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Virgin Olive Oil and Its Use in Gastronomic Offer of Dalmatia and Istria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Olive growing is a significant, developing branch of the Croatian economy in total agricultural production. Virgin olive oil is one of the most nutritious fats in the Croatian gastronomic offer, especially in Istria and Dalmatia. For this reason, the chefs' knowledge regarding virgin olive oil is required. The quality of olive oil is determined by live varieties, cultivation climate, and method of production. This paper aims to examine the presence of virgin olive oil in the food preparation of Croatian restaurants and the possibility of its application in Croatian restaurants. This study has shown that restaurants in Istria and Dalmatia use mostly virgin olive oil, produced exclusively in Croatia. Croatian hospitality workers have only domestic oil in their offer, mostly from their production. Many chefs from this study believed the consumption of olive oil should be higher. The results may encourage the olive oil producers, and hospitality workers, to monitor the competitiveness of the product in markets.

Keywords: Olive; virgin olive oil; gastronomy; offer.

1. INTRODUCTION

Olive growing is economically a very important branch in Croatian overall agricultural production, both from the point of view of the existing level of production and concerning the possibilities of increasing the production in the coming period. Olive tourism has been developing over the last years in Croatia [1]. This is partly due to the help of the state, i.e. the Ministry of Agriculture, which

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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 [2].

Due to various agro-economic factors in the last century, the number of productive trees in Croatia has been drastically decreasing. For this reason, today's production does not meet the consumption needs, and therefore olive oil and olive fruit need to be imported [3].

In the Croatian area, olives have been grown and cultivated since ancient times and are one of the plant crops that have it 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 [4].

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 [5].

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 [6].

Virgin olive oil, as one of the most nutritious fats in the diet, is traditionally used in Croatian gastronomy [7,8]. The paper aimed to examine the representation of virgin olive oil in food preparation in Croatian restaurants, 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.

2. OLIVE AND THE ECONOMY

Olive is considered the oldest cultivated plant species [9]. 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 [9].

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 the Croatian 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 [10]. 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 [11]. There is a long tradition of olive growing in Croatia, especially in the coastal and insular areas of the country. Oblica sort makes around 75% of all olive trees in Croatia and is principally utilized for olive oil production [12]. In the territory of Croatia, mostly domestic autochthonous varieties are grown, shown in Table 1, while the introduced varieties are less represented. 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.

There are adequate natural conditions for olive growing in the Croatian coastal area. In some Croatian parts, like on islands, olive growing, and tourism offers employment for the 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 [13].

Table 1. Olive varieties by subregions in Croatia

Subregions	Varieties
Istria	bjelica, buga, moražola, rosinjola, crnica and drobnica
Kvarner and coastal Velebit region	slivnjača, plominka, rosulja, slatka, drobnica and oblica
Northern Dalmatia	oblica, drobnica, piculja, oštrica, grambučela and krvavica
Central Dalmatia	oblica, drobnica, levantinka and lastovka
Southern Dalmatia	oblica, uljarica, murgulja, piculja, želudarica, dužica, mezanica, žutica and grozdača

Note: Adapted from 'Handbook of Olive Growing' by Barbarić, M. Raič, A. Karačić, A. Handbook of Olive Growing, Federal Agromediterranean Institute Mostar, Mostar. 2014

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 2019, Croatia imported $579k and exported $262k of olive oil. The oil was mainly imported from Spain, Italy, Greece, the Netherlands, and Turkey [14].

In Croatia, there are enough favorable 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 [15].

3. VIRGIN OLIVE OIL AND ITS PROPERTIES

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 nutritional properties in terms of saturated, monounsaturated and polyunsaturated acids, the presence of phytosterols, vitamins and natural remedies against oxidation [16]. 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 il extraction, with preventive removal of fruits attacked by parasites or affected by frost.

Once the harvesting process has been carried out in the most appropriately, 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 [17].

There are several 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 [18]. The 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 apple, artichoke or almonds [19].

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 [20].

To date, there no device could evaluate each 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 [19].

The 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 [16].

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 has a free fatty acid content, expressed as oleic acid, of not more than 0,8 g per 100 g, and has 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 [19,16,21].

The 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 its 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 respected when storing it in the household [22].

First and foremost, the oil must be protected from direct light and heat, and the bottle, once opened, should be tightly closed. These rules are necessary for the preservation of antioxidants, which are normally very unstable. Once exposed to air, the oil should be consumed within a reasonable period, with regular closing of the bottle with a stopper after use, avoiding leaving metal funnels on the neck of the bottle that prevents complete closure [23].

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 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 [24].

The smoking point (210 °C) of olive oil is significantly higher than the points of the standard household cooking oils. The smoking point is 160 - 180 °C when deep frying and 180 - 200 °C when baking in the oven. Extra virgin olive oils do not undergo significant structural changes at temperatures below the smoking point, and they retain their nutritional value better than other vegetable oils that contain a higher proportion of thermolabile polyunsaturated fatty acids [25].

Australian researchers De Alzaa, Guillaume, and Ravetti compared the heating effect of extra virgin olive oil with the heating effect of other common cooking oils. 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 the oil, were linked to negative effects on human health. In the study, extra virgin olive oil was the safest and most stable even when used at high temperatures and therefore the most desirable [26].

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 [25].

However, regardless of all the positive aspects of olive oil, it should be emphasized that at cooking temperatures, extra virgin olive oils can still lose a certain amount of biologically valuable compounds such as phenols, vitamin E, and volatile substances which change the taste, and the odour of oil [24]. 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. Due to the phenolic profile of olive oil, the meals that contain olive oil show higher antimicrobial properties [27].

3.1 Virgin Olive Oil and Thermal Stability

With elevated temperature and in the presence of atmospheric oxygen, the oxidation of fats is significantly accelerated. The intensity of the oxidation process is proportional to the degree of fat saturation (the content of mono and polyunsaturated acids).

The higher the temperature, the sooner the unwanted changes occur, which may form toxic components of fats. Each fat has its 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 (2- propenal), a substance that is extremely harmful to the liver [28]. Olive oil showed only 9 mg of acrolein (2 – propenal) at 180˚C and 34 mg at 240˚C, which indicates a favorable heat resistance, compared to other cooking oils [29].

3.2 Oil Composition and its Organoleptic Properties

Vegetable oils generally consist of glycerides, monounsaturated, polyunsaturated, and saturated acids, and other very important ingredients, both from a nutritional, organoleptic and analytical aspect, for distinguishing biological origin and for classifying oils on the market [30,21]. 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 [22,31]. The percentage of fatty acids in olive oil: 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% [21].

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 present as yellow colour [32]. 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 [21].

4. METHODS

The paper is 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 several various Croatian restaurants throughout Istria and Dalmatia.

4.1. Examinees

Thirty chefs employed in hotels and restaurants in Istria and Dalmatia participated in the survey. Examinees were asked for the data regarding the consumption, purchase, price of virgin olive oil, and personal opinions on the usage of olive oil.

5. THE RESULTS OF THE QUALITATIVE SURVEY

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

Sixty-three percent of respondents were male, and 37% were female. Considering the region to which they belonged, 57% were from Istria and 43% from Dalmatia.

The first question was related to the capacity of the restaurant: the total number of venues was 17. The largest number of venues had 50 seats – 5 of them (29.4%), there were 3 (17.6%) with 40 seats, 2 (11.8%) with 60 – 70, and 2 (11.8%) with 30 seats as well. There was one venue with 45 seats (5.9%), one with 60 (5.9%), one with 150 (5.9%), one with 90 (5.9%), and one with 400 seats (5.9%).

Table 2. The percentage of the examinees and their region in Croatia

Men	Women
63%	37%
Region - Istria	**Region - Dalmatia**
57%	43%

The second question referred to the frequency of use of virgin olive oil. Most examinees, 28 (93.3%) used virgin olive oil often in the facility where they are employed, while 2 (6.6%) 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 150 to 600 litres. Most of the examinees consumed 150, 200, 500 and 600 litres annually (13.3% in each group). The variety of answers should come as no surprise, given that not all facilities had the same number of seats, nor do they have 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 olive oil (listed in Table 1.) used by 30 examinees. The most used were multi-variety mixtures and bjelica, 8 (26.6%) of each, followed by leccino with 6 (20%) and Pendolino with 4 (13.3%). Other species used were: žutica, levatnika, oblica, and lastovka with 3.3% 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. Sixty percent of 30 examinees used oil they produced, while 40% 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 30 examinees, 17 (55.6%) of them, believed that the region in which their restaurant is located did not produce enough virgin olive oil per year, while 13 (43.3%) 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, 35.3% of the examinees from Istria considered the production was not sufficient, while 76.9% of the examinees from Dalmatia recognised the production insufficient.

The ninth question was related to the price of olive oil: the largest number of respondents, 60% of them did not buy virgin olive oil because it was produced domestically, while 40% of respondents bought it at a price higher than 3 euros per litre.

The tenth question referred to the assessment of the consumption of virgin olive oil per capita. There were 3 possible answers; 1) the consumption is insufficient, 2) the consumption is sufficient, 3) the consumption should be higher. Half of the respondents thought that oil consumption in Croatia should be higher, 10 (33.3%) of them thought that the consumption was insufficient, while 5 (16.7%) thought that the consumption was sufficient.

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 virgin olive oils and their use in Croatian gastronomy were presented in this study. The results showed that the chefs of Istria and Dalmatia use virgin olive oils from their production or domestic producers. The consumption of olive oil in Istria was higher than in Dalmatia.

The most used virgin olive oils are Bjelica, and the oil mixtures of different varieties. The research shows that none of the restaurants use imported oil, and all the oils were of domestic origin. Virgin olive oil is the nutritionally valuable fat, and it is important to encourage the cultivation of home-grown olives and the production of the finest virgin olive oils. Furthermore, many chefs from the study believed the consumption of virgin olive oil in Croatia should be higher. Therefore, the results may encourage the producers of virgin olive oil, but also all hospitality workers, for monitoring the competitiveness of the product in particular markets.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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