



Exploring the impact of beliefs and experiential factors on extra virgin olive oil consumption

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ABSTRACT

Italian extra virgin olive oil, globally acclaimed for quality and integral to the Mediterranean Diet, attracts heightened demand in high-income societies. This study, utilizing Multivariate Analysis of Variance (MANOVA), delves into the interplay between socio-demographic variables and consumer behavior in olive oil preferences. Key findings reveal that variables like sustainable certification interest, attention to labeling, knowledge of certification, purchasing preferences, gender, and olive oil knowledge significantly differentiate consumer groups. Specific MANOVA analysis highlights the distinct impact of gender, certification knowledge, labeling attention, and sustainable certification interest on factors like price, brand, origin, certification, production method, and packaging importance. This study provides concise insights into complex dynamics of consumer behavior surrounding Italian extra virgin olive oil. Identified influential factors shed light on nuanced relationships between socio-demographic variables and consumer preferences, aiding agri-food companies in aligning products with evolving needs in high-income societies. The results of this study suggest a significant difference in the combined variables across gender, knowledge certification, attention to labeling, and interest in sustainable certification, indicating varying responses to the importance of price.

1. Introduction

Extra-virgin olive oil (EVOO) stands as a quintessential component of the Mediterranean diet, representing one of the oldest and most cherished foods in the region [1]. The global popularity of the Mediterranean diet has led to a substantial increase in the consumption of extra virgin olive oil in various countries, both within and beyond Europe [2–5]. This surge can be attributed to heightened consumer awareness regarding the health benefits associated with olive oil, coupled with a growing preference for healthier dietary choices [6]. The contemporary consumer focus on the food-health correlation has shifted preferences towards foods recognized for positively impacting health, contributing to overall well-being, and mitigating the risk of certain diseases [7,8].

Extra virgin olive oil, sought after by those adopting health-conscious diets, delivers essential nutrients that enhance the quality of life due to its associated benefits [5]. Recent studies in medical literature underscore the antioxidant, anti-inflammatory, and nutraceutical therapeutic properties of extra virgin olive oil [9–12]. The ripening process of the olive fruit involves the synthesis of organic substances, with triglycerides, diglycerides, and monoglycerides constituting the majority

(95–98 percent) of the final product. The remaining fraction comprises beneficial compounds like beta-carotene (provitamin A), tocopherols (vitamin E), and phenolic compounds, all recognized for their remarkable antioxidant activity [13].

Extra virgin olive oil, according to standards set by the International Olive Council [14] and adopted by the European Union, is obtained exclusively through mechanical or physical processes without causing alterations to the oil. It undergoes minimal treatments such as washing, decantation, centrifugation, and filtration. Meeting strict criteria, including a maximum free acidity of 0.80 g per 100 g expressed as oleic acid, ensures its classification as extra virgin olive oil (IOC, 2022).

Given its crucial role in the global, European, and national agricultural sector, and considering the positive consumption trends, understanding consumer preferences becomes imperative. While past studies have explored attributes influencing preferences and purchase choices, a comprehensive analysis simultaneously addressing various attributes is lacking in the literature.

The objective of this study was to investigate the relationships between socio-demographic factors and consumer preferences for olive oil using multivariate analysis techniques, specifically focusing on the

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impact of variables such as gender, knowledge certification, attention to labeling, and interest in sustainable certification.

The research hypotheses of this study can be organized into three points.

1. There will be significant differences in consumer preferences for olive oil across various socio-demographic groups, including gender, knowledge certification level, attention to labeling, and interest in sustainable certification.
2. Certain socio-demographic factors, such as interest in sustainable certification and knowledge certification level, will significantly influence consumer preferences for specific attributes of olive oil, such as price, brand, origin, certification, production method, and packaging.
3. The inclusion of multivariate analysis techniques, particularly MANOVA, will provide a comprehensive understanding of the complex relationships between socio-demographic variables and consumer preferences for olive oil, enhancing the statistical power and accuracy of the analysis.

The paper unfolds with an introduction emphasizing the importance of quality in the agri-food sector, followed by an industry analysis of olive oil in Italy. A literature review illuminates the current state of knowledge on pertinent topics, leading to the materials and methods section, detailing the questionnaire and analysis approaches. The subsequent results section encompasses descriptive and inferential analyses, with the conclusions offering insights into future research directions and acknowledging study limitations.

2. The agri-food quality

The quality and safety of agri-food products have received increasing attention from consumers and legislators. This is also influenced by advertising campaigns and the disposable income of consumers, which is higher on average in developed countries than in developing countries. The increase in per capita income results in an increase in demand for quality products and therefore agribusinesses must equip themselves to meet these new consumer demands [15]. The globalization of markets also determines the need for information on product quality as the distance between places of production and places of consumption increases. There has been a change in recent years in both the production and marketing of agri-food products that has affected the entire agri-food sector (plant and animal products both fresh and processed). This structural and functional evolution of the agri-food sector is mainly due to new characteristics to new consumer needs, new business models adopted by large-scale retail that determine large-scale enterprises need large quantities of agri-food products of plant and animal origin and products with a high degree of processing available on all outlets globally with a shelf-life compatible with business strategies [16]. At the local level, there always remain agricultural commodities that are mainly for the local market. In addition, it must be remembered that in recent years there has been increasing integration of the production sector with the end-consumer market in terms of information flows, knowledge of markets, and consumer needs and expectations. The new role of public interventions in the agribusiness sector also determines product quality requirements. And again, the growing importance of quality and related issues (trademarks, information transparency, product, and supply chain traceability, counterfeiting, and food fraud). In addition, recent health and nutritional needs expressed by new lifestyles are in close harmony with careful attention to the issues of resource sustainability and the to the sustainability of resources and the protection of environmental ecosystems and biodiversity [17]. Finally, the constant evolution of consumer tastes and preferences, evidenced by fluctuations in demand over time. In this context, knowledge and interpretation of the timing and methods by which consumers who consumers seek information, research, obtain, perceive, and evaluate

the quality (as value-added and the associated increase in willingness to pay) become increasingly important. Moreover, while it is possible to establish a variable scale of values based on sensory perception of the quality of a food product, ranging from very good to very bad without judging its edibility, this is not possible for defining the healthiness and hygienic safety of products healthiness and hygienic safety of products available in consumer markets [18]. In more recent years, consumers have shown increased attention to investigating the characteristics that define the quality of food products, due to greater availability in the marketplace and a market environment and being more sensitive to these issues. Quality is a multidimensional and dynamic concept. According to Lancaster [19], “Quality is, in fact, a complex value whose definition includes competing objective and subjective components.” For this reason, quality is not a characteristic that can be immediately described or immediately identified but is primarily an idea that each of us has concerning what satisfies a specific need “. “The more a product’s characteristics correspond to the set of expectations we have of it, the more we are convinced to consider it to be of quality” [20]. At this point, it becomes important to delve into the analysis of the perception of quality aspects, along with quality indicators, in an objective and technical sense, as well as measures and models for interpreting customer satisfaction in the theoretical context of information economics. Indeed, the introduction of certified quality products into the market, reflecting higher production costs and thus higher prices, implies the need to estimate the economic value attributed to their quality (price evaluation) by the end buyers of these products about the increased availability products with the increased willingness to pay. Problems concerning the role of information in market dynamics require a dual approach. Firstly, addressing information imbalances between supply and demand involves implementing branding, certification, and pprox.g policies for agri-food products. Secondly, both public and private organizations and institutions, at national and international levels, play a pivotal role in regulating and enforcing rules and procedures to manage market transaction costs. This includes corporate and collective branding, agreements on quality and value indicators, and communication strategies aimed at enhancing the conditions for economic exchange and reducing information asymmetry typical of imperfect markets [21]. Moreover, at present, the quality of agrifood production and the economic efficiency of markets are closely linked to the growing role of information. It is possible to say that this type of situation does not always security and correctness of the information and at the same time the ability of consumers to make informed and complete choices. From the point of view of the economic efficiency of production markets, these elements contribute to a kind of functional distortions that can prevent the proper functioning of the profile system of economic theory and provide misunderstandings and information asymmetries. These specific conditions seem capable of producing simultaneous disadvantages for producers and consumers in terms of the natural relationship between supply and demand in both the short and long run equilibrium-oriented markets.

2.1. Olive-oil sector in Italy

According to Ref. [22] (Institute of Agricultural Food Market Services), the olive oil sector in Italy exhibits a vast structure, encompassing 1.16 million hectares dedicated to olive cultivation, with 619 thousand olive-growing enterprises and 4319 mills in operation. This notable fragmentation is compensated by the proximity of processing plants to harvesting sites, allowing for the milling of olives within 24 h, enhancing product quality. In 2022, Italian olive oil production experienced a significant decrease of 27%, amounting to approximately 241,000 tons, in contrast to the previous year’s 329,026 tons in 2021. This decline aligns with a broader trend in the Mediterranean basin, with Spain, contributing about 45% to global production, witnessing a 55% decrease in 2022. Despite the decrease, Italy maintains a substantial 15% share of world olive oil production.

Domestic demand for olive oil in Italy has remained generally stable,

with per capita consumption showing a gradual increase from 7.6 L in 2019 to 8.3 L in 2022. However, despite domestic production, consumption consistently exceeds supply, with total apparent consumption reaching around 500,000 tons. Economically, a shift in the supply curve, characterized by decreasing supply and constant demand, has led to an increase in olive oil prices [23]. The demand for olive oil appears rigid, with changes in food prices having minimal impact on quantity demanded due to the essential nature of the product.

In other words, changes in food prices have little impact on the quantity demanded. Thus, the elasticity of demand in response to price changes is low, indicating a rigid demand. This is explained by the fact that most of these products are intended to satisfy a primary and indispensable need of the consumer. Furthermore, price changes not only influence the quantity demanded by consumers in the market, but can also cause the entry or exit of ‘marginal’ consumers, those who had or no longer had sufficient purchasing power before the price change. The value of the elasticity of demand for a product with respect to market price changes is closely linked to the degree of substitutability of the good: it will be higher if there are many substitutes available [24]. This also depends on the importance of the product in the consumer’s expenditure; the greater the weight of that product in the consumer’s expenditure, the less sensitive the consumer will be to the purchase of the good (and, consequently, the value of the elasticity will be low, other conditions remaining constant). This scenario has significant implications for producers and consumers, with a potential increase in income for the former and a possible reduction in purchasing power for the latter. It also underlines Italy’s non-self-sufficiency in olive oil production necessitates imports to meet domestic demand [25].

Regarding the sector of geographical indication certifications, Italy, with 42 PDOs (Protected Designation of Origin) and 8 PGIs (Protected Geographical Indication), represents a specificity, but geographical indication oils remain a niche product, standing at around 13,330 tons of certified product, not capturing significant market shares. The SWOT analysis conducted highlights both significant strengths and challenges. Among the strengths, the presence of important olive-growing areas stands out, both in terms of quantity and product quality. The possibility to differentiate production through more than 500 olive varieties offers the sector a high potential to adapt to market needs [26]. The increasing focus on quality production, underlined by PDO/PGI certifications, reflects a commitment to high production standards. The sector boasts a high level of know-how and has traced olive product chains involving about 400 farms. However, some weaknesses need to be addressed, such as the fragmentation of the production structure with small farm sizes and the spread of olive growing in difficult areas [27]. Low land mobility and limited generational turnover represent further challenges, together with the weak role of producer organizations in concentrating supply and enhancing the value of the product. Poor aggregation capacity and limited digital infrastructure are further critical aspects. On the other hand, the sector can capitalize on emerging opportunities, such as the growing consumer awareness of quality production and the Mediterranean diet as an intangible and “made in Italy” asset [28]. Oil tourism and diversification of activities represent innovative and engaging marketing strategies to promote the olive oil sector and can open new economic perspectives [29]. These approaches not only attract the attention of consumers, but also offer unique experiences that help to differentiate the product in the market [30]. In addition, the increasing focus on the concept of sustainability, both economic and environmental and social, offers new avenues to capture market share among consumers attentive to these characteristics [31]. However, the sector faces threats such as increasing international competition on production costs and quality, particularly from multinational brands. The sector’s ability to adapt to these dynamics and capitalize on emerging opportunities will be crucial for maintaining and enhancing its position in the global olive oil market [32].

3. Literature review

The literature investigating consumer preferences regarding extra virgin olive oil is extensive [33–44]. Food products introduced to the market have a number of research, experience, and belief (SEC) attributes, which exert a more or less pronounced influence on consumer choices [45]. These attributes are communicated to the consumer by means of intrinsic or extrinsic quality indicators; the former represent product characteristics that cannot be changed without altering the very nature of the product, while the latter concern information about the product, so they can be changed without intervention with respect to the nature of the product [46]. In the case of extra virgin olive oil, it has been repeatedly shown that product quality, price, country of origin, certifications of origin, production method, and packaging significantly influence consumer preferences [47–49]. All these attributes have characteristics of “search, experience, and belief” [50]. According to Nelson [51], search attributes refer to visual characteristics of products (such as size, color, and imperfections) so they can be “researched” before purchase by careful analysis of the product; whereas, experiential attributes (such as taste) can be ascertained at a stage after purchase, as they are not ascertained until after the product is consumed. Belief attributes (e.g., sustainable production process, health benefits, product origin, quality certifications) unlike the previous ones, cannot be verified either before purchase or after purchase and subsequent consumption [52], as the information to verify these attributes cannot be assessed by the consumer who directs his or her choices based on suggestions and expectations conveyed by extrinsic quality indicators such as label claims. Between these three attributes, in reality, there is not always a clear-cut distinction; as far as olive oil is concerned, the most significant research attributes are definitely the packaging (shape, color and size of the bottle, label design), color, smell and taste, which can also be considered attributes of experience as a result of previous consumption experiences [50], and again the brand name, which from a belief attribute can become contextually an attribute of experience and research. Over the years, several studies have been conducted on consumer perception with respect to quality indicators and purchasing behavior with results varying by research country and thus market. Therefore, for the sake of clarity of exposition and greater adherence to the intentions of our study, we will continue the literature review based on the items analyzed (price, brand, origin of olives, quality certifications, sustainable certification and to packaging). Regarding Price, falls among the extrinsic indicators and, as an index of quality, is framed in several studies as one of the most important attributes at the time of consumer purchase [53], especially in countries characterized by an emerging market (e.g., UK and U.S.) and consumers with little awareness with respect to the characteristics of olive oil [54–56]. In the Spanish market, despite a widespread culture with respect to the consumption of quality olive oil, a dichotomy is observed, due to key socioeconomic aspects (level of education and purchasing power), with respect to consumer choices, which are divided between those who choose olive oil on the basis of the best price and those who are also guided in their choice by other quality indicators [57]. Similar results were observed in a recent study conducted in Greece by Marakis et al. [58], who attribute to the effects of the economic crisis the shift of price from an uninformative selection criterion [59] to a more relevant attribute; moreover, it is interesting to note that although price was indicated as important, only one-third of the Greek population surveyed considered the high price of olive oil a factor that highlights the perceived economic value of this food. As for Italian consumers, a study conducted by Di Vita et al. [60] shows that, among quality signals, price is confirmed as the predominant variable, and consumers in northern Italy who come from areas where olive oil production is not typical perceive price as the most important indicator of quality.

As for brand well-known occupy a significant place within the EVOO oil market [61]. Brand, as a credence attribute, correlates closely with the perceived quality of a product and, for that reason, positively

influences purchase choices [62]. The choice to purchase olive oil of a particular brand is affected by the influence of price as well as consumer trust. For loyal consumers, price has less influence since it is the brand itself that conveys the image of quality; in fact, preference for an olive oil brand is associated with higher brand awareness and higher levels of loyalty [63]. Concerning the origin of the product generates higher quality expectations in consumers [64]. In most of the studies available to us, the attribute “origin of olives” and, consequently, of the final product, is almost always investigated indirectly by analyzing EU designations of origin. In fact, several studies incorporate this attribute within PDO and PGI certifications, whereas, few studies investigate this aspect by separating it from the aforementioned certifications. The decision to analyze this attribute directly is twofold: first, only a small proportion of oils on the market are PDO or PGI certified; moreover, EU designations of origin have not yet fully expressed their potential as tools for differentiation and protection as they are still little known to consumers [18]. Carzedda et al. [61], investigating consumer preferences for extra virgin olive oil in Italy, state that geographic origin, especially if 100% Italian, and credibility attributes – PDO/PGI certification and organic production – positively influence consumer preferences and note a preference for Italian and local olive oil with certification of origin of the raw material. Several studies, however, have focused on the close correlation between the attribute of origin and traceability, as consumers consider information on the origin of olives to be the most important element in product traceability [65,66]. About PDO and PGI Quality Certifications, the European system of geographical indications (Gis) distinguishes between two types of GI, “Protected Designation of Origin” (PDO) and “Protected Geographical Indication” (PGI), these, in essence, differ in the link between origin and product characteristics, which in the case of PDO is stronger [67]. Origin labeling programs are seen as a key mechanism through which consumers can link the overall quality of a product to the origin of the product [68]. Over the years, several studies have been jointly concerned with analyzing the implications that these EU certifications have on the choices of consumers, who are willing to pay an additional premium for both PDO and PGI, but who value PDO-labeled EVOO oil more than PGI-labeled EVOO oil [61,67,68]. Respect to Sustainable certification, in recent years, public interest in sustainable production and consumption practices has increased and involves all actors in the food chain [69]. Indeed, today’s consumer is increasingly attentive to ethical, social and environmental issues related to sustainable food production [70]. Sustainable certifications provide consumers with guarantees not only in terms of quality but also in terms of environmental and social compliance. In the agribusiness sector, the concept of sustainability is closely related to organic production, although sustainability refers to a wider range of agricultural elements and practices, organic certification remains for consumers the main recognizable hallmark of the environmental sustainability of food [61].

4. Materials and methods

To fulfill the objectives of the study, we conducted interviews with a sample of participants utilizing an online questionnaire. In practice, a bespoke form was crafted, featuring multiple-choice and closed-response questions. The survey was executed from April 1, 2023 to June 1, 2023, utilizing an online platform accessible from any device with an internet connection. Distribution occurred through private social networks (WhatsApp, Facebook, and Instagram) and personal mailing lists [71]. Google Forms was selected for its user-friendly interface, swift data collection, and customizable question options. It facilitated coordinated response management and real-time data collection, ensuring efficient engagement with participants. The chosen administration approach allowed for a broader population data collection, aiding in achieving the research objectives. Within the constraints of the established sample size, time, and resources, 502 consumers, specifically focusing on the Italian demographic, completed the

questionnaire and participated in the survey.

The study adhered to privacy regulations, including Art. 13 of EU [72]. All participants were thoroughly briefed on the study’s requirements and were duly informed before participating that the questionnaire would be anonymous. While employing an online questionnaire and non-probability sampling, it is crucial to acknowledge certain limitations, such as the potential lack of representativeness. Given that participants were not randomly selected, the sample may not perfectly mirror the characteristics of the larger community. Despite this limitation, non-probabilistic sampling can be advantageous in specific scenarios, especially when reaching a particular population through probabilistic approaches proves challenging or expensive. The study is divided into two sections: the first entails a descriptive analysis of the reference sample, focusing on Italian consumers, while the second involves a Multivariate Analysis of Variance (MANOVA).

4.1. Descriptive analysis

This study’s demographic composition is outlined in several distribution tables. The gender distribution reveals a majority of female participants, constituting 57.4% of the sample, while males represent 42.6%. Age distribution indicates that the 15–20 age group is the most prevalent at 39.4%, followed by the 21–30 age group at 25.9%. Family size distribution demonstrates that families with four members are the most common at 42.8%, followed by those with five members at 16.5%. Educational level distribution highlights that the majority of participants hold a high school certificate, accounting for 70.3%. Regarding residence, participants predominantly reside in medium-sized cities (50.0%), followed by large cities (36.7%). Lastly, income distribution shows the highest percentage within the €10,001–€25,000 range at 36.7%. These tables collectively provide a comprehensive snapshot of the sample’s demographic characteristics, essential for contextualizing and interpreting the study’s findings.

Table 2 provides comprehensive insights into participants’ extra virgin olive oil consumption habits (see Table 1). A notable 83.27% of respondents demonstrated familiarity with extra virgin oil, while

Table 1
Socio-demographic profile.

Socio-demographic profile			
Variables	Levels	N	%
Gender	Male	288	57,4
	Female	214	42,6
Age	15–20	198	39,44
	21–30	130	25,90
	31–40	46	9,16
	41–50	51	10,16
	51–60	56	11,16
	61–70	13	2,59
	Over 70	8	1,59
Family size	1	28	5,58
	2	61	12,15
	3	93	18,53
	4	215	42,83
	5	83	16,53
Educational level	Bachelor's degree	49	9,76
	Lower secondary school certificate	52	10,36
	Master's degree	39	7,77
	master's or doctoral degree	9	1,79
	Upper secondary school certificate	353	70,32
Residence city dimension	Average Size (between 5001 and 250,000 inhabitants)	251	50,00
	Large Size (>250,000 inhabitants)	184	36,65
	Small Size (up to 5000 inhabitants)	67	13,35
Income	> €50.000	50	9,96
	€10.001–€25.000	184	36,65
	€25.001–€50.000	128	25,50
	until €10.000	140	27,89

Source: own elaboration

Table 2
Consumption habits profile.

About extra virgin oil	Answer	N	%
Knowledge	No	84	16,73
	Yes	418	83,27
Quality evaluation	Filtered	249	49,60
	indifferent	115	22,91
	unfiltered	138	27,49
Frequency of consumption	Once a week	9	1,79
	1–2 times per month	3	0,60
	2–3 times per week	88	17,53
	Everyday	401	79,88
	Never	1	0,20

Source: own elaboration

16.73% indicated a lack of knowledge. Regarding quality preferences, 49.60% expressed a preference for filtered oil, 27.49% favored unfiltered, and 22.91% were indifferent. Notably, the majority of participants (79.88%) reported consuming extra virgin oil daily, indicating a high daily consumption rate. Additionally, 17.53% reported consumption 2–3 times per week, with smaller percentages indicating weekly (1.79%) or 1–2 times per month (0.60%) consumption. Remarkably, only 0.20% reported never incorporating extra virgin olive oil into their diets. These findings collectively underscore the widespread awareness and routine inclusion of extra virgin olive oil in participants’ consumption patterns, revealing a nuanced landscape of preferences and usage frequencies. Overall, the table reveals a widespread knowledge of extra virgin oil among participants. Filtered oil is the most preferred type, and a substantial proportion of respondents incorporate extra virgin oil into their daily diet. These consumption habits provide valuable context for understanding the preferences and behaviors of the study participants about extra virgin oil.

Instead, Table 3 presents the descriptive statistics for participants’ ratings of the importance of various factors related to extra virgin olive oil, measured on a Likert scale from 1 to 5 (1 indicated strongly disagree while 5 strongly agree). On average, participants moderately value the price of olive oil, with a moderate level of variability indicated by the standard deviation. Brand appears to have a lower average importance, with a wider range of responses, as indicated by the higher standard deviation. Participants, on average, find the origin of olive oil relatively important, with a moderate level of variability. Certification holds a moderate level of importance, with responses showing moderate variability. Participants express a moderate level of importance regarding the production methods of olive oil, with moderate variability. Packaging has a lower average importance, and responses exhibit moderate variability. In summary, participants generally rate origin as the most important factor, followed by price and certification. Brand and packaging receive lower average importance ratings. The median values provide insights into the central tendencies of the ratings, while standard deviations indicate the degree of variability in participants’ responses (see Table 4).

4.2. Multivariate Analysis of Variance (MANOVA)

Multivariate Analysis of Variance (MANOVA)(see Table 5) extends the principles of Analysis of Variance (ANOVA) to simultaneously assess

Table 3
Importance of various factors (items) related to extra virgin olive oil.

	Importance of (Likert Scale from 1 to 5)					
	Price	Brand	Origin	Certification	Production methods	Packaging
Mean	3,05	2,48	3,61	3,40	3,37	2,52
Median	3,00	2,00	4,00	3,00	3,00	2,00
St.Dev.	1,35	1,34	1,41	1,36	1,40	1,36

Source: Source: own elaboration

Table 4
General MANOVA.

Variable	Pillai	pprox_F	p_value
Interest_for_sustainable_certific.	0.0704567	608.904	3,67E+00
Attention_tolabel	0.0613851	525.378	2,94E+01
Knowledge_certification	0.0458567	386.087	8,96E+02
PurchaYesng_place	0.0337846	280.893	1,07E+04
Gender	0.0327584	272.071	1,31E+04
Knowledge_Oil	0.0314114	260.522	1,71E+04
Price_for1liter	0.024978	205.797	5,68E+04
Family_Size	0.0157545	128.587	2,62E+05
Consumption_frequencies	0.0151468	123.551	2,87E+05
Quality_evaluation	0.0105318	0.85506	5,28E+05
ReYesdence_City	0.0100879	0.81865	5,56E+05
Income	0.00944836	0.76626	5,97E+05
Educational_level	0.00686219	0.55507	7,66E+05
Age	0.00318625	0.25678	9,56E+05

Source: own elaboration

the impact of categorical independent variables on multiple dependent variables. Unlike ANOVA, which focuses on one categorical independent variable and a single continuous dependent variable, MANOVA accommodates scenarios involving several dependent variables.

Key Concepts:

Objective: MANOVA aims to identify statistically significant differences in the means of dependent variables across levels of a categorical independent variable (or multiple categorical independent variables).

Dataset Representation: In a dataset with k groups and p dependent variables, data matrices X1, X2, ..., Xk represent each group. Each Xi is an ni × p matrix with ni observations for group i.

Assumptions.

- **Multivariate Normality:** Dependent variables should follow a multivariate normal distribution within each group.
- **Homogeneity of Covariance Matrices:** Covariance matrices of dependent variables should be equal across groups.
- **Linearity:** Relationships between independent variable(s) and dependent variables should be linear.

Hypotheses.

- **Null Hypothesis (H0):** No differences in mean vectors of dependent variables among groups.
- **Alternative Hypothesis (Ha):** At least one group is different.

Test Statistic: Typically, Wilks’ Lambda (Λ) measures the proportion of unexplained variance in dependent variables. $\Lambda = \det(W+B)\det(W)$, where W is the within-groups covariance matrix, and B is the between-groups covariance matrix.

Interpretation: A small Λ suggests evidence against H0, indicating significant differences in mean vectors among groups.

Application to the Study: In our research on consumer preferences for olive oil, MANOVA is chosen for its suitability in examining the relationships between socio-demographic factors and various outcome variables. These variables encompass knowledge, quality evaluation, consumption frequencies, and the importance attributed to factors like price, brand, origin, certification, production method, and packaging.

MANOVA is a preferred statistical method when dealing with studies involving multiple dependent variables. It efficiently manages interrelated variables, allowing for a comprehensive assessment of their collective relationships with independent variables. By conducting a simultaneous analysis, MANOVA avoids the pitfalls of inflated Type I error rates associated with separate univariate analyses, leading to a more efficient and reliable interpretation of results. The approach increases statistical power by combining information from various dependent variables, thereby enhancing the ability to detect significant effects. Additionally, MANOVA aids in controlling Type I errors during

Table 5
Specific MANOVA.

Variable	Pillai	Approx F	df1	df2	Pr(>F)
Gender	0.0328	27.207	6,00E+00	482	0.0131 *
Age	0.0032	0.2568	6,00E+00	482	0.9565
Family_Size	0.0158	12.859	6,00E+00	482	0.2620
Educational_Level	0.0069	0.5551	6,00E+00	482	0.7661
ReYesdence_City	0.0101	0.8187	6,00E+00	482	0.5558
Income	0.0094	0.7663	6,00E+00	482	0.5967
Knowledge_Oil	0.0314	26.052	6,00E+00	482	0.0171 *
Quality_evaluation	0.0105	0.8551	6,00E+00	482	0.5280
Consumption_frequencies	0.0151	12.355	6,00E+00	482	0.2865
PurchaYesng_place	0.0338	28.089	6,00E+00	482	0.0107 *
Price_for1liter	0.0250	20.580	6,00E+00	482	0.0568.
Knowledge_certification	0.0459	38.609	6,00E+00	482	0.0009 ***
Attention_tolabel	0.0614	52.538	6,00E+00	482	0.00003 ***
Interest_for_sustainable_certific.	0.0705	60.890	6,00E+00	482	0.00000 ***

Source: own elaboration

simultaneous testing, maintaining the overall significance level. This holistic view permits the investigation of main effects and potential interactions among independent variables, offering a nuanced understanding of how socio-demographic factors collectively influence specific outcomes, such as olive oil preferences.

In summary, MANOVA is a robust choice aligned with the complex nature of our dataset, facilitating a comprehensive analysis of the factors influencing consumer preferences for olive oil.

Pillai’s Trace.

- Focus on variables with a higher Pillai’s Trace, as higher values indicate greater differentiation between groups.
- Variables such as “Interest_for_sustainable_certification,” “Attention_tolabel,” “Knowledge_certification,” “PurchaYesng_place,” “Gender,” and “Knowledge_Oil” seem to have a greater influence on differentiation.

Approximate F.

- Give more weight to variables with higher Approximate F values, as these indicate greater overall significance of the model.
- Variables like “Interest_for_sustainable_certification,” “Attention_tolabel,” “Knowledge_certification,” “PurchaYesng_place,” and “Gender” have higher Approximate F values, suggesting significant contributions to the model.

P-value.

- Focus on variables with a p-value below a significance threshold (such as 0.05), as this indicates a significant association with differentiation between groups.
- Variables like “Gender,” “Knowledge_Oil,” “PurchaYesng_place,” “Interest_for_sustainable_certification,” and “Attention_tolabel” are considered statistically significant, as their p-values are below the 0.05 threshold.

In summary, prioritize variables that emerge as significant in two or more of the above-mentioned criteria. For instance, “Interest_for_sustainable_certification” appears to be particularly influential, as it shows elevated values in all three criteria.

Combining the three criteria (Pillai’s Trace, Approximate F, and p-value), we can consider variables that show a significant and consistent contribution to the MANOVA results. Below are the variables that appear most relevant based on the three criteria:

Interest_for_sustainable_certification.

- Pillai’s Trace: 0.0704567
- Approximate F: 608.904

- p-value: 3.67E-06

Attention_tolabel.

- Pillai’s Trace: 0.0613851
- Approximate F: 525.378
- p-value: 2.94E-05

Knowledge_certification.

- Pillai’s Trace: 0.0458567
- Approximate F: 386.087
- p-value: 8.96E-04

These variables consistently demonstrate high Pillai’s Trace values, significant Approximate F values, and low p-values, indicating that they contribute significantly to the differentiation between groups in the MANOVA results.

The MANOVA analysis revealed significant differences in the combined variables of “ImportanceOf_PRICE,” “ImportanceOf_BRAND,” “ImportanceOf_ORIGIN,” “ImportanceOf_CERTIFICATION,” “ImportanceOf_PRODUCTIONMETHOD,” and “ImportanceOf_PACKAGING” across specific factors. Here is the interpretation for the significant variables.

1. Gender:

- **Interpretation:** There is a significant difference between groups regarding the variables of interest (such as “ImportanceOf_PRICE”) based on gender.

2. Knowledge_certification:

- **Interpretation:** Groups significantly differ in their responses to variables of interest (e.g., “ImportanceOf_PRICE”) concerning knowledge certification.

3. Attention_tolabel:

- **Interpretation:** Significant differences exist between groups in their responses to variables like “ImportanceOf_PRICE” based on attention to labeling.

4. Interest_for_sustainable_certific.:

- **Interpretation:** There is a significant variation between groups in their responses to variables (e.g., “ImportanceOf_PRICE”) concerning interest in sustainable certification.

These results highlight that specific factors, namely gender, knowledge certification, attention to labeling, and interest in sustainable certification, contribute significantly to the observed variations in the combination of “ImportanceOf_PRICE” across different groups. The variables marked with asterisks (*) or other symbols are statistically significant, emphasizing their influence on the observed differences.

Interest_for_sustainable_certification.

- Contrast between level 1 and level 2: estimate = -0.175 , standard error (SE) = 0.156 , t-ratio = -1.120 , p-value = 0.2632 .

Attention_tolabel.

- Contrast between level 1 and level 2: estimate = -0.140 , SE = 0.116 , t-ratio = -1.208 , p-value = 0.2275 .

Knowledge_certification.

- Contrast between level 1 and level 2: estimate = -0.260 , SE = 0.121 , t-ratio = -2.143 , p-value = 0.0326 .

Interpretation.

3. **Interest_for_sustainable_certification:** There is no significant evidence of differences between levels 1 and 2, as the p-value is higher than the significance level of 0.05.
4. **Attention_tolabel:** There is no significant evidence of differences between levels 1 and 2, as the p-value is higher than the significance level of 0.05.
5. **Knowledge_certification:** There is significant evidence of differences between levels 1 and 2, as the p-value is lower than the significance level of 0.05.

In general, when the p-value is below 0.05, we can reject the null hypothesis of no differences between levels. Therefore, for Knowledge_certification, we can conclude that significant differences exist between levels 1 and 2.

In conclusion, the Multivariate Analysis of Variance (MANOVA) conducted on the dataset, encompassing various socio-demographic factors and consumer preferences for olive oil, has unveiled meaningful insights into the relationships among multiple dependent variables. The study successfully identified variables that significantly contribute to the differentiation between groups, shedding light on the nuanced dynamics of consumer behavior in the context of olive oil preferences.

The strengths of our study lie in its comprehensive analysis facilitated by MANOVA, allowing for a thorough examination of the impact of socio-demographic variables on a multivariate set of consumer preferences. This approach provides a holistic understanding of the intricate relationships within the dataset. The efficiency of MANOVA in handling correlated dependent variables enhances the statistical power of our analysis, reducing the risk of Type I errors associated with multiple comparisons. Furthermore, the strategic selection of variables, such as "Interest_for_sustainable_certification," "Attention_tolabel," and "Knowledge_certification," based on Pillai's Trace, Approximate F, and p-values, ensures the inclusion of highly influential factors, adding depth to our findings.

However, the study is not without its limitations. Assumption challenges, including the reliance on multivariate normality and homogeneity of covariance matrices in MANOVA, may impact the accuracy of results, and deviations from these assumptions should be acknowledged. Additionally, the cross-sectional nature of the study provides a snapshot of consumer preferences at a specific point in time. Future research endeavors could benefit from adopting longitudinal approaches to capture evolving trends and preferences over time, offering a more dynamic perspective on olive oil consumer behavior. Future research directions in the field of olive oil consumer behavior could benefit from a more holistic approach. Longitudinal studies are recommended to track the dynamic evolution of consumer preferences over time, considering societal shifts and emerging trends. Complementing quantitative data, qualitative exploration through methods like interviews or focus groups can unveil the deeper motivations influencing consumer choices. Moreover, investigating regional and cultural variances in olive oil

preferences would contribute to a more nuanced understanding, acknowledging the diversity within the global market. Finally, a comprehensive examination of external factors, such as the impact of marketing strategies or health trends, holds the potential to provide actionable insights for stakeholders in the olive oil industry. This integrated approach promises a richer understanding of the multifaceted dynamics shaping consumer behavior in the olive oil market.

In essence, while this study has provided valuable insights into the multifaceted relationships between socio-demographic factors and olive oil preferences, there remains ample room for further exploration. Addressing the identified weaknesses and pursuing future research directions will contribute to a more comprehensive understanding of consumer behavior in the olive oil market, facilitating informed decision-making for producers, marketers, and policymakers.

5. Discussion and conclusions

Extra virgin olive oil plays a central role in the Mediterranean diet, considered one of the healthiest dietary patterns globally. Abundant in monounsaturated fats and antioxidants, extra virgin olive oil contributes to the prevention of cardiovascular and inflammatory diseases [73,74]. Its presence provides a source of healthy energy and enhances the absorption of essential nutrients. Thanks to its beneficial properties, extra virgin olive oil not only imparts a distinctive flavor to dishes but also plays a crucial role in promoting overall health and maintaining a balanced lifestyle within the context of the Mediterranean diet [75]. Its culinary versatility and health benefits make it a key component in the nutritional approach typical of Mediterranean regions.

Numerous previous studies have extensively explored consumer preferences regarding olive oil attributes, as highlighted in literature review papers. The majority of these studies center their focus on Mediterranean countries and employ a variety of conjoint methodologies. Furthermore, many of these investigations have explored the potential diversity in consumer preferences for olive oil attributes, as well as delving into different consumer profiles among other factors.

This study holds several implications at the business level and provides insights into consumer preferences for the olive oil industry, policymakers, and academics.

The stakeholders involved in the agricultural and food industry, such as farmers, distributors, and governmental bodies, can be affected by consumer preferences regarding olive oil.

Understanding the multiple influences of price, brand, origin, certification, production method and packaging is crucial for producers and traders seeking to meet the diverse needs and preferences of consumers in this dynamic and competitive industry [76]. To customize marketing strategies olive oil producers should take into account several key aspects.

Origin preferences emphasize the enhancement of regional characteristics and terroir, turning provenance into a distinctive element in the choice of olive oil in order to appreciate the food and wine sector. Moreover, operating within a fiercely competitive market, olive oil producers must carve out their distinctive identity by highlighting attributes like product excellence, detailed labeling, and other features that resonate with consumer tastes.

In light of this significance, it becomes crucial to emphasize the specific regions or countries of origin, accentuating the superior quality and authenticity of the products. Additionally, recounting stories about the traditional production techniques, cultural heritage, and expertise behind the product can greatly enhance marketing efforts.

The relevance of certification highlights a growing consumer awareness of quality and authenticity, demanding greater transparency in production practices. The shift in attitudes towards production methods suggests that the industry needs to balance innovation with respect for traditions, responding to the expectations of consumers who value both craftsmanship and sustainable practices. Becomes progressively imperative give prominence to the organic label certification,

showcasing the product's strict adherence to organic standards and its advantageous impact on health and the environment. Utilize eco-friendly packaging materials, underlining the product's commitment to sustainability. Additionally, it is essential to communicate the brand's dedication to organic farming practices.

The multifaceted landscape of consumer preferences in olive oil requires a holistic approach from olive oil professionals, who must be prepared to adapt to changing market dynamics and offer products that reflect the diversity of consumer tastes and expectations.

The results of our study should also be taken into consideration by institutions, as they demonstrate the level of interest consumers have in the various EU quality regimes, providing insights into the effectiveness of certifications as tools for enhancing the quality of food products.

Moreover, recognizing market demand is essential for the government to enact policies that bolster domestic agriculture, like offering tax incentives or establishing programs encouraging public institutions to procure local goods, thereby elevating the significance of Italian production [38].

In summary, the Multivariate Analysis of Variance (MANOVA) applied to the dataset exploring socio-demographic factors and consumer preferences for olive oil has yielded valuable insights. The examination of combined variables, including the importance of price, the importance of brand, the importance of origin, the importance of certification, the importance of production method and finally, the importance of packaging, has uncovered significant differences across specific factors. Notably, gender, knowledge certification, attention to labeling, and interest in sustainable certification emerged as influential factors contributing to variations in consumer perceptions, particularly regarding the importance of price.

The evidence that has emerged regarding the importance of socio-demographic factors in consumer choice allows for a broader understanding with respect to the processes that direct the purchase decision.

The statistical analyses emphasized the significance of certain variables in influencing observed differences. Further scrutiny of specific factors revealed nuanced contrasts between levels, with attention to sustainable certification and labeling showing no significant evidence of differences between levels, while knowledge certification demonstrated significant disparities between levels 1 and 2. This suggests that consumers with varying levels of knowledge certification exhibit distinct preferences concerning the importance of price.

Limitations of this study include potential deviations from statistical assumptions, such as multivariate normality and homogeneity of covariance matrices in MANOVA, which could impact result accuracy. Additionally, the study's cross-sectional design offers only a snapshot of consumer preferences at a specific time, without considering their evolution over time. Furthermore, the generalizability of the findings may be limited by variations in participant characteristics and study context.

Future research could adopt longitudinal approaches to track changes in consumer preferences over time, providing a more dynamic understanding of behavior. Integrating qualitative methods like interviews or focus groups would deepen insights into the underlying motivations guiding consumer choices. Exploring regional and cultural variations in olive oil preferences could offer a more nuanced understanding of the global market. Investigating the influence of external factors such as marketing strategies or health trends would provide valuable insights for stakeholders in the olive oil industry.

In conclusion, this comprehensive exploration of olive oil consumer behavior provides a nuanced understanding of the intricate interplay between socio-demographic factors and preferences. The identified variables not only contribute significantly to observed variations but also underscore the importance of considering multiple dimensions in comprehending consumer choices within the olive oil market. This research lays the foundation for future studies and strategic considerations in the olive oil industry.

CRediT authorship contribution statement

Filippo Sgroi: Writing – review & editing, Writing – original draft, Conceptualization. **Caterina Sciortino:** Methodology. **Giusi Giamporcuro:** Writing – original draft, Data curation. **Federico Modica:** Writing – review & editing.

Declaration of competing interest

We declare not to be in a conflict of interest Journal of Agriculture and Food Research.

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Data availability

Data will be made available on request.

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