

# Virgin Olive Oil and its Use in Croatian Gastronomic Offer

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## ABSTRACT

Olive growing is a very important branch of the economy in total agricultural production. Virgin olive oil is an indispensable food product and the healthiest fat in the Croatian gastronomic offer, mostly in Istria and Dalmatia. For this reason, the knowledge of chefs about virgin olive oil is important. Olive varieties, cultivation climate, method of production determine the quality of virgin olive oils and the paper aims to examine its presence in food preparation in Croatian restaurants and the possibility of its application in new gastronomic trends. Survey research has shown that restaurants in Istria and Dalmatia use significant amounts of virgin olive oil, produced exclusively in Croatia. Croatian hospitality workers have only domestic oil in their offer, mostly from their own production. It can be concluded that the consumption of virgin olive oil in Croatia should be significantly higher, primarily due to its beneficial effect on health, but also due to the development of Croatian olive growing. The results of qualitative research can greatly serve the producers of olive oil, but also all hospitality workers, to monitor the competitiveness of the product in particular markets.

*Keywords: olive, virgin olive oil, gastronomy, offer*

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## 1. INTRODUCTION

Olive growing is economically a very important branch in our overall agricultural production, both from the point of view of the existing level of production and in relation to the possibilities of increasing the production in the coming period. Over the last ten years, olive growing has been of interest to agricultural producers and, in a certain way, it is reaching its peak. This is partly due to the help of the state, i.e. the Ministry of Agriculture, which promotes olive growing as an agricultural branch of significant interest to the country by creating various incentives for agricultural development, programs for raising new olive groves and restoration of the old ones (Ilak Peršurić & Juraković, 2006).

Due to various agro-economic factors in the last century, the number of productive trees in our country has been drastically decreasing. For this reason, today's production does not meet our consumption needs and therefore olive oil and olive fruit have to be imported.

In our area, olives have been grown and cultivated since ancient times and are one of the plant crops that have made possible for mankind to maintain and develop. Olive is an indestructible, long-living plant, so when it freezes or suffers from a fire, it quickly regenerates from the stump or root due to its regenerative properties. There are trees thousands of years old still preserved along the Adriatic coast.

As an agricultural crop, often neglected and left to harmful influences of natural factors, the olive has produced fruit quite irregularly, which partly influenced the displacement of the population from predominantly olive groves. With the shift of the rural population from agriculture to other industries, and due to excessive and economically unjustified imports of oils and olive fruits, there was a devastating decline in olive production and many fertile olive groves along the Adriatic coast took on the appearance of neglected forest vegetation.

In the last twenty years, thanks primarily to the enthusiasm of experts in agriculture and advances in science, the preconditions for more regular and higher yields have been created, which has significantly contributed to the restoration of abandoned olive groves, new plantations, and the gradual return of younger generations to olive production.

Virgin olive oil, as the healthiest fat in the diet, is traditionally used in Croatian gastronomy. Olive oil tastings as well as the preparation of traditional and modern dishes using this product makes a new opportunity for Croatian tourism. The aim is to investigate the use of virgin olive oils in Croatian restaurants.

## 2. OLIVE AND THE ECONOMY

Olive is considered to be the oldest cultivated plant species (Žanetić & Gugić, 2006). Olive is an evergreen subtropical plant that botanically belongs to the family Oleaceae, genus *Olea*, and the species bears the Latin name *Olea europaea L.* It is light green or dark green and has an elliptical shape. Olive is a long-lived, richly branched evergreen tree or shrub with an irregular and distinctly bumpy trunk and a spindle-shaped and highly branched root (Jankulovski, 2019).

It is assumed that the ancestral home of the olive is Palestine or Asia Minor, from where its cultivation spread to other Mediterranean countries, including our region. Today, more than 800,000,000 olive trees are grown in the world in an area of about 9,600,000 ha. There are about 786,000,000 olive trees in the Mediterranean area which produce about 95% of the world's yield. Spain and Italy have the largest number of olive trees and are the leading producers of olive oil. Significant producers are also Greece, Tunisia and Turkey (Barbarić, Raič & Karačić, 2014).

In Croatia, there are around six million olive trees growing on about 30,000 hectares, which makes 0.5 percent of the total agricultural area in Croatia. 45,000 households are engaged in olive growing, and the most common variety is *oblica* with a 60 percent share in the total number of crops. Croatia's share in the world's olive groves is only 0.2 percent, and the consumption is two litres per capita per year, while the EU average is 12 litres. Last year olive yield and oil production failed significantly due to the bad weather, so out of 28,540 tons of processed fruit, only 31,131 hectolitres of oil were produced in 173 oil mills, and the growing needs of the market will have to be replaced by imports. In the territory of Croatia, mostly domestic autochthonous varieties are grown, shown in Table 1, while the introduced varieties are less represented.

**Table 1. Olive varieties by subregions**

<b>There are more varieties in every subregions, of which the most important ones are</b>	<b>Varieties</b>
Istria	<i>bjelica, buga, moražola, rosinjola, crnica and drobnica</i>
Kvarner and coastal Velebit region	<i>slivnjača, plominka, rosulja, slatka, drobnica and oblica</i>
Northern Dalmatia	<i>oblica, drobnica, piculja, oštrica, grambučela and krvavica</i>
Central Dalmatia	<i>oblica, drobnica, levantinka and lastovka</i>
Southern Dalmatia	<i>oblica, uljarica, murgulja, piculja, želdarica, dužica, mezanica, žutica and grozdača</i>

There are natural conditions for successful olive growing in our entire coastal area. In its long centuries of cultivation in this area, olive growing as an agricultural branch experienced its ups and downs, depending on various agro-economic factors.

In the structure of the economy in some areas and especially on islands, olive growing and tourism, as economic branches that complement each other from the point of view of employment, form the basis of existence of its inhabitants. This orientation of the economy has already partially stopped emigration from some islands and provided an opportunity to ensure the livelihood of younger generations. The olive tree is a symbol of the Mediterranean, grown throughout the coastal area, which is the Adriatic

region of olive growing, divided into 5 subregions: 1. Istrian coast 2. Kvarner islands 3. Northern Dalmatia 4. Central Dalmatia 5. Southern Dalmatia.

The Republic of Croatia does not produce sufficient quantities of olive oil for domestic consumption, so part of the consumption is covered by import. In 2017, according to the Croatian Bureau of Statistics, 3,323 tons of olive oil worth EUR 14,100,000 were imported, while the export of olive oil in the same period amounted to 365 tons worth EUR 3,200,000, which represents a negative foreign trade balance, i.e. a deficit of EUR 10.9 million.

In Croatia, there are enough favourable conditions for increasing olive production to meet the needs of the domestic market and part of the foreign market. This can be objectively achieved by modernizing and intensifying existing production and raising new plantations on more fertile soils and using modern equipment with the application of the necessary agrotechnical measures (Žanetić & Gugić, 2006).

### **3. VIRGIN OLIVE OIL AND GASTRONOMY**

The main aspects that express the quality of virgin olive oil are its organoleptic properties, stability to oxidation, absence of contaminants, such as various plant protection products, phytohormones, organic and chlorinated solvents and, of course, nutritional properties in terms of saturated, monounsaturated and polyunsaturated acids, the presence of phytosterols, vitamins and natural remedies against oxidation (Žužić, 2008). As for any other agri-food product, the greatest value of oil therefore consists in preserving and emphasizing the basic properties that arise from the primary raw material, i.e. from the olive fruit.

It is therefore necessary to assume that it is impossible to produce good oil if we have poor raw material at the starting point, even with the application of the most modern oil production processes; hence the need for careful selection of fruits, since any deficiency directly affects the result of squeezing, with preventive removal of fruits attacked by parasites or affected by frost.

Once the harvesting process has been carried out in the most appropriate manner, it is equally important that the olives are transported with the utmost care and in the shortest possible time to the oil mill. The weight of the fruit in the pile during transport causes damage to the fruit in the lower layers, which can result in mould and the start of the process of fermentation. Therefore, it is a good idea to transport the product in airy baskets and to start processing as soon as possible.

There are a number of different olive processing technologies, but cold pressing produces the healthiest olive oil. This process preserves the organoleptic (colour, aroma, taste and texture) and chemical properties of olive oil. Sensory analysis also checks the specific properties desirable for extra virgin olive oil - bitterness, spiciness, smell and taste of olive fruit, sweetness, the smell of freshly cut green grass or the smell of leaves, tomatoes, artichokes, almonds, apples or kiwis.

Today, continuous methods are mostly used, which have replaced pressing with other physical principles that allow the separation of oil from the solid part. The centrifugation system, for example, uses the difference in the specific gravity of the individual ingredients to first separate the pulp from the liquid part and then separate the oil part from the vegetable water.

To date, there is no device that could evaluate each individual ingredient that participates in the creation of countless tonal aromas of virgin oil based on chemical-physical parameters. It is inevitable, therefore, to rely on sensory analysis.

It is important to repeat that olive oil is the first of the agri-food products for which sensory analysis, based on the PANEL TEST (a special standardized analytical method performed by a group of selected, educated and trained evaluators), is a criterion for market classification of products (Žužić, 2008).

Oils obtained from the olive fruit exclusively by mechanical or other physical means under conditions that do not cause undesired changes and which have not undergone any additional treatment other than washing, decanting, centrifugation and filtration, are classified as follows:

**Extra virgin olive oil:** virgin olive oil having a free fatty acid content, expressed as oleic acid, of not more than 0,8 g per 100 g, and having other properties as provided for in this category of oil;

**Virgin olive oil:** virgin olive oil having a free fatty acid content, expressed as oleic acid, of not more than 2 g per 100 g and having other properties consistent with those provided for this category of oil;

Normally, oil that is properly stored in a closed bottle easily reaches the second year of aging. In itself, it contains antioxidant substances that protect it from rancidity, although the intensity of their action gradually decreases over time. The presence of such antioxidants (among which are phenolic ingredients and tocopherols) can be in vain if certain rules are not followed when storing it in the household.

First and foremost, the oil must be protected from direct light and heat, and the bottle, once opened, should be tightly closed: these are three simple but necessary rules, necessary for the preservation of antioxidants, which are normally very unstable. Once exposed to air, the oil should be consumed within a reasonably short period of time, with regular closing of the bottle with a stopper after use, avoiding leaving metal funnels on the neck of the bottle that prevent complete closure.

The production of only one litre of oil requires an average of five kilograms of olives, which will retain the best taste, colour and nutritional value by cold pressing, and, of course, its properties are best expressed when used cold or only slightly heated, in which case all desirable components and aromas are preserved. The best olive oil is packaged in dark bottles, green in colour without strong taste and odour and used no later than 24 months after filling. During cooking, it is very important to choose an oil that is stable when heated, as some oils can produce very harmful substances when exposed to high temperatures. Saturated and monounsaturated fatty acids are quite resistant to heat, while polyunsaturated fatty acids are sensitive to heat. Extra virgin olive oil is rich in thermostable oleic monounsaturated fatty acid (55-83%) and antioxidants, especially phenolic compounds and vitamin E, which naturally protect the oil from oxygen and high temperatures, so that olive oil is special in this aspect as well. This composition makes extra virgin olive oil stable even at high temperatures and therefore suitable for frying, sautéing or baking.

The high smoking point (210 °C) of olive oils is significantly higher than standard household cooking temperatures such as 160 - 180 °C when deep frying and 180 - 200 °C when baking in the oven. Extra virgin olive oils at temperatures below the smoking point do not undergo significant structural changes and retain their nutritional value better than other vegetable oils that have a higher proportion of thermolabile polyunsaturated fatty acids.

There is also a very large number of research that has confirmed that extra virgin olive oil is one of the safest and most stable oils when used for cooking at high temperatures. Australian researchers De Alzaa, Guillaume and Ravetti published their study in the journal *Acta Scientific Nutritional Health* in 2018, in which they compared the heating effect of extra virgin olive oil with the heating effect of other common cooking oils such as virgin olive oil, refined olive oil, peanut oil, grape seed oil, coconut oil, canola oil, sunflower oil and avocado oil. They examined the effect of frying oil at temperatures between 150 - 240 °C for about 20 minutes, and the effect of deep frying at a temperature of 180 °C for 30 minutes to 6 hours with a significant number of parameters related to oil stability. When cooking oils are exposed to high temperatures, their degradation begins and degradation by-products are formed (free fatty acids, trans-fatty acids, secondary oxidation products, polar substances). Some of these substances, apart from spoiling the smell and the taste of oil, were linked to negative effects on human health. In their study, Australian researchers found that among the oils tested, extra virgin olive oil was the safest and most stable even when used at high temperatures and therefore the most desirable. In addition, it is important to emphasize that it is an ingredient that can contribute to a better and more specific taste of food due to its special fragrant and flavourful properties. Another advantage of using extra virgin olive oil when frying is that it creates a crispy crust on the surface of the food that prevents oil penetration into the food and therefore food fried in olive oil has lower fat content than food fried in other refined vegetable oils.

However, regardless of all the positive aspects of olive oil, it should be emphasized that at cooking temperatures, extra virgin olive oils still lose a certain amount of biologically valuable compounds such as phenols, vitamin E and volatile substances which change the taste and the smell of oil.

Virgin olive oil is perfect for serving along with seafood specialties, it is also often found on meat plates, and the best is to add it when the dish is ready. Creative salads with arugula, basil or tomato and other Mediterranean vegetables and herbs simply crave quality olive oil. The oils that already contain aromatic herbs and other additives - truffles, porcini, mint, lemon, pepper, bay leaf, garlic, blueberry, rosemary or dill are especially valued. Not many know about making desserts by adding virgin olive oil because its perfect fat profile also serves as a preservative and allows for longer storage of cakes.

### **3.1. Virgin Olive Oil when Frying**

With elevated temperature and in the presence of atmospheric oxygen, the occurrence of oxidation of fats is significantly accelerated in comparison to oxidation at room temperature. The intensity of the oxidation process is proportional to the degree of fat saturation (the content of mono and polyunsaturated acids), while antioxidant substances provide resistance. Only olive oil shows high stability to the combined attack of oxygen and high temperature.

The higher the temperature, the sooner there are unwanted changes in fats which, in the final analysis, can be the cause of toxic effects. Each fat has its own specific level of tolerance to high temperatures, which we call the smoking point. Above this thermal level, glycerol, otherwise a component of triglycerides, is broken down to form acrolein, a substance that is extremely harmful to the liver.

That level must never be exceeded; it is good to remind that olive oil has one of the highest smoking points compared to all other oils and can withstand temperatures up to 180 °C. Even more important is the duration of frying: after 20 minutes of exposure to not too high temperatures, the first changes appear in the fat, but only after long heating do the real toxic effects occur, with the formation of decomposition products such as cyclic monomers and peroxides; and in this case, olive oil is characterized by a significantly lower degree of degradation compared to other vegetable oils.

### **3.2. Oil Composition and its Organoleptic Properties**

Vegetable oils generally consist of glycerides (98-99.7%), monounsaturated, polyunsaturated and saturated acids, and other ingredients (0.3-5%) which are very important, both from a nutritional, organoleptic and analytical aspect, for distinguishing biological origin and for classifying oils on the market.

Organoleptic properties allow us to distinguish products that might otherwise be considered identical based on physicochemical analyses. The quality of extra virgin olive oils derives from two types of analysis: chemical-physical analyses, which aim to determine the real composition in terms of the percentage of fatty substance and the degree of its acidity; and sensory analysis in which the oil is evaluated in terms of its visual, olfactory and taste properties. The percentage of fatty acids: saturated fatty acids 4.3% monounsaturated fatty acids 77.0% of which: oleic acid 75.7% polyunsaturated fatty acids 8.7% of which: linoleic acid 8.1% and linolenic acid 0.6 % (Ivošević, 2003).

Numerous fat-soluble pigments such as xanthophylls, chlorophylls, carotenes and carotenoids contribute to the colour of olive oil. In case chlorophyll predominates, the oil will be green in colour, while a larger amount of carotene and carotenoids will give us oils of a more or less intense yellow colour. The nuances of aroma that can be detected by smell and taste are determined by numerous substances belonging to alcohols, aldehydes, esters, hydrocarbons and polyphenols.

These substances are derived from special compounds found in olives which, due to hydrolytic processes, become partially soluble in oil. Many freshly squeezed oils are dominated by bitter and spicy flavours and are characterized by binding in the mouth, which can be attributed to the abundance of flavonoids and secoiridoids.

## 4. METHODS

The paper is based on a review of professional and scientific literature, and the qualitative part of this review article is based on a method that includes the collection and processing as well as a presentation of the obtained data. Field research, i.e. the collection of primary data was conducted through a questionnaire. The survey was conducted online in a number of various Croatian restaurants throughout Istria and Dalmatia.

### 4.1. Examinees

30 chefs employed in hotels and restaurants in Istria and Dalmatia participated in the survey. Examinees were asked for official data related to the consumption, purchase and price of virgin olive oil and personal opinions on the usage of olive oil in Croatian gastronomy.

### 4.2. The aim of the paper

The aim of the paper was to examine the representation of virgin olive oil in food preparation in Croatian restaurants and the possibility of its application in new gastronomic trends apart from traditional cuisine. Virgin olive oil, as the healthiest fat in the diet, is traditionally used in Croatian gastronomy. Virgin olive oil tastings together with the preparation of traditional and modern dishes using this product make a new opportunity for Croatian tourism.

The aim of this paper is to analyse the frequency of use of virgin olive oils in Croatian gastronomy, to point out the importance of the affirmation of this high-value food in the tourist offer and to compare Istria and Dalmatia in this regard.

## 5. THE RESULTS OF THE QUALITATIVE SURVEY

This qualitative survey was conducted on 30 examinees, chef employed in hotels and restaurants throughout Istria and Dalmatia.

**Table 2. The percentage of the examinees and their region**

Men	Women
62%	38%
Region - Istria	Region - Dalmatia
55,6%	44,4%

62% of respondents were male, while 38% were female. Considering the region to which they belonged, 55.6% were from Istria and 44.4% from Dalmatia.

**The first question** was related to the capacity of the restaurant: the largest number of venues had 50 seats - 29.4% of them, there were 17.6% of venues with 40 seats, 11.8% percent of restaurants with 60-70 and 30 seats. Other restaurants ranged in number from 45 to 400 seats.

**The second question** referred to the frequency of use of virgin olive oil. The majority of examinees, 94.4% of them often used virgin olive oil in the facility where they are employed, while 5.6% of them did so in moderation.

**The third question** was related to the average annual consumption of virgin olive oil in the restaurant. Examinees' responses ranged from 200 to 600 litres. 13.3% of them consumed 150, 200, 500 and 600 litres annually. The variety of answers should come as no surprise, given that not all facilities had the same number of seats, nor do they had the same number of guests.

**The fourth question** was about the category of oil used in the catering facility, all respondents used exclusively virgin olive oil.

**The fifth question** referred to the type of olives used, the most commonly used were multi-variety mixtures and *bjelica*, 25.81% each, followed by *leccino* with 19.35% and *pendolino* with 16.13%. Other species used were: *žutica*, *levatnika*, *oblica* and *lastovka* with 3.23% each.

**The sixth question** was related to the origin of virgin olive oil, all respondents used oil made in Croatia.

**The seventh question** referred to the method of procurement of oil. 61.1% of them used oil they produced, while 38.9% of them bought oil from domestic producers.

**The eighth question** referred to the adequacy of oil production in the region. Slightly more than half of the examinees, 55.6% of them, believed that the region in which their restaurant is located did not produce enough virgin olive oil per year, while 44% thought it was sufficient. Here it should be highlighted that the examinees were from Istria and Dalmatia, which do not produce the same amount of olive oil.

**The ninth question** was related to the price of olive oil: the largest number of respondents, 64.7% of them, did not buy virgin olive oil because it was produced domestically, while 35.3% of respondents bought it at a price higher than 3 euros.

**The tenth question** referred to the assessment of the consumption of virgin olive oil per capita. Half of the respondents thought that oil consumption in Croatia should be higher, 33.3% of them thought that the consumption was too low, while 16.7% thought that the consumption was fine.

**The eleventh question** was related to the positive impact of virgin olive oil on health, all respondents believed that its consumption had a positive effect on health.

## 6. CONCLUSION

Findings on olive varieties, virgin olive oils and their use in Croatian gastronomy were presented. The results of the survey showed that the chefs of Istria and Dalmatia use virgin olive oils from their own production or domestic producers.

There is a difference in consumption where Istria is largely ahead of Dalmatia. Virgin olive oils from 8 different olive varieties are used, the majority hold *bjelica* and the oil mixtures of different varieties. The research shows that none of the restaurants use imported or industrial oil. Virgin olive oil, as the most nutritionally valuable fat, occupies a significant place in traditional Croatian gastronomy, and it is important to further encourage the cultivation of home-grown olives and the production of the finest virgin olive oils.

Considering all the above, it can be concluded that the consumption of virgin olive oil in Croatia should be significantly higher, primarily due to its very positive impact on health but also due to the development of Croatian olive growing. The results of qualitative research can greatly serve the producers of virgin olive oil, but also all hospitality workers, for monitoring the competitiveness of the product in particular markets.

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