achieve these goals, it enlists the help of an expert group which it convenes twice a year.

It has other key priorities too, one of which is to keep track of the harmonisation of national and international regulations with the IOC trade standards for olive oils and olive pomace oils and table olives. Aligning standards is essential to facilitate international trade and to encourage and ensure fair trading practices; it is likewise essential to protect consumer health and to make sure that product content coincides with product labelling. This is why it is important to highlight that IOC standards are compulsory in international trading in olives and olive oil by IOC Members.

**IOC recognition of chemical and sensory testing laboratories**

The IOC runs a scheme where it awards recognition to chemical and sensory testing laboratories that comply with a specific set of requirements. This quality-oriented scheme is meant to increase mutual confidence among laboratories themselves as well as to increase industry’s confidence in laboratory testing. Recognition is reviewed every year and the requirements are stipulated in two separate IOC Decisions:

- **Decision regarding the IOC certificate of recognition for laboratories undertaking the sensory analysis of virgin olive oils (DEC-15/101-IV/2013):**
  Sensory labs designated by the competent domestic authorities must prove they are proficient in applying the method adopted by the IOC for the organoleptic assessment of virgin olive oil in two annual tests organised by the IOC Executive Secretariat. The
IOC thus has assurances not only about the proficiency of the labs but also about their equipment, installations and panel (tasters and panel leader) and quality management. In the past sensory labs accredited by a national accreditation body but not necessarily designated by the competent domestic authorities were also allowed to participate in IOC proficiency tests.

- Decision regarding the IOC certificate of recognition for olive oil testing laboratories (DEC-14/101-IV/2013): Labs must be accredited by a national accreditation body and prove they are proficient in applying the methods adopted by the IOC for testing the purity and quality of olive oils and olive pomace oils in an annual test organised by the IOC Executive Secretariat.

The IOC also teamed with the European Cooperation for Accreditation (EA) to produce joint rules for the accreditation of olive oil chemical and sensory testing laboratories by national accreditation bodies.

In all, 83 laboratories and 71 official panels from a spread of countries (both IOC member countries – Argentina, Czech Republic, Croatia, France, Germany, Greece, Iran, Israel, Italy, Jordan, Latvia, Morocco, Portugal, Slovenia, Spain, Syria, Tunisia, Turkey and Uruguay – and non-members – Australia, Brazil, Canada, China, South Africa and the United States) have taken part in the annual check test held to award recognition for the period 2015-2016. The list of laboratories that earned IOC recognition for 2014–2015 (the list changes every year) is published on the IOC website (http://www.internationaloliveoil.org/estaticos/view/226-laboratories-panels).

The test certificates issued by recognised tasting panels may have legal weight in disputes. Panels are allowed to show the IOC logo on their official documents, but only during the period for which they have been awarded recognition.

To sum up, the International Olive Council provides a forum for its Members to draw up rules for olive products, which they adopt by consensus. Those rules are designed to improve and control quality, with the aim of achieving a transparent international market and stimulating consumption of olive oil, olive pomace oil and table olives.

**Keywords:** olive oil, table olives, quality, trade standards, authenticity, testing methods, international cooperation, laboratories, agreement.
Olive oil production is growing rapidly in Europe and worldwide, boosted by a positive image and a rise in consumption. To preserve its quality is then an important issue for the EU.

In this view, the EU has set up two main Regulations to ensure that the quality, authenticity, labelling and marketing of olive oil is safeguarded:

- Commission Implementing Regulation (EC) No 29/2012 on the marketing standard for olive oil prescribes the information related to the labelling of olive oil, the designation of origin, the packaging, the optional indications (e.g., ‘first cold processing’), the blend of olive oil with other vegetable oils down specific standards for retail-stage marketing of olive oils.

- Commission Regulation (EEC) No 2568/91 defines the chemical and organoleptic characteristics of olive oil, lays down methods to assess those characteristics and imposed conformity checks.

The regulation on olive oil characteristics and methods of analyses is regularly updated on the basis of the opinion of chemical experts and in line with the work carried out within the International Olive Council (IOC). The rules are adapted to any changes in olive oil compositions and/or varieties of olives, to technical and/or scientific progress.

Sixty five Chemical testing laboratories and 57 Sensory testing laboratories, recognized by IOC are involved in the monitoring of compliance of virgin olive oils with the two above-mentioned regulations.

These testing laboratories have to demonstrate regularly their competence applying the methods recommended by the IOC and to be accredited by their relevant national accreditation body. As regards sensory testing laboratories, Member States (MS) may designate additional laboratories (cf. Article 4 of R 2568/1991).

Conformity checks prescribed by the EU are carried out by MS to ensure that the olive oil marketed is consistent with the category declared. They are based on a risk analysis with a minimum requirement of one conformity check per 1000 tons of olive oil consumed in the MS and exported from that MS. However, each MS could carry additional controls at national level. MS have to report to the Commission the results of these conformity checks of the previous calendar year no later than 31 May of each year.

The EU also finances the research program (OLEUM) related to olive oil authentication in view to detect undesired processing (e.g. deodorisation), or adulteration and to verify the quality of olive oil based on novel technological advances. This research should start in 2016.

Through these actions, the EU expresses its commitment to promote public image of the virgin olive oil, fight fraud and improve consumer protection and information.

References
The History of the Sensory Evaluation of Virgin Olive Oil

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Prehistory
From Babylonians (Hammurabi code) to Romans
1890-1966 (Reg. 136 of the September, 22 1966)

History
The development of the organoleptic method in IOOC Madrid (D. Rafael Gutiérrez González-Quijano)
Reg. 2568 of the July, 11 1991
The change 1994/1995: separation of the evaluation mode from the classification mode with robust statistical techniques (COI/T20/Doc.15)
November 2005: method for the determination of the sensory profile of virgin and extra virgin olive oil under denomination of origin (COI/T20/Doc.22)

Future
Chemical determination of the virgin olive oil defects standards; coupling instrumental method of analysis with sensory evaluation of the defect