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# Oils and Fats

Composition

Physico-chemical characteristics

Fat oxidation

Processing and refining

Extra-virgin olive oil



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**Unit 1** Lipids: chemical nature, nomenclature and classification. Compositional characteristics of edible fats: saponifiable and unsaponifiable fraction, constituents, biosynthetic characteristics, chemical-physical properties. Essential fatty acids: concept of essentiality.

**Unit 2** Reactions involving the lipid fraction: oxidative, hydrolytic and ketone rancidity. Autoxidation and photoxidation. Changes induced by exposure to high temperatures (deep-frying) and due to ageing.

**Unit 3** Outline of technology: food fat extraction techniques (squeezing and extraction), rectification, hydrogenation, trans-esterification and fractionation processes, characteristics of the derived products. Learn more about palm oil.

**Unit 4** Olive oil: botanical notes, reference legislation, production technology, compositional characteristics, quality and authenticity parameters. Analysis of olive oil: chemical and sensory analyses

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Contents

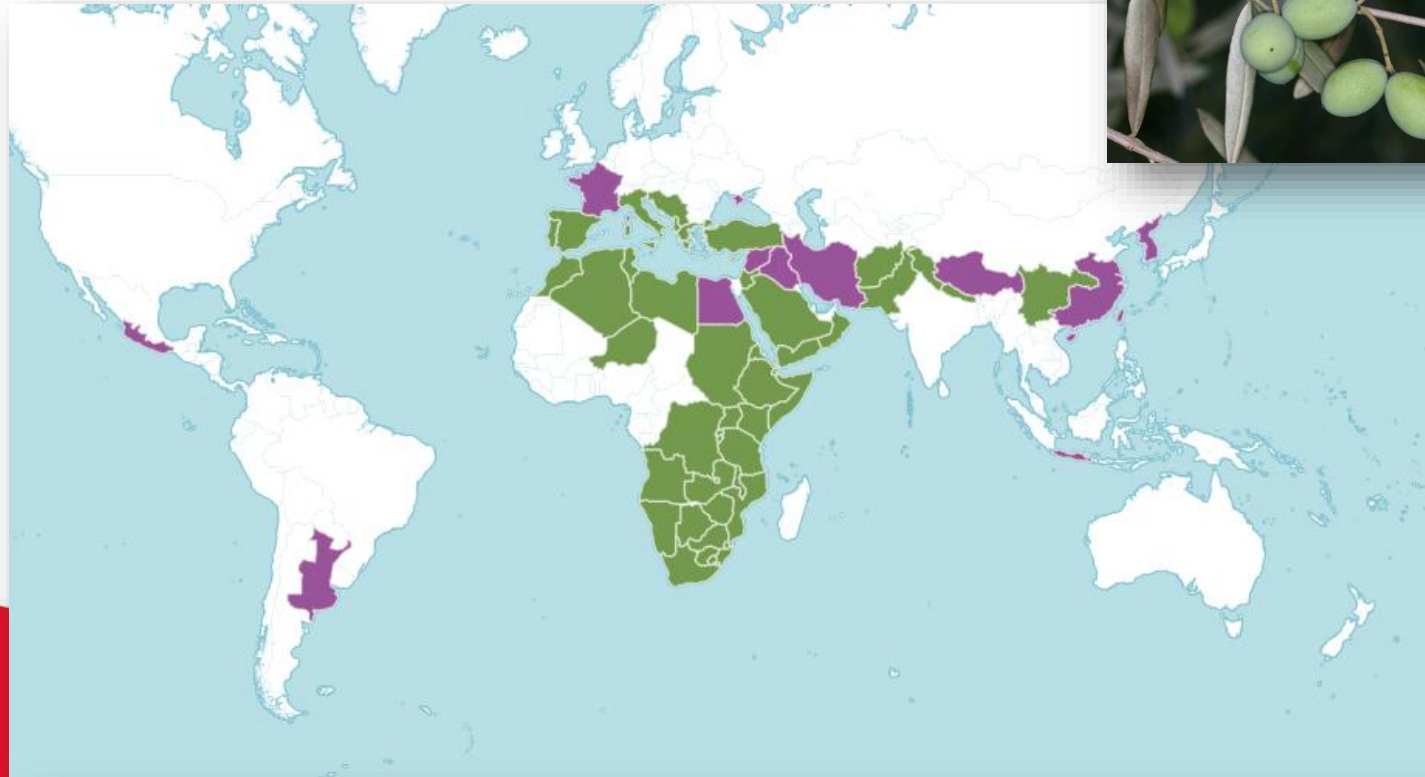
# *Olea europaea* - Oleaceae family



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Olive

■ Native ■ Introduced ■ Extinct

<https://www.kew.org/plants/olive>

*Olea europaea*, commonly called common olive, is an evergreen tree that is native to the Mediterranean region.

It typically grows to 20-30' tall with a rounded crown. Young trees have smooth gray bark, but trunks and branches will gnarl somewhat picturesquely with age. Opposite, elliptic to lance shaped leaves (to 3" long) are gray-green above and silver-green beneath. Very small white flowers bloom in panicles (to 2" long) in summer on stems from the leaf axils. Flowers are fragrant. Flowers give way to oval green drupes (olives to 1.5" long) which ripen to black. Each olive contains a single pit. Olives from this species are commercially harvested as eating olives and for production of olive oils. A large number of different commercial varieties are grown for fruit production.

# Olea europaea - Oleaceae family



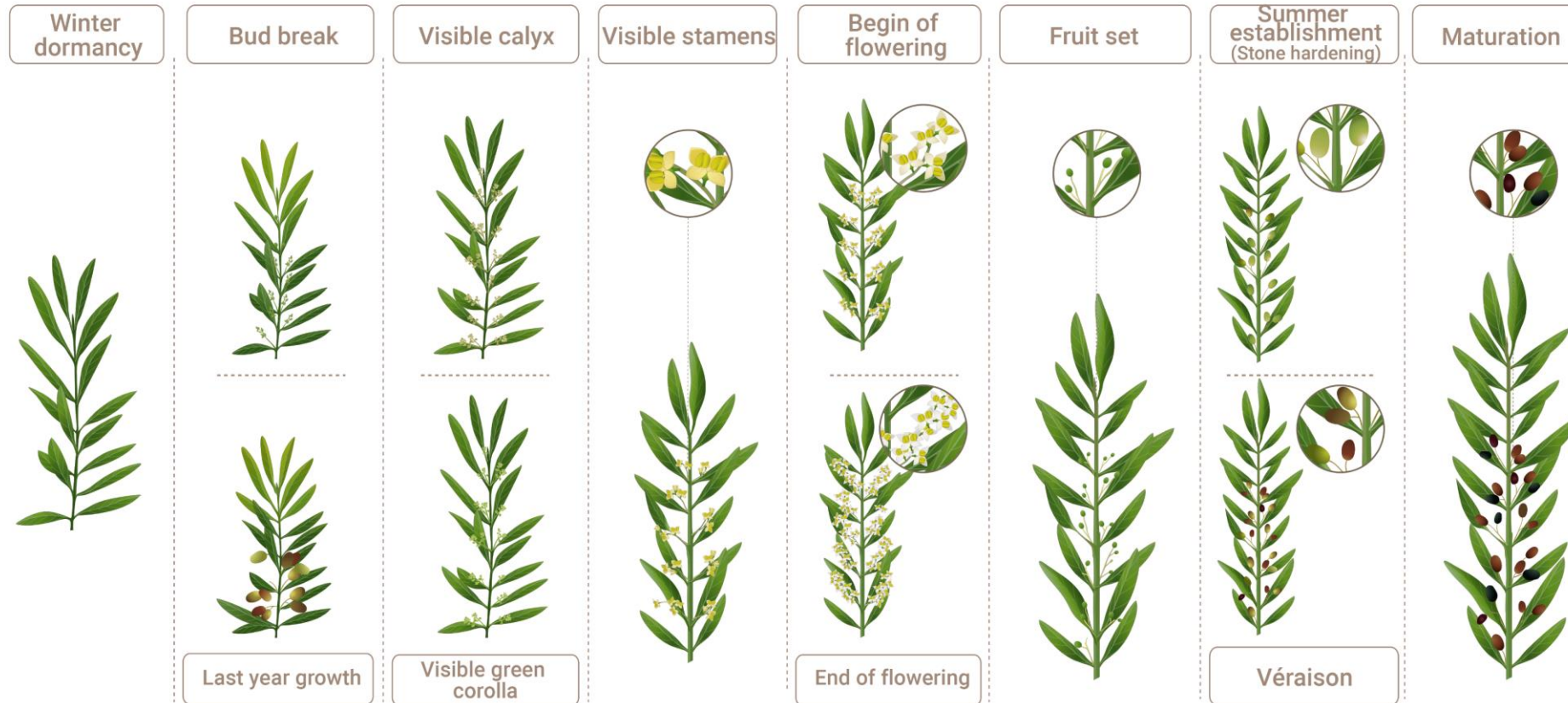
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Phenological stages

## -OLIVO-



# Olea europaea - Oleaceae family








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## Phenological stages

Stage	1	2	3	4	5
					
	Completed endocarp lignification	Pericarp cell expansion	Onset of ripening	Veraison	Completed fruit ripening
DPA	70	125	168	182	210
Fresh weight (g fruit <sup>-1</sup> )	1.05 ± 0.15	2.82 ± 0.20	3.75 ± 0.25	3.86 ± 0.19	4.01 ± 0.17
Firmness (N cm <sup>-1</sup> )	793.33 ± 63.14	785.50 ± 68.79	505.31 ± 30.25	385.31 ± 48.70	103.50 ± 34.30
% Lipid	2.45 ± 0.08	6.00 ± 0.15	8.30 ± 0.19	14.10 ± 0.25	18.50 ± 0.39

## Sphingolipid Distribution, Content and Gene Expression during Olive-Fruit Development and Ripening

Carla Inès<sup>1</sup>, María C. Parra-Lobato<sup>1</sup>, Miguel A. Paredes<sup>1</sup>, Juana Labrador<sup>1</sup>, Mercedes Gallardo<sup>2</sup>, Mariana Saucedo-García<sup>3</sup>, Marina Gavilanes-Ruiz<sup>4</sup> and María C. Gomez-Jimenez<sup>1\*</sup>



FIGURE 1. Developmental stages of the olive fruit of the cv. Picual. Stage 1: 'completed pit hardening'; Stage 2: 'peak of cell expansion'; Stage 3: 'the onset of ripening'; Stage 4: 'veraison'; Stage 5: 'fully ripe.' DPA: days post-anthesis. Fresh weight and firmness measurements were performed on whole fruits. Lipid content measurements were performed on fruit pericarps. Asterisks indicate statistically significant changes ( $P < 0.05$ ) with respect to the preceding point. Data are the means of three independent experiments  $\pm$  SE.

# *Olea europaea* - Oleaceae family

The cultivars are classified into three groups:

- ✓ Oil cultivar
- ✓ Table cultivar
- ✓ Dual purpose cultivar

The oil cultivars are characterized by a high lipid content and a good oil yield, the fruit is medium or small in size.

The table cultivars, on the other hand, have a lower oil yield but are larger and are sold for direct use.

In the Mediterranean alone there are more than 1000 genetic types of olive trees. Vegetative propagation limited to individual territories for hundreds of years has led to the evolution of a large number of landraces and cultivars. In Italy there are about 500 genetic types.



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# Olea europaea - Oleaceae family

<https://www.internationaloliveoil.org/the-world-of-olive-oil/>



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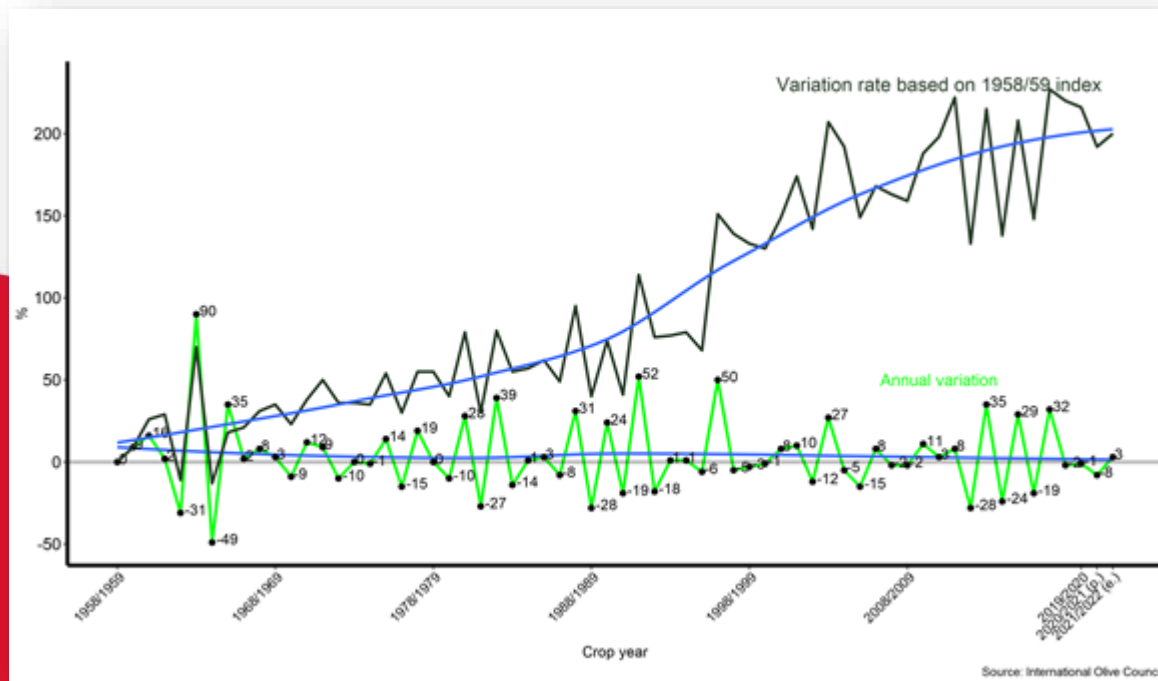


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Olive oil production has tripled in the last 60 years to reach 3 266 500 t in the 2019/20 crop year. Provisional data for 2020/21 point to a 7.9% fall in production for a volume of 3 010 000 t. Estimates for the 2021/22 crop year put production at 3 098 500 t (+2.9%).



Provisional figures for the 2020/21 crop year put world production of olive oil at 3 010 000 t, which is 256 500t or 7.9% less than the previous year. Consumption is expected at around 3 125 000 t (-4.4%) and imports and exports at 1 122 500 t and 1 108 500t respectively.

# Olea europaea - Oleaceae family



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Production (×1000tn)	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021(p.)	Average	2021/2022(e.)	%variation rates
<b>EU, of which:</b>	<b>1 752</b>	<b>2 188</b>	<b>2 264</b>	<b>1 920</b>	<b>2 051</b>	<b>2 035</b>	<b>1 974</b>	<b>↓ -3.8%</b>
SPAIN	1 291	1 262	1 790	1 125	1 389	1 371	1 300	↓ -6.4%
GREECE	195	346	185	275	275	255	225	↓ -18.2%
ITALY	182	429	174	366	274	285	315	↑ 15.2%
PORTUGAL	69	135	100	140	100	109	120	↑ 20.0%
<b>Other IOC countries, of which:</b>	<b>620</b>	<b>1 007</b>	<b>808</b>	<b>1 158</b>	<b>758</b>	<b>870</b>	<b>936</b>	<b>↑ 23.5%</b>
TUNISIA	100	325	140	440	140	229	240	↑ 71.4%
TURKEY	178	263	194	230	210	215	228	↑ 8.3%
MOROCCO	110	140	200	145	160	151	200	↑ 25.0%
ALGERIA	63	82	97	126	70	88	98	↑ 39.0%
EGYPT	30	40	41	40	30	36	20	↓ -33.3%
ARGENTINA	24	45	28	30	30	31	30	↓ 0.0%
<b>Non-IOC producers:</b>	<b>190</b>	<b>184</b>	<b>233</b>	<b>188</b>	<b>200</b>	<b>199</b>	<b>188</b>	<b>↓ -6.2%</b>
<b>TOTAL</b>	<b>2 561</b>	<b>3 379</b>	<b>3 305</b>	<b>3 266</b>	<b>3 010</b>	<b>3 104</b>	<b>3 099</b>	<b>↑ 2.9%</b>

Provisional figures for the 2020/21 crop year put world production of olive oil at 3 010 000 t, which is 256 500t or 7.9% less than the previous year. Consumption is expected at around 3 125 000 t (-4.4%) and imports and exports at 1 122 500 t and 1 108 500t respectively.



# Olea europaea - Oleaceae family

The IOC member countries produced 2 809 500t of olive oil in the 2020/21 crop year, which accounts for 93.3% of the world total. Some 2 051 200t (+6.8% on the previous crop year) came from the EU: **Spain** produced 1 389 000t (+23.4%), **Italy** 273 500t (-25.4%), **Greece** 275 000t (stable) and **Portugal** 100 000t (-28.8%).

The remaining member countries produced 34.5% less than the previous crop year, totaling 758 500t: **Turkey** produced 210 000t (-8.7%), **Morocco** 160 000t (+10.3%), **Tunisia** 140 000t (-68.2%) and **Algeria** 70 500t (-44%). Consumption reached 2 054 000t in IOC member countries and 1 071 000t in non-member countries.



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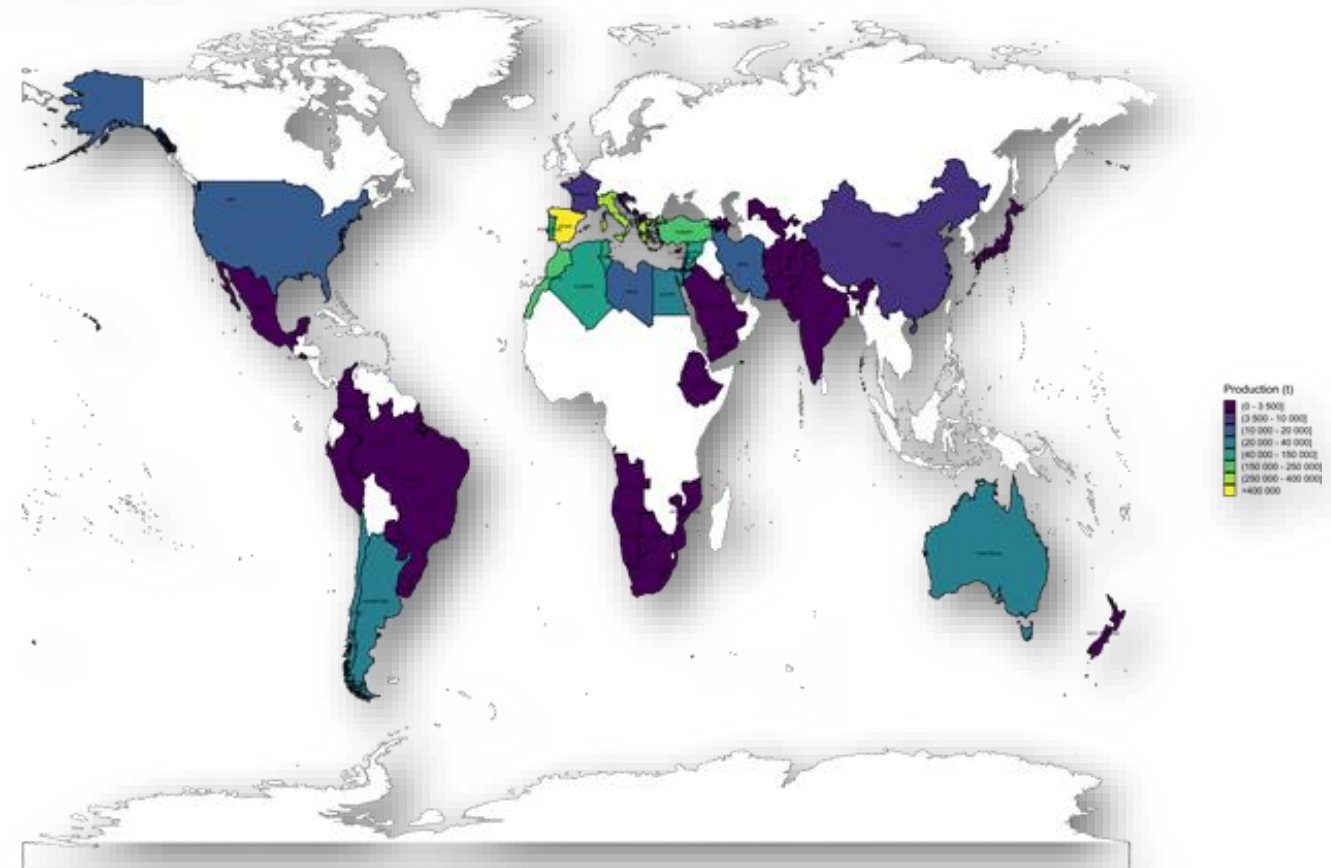


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World olive oil production, 2020/21 crop year



Source: International Olive Council

## *Olea europaea* - Oleaceae family

Italy is the country with the largest number of olive tree varieties in the world. More than 500 varieties of olives grow on our olive trees, which is about 42% of the world's olive varieties. In Spain and Greece, countries where a lot of olive oil is produced, there are significantly fewer olive varieties.

<b>CULTIVAR</b>	<b>REGION OF ITALY</b>	<b>USE</b>
Leccino	Center / Northern Italy	Production of oil and table olives
Nocellara del Belice	Sicily	Production of oil and table olives
Taggiasca	Liguria	Production of oil and table olives
Casaliva	Lombardy, Trentino Alto Adige, Veneto	Production of oil
Coratina	Puglia	Production of oil
Pisciottana	Campania	Production of oil
Moraiolo	Tuscany, Umbria	Production of oil
Frantoio	Tuscany, Umbria	Production of oil
Itrana	Lazio / Campania	Production of oil and table olives
Carolea	Calabria	Production of oil
Moresca	Sicily	Production of oil

These different varieties of olives have unique characteristics that vary by location and region.

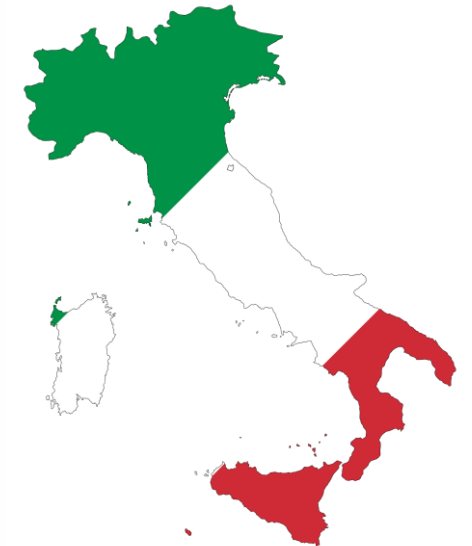


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Olive Oils  
- Italy -



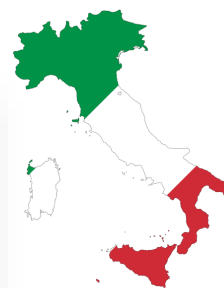
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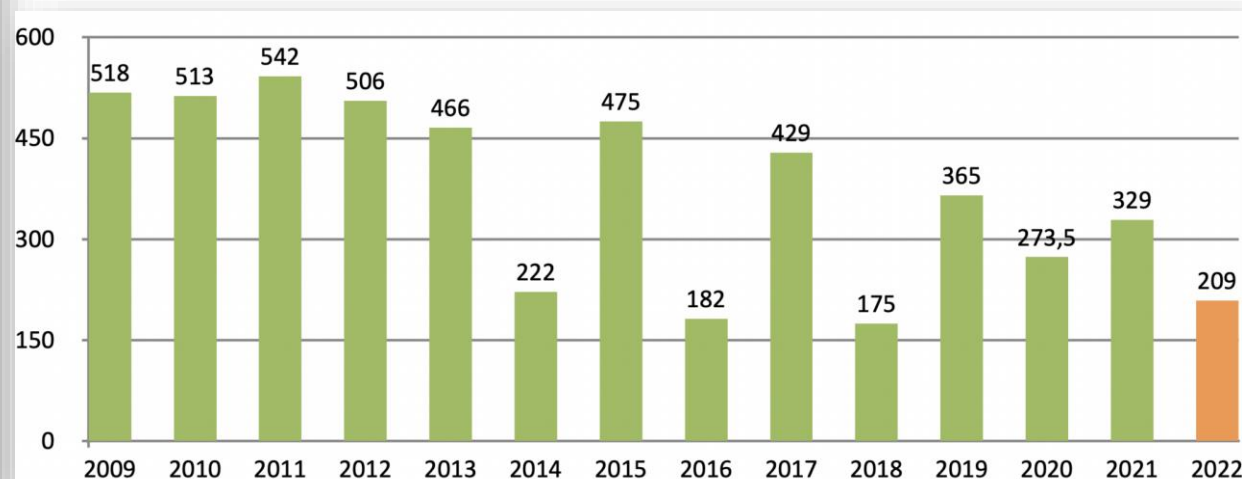
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	Media (15-18)	2018	2019	2020	2021	2022*	Var. % 2022/21
Puglia	156.263	73.108	208.755	117.477	177.407	85.686	-52%
Calabria	40.969	14.011	53.758	32.983	38.870	29.316	-25%
Sicilia	34.210	18.109	34.373	32.650	44.792	26.109	-42%
Campania	11.711	6.776	15.536	12.512	12.166	14.288	17%
Toscana	17.644	20.788	9.930	20.128	10.918	13.866	27%
Lazio	14.806	8.746	10.851	17.191	10.853	10.853	0%
Abruzzo	9.953	7.146	8.936	7.915	11.037	6.622	-40%
Umbria	5.258	6.395	3.825	6.960	3.178	4.036	27%
Basilicata	4.418	1.260	6.451	3.990	5.919	3.551	-40%
Sardegna	4.589	1.661	4.375	3.989	3.613	3.142	-13%
Liguria	4.156	5.245	1.488	4.670	3.682	2.761	-25%
Marche	3.604	2.220	2.424	3.644	3.158	2.684	-15%
Molise	2.916	2.391	2.877	2.823	1.517	1.934	27%
Emilia Romagna	1.170	1.258	785	1.524	1.165	1.631	40%
Veneto	2.176	3.652	321	3.065	420	700	67%
Lombardia	856	1.481	123	1.242	157	380	142%
Trentino Alto Adige	358	494	10	592	90	200	122%
Friuli Venezia Giulia	128	155	90	120	74	104	41%
Piemonte	10	21	3	24	10	16	60%
<b>ITALIA</b>	<b>315.196</b>	<b>174.917</b>	<b>364.911</b>	<b>273.500</b>	<b>329.026</b>	<b>207.879</b>	<b>-37%</b>

Production estimates prepared by ISMEA in collaboration with Italia Olivicola and Unaprol, and based on the latest survey at the beginning of November, indicate that production of olive oil in Italy in 2022-2023 should amount to 208,000 tonnes, a decrease of 37% on the previous season.



Italian production of pressed olive oil (tonnes) - divided by region

# Designations and definitions of Olive Oils

EU legislation regulates marketing standards for olive oils and olive-pomace oils.

- ✓ Regulation (EU) No 1308/2013 establishes a common organization of the markets in agricultural products.
- ✓ Commission Delegated Regulation (EU) 2022/2104 addresses marketing standards for olive oil. In particular, this regulation foresees rules on olive oil packaging and labelling (mandatory and optional requirements) and defines the specific characteristics applicable to each category.
- ✓ Commission Implementing Regulation (EU) 2022/2105 established the rule to verify compliance with the characteristics set for different olive oil categories in Commission Delegated Regulation (EU) 2022/2104. To verify the characteristics, laboratories and tasting panel have to use specific methods of analysis. This regulation also defines control requirements for Member States control authorities.



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# Designations and definitions of Olive Oils



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Virgin olive oils are the oils obtained from the fruit of the olive tree (*Olea europaea* L.) solely by mechanical or other physical means under conditions, particularly thermal conditions, that do not lead to alterations in the oil, and which have not undergone any treatment other than washing, decantation, centrifugation and filtration.

Category	Acidity (%) <sup>(1)</sup>	Peroxide value (mEq O <sub>2</sub> /kg)	K <sub>232</sub>	K <sub>268</sub> or K <sub>270</sub>	ΔK
1. Extra virgin olive oil	≤ 0,80	≤ 20,0	≤ 2,50	≤ 0,22	≤ 0,01
2. Virgin olive oil	≤ 2,0	≤ 20,0	≤ 2,60	≤ 0,25	≤ 0,01
3. Lampante olive oil	> 2,0	—	—	—	—
4. Refined olive oil	≤ 0,30	≤ 5,0	—	≤ 1,25	≤ 0,16
5. Olive oil composed of refined olive oil and virgin olive oils	≤ 1,00	≤ 15,0	—	≤ 1,15	≤ 0,15
6. Crude olive-pomace oil	—	—	—	—	—
7. Refined olive-pomace oil	≤ 0,30	≤ 5,0	—	≤ 2,00	≤ 0,20
8. Olive-pomace oil	≤ 1,00	≤ 15,0	—	≤ 1,70	≤ 0,18

Acidity % = oleic acid g/100 g oil  
Peroxide value: primary oxidation level

K<sub>232, 268/270</sub>: UV absorbance at different wavelengths is suggestive of the presence of conjugated dienes and trienes

Pomace oil: oil extracted with solvent(s) from the residual panel of press (*sansa* in Italian)

# Designations and definitions of Olive Oils



Category	Sterols composition						Total sterols (mg/kg)	Erythrodiol and uvaol (%) <sup>(*)</sup>	Waxes (mg/kg) <sup>(**)</sup>
	Cholesterol (%)	Brassicasterol (%)	Camposterol <sup>(1)</sup> (%)	Stigmasterol (%)	Apparent $\beta$ -sitosterol <sup>(2)</sup> (%)	$\Delta$ -7-stigma-stenol <sup>(1)</sup> (%)			
1. Extra virgin olive oil	≤ 0,5	≤ 0,1	≤ 4,0	< Camp.	≥ 93,0	≤ 0,5	≥ 1 000	≤ 4,5	C42 + C44 + C46 ≤ 150
2. Virgin olive oil	≤ 0,5	≤ 0,1	≤ 4,0	< Camp.	≥ 93,0	≤ 0,5	≥ 1 000	≤ 4,5	C42 + C44 + C46 ≤ 150
3. Lampante olive oil	≤ 0,5	≤ 0,1	≤ 4,0	—	≥ 93,0	≤ 0,5	≥ 1 000	≤ 4,5 <sup>(3)</sup>	C40 + C42 + C44 + C46 ≤ 300 <sup>(3)</sup>
4. Refined olive oil	≤ 0,5	≤ 0,1	≤ 4,0	< Camp.	≥ 93,0	≤ 0,5	≥ 1 000	≤ 4,5 <sup>(4)</sup>	C40 + C42 + C44 + C46 ≤ 350
5. Olive oil composed of refined olive oil and virgin olive oils	≤ 0,5	≤ 0,1	≤ 4,0	< Camp.	≥ 93,0	≤ 0,5	≥ 1 000	≤ 4,5	C40 + C42 + C44 + C46 ≤ 350
6. Crude olive-pomace oil	≤ 0,5	≤ 0,2	≤ 4,0	—	≥ 93,0	≤ 0,5	≥ 2 500	> 4,5 <sup>(3)</sup>	C40 + C42 + C44 + C46 > 350 <sup>(3)</sup>
7. Refined olive-pomace oil	≤ 0,5	≤ 0,2	≤ 4,0	< Camp.	≥ 93,0	≤ 0,5	≥ 1 800	> 4,5	C40 + C42 + C44 + C46 > 350
8. Olive-pomace oil	≤ 0,5	≤ 0,2	≤ 4,0	< Camp.	≥ 93,0	≤ 0,5	≥ 1 600	> 4,5	C40 + C42 + C44 + C46 > 350

<sup>(1)</sup> See the Appendix to this Annex.

<sup>(2)</sup> Apparent  $\beta$ -sitosterol:  $\Delta$ -5,23-stigmastadienol+clerosterol+  $\beta$ -sitosterol+sitostanol+  $\Delta$ -5-avenasterol+  $\Delta$ -5,24-stigmastadienol.

<sup>(3)</sup> Oils with a wax content of between 300 mg/kg and 350 mg/kg are considered to be lampante olive oil if the total aliphatic alcohol content is less than or equal to 350 mg/kg or if the erythrodiol and uvaol content is less than or equal to 3,5 %.

<sup>(4)</sup> Oils with an erythrodiol + uvaol content of between 4,5 and 6 % must have an erythrodiol content of less than or equal to 75 mg/kg.

<sup>(5)</sup> Oils with a wax content of between 300 mg/kg and 350 mg/kg are considered to be crude olive-pomace oil if the total aliphatic alcohol content is above 350 mg/kg and if the erythrodiol and uvaol content is greater than 3,5 %.

# Designations and definitions of Olive Oils



## Extra virgin olive oil

Virgin olive oil which has a free acidity, expressed as oleic acid, of not more than 0.8 grams per 100 grams, and the other characteristics of which correspond to those fixed for this category in the IOC standard.

## Ordinary virgin olive oil

Virgin olive oil which has a free acidity, expressed as oleic acid, of not more than 3.3 grams per 100 grams and the other characteristics of which correspond to those fixed for this category in the IOC standard. This designation may only be sold direct to the consumer if permitted in the country of retail sale. If not permitted, the designation of this product has to comply with the legal provisions of the country concerned.

## Virgin olive oil

Virgin olive oil which has a free acidity, expressed as oleic acid, of not more than 2 grams per 100 grams and the other characteristics of which correspond to those fixed for this category in the IOC standard.

## Virgin olive oil not fit for consumption

Virgin olive oil not fit for consumption as it is, designated lampante virgin olive oil, is virgin olive oil which has a free acidity, expressed as oleic acid, of more than 3.3 grams per 100 grams and/or the organoleptic characteristics and other characteristics of which correspond to those fixed for this category in the IOC standard. It is intended for refining or for technical use.



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# Designations and definitions of Olive Oils



## Refined olive oil

Refined olive oil is the olive oil obtained from virgin olive oils by refining methods which do not lead to alterations in the initial glyceridic structure. It has a free acidity, expressed as oleic acid, of not more than 0.3 grams per 100 grams and its other characteristics correspond to those fixed for this category in the IOC standard. This designation may only be sold direct to the consumer if permitted in the country of retail sale.

## Olive oil

Olive oil is the oil consisting of a blend of refined olive oil and virgin olive oils fit for consumption as they are. It has a free acidity, expressed as oleic acid, of not more than 1 gram per 100 grams and its other characteristics correspond to those fixed for this category in the IOC standard. The country of retail sale may require a more specific designation.



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# Designations and definitions of Olive Oils



## Olive pomace

Olive pomace oil is the oil obtained by treating olive pomace with solvents or other physical treatments, to the exclusion of oils obtained by re esterification processes and of any mixture with oils of other kinds. It is marketed in accordance with the following designations and definitions:

**Crude olive pomace oil** is olive pomace oil whose characteristics correspond to those fixed for this category in the IOC standard. It is intended for refining for use for human consumption, or it is intended for technical use.

**Refined olive pomace oil** is the oil obtained from crude olive pomace oil by refining methods which do not lead to alterations in the initial glyceridic structure. It has a free acidity, expressed as oleic acid, of not more than 0.3 grams per 100 grams and its other characteristics correspond to those fixed for this category in the IOC standard. This product may only be sold direct to the consumer if permitted in the country of retail sale.

**Olive pomace oil** is the oil comprising the blend of refined olive pomace oil and virgin olive oils fit for consumption as they are. It has a free acidity of not more than 1 gram per 100 grams and its other characteristics correspond to those fixed for this category in the IOC standard. The country of retail sale may require a more specific designation.



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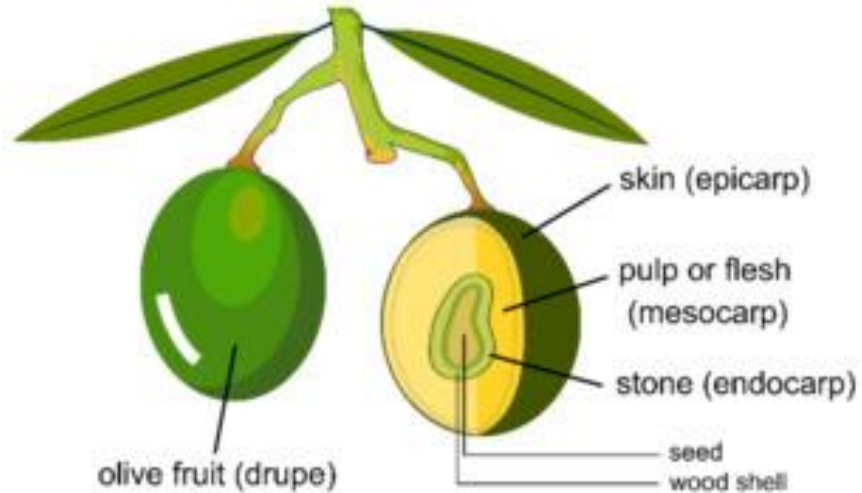
# Olive fruit composition and related oil



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99% of the oil is contained in vacuoles of the oil cells of the mesocarp; only 1% is present in the cytoplasm.

Constituents	Pulp (%)	Stone (%)	Seed (%)
Water	50–60	9.3	30
Oil	15–30	0.7	27.3
Nitrogen containing compounds	2–5	3.4	10.2
Sugar	3–7.5	41	26.6
Cellulose	3–6	38	1.9
Minerals	1–2	4.1	1.5
Polyphenols (aromatic compounds)	2–2.25	0.1	0.5–1
Others	—	3.4	24

When the olive fruit undergoes over ripening the oleosomes membrane, made by phospholipids and related substances, degrades and triglycerides are exposed to the cytoplasmatic medium. Lipases and esterases start hydrolysis and free acidity raises.

Free acidity is a quality index of optimal olives ripening stage.

# Olive fruit composition and related oil



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## Codex Alimentarius Standard on Olive oil

CODEX Stan 33

### 3.9 Fatty acid composition as determined by gas chromatography (% total fatty acids)

Fatty acid	Virgin olive oils	Olive oil Refined olive oil	Olive-pomace oil Refined olive-pomace oil
C14:0	0.0 - 0.05	0.0 - 0.05	0.0 - 0.05
C16:0	7.5 - 20.0	7.5 - 20.0	7.5 - 20.0
C16:1	0.3 - 3.5	0.3 - 3.5	0.3 - 3.5
C17:0	0.0 - 0.3	0.0 - 0.3	0.0 - 0.3
C17:1	0.0 - 0.3	0.0 - 0.3	0.0 - 0.3
C18:0	0.5 - 5.0	0.5 - 5.0	0.5 - 5.0
C18:1	55.0 - 83.0	55.0 - 83.0	55.0 - 83.0
C18:2	3.5 - 21.0	3.5 - 21.0	3.5 - 21.0
C18:3 <sup>4</sup>			
C20:0	0.0 - 0.6	0.0 - 0.6	0.0 - 0.6
C20:1	0.0 - 0.4	0.0 - 0.4	0.0 - 0.4
C22:0	0.0 - 0.2	0.0 - 0.2	0.0 - 0.3
C24:0	0.0 - 0.2	0.0 - 0.2	0.0 - 0.2
<i>Trans</i> fatty acids			
C18:1 T	0.0 - 0.05	0.0 - 0.20	0.0 - 0.40
C18:2 T + C18:3 T	0.0 - 0.05	0.0 - 0.30	0.0 - 0.35

# Olive fruit composition and related oil



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Olive oil triacylglycerol fraction <sup>a</sup>			
Fatty acids (%)		Triacylglycerols (%)	
Palmitic, C16:0	13.09	LLL	0.267
Palmitoleic, C16:1	1.18	OLLn + PoLL	0.292
Stearic, C18:0	2.45	PLLn	0.082
Oleic, C18:1	68.04	OLL	3.855
Linoleic, C18:2	13.35	OOLn + PoOL	1.481
Arachidic, C20:0	0.42	PLL + PoPoO	1.456
Linolenic, C18:3	0.51	PLL + PoPoL + PoPo	0.921
Eicosenoic, C20:1	0.27	OOL	15.69
Behenic, C22:0	0.12	PoOO	1.982
Lignoceric, C24:0	0.096	PLO	8.81
Palmitic/Arachidic ratio	31.01	PoPP + SPoL + Oln	1.197
Linoleic/Palmitic ratio	1.02	PLP + PoPP	1.31
Linolenic/Arachidic ratio	1.2	OOO	31.72
		SOL	1.732
		POO	19.66
		POP	3.72
		AOO	0.265
		SOO	3.728
		POS + SLS	1.156

<sup>a</sup>O = oleic, L = linoleic, Ln = linolenic, P = palmitic, S = stearic, Po = palmitoleic, A = arachidic.



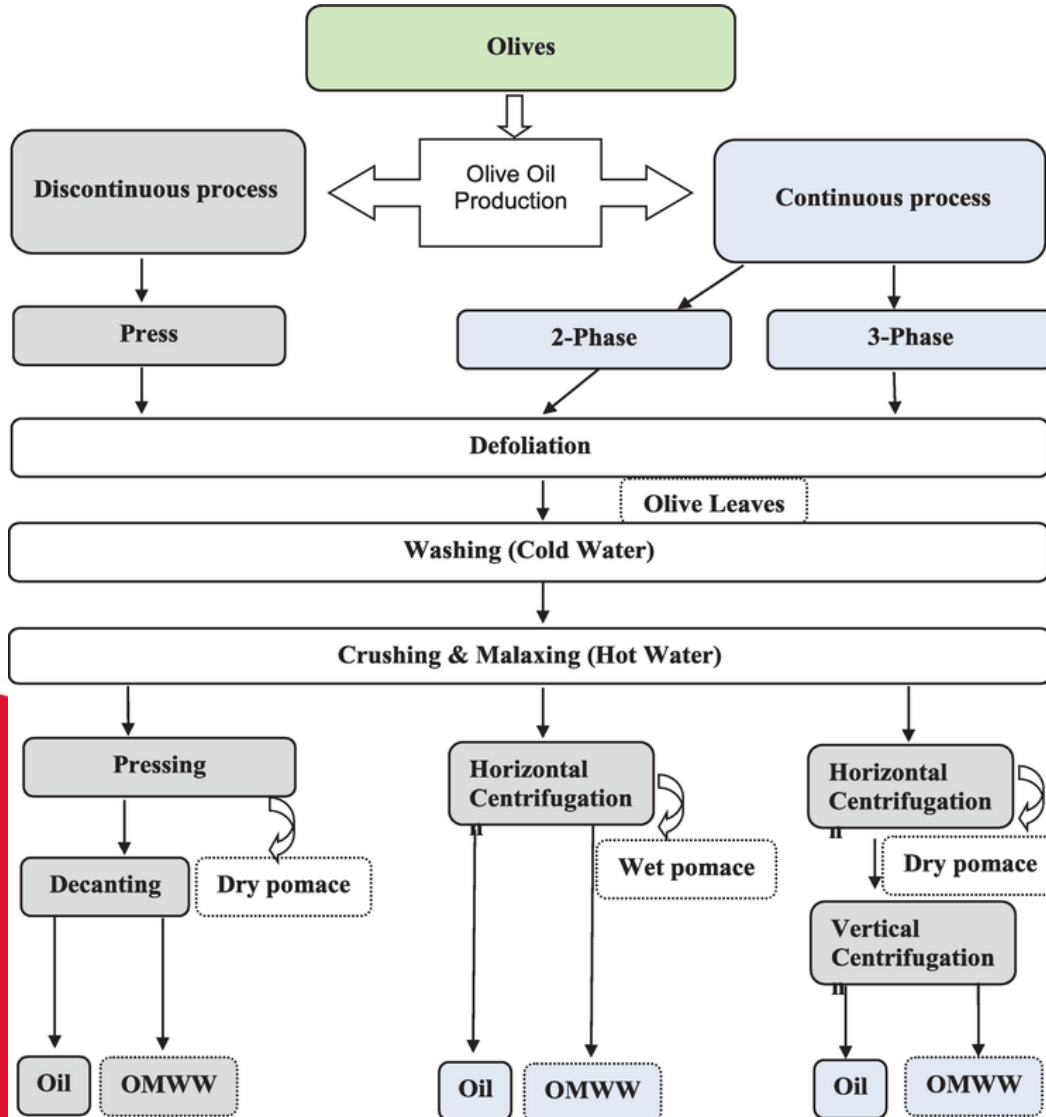
# Olive oil extraction technology and processes



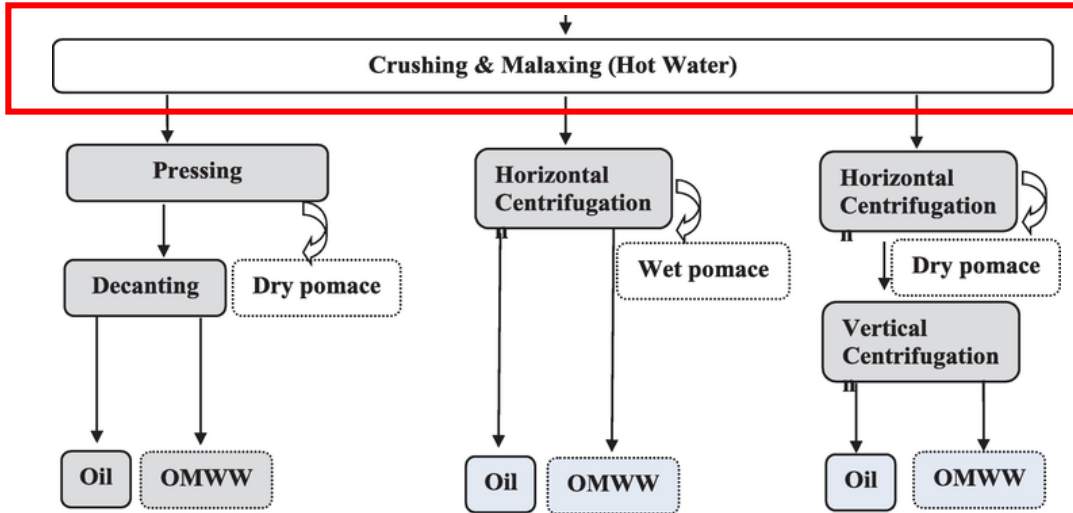
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# Olive oil extraction technology and processes



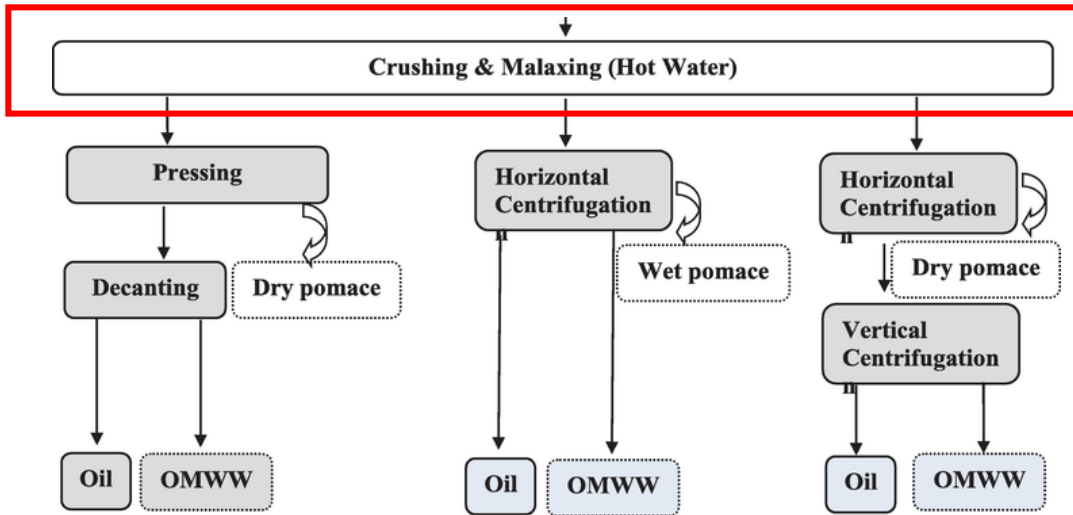
## Milling and Crushing:

Currently the most used milling methods are: traditional milling (*molitura*) consisting of two granite wheels that rotate on a large plate where they crush the olives to obtain the paste;

modern milling or crushing (*frangitura*), as a continuous cycle: the olive paste is obtained by breaking up the olives with a series of mechanical hammers.



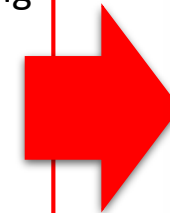
# Olive oil extraction technology and processes



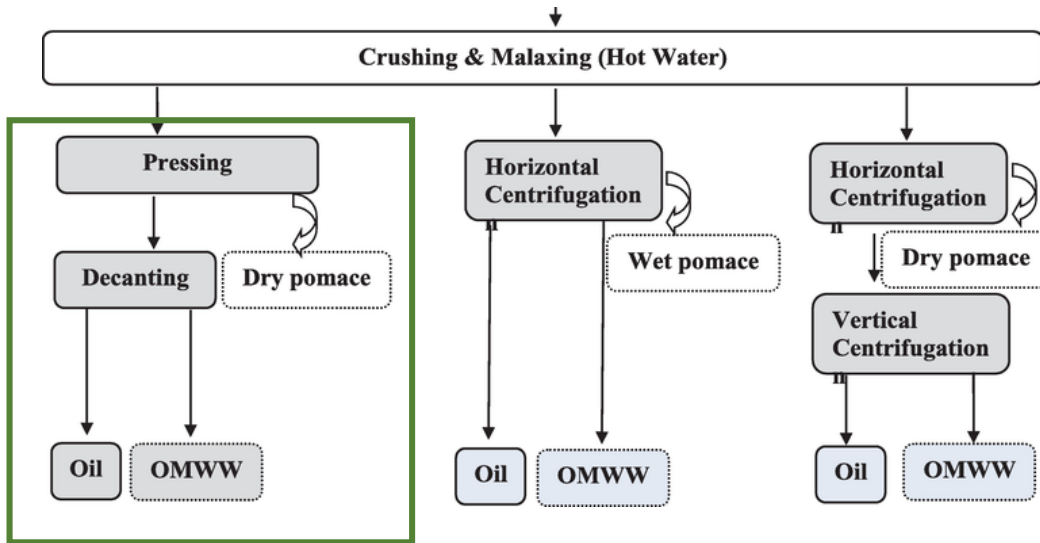
## Malaxation

The **malaxation** involves stirring the olive paste slowly, which aids in the coalescence of small drops into large ones and favors the breakage of the unbroken cells containing oil. The malaxers have two or three cylindrical vats in tandem, each one with a rotating helix with several wings that mix the paste at low speed (15-20 rpm) for a period of time between 30 min and 75 min, depending on the paste characteristics.

The extraction yield is directly correlated to time and temperature. A rise in temperature and time increases the yield. However, the temperature of the paste should not be higher than 30°C to avoid change in the oil color (from yellow-green to reddish), the increase of acidity and the degradation of the volatile compounds that would result in a VOO with the negative sensory attribute “heated”.



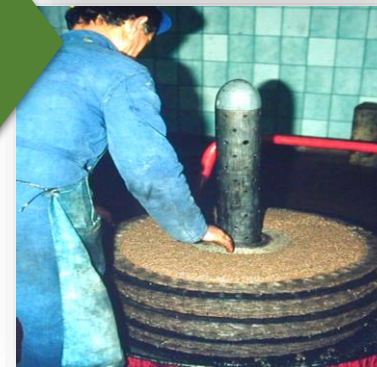
# Olive oil extraction technology and processes



## Traditional pressing

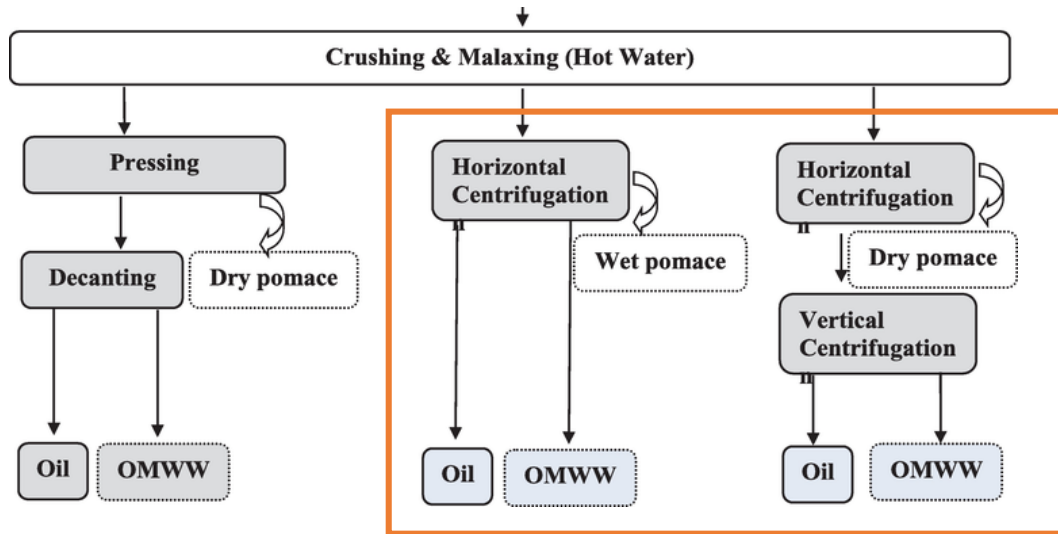
the kneaded paste is spread on special *fiscoli*, i.e. circular filtering panels in synthetic fiber (once made exclusively of vegetable fibers), perforated in the center and overlapping (every three *fiscoli* a rigid steel disk is placed forming the *teme*) and stacked in a special steel column placed on a trolley equipped with grooves.

Once the tower, composed of about 20 *teme*, is formed, a pressing is carried out around the four atmospheres.





# Olive oil extraction technology and processes

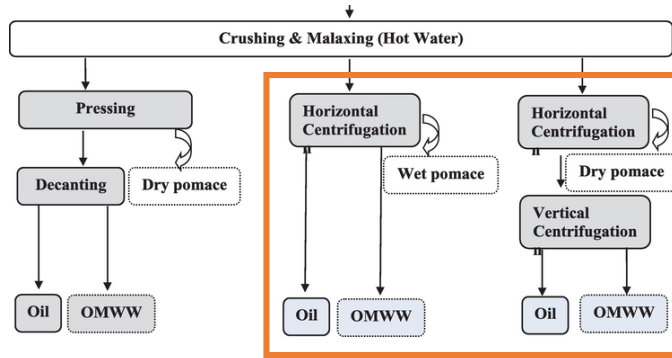


## Horizontal centrifugation by decanters

the paste is placed in a decanter (horizontal centrifuge) with two or three outlets, adding water (from 10 to 20% with respect to the weight of the olives) at a controlled temperature of about 28°C.



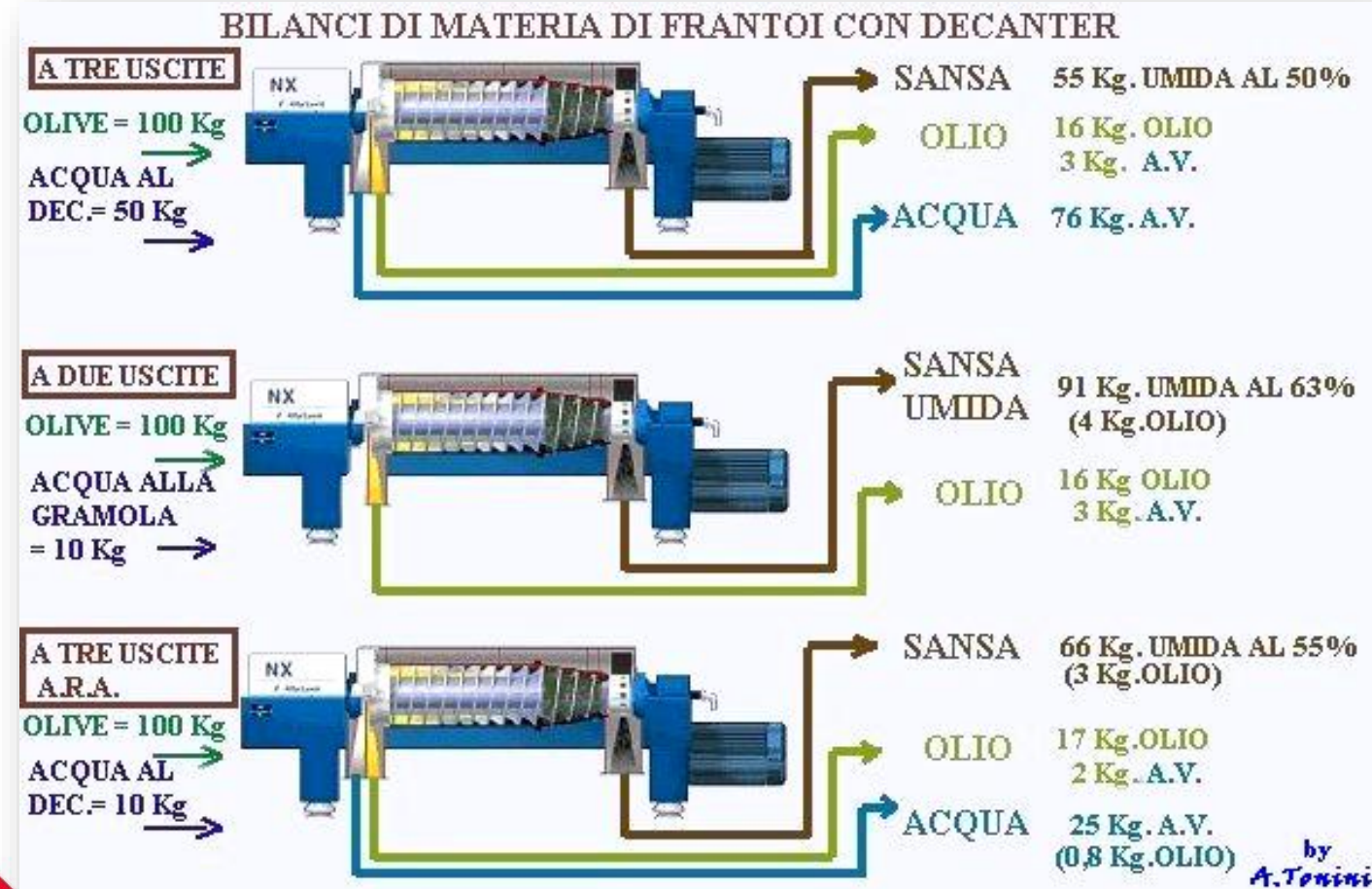
# Olive oil extraction technology and processes



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# Olive oil extraction technology and processes



## Separation of oil from vegetation water

- ✓ Natural outcrop (Decantation)
- ✓ Centrifugation (vertical centrifuges, about 5000 rpm, manual or automatic sludge discharge)

## Refinement

- ✓ Possible washing
- ✓ Clarification by decantation
- ✓ Ripening 4-6 months with 1-2 decanting

No light, air, humidity

Inert containers with narrow bottoms

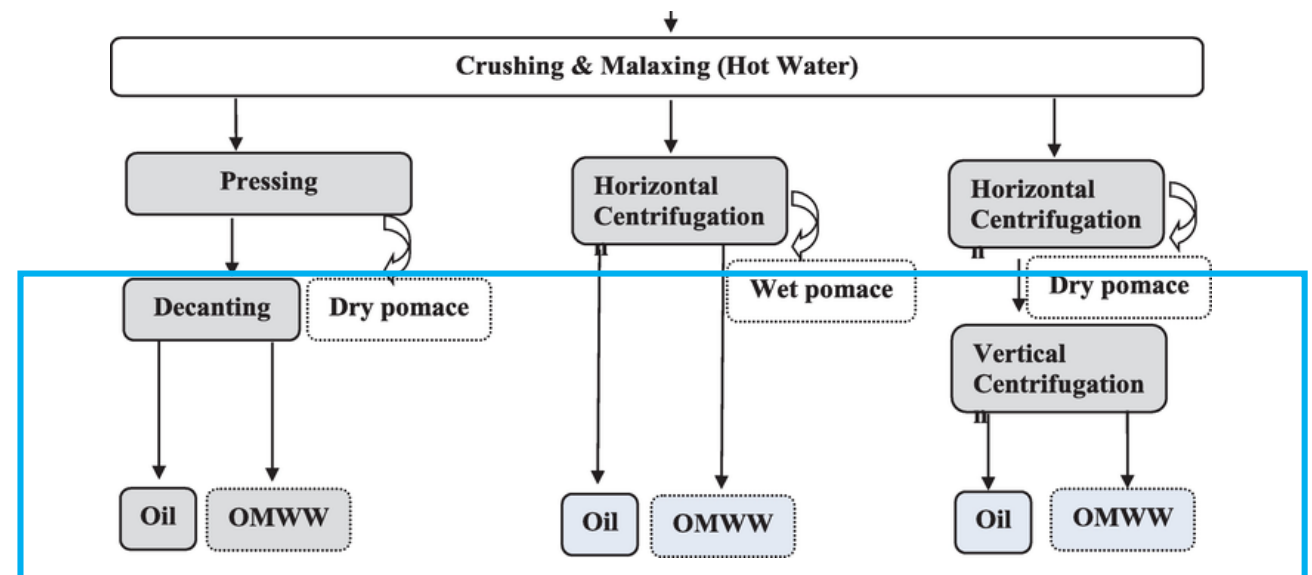
Temperature <15°C

Maximum duration 18 months for virgin oils

## Optional interventions

Winterization

Filtration



# Olive oil sensory analysis and categories

Sensory analysis is carried out by a “test panel”, i.e. an official tasting group of specialists qualified in using approved methods. A test panel is an essential tool for both checking oil quality highlighting the absence of perceivable defects accompanied by pleasant aroma and taste notes.



**INTERNATIONAL OLIVE OIL COUNCIL (IOOC)**  
Profile Sheet

**DEFECTS**

Fusty

Musty - Humid

Winey - Vinegary  
Acid - Sour

Muddy sediment

Metallic

Rancid

Other

**POSITIVE ATTRIBUTES**

Fruity

Bitter

Pungent

Name of Taster: \_\_\_\_\_  
Sample Code: \_\_\_\_\_ Date: \_\_\_\_\_



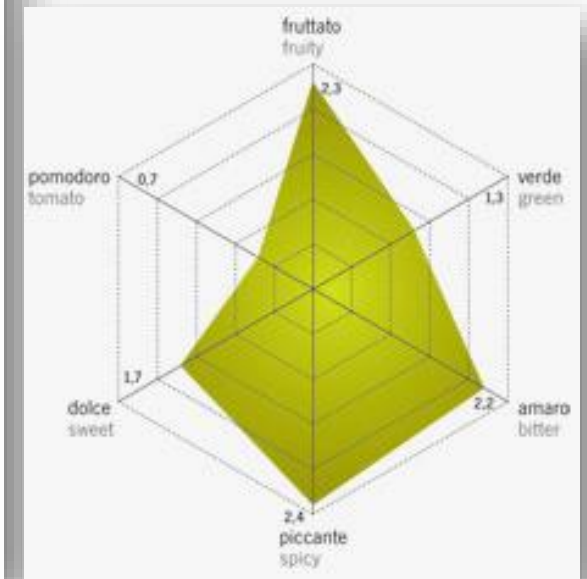
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# Olive oil sensory analysis and categories



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**Table 14.7.** Important aroma substances of two *extra virgine* olive oils<sup>a</sup>

Aroma substance	Aroma quality	Oil I		Oil II	
		C	A <sub>x</sub>	C	A <sub>x</sub>
Isobutyric acid ethyl ester	Fruity	4.9	7	14	19
2-Methylbutyric acid ethyl ester	Fruity	3.9	5	14	19
Cyclohexanoic acid ethyl ester	Fruity	1.6	4.2	4.3	11
(Z)-3-Hexenal	Green	33	12	53	19
(Z)-2-Nonenal	Green, fatty	9	15	10	17
Acetic acid	Like vinegar	10,490	10	6680	6
4-Methoxy-2-methyl-2-butanethiol	Like blackcurrants	n.d.		1.8	40

<sup>a</sup> Oil I is from Italy, oil II from Spain; concentration C is in  $\mu\text{g}/\text{kg}$  and the aroma value A<sub>x</sub> is calculated on the basis of the odor thresholds (retronasal) in an oil; n.d.: not detectable ( $C < 0.05 \mu\text{g}/\text{kg}$ ).

# Olive oil sensory analysis and categories



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INTERNATIONAL OLIVE COUNCIL'S METHOD FOR THE ORGANOLEPTIC ASSESSMENT OF VIRGIN OLIVE OIL  
European COMMISSION REGULATION (EEC) No 2568/91 of 11 July 1991 on the characteristics of olive oil and olive-residue oil and on the relevant methods of analysis (1991R2568 — 16.10.2015 )

- ✓ **Extra virgin olive oil:** the median of the defects is 0 and the median of the fruity attribute is above 0.
- ✓ **Virgin olive oil:** the median of the defects is above 0 but not more than 3,5 and the median of the fruity attribute is above 0.
- ✓ **Lampante olive oil:** the median of the defects is above 3,5 or the median of the defects is less than or equal to 3,5 and the fruity median is equal to 0.

GENERAL BASIC VOCABULARY FOR SENSORY ANALYSIS  
Refer to the standard IOC/T.20/Doc. No 4 "Sensory Analysis: General Basic Vocabulary"

- ✓ Fruity
- ✓ Bitter
- ✓ Pungent

- ✓ Fusty/muddy sediment
- ✓ Musty-humid-earthly
- ✓ Winey-vinegary-acid-sour
- ✓ Rancid

# Olive oil sensory analysis and categories



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Article

Characterization of the Key Odorants in High-Quality Extra Virgin Olive Oils and Certified Off-Flavor Oils to Elucidate Aroma Compounds Causing a Rancid Off-Flavor

Anja Neugebauer, Michael Granvogl, and Peter Schieberle\*

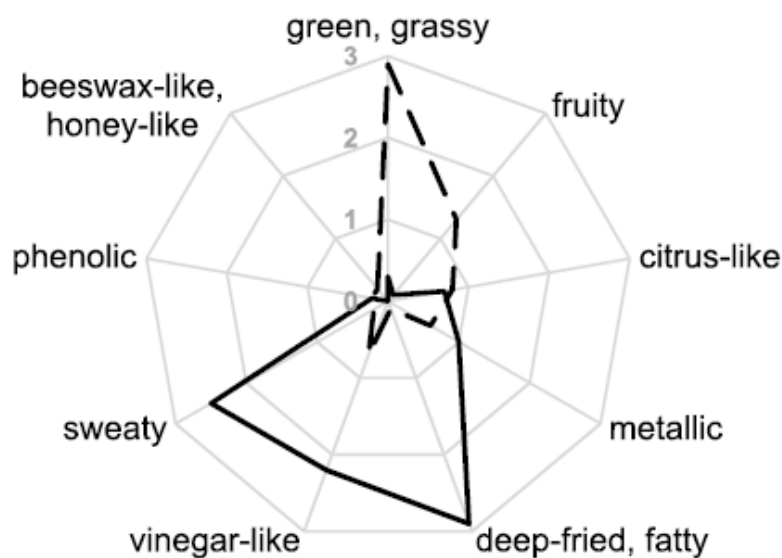


Figure 1. Aroma profile analysis of the rancid olive oil (*RanOO1*, solid line) and the premium extra virgin olive oil (*PreOO1*, dashed line).

aroma compound	OT <sub>oil</sub> <sup>a</sup> (μg/kg)	OAV <sup>b</sup>	
		PreOO1	RanOO1
( <i>E,Z</i> )-2,4-decadienal	4 <sup>c</sup>	<1	3480
hexanoic acid	460	<1	3070
octanal	140	<1	2590
hexanal	300	4	1090
( <i>E</i> )-2-octenal	120 <sup>d</sup>	<1	1000
( <i>E,E</i> )-2,4-decadienal	66	<1	971
butanoic acid	34	<1	821
acetic acid	350	10	614
3-ethylphenol	8 <sup>d</sup>	<1 <sup>i</sup>	516
pentanoic acid	400	<1	480
( <i>E</i> )-2-nonenal	140	<1	385
( <i>E,E</i> )-2,4-nonadienal	30	<1	325
( <i>Z</i> )-2-nonenal	4	<1	144
heptanal	500	<1	89
<i>trans</i> -4,5-epoxy-( <i>E</i> )-2-decenal	13	23	78
( <i>E</i> )-2-heptenal	1200	<1	66
( <i>E</i> )-2-decenal	2200 <sup>d</sup>	n.c. <sup>k</sup>	33
( <i>E,Z</i> )-2,4-nonadienal	30 <sup>e</sup>	n.c. <sup>k</sup>	33
nonanal	610 <sup>d</sup>	<1	27
3-methylbutanoic acid	11	<1	20
( <i>E,Z</i> )-2,6-nonadienal	65	<1	8
( <i>E</i> )-2-undecenal	7700 <sup>d</sup>	<1	8
( <i>E,Z</i> )-2,4-heptadienal	55 <sup>f</sup>	<1 <sup>i</sup>	5



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**Grazie**