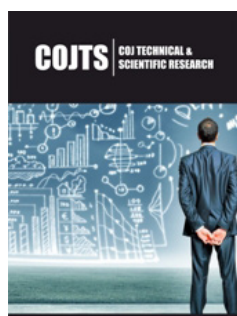


Sensory Analysis of Olive Oil

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Abstract

Sensory analysis of oil, meaning the official organoleptic assessment of olive oil respectively the panel test (PT), relies on the standards of the International Olive Council (IOC), furthermore as on the Regulation (EC) 640/2008 of the European Commission (EC). These regulations lead to the classification of oil as extra virgin (EVOO), virgin (VOO) or Lampante, that but isn't comfortable to obviously discriminate between totally different quality levels inside the grade EVOO. This chapter was meted out to the study sheet for sensory analysis; look at and methodology conditions, classification of olive oil. quality indices, polyphenols, tocopherols, volatile compounds, effects of selection, extraction system and storage conditions corresponding to packaging sort and temperature variation on the sensory analysis of virgin oil.

Keywords: Olive oil; Sensory attributes; Volatile compounds; Quality indices

Introduction

Sensory analysis is a necessary technique to characterize food and investigate shopper preferences. International cooperative studies, supported by the International oil Council (IOC) have provided a sensory written methodology for VOOs, known as the COI Panel test. Such an approach relies on the judgments of a panel of assessors, conducted by a panel leader, UN agency has comfortable information and skills to organize sessions of sensory analysis, encourage judgment, method information, interpret results and draft the report. The panel typically consists of a bunch of eight to twelve persons, elect and trained to spot and live the intensity of the various positive and negative sensations perceived. Sensory assessment is meted out in step with written rules, in a very specific tasting space, mistreatment controlled conditions to reduce external influences, employing a correct tasting glass and adopting each a selected vocabulary and a profile sheet that features positive and negative sensory attributes (Dec-23/98-V/2010). assortment of the results and applied mathematics elaboration should be standardized (EEC Reg. 2568/91, EC Reg. 640/08). the color of VOO, that isn't considerably relating to its quality, could turn out expectations and interferences within the flavor's perception part. so as to eliminate any prejudices which will have an effect on the smelling and tasting phases, panelists use a dark-colored (blue or amber-colored) tasting glass. normally oil is outlined on the idea of its sensory characteristics. world organization (EU) rules establish the organoleptic quality of virgin oil by suggests that of a panel take a look at, evaluating positive and negative descriptors (EU regulations). For the organoleptic assessment, many volatile compounds square measure thought-about because the main accountable for negative and positive attributes. Volatile compounds, either major or minor, square measure crucial to oil quality; even once gift below their locative threshold, they'll still be vital to know their formation and degradation pathways and supply helpful quality marker data.

Definition and Classification of Oil

Virgin oil is that the oil obtained from the fruit of the fruit tree either by mechanical or different physical suggests that beneath conditions, significantly thermal conditions, that don't cause alterations within the oil, and that has not undergone any treatment nevertheless laundry, decantation, activity and filtration. the assorted categories of oil as divided by European legislation square measure reported. The subdivisions in several categories square

measure supported the degree of acidity furthermore as different analytical parameters and sensory analysis indices.

a) Extra virgin oil: is that the virgin olive oil that incorporates a free acidity, expressed as oleic acid, of less than zero.8 gram per one hundred grams, and therefore the sensory characteristics with median defects is three.5 and therefore the median of fruitiness bigger than zero.

b) Virgin oil: is that the virgin olive oil that incorporates a free acidity, expressed as monounsaturated fatty acid, of less than a pair of grams per one hundred grams and therefore the sensory characteristics with median defects bigger than zero, however lower than or capable a pair of.5 and therefore the median of fruitiness bigger than zero.

c) Lampante oil: is that the virgin olive oil that incorporates a free acidity, expressed as monounsaturated fatty acid, of over a pair of grams per one hundred grams and therefore the sensory characteristics with median defects bigger than three.5 or if the median defects is a smaller amount than or capable three.5 and therefore the median of fruitiness is zero. Such oil is meant for processing functions.

d) Refined oil: is that the olive oil obtained from lampante olive oils by processing ways that don't cause alterations within the initial glyceridic structure, that incorporates a free acidity, expressed as monounsaturated fatty acid, of lower than or capable zero.3 grams per one hundred grams.

e) Blended oil: is that the oil consisting of a mix of refined oil and virgin olive oil that incorporates a free acidity, expressed as monounsaturated fatty acid, of lower than or capable one gram per one hundred grams. It is used for human consumption.

f) Crude olive-pomace oil: is that the oil obtained by treating olive pomace with solvents, to the exclusion of oils obtained by re-esterification processes and of any mixture with oils of other forms. This oil is meant for processing with a read to its use in food for human consumption.

g) Refined olive-pomace oil: is that the oil obtained from crude olive-pomace oil by processing ways that don't cause alterations within the initial glyceridic structure, that incorporates a free acidity, expressed as monounsaturated fatty acid, of lower than or capable zero.3 grams per one hundred grams.

h) Olive-pomace oil: is that the oil comprising the mix of refined olive-pomace oil and virgin oil that incorporates a free acidity, expressed as monounsaturated fatty acid, of lower than or capable one gram per one hundred grams. It is used for consumption, but in no case should this blend be called olive oil.

One vital thought is that the primary 2 oils square measure the most effective for human consumption thanks to them being inside the set parameters, once obtained directly from the olive press. The third sort of oil can't be consumed till it's been corrected, which provides the fourth sort of oil. A small amount of extra-virgin olive

oil or virgin olive oil is added to this rectified oil and is known as olive oil.

Olive oil tasting attributes

Olive oil as judged by consultants shows a mess of either positive or negative characteristics.

Positive attributes:

- a. **Almond:** light-weight smell recalling that of contemporary or dried almond.
- b. **Apple:** A sensation recalling this fruit.
- c. **Artichoke:** A smell recalling raw artichoke.
- d. **Astringent:** A puckering sensation within the mouth created by phenol.
- e. **Bitter:** this is often a most popular characteristic style of olive oils, if it's not too extremely intense.
- f. **Fruity:** vary of smells (dependent on variety) characteristic of oil from healthy contemporary fruit, inexperienced or ripe, perceived directly and/or retro nasally. Fruitiness is qualified as inexperienced if the vary of smells is comparable to inexperienced grass. Fruitiness is qualified as ripe if the vary of smells is comparable to ripe fruit and is characteristic of oil from inexperienced and ripe fruit.
- g. **Green grass:** A sensation recalling that of freshly cut grass.
- h. **Hay:** A smell recalling that of dried grass.
- i. **Spicy:** A touch sensation kind of like that of a light-weight capsicum pepper plant, particularly within the back of the throat, which may force a cough.

Negative attributes:

- a) **Brine:** Salty style of oil made up of brined olives.
- b) **Coarse:** A touch sensation within the mouth thanks to texture of oil.
- c) **Cucumber:** Off flavor from prolonged storage, significantly in tin.
- d) **Dreggiest:** Odour of heat grease and is caused by the poor or lack of the decanting method.
- e) **Earthy:** This term is employed once oil has no inheritable a musty wet odour as a result of it's been ironed from unwashed, muddy olives.
- f) **Esparto:** Hemp-like smell no inheritable once olive paste has been unfold on Esparto mats. Smells could dissent in step with whether or not the mates square measure inexperienced or dried.
- g) **Hemp:** Caused by the utilization of filtering panels, those aren't absolutely clean, and recollect hemp.

- h) Flat:** Oils that have lost their characteristic aroma and have neither style nor smell.
- i) Frozen:** Thanks to olives that are exposed to phase change temperatures. Once soft-bo, this oil provides off terribly unpleasant odours.
- j) Fusty:** thanks to olives chemical action in piles whereas in storage waiting to be ironed.
- k) Grubby:** Smell imparted by grubs of the olive fly. The smell is each rotten and putrid at an equivalent time.
- l) Heated:** Prolonged heating throughout extraction process.
- m) Muddy:** Typical odour of oil that has been keep to long on its own sediment.
- n) Musty:** musty smell from olives being keep too long before pressing.
- o) Metallic:** Oils processed or keep with extended contact to metal surfaces.
- p) Rancid:** recent oils that have started oxidizing thanks to exposure to light-weight or air.
- q) Vegetable water:** Oils that have absorbed the unpleasant odours and flavours of the vegetable water once pressing that they need remained up to date for too long.
- r) Wine-vinegar:** Typical odour of wine or vinegar thanks to fermentation of olives.

Factors Moving Sensory Properties of Oil

Processing of healthy olives

When the common olive fly (*Bactrocera oleae*) attacks olives (from the start of summer to the beginning of harvesting), harm happens as a results of larval growth: oils from broken fruits show changes in each volatile and phenolic resin compounds that influence negatively the sensory properties and aerobic stability of the merchandise, particularly throughout oil storage (polar phenols have a basic role as antioxidants throughout storage). The dangerous style thanks to these changes caused by the olive fly is accepted as a grubby defect [1,2]. so as to get a top-quality oil, it's necessary to method olives that aren't ripe. the utilization of fruits that have part degraded tissues cause a rise in catalyst and microorganism activities and aerobic reactions; so, the made oil most likely are characterized by a higher free acidity and perceivable sensory defects. once olives square measure accumulated in piles for several days, the warm temperature and humidness within the mass promotes proliferation of bacterium, yeasts and moulds, manufacturing undesirable fermentation and degradation that create to specific volatile molecules accountable for unpleasant odours (i.e. winey, fusty and mouldy). Winey, the standard pungent sensory note perceptible in oils made by olives keep in piles or in jute sacks for many days, arises from alcoholic fermentation: eubacteria and *Acetobacter* are detected in olives causation

fermentative processes. the most organism found in olives depends on the length of storage: at the start the Enterobacteriaceae genera bacteria genus and enteric bacteria prevail, whereas *Pseudomonas*, true bacteria and genus *Serratia* square measure predominant once longer periods of your time. The activity of those microorganisms ends up in the presence of low concentrations of synthesis volatiles and enormous amounts of compounds corresponding to the branched alcohols thanks to degradation of amino acids that cause the standard undesirable sensory note called fusty [3,4]. the foremost bumper class Deuteromycetes found in olives keep at high humidness square measure many species of the fungus genus in conjunction with ascomycetes *Penicillium*; these organisms oxidize free fatty acids manufacturing primarily alkyl radical ketones, in distinction to yeasts of the genera fungus, fungus genus and *Pichia* that square measure ready to scale back radical compounds. Enzymes from these microorganisms interfere with the LOX pathway to provide volatile C8 molecules characterised by terribly low odour thresholds and scale back some C6 compounds. This volatile profile is accountable for the musty defect of EVOO.

Variety: The various varieties represent a very important part for the assembly of additional virgin olive oils, characterized by totally different organoleptic characteristics.

Cultivation: Techniques (irrigation, fertilization, treatment of plants, diseases etc.). Among the environmental factors that influence the standard of the olives and so the oil, each the temperature and therefore the quantity of water offered have a very important role, with the primary moving the acidic composition of the olives, whereas the latter the number of phenolic resin substances.

Maturity index of the olive fruits: The early harvest typically provides an additional bitter and spicy oil thanks to the high phenol content.

Harvest time and storage of the olive fruits: The quality of the oil is very conditioned by the state of integrity of the olive. ancient manual gathering techniques avoid damaging the fruit compared to mechanical ways. Storage of the olives in not terribly huge crates, avoids AN excessive mass of olives that might either become crushed or hot, facilitating attacks from micro-organisms furthermore as chemical reaction and fermentation.

De-leafing and laundry of the olive fruits: Before being processed, the olives should be cleansed of any superfluous material, together with leaves, and branches. These square measures all parts which will negatively influence the standard of the oil.

Pressing extraction of olive oil: The olives square measure broken throughout the pressing part with the skin and therefore the pulp being torn furthermore because the stone crushed. The press can be a traditional pan-mill one, either discontinuous system or combined with an extraction system so as to hold out continual activity. These presses will either be hammers or disks. Metal presses have an additional violent pressing of the olive (above all

beat ones) furthermore as a bigger laceration of the skin, giving a better extraction of the phenolic resin composites and so an additional bitter and spicy oil that lasts longer.

Storage of oil beneath appropriate conditions: In unfiltered oil, the low amounts of sugars or proteins that stay for extended times in oil is hard or degraded by specific anaerobic microorganisms of the true bacteria genus, fermentation. The filtration of newly produced oil will avoid this development. it's far-famed [5-7] that EVOO incorporates a low quantity of water, and for this reason it is thought-about as a water-in-oil emulsion [2]. The orientation of phenolic resin compounds within the interface and therefore the active surface of water droplets will shield against the chemical reaction of oil. in step with some researchers [8,9], the steadiness of unfiltered samples is considerably over that of the corresponding filtered oils. This coincides with a better total phenolic resin content in unfiltered oils thanks to a bigger quantity of blended water. On the opposite hand, higher water levels square measure expected to favour catalyst chemical action, together with enzyme, lipoxygenase and polyphenol enzyme activities. Thus, a additional speedy chemical reaction of unfiltered oil is predicted. Some authors [10] ascertained that hydrolytic processes occur in parallel with chemical reaction throughout long run storage.

Methodology of Sensory Evaluation

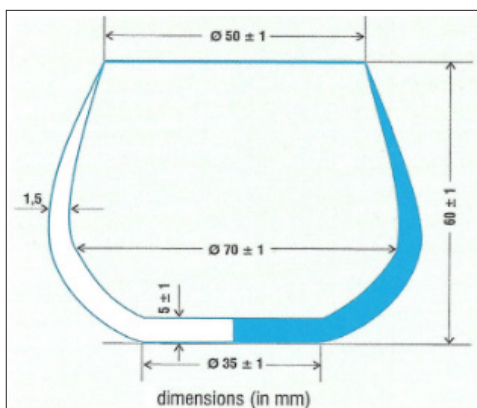


Figure 1: Tasting glass.

A sensory written methodology for virgin olive oils, known as the COI Panel test, represents the foremost valuable approach to gauge the sensory characteristics of VOO. The use of statistical procedures to analyze data from assessor's evaluation provides results that can be trusted as well as methods usually adopted in scientific fields. the aim of this international technique is to standardize procedures for assessing the organoleptic characteristics of VOO, and to ascertain the methodology for its classification. this technique, incorporated into rules of the EC Union since 1991, uses, as AN analysis tool, a bunch of 8-12 persons elect in a very controlled manner, UN agency fitly trained to spot and measure the intensity of positive and negative sensations (EEC Reg. 2568/91). a set of ways and standards has been adopted by the International oil Council (IOC or COI) for sensory analysis of olive oils. These documents (IOC/T.20/Doc. 4/rev.1 and IOC/T.20/Doc.15/rev.2) describe the overall and

specific terms that tasters use. a part of the vocabulary is common to sensory analysis of all foods (general vocabulary), whereas a selected vocabulary has been developed unplanned and established by sensory IOC/T.20/Doc.14/rev.2) includes precise recording of the right tasting temperature, furthermore because the dimensions and color of the tasting glass (Figure 1) and characteristics of the room.

Profile sheet (for use by taster)	
DEFECTS PERCEIVED	INTENSITY
"Atrojado" (fusty)	_____ →
Mustiness/humidity	_____ →
Winey/vinegary	_____ →
Muddy sediment	_____ →
Metallic	_____ →
Rancid	_____ →
Other (specify)	_____ →
POSITIVE ATTRIBUTES PERCEIVED	
Fruity	_____ →
Bitter	_____ →
Pungent	_____ →
Name of taster	Sample code
	Date

Figure 2: Profile sheet for VOO assessment currently adopted by the EU (EC Reg. 796/02).

The panel leader is that the person behind for choosing, coaching and observance tasters to determine their level of power in step with (IOC/T.20/Doc.14/rev.2). the quantity of candidates is usually bigger than that required so as to pick out people who have a bigger sensitivity and discrimination capability. Screening criteria of candidate's square measure based on sensory capability, however additionally on some personal characteristics of candidates. Given this, the panel leader can in person interview an outsized variety of candidates to become accustomed to their temperament and perceive habits, hobbies, and interest within the food field. He uses this data to screen candidates and rejects those that show very little interest, aren't without delay offered or UN agency square measure incapable of expressing themselves clearly. The determination of the detection threshold of the group of candidates for characteristic attributes is necessary because the "threshold concentration" is a point of reference common to a normal group and may be used to form homogeneous panels on the basis of olfactory-gustatory sensitivity. a range of tasters is created by the intensity rating technique, as described by [11]. A series of twelve samples is ready by diluting a VOO characterized by a really high intensity of a given attribute in AN odorless and tasteless medium (refined oil or paraffin). The panel leader sends out the candidate, removes one in every of the twelve tasting glasses from the series, and places the remaining together; the candidate is named back within the

space and is asked to properly replace the testing glass withdrawn from the series by comparison the intensity of this last therewith of the others. The take a look at is meted out for fusty, rancid, tasteful and bitter attributes to verify the discriminating capability of the candidate on the complete scale of intensities. The stage coaching of assessors is important to familiarize tasters with the particular sensory methodology, to heighten individual talent in recognizing, characteristic and quantifying the sensory attributes and to enhance sensitivity and retention with regards to the assorted attributes thought-about, so the top result's precise and consistent. additionally, they learn to use a profile sheet (Figure 2).

Biosynthesis of the Volatile Compounds of Olive Oil

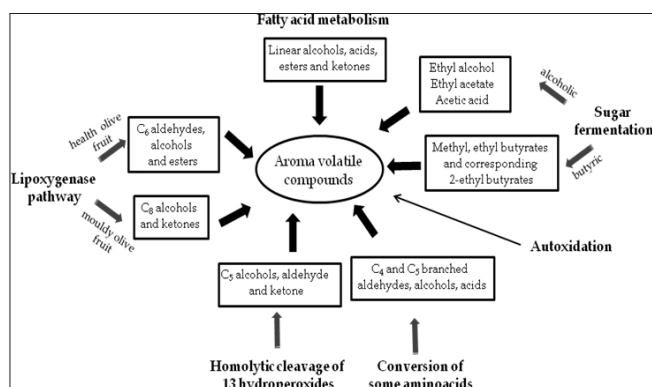


Figure 3: The main pathways involved in the formation of the volatile compounds.

The wide range of volatile compounds found in top quality virgin oil square measure made through biogenic pathways of the olive fruit, specifically the lipoxygenase (LOX) pathways, and carboxylic acid or amino alkanolic acid metabolism, as pictured in (Figure 3) [12]. Besides the contribution of many volatile compounds, connected with the mentioned pathways, the role of different compounds, particularly aldehydes derived from auto-oxidation processes, ought to even be thought-about to the ultimate aroma of the olive oils [3]. different metabolized product, originated from potential fermentations, conversion of some amino acids, catalyst activities of moulds or aerobic processes, square measure closely connected with off-flavour of virgin oil. As illustrated in Figure 1, many compounds specifically carbonyl compounds, alcohols, esters and hydrocarbons contribute to the aroma profile of oil [12]. The volatile compounds, accountable for virgin oil aroma, square measure usually: low relative molecular mass (<300 Da); high volatility, comfortable hydrosolubility, honest liposolubility and chemical options to bond with specific proteins [3].

During crushing and malaxation steps, considerable changes, in oil chemical composition happens accomplished by the activation of olive fruit enzymes thanks to the inherent disruption of cellular tissues. Consequently, the LOX pathway is initiated by the reaction of triglycerides and phospholipids, mediate by acyl group hydrolase (AH), resulting in the discharge of fatty acids. Lipoxygenases, once their unleash, become right away active and rework the unsaturated

fatty acids, made by the action of AH, linolenic (LnA) and linoleic (LA) acids, into their corresponding 9- and 13-hydroperoxides. The subsequent cleavage of fatty acids 13-hydroperoxides is catalyzed by specific hydroperoxide lyases (HPL) resulting in the formation of C6 aldehydes (Z)-hex-3-enal and hexanal from linolenic and linoleic acids, respectively) and oxoacids (Figure 4). The unsaturated sort of C6 organic compound (Z)-hex-3-enal bear speedy isomerization to the additional stable (E)-hex-2-enal. The action of alcohol dehydrogenase (ADH), catalyses the reversible reduction of open-chain C6 aldehydes to the corresponding volatile alcohols [13]. Alcohol species square measure any reworked into esters thanks to the chemical action activity of alcohol acyl group enzyme (AAT), manufacturing acetates [14]. Many factors, for example cultivar and extraction method, together with in operation temperature, seem to play a relevant role on the advance of AAT activity [15]. once the substrate is LnA, LOX catalyses, besides the hydroperoxide formation, additionally its cleavage, via AN alkoxy radical, increasing the formation of stable pent-1,3-diene radicals. These compounds will suffer dimerization resulting in the assembly of C10 hydrocarbons (pentene dimmers) or react with a chemical group gift within the medium, resulting in C5 carbonyl compounds [16]. the foremost vital fraction of volatile compounds, of top-quality virgin olive oils, contains C6 and C5 compounds, particularly C6 linear unsaturated and saturated aldehydes. The presence of different volatile compounds, specifically C7-C11 monounsaturated aldehydes, C6-C10 dienals, C5 branched aldehydes and alcohols and a few C8 ketones, in comparatively high concentrations, within the aroma of virgin oil, is related to unpleasant notes. The presence, or lack of defects, within the aroma of olive oils is said with the contribution of the assorted pathways concerned on volatiles formation.

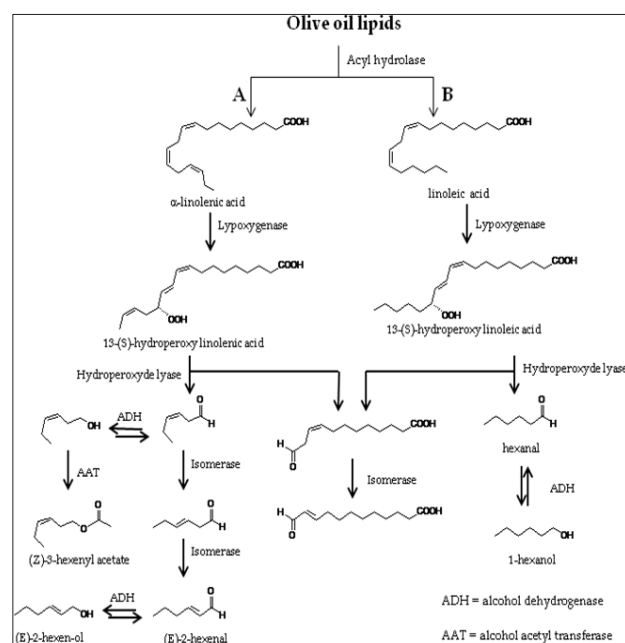


Figure 4: Lipoxygenase pathway for the formation of major volatile compounds.

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