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Testing consumers' acceptance for an extra-virgin olive oil with a naturally increased content in polyphenols: The case of ultrasounds extraction

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ABSTRACT

Innovation is fundamental for all agri-food companies to increase competitiveness. Being extra-virgin olive oil (EVOO) a traditional food product (TFP), the main obstacle to innovation is its traditional nature. This study evaluated consumers' acceptance for an EVOO with a naturally increased content of poliphenols, as it has been extracted through ultrasounds. This product has been compared with a set of emerging innovations that may be introduced in the next future. To this end, a choice experiment was carried out bent on the estimation of a Latent Class Model (LCM). A nationally-representative sample of EVOO consumers were involved in a web-based interview. The LCM analysis highlighted three segments of consumers: *(1) innovative; (2) traditionalist; (3) cautious*. Results showed that there is cluster of consumers willing to accept this innovation, therefore its introduction on the market appears to be possibly successful.

1. Introduction

Phenolic compounds are believed to play a key role in human longevity achieved in the modern era (Lutz, Fuentes, Ávila, Alarcón, & Palomo, 2019). Among other substances contained in foods constituting a healthy diet, phenolic compounds are believed to reduce risk factors for cardiovascular diseases and aging-related diseases (Dauchet, Amouyel, & Dallongeville, 2009; Wang et al., 2014). Although evidence on the effects on health played by phenolic compounds is not available for all the foods concerned, the European Food Safety Authority officially confirmed such healthy effects through approving the use of a health claim on extra-virgin olive oil (EVOO) related to its content in hydroxytyrosol and its derivatives, the latter being an element able to prevent oxidative and inflammatory processes (Caporaso et al., 2015; EFSA 2011; Peyrol, Riva, & Amiot, 2017; Roselli, Clodoveo, Corbo, & De Gennaro, 2017).

In this context, there is an innovation in EVOO production that appears to be of particular interest: extraction assisted by ultrasound. This innovation allows an improvement in the efficiency of the EVOO production process, representing a benefit for producers (Clodoveo, 2012). In addition, EVOO can be obtained which is higher in phenolic compounds compared to that extracted with traditional technology (Clodoveo et al., 2016). While phenolic compounds tend to give EVOO a bitter taste, in the above case this does not happen: the taste of the final product is lower in bitterness than traditional products (Clodoveo et al., 2017).

EVOO is conventionally categorized as a Traditional Food Product (TFP)[1] (Caputo, Sacchi, & Lagoudakis, 2018). Attitudes to innovation for this category of products appear conflicting, judging from mixed responses to consumer surveys (Guerrero et al., 2009; Vecchio, Lombardi, Cembalo, Caracciolo, & Cicia, 2016). Innovations that appear more successful are those conferring specific benefits on consumers, such as improvements in nutritional and health properties or convenience, without detracting from the traditional nature of the product (Almli et al., 2011). Furthermore, among consumers, there are some groups who show greater acceptance, such as those who display openness to new foods (Hersleth, Lengard, Verbeke, Guerrero, & Næs, 2011).

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[1] According to Guerrero et al. (2009), a traditional food product may be defined as "*a product frequently consumed or associated with specific celebrations and/or seasons, normally transmitted from one generation to another, made accurately in a specific way according to the gastronomic heritage, with little or no processing/manipulation, distinguished and known because of its sensory properties and associated with a certain local area, region or country*".

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In this study, we aimed to assess whether an innovation on a TFP, namely ultrasound-extracted EVOO, would be able to capture consumer acceptance on the market. Most innovative products, despite appearing potentially successful, fail when they actually arrive on the market (Dijksterhuis, 2016; van Kleef, van Trijp, & Luning, 2005). Innovation failure can have serious repercussions, wiping out investments and wasting valuable resources for the Italian EVOO industry which has undergone several adverse events in recent years (Cornara et al., 2017). Therefore, our study aimed to answer the following research question: *Will consumers accept the innovative EVOO extracted with ultrasound technology, once it has come onto the market?*

A previous exploratory investigation on ultrasound-extracted EVOO found a potentially positive response for the possibility of buying the product. This suggests that acceptance on the Italian market may be possible, although the response from consumers may depend on different individual traits, such as quality perception, sensory preferences and individual level of education (Roselli, Cicia, et al., 2018). In this context, this study aimed to take a step forward in understanding the topic.

For this purpose, a survey was set up with a choice experiment. The investigated innovation was compared to others in order to simulate the competition actually occurring on the market. Since convenience characteristics (e.g. easy preparation and handling of the product) have been highlighted as the key competitive advantage for innovative TFPs (Guerrero et al., 2009), we compared the acceptance of ultrasonically assisted extraction with that assisted by microwave technology, another technology able to improve the efficiency of the EVOO extraction process. Two innovations that extend EVOO shelf-life were also taken into account: nitrogen packaging and bag-in-box.

Other important attributes defining the quality of EVOO and its characteristics were then considered. In order to identify the most important individual traits of the consumers, according to their degree of acceptance, the survey also collected demographic and psychological traits of respondents.

The article is structured as follows: the theoretical framework is presented in Section 2, and the survey is described in Section 3; after the results in Section 4, the conclusions convey the main insights obtained.

2. Theoretical framework

2.1. Product attributes

In order to investigate the importance of the innovation according to consumers, we defined a set of attributes which constitute EVOO quality. The most important EVOO attributes were collected from the relevant literature on the topic in question (Del Giudice, Cavallo, Caracciolo, & Cicia, 2015). Together with these attributes, price was added, the levels being determined according to the prices as transmitted by IRI Infoscan data: the chosen prices were those at the 20th, 40th, 60th and 80th percentile of the whole distribution. This allowed us to represent the majority of prices that consumers actually encounter while shopping for groceries.

The first relevant attribute to be considered is product origin. It is a multi-faceted quality cue, linked to concepts such as typicality[2] and ethnocentrism[3], embedding a set of other attributes, such as safety and traceability (Caporale, Policastro, Carlucci, & Monteleone, 2006; der Lans, Ivo, Van Ittersum, De Cicco, & Loseby, 2001; Menapace, Colson, Grebitus, & Facendola, 2011). Furthermore, it appears to be one of the main elements considered by consumers while shopping for EVOO (Cavallo, Caracciolo, Cicia, & Del Giudice, 2018; Del Giudice, Cavallo, Caracciolo, & Cicia, 2015). According to the existing legislation for the designation of origin on the EVOO label (EC Regulation No. 29/2012), three levels for the above attribute are used: “100% from Italy”, “from EU countries” and “from extra-EU countries”.

Among the attributes determining EVOO purchases, we also considered two certifications: organic and Protected Designation of Origin (PDO). Organic production is a method to obtain food and other agricultural products based on the use of processes with minimal impacts on the environment and the health of humans, plants and animals (EC Regulation No. 834/2007), while the PDO label, according to EC Regulation No. 1151/2012, is a geographical indication which can be used to differentiate food products originating from a specific place or region and whose quality is more attributable to its geographical origin. The aim of such labeling schemes is to reduce information asymmetry, signaling to consumers the presence of a bundle of quality characteristics, linked either to the region or area of origin (Aprile, Caputo, & Nayga, 2012), or to the organic production method (Liang, 2016). As a result, consumers may have higher quality expectations for certified products compared to products without such labels and usually show a higher willingness to pay for them (Caracciolo et al., 2018; Castriota & Delmastro, 2015; Cicia, Del Giudice, & Scarpa, 2002; Rickard, McCluskey, & Patterson, 2015).

Also, as an intrinsic attribute, organoleptic attributes have been added to the study. EVOO taste can essentially be represented by four sensory attributes, as defined by EC Regulation No. 2568/91 and subsequent amendments: fruity, pungent[4], sweet and bitter. Although the reaction of consumers is heterogeneous towards EVOO taste (Delgado & Guinard, 2011), an important trend has been highlighted elsewhere: despite bitter and pungent notes are not preferred by the majority of consumers (Del Giudice, Cavallo, Caracciolo, & Cicia, 2015), a preference for the latter two sensory features is shown by expert consumers and can be considered an indicator of technological quality of EVOO (Del Giudice, Cavallo, & Vecchio, 2018; Tuorila, Recchia, Monteleone, & Langstaff, 2014; Vecchio, Cavallo, Cicia, & Del Giudice, 2019).

In order to investigate the reaction of consumers to ultrasound-extracted EVOO, we considered the performance of this innovation compared to similar ones. It was, thus, possible to separate the individuals’ preference for novelty, in general, from the preference for this single innovation. For this purpose we chose three other innovations:

(a) microwave treatment: microwave radiation used in olive oil extraction plants during the malaxation phase. Although it allows the olive paste to be conditioned in a shorter time than the traditional system and avoids problems associated with process discontinuity, the resulting EVOO has a lower content of phenolic compounds (Kalogianni, Georgiou, & Hasanov, 2019; Tamborrino, Romaniello, Zagaria, & Leone, 2014).
(b) nitrogen packaging: EVOO packed in a material with low oxygen permeability and air removed in the headspace, either by fully filling EVOO bottles or replacing air with nitrogen, an inert conditioning gas (Sanmartin et al., 2018).
(c) bag-in-box packaging: EVOO packed in a new container type intended for household use in order to retain its original quality longer than that of traditional containers (Garrido-Delgado, del Mar Dobao-Prieto, Arce, & Valcárcel, 2015; Lolis, Badeka, & Kontominas, 2019)

[2] Typicality may be defined as the degree of resemblance with the majority of products belonging to a particular geographical area, culture or tradition (Caporaso et al., 2006).

[3] This is the belief that foreign-made goods are negative for the domestic economy and thus should not be preferred over others (Shimp & Sharma, 1987).

[4] According to EC Regulation 2015/183 pungency is *“a biting tactile sensation characteristic of oils produced at the start of the crop year, primarily from olives that are still unripe. It can be perceived throughout the whole of the mouth cavity, particularly in the throat”*.

The final set of innovation levels is thus balanced: two innovations increase the efficiency of the EVOO extraction process (benefiting producers) and two extend the shelf-life of the final product (benefiting consumers). Although the content of phenolic compounds does not change for packaging innovations, by extending shelf-life their content persists for longer (Sanmartin et al., 2018).

2.2. Characteristics of consumers

In a context where ratings are highly subjective and preferences are heterogeneous, it is important to allow for the psychological characteristics of consumers. There are several individual traits which are able to shape perceptions and lead to different behaviors (Cavallo & Piqueras-Fiszman, 2017; Piqueras-Fiszman, Ares, & Varela, 2011; Piqueras-Fiszman & Spence, 2015). To this end, and for better segmentation, via the survey we collected some information on the individual traits characterizing the respondents.

The respondents were characterized according to their habits in terms of EVOO purchasing. The Italian EVOO market represents a particular case in which direct farm purchase has an important share, especially in the most important production areas where consumers are highly familiar with the product (Pomarici & Vecchio, 2013).

Some psychological dimensions were also measured. First of all, the survey helped to categorize respondents according to their degree of neophobia towards new technologies through the Abbreviated Food Technology Neophobia Scale (AFTNS) which was rated on a Likert scale from 1 to 7 (Schnettler et al., 2017). Indeed, as the core of our study was to investigate how consumers react to a specific new technology, knowledge of how the individual engages with new technologies in food, in general, could be a valuable measure to understand and predict consumer behavior (Cavallo & Materia, 2018).

Two sub-scales were taken from the Health and Taste Attitude Scale (HTAS) by Roininen et al. (2001) in order to ascertain the personal relationship with food and its benefits. As regards the choice of food, consumers are constantly faced with the dilemma of choosing food with either the highest health potential, or the best taste. These two choices are seen as opposite alternatives, being the long- or short-term consequences of food consumption, respectively (Raghunathan, Naylor, & Hoyer, 2006). This scale helps to understand which of the two represents the stronger reason for the personal choice of food. The investigated traits were: to what extent the individual considers health while shopping for food (GHI - General Health Interest) and to what extent food is considered only as a source of pleasure (FP - food as Pleasure). They were also evaluated on a Likert scale from 1 to 7 (Roininen, Lähteenmäki, & Tuorila, 1999).

The last personal trait recorded by the survey was the Food Decision Involvement Scale (FDI) by Levi, Chan, and Pence (2006). Given that the degree of effort devoted to purchases can depend, among other factors, on the degree of involvement felt with the category of products, the survey aimed to measure the degree of involvement with the individual's food decisions. The reason lies in the different mental processes and trade-offs occurring in the mind of the consumer who is making a piecemeal decision vs. the consumer who is making a heuristic decision (Petty & Cacioppo, 1986).

Finally, the main socio-demographic characteristics of respondents were collected. Previous studies have shown that EVOO preferences are partially linked to demographics (Giannoccaro, Carlucci, Sardaro, Roselli, & De Gennaro, 2019; Roselli, Giannoccaro, Carlucci, and De Gennaro, 2018). In particular, we asked for details regarding the household member responsible for purchasing, such as gender, age and education, as well as income, size of household and place of residence.

3. The survey

A consumer survey was carried out in Italy, the largest olive oil consumer country in the world, during November-December 2017. A market research agency recruited a nationally representative sample of consumers who were involved in a web-based interview. The inclusion criteria for the target population were that: (i) the interviewee was the household member responsible for food purchasing, and (ii) he/she had bought EVOO at least once in the year prior to the survey. Ultimately, a total of 1003 responses were recorded. Participants were recruited with stratified quota sampling based on the geographical area, municipality size, age, gender and education, in order to ensure the representativeness of the sample at national level.

Table 1
Socio-demographic characteristics of the sample.

Variable	Count	% of sample	Italian adult population (%)*
Total sample	***1003***	***100.00***	***100.00***
Gender:			
Male	464	46.26	48.04
Female	539	53.74	51.96
Age groups, years *(sample: Mean: 43.37 years, St. Dev.: 13.50)*			
< 35	284	28.32	21.47
35–55	486	48.45	38.00
> 55	233	23.23	40.53
Education:			
primary	117	11.67	42.94
secondary	537	53.54	40.59
tertiary	349	34.79	16.47
Self-reported income:			
below average	265	26.42	n.a.
average	645	64.31	n.a.
above average	93	9.27	n.a.
No. of household members:			
< 3	325	32.41	36.83
3	307	30.61	24.85
> 3	371	36.99	38.32
Italian areas (Nielsen):			
North	455	45.36	45.89
Center	227	22.63	22.85
South	321	32.01	31.26

* Source: Italian Institute of Statistics – (ISTAT, 2020).

The composition of the final sample based on the participants' socio-demographics is summarized in Table 1. It appeared to be quite balanced with some deviations with respect to the Italian adult population: the older and least educated respondents were underrepresented compared to the Italian adult population as a whole. Although this is a common limit of Internet surveys, it was assumed that this discrepancy does not have a significant impact on the results.

3.1. Informative messages

To test consumer's reaction to novel elements in EVOO production, in our survey we used a set of innovations that the consumer had to consider as available options in the choice experiment. For this purpose, we provided information about each innovation considered in the study. Information content was created based on previous research and following guidelines about how to formulate product information in experiments. To create balanced information, we formulated each description controlling for its content, framing, linguistic style and order of presentation (Buda & Zhang, 2000; Rosenblatt, Dixon, Wakefield, & Bode, 2019; Soliha & Dharmmesta, 2012). To control for content, we presented the same product attributes for each innovation (i.e., production cost, taste, quantity of extracted oil, amount of healthy substances, shelf-life, characteristics of olive orchards and their landscape value, olive harvesting and packaging). We also used the same style of language for each information item regarding production. To control for the framing effect, moreover, in each information item we presented any gains or losses, and the similarity to the traditional production. To control for the order of presentation, the description of each production

was presented in randomized order. Below is a transcription of the presented information.

Below is a list of innovations that can be applied to the traditional production of extra-virgin olive oil. These innovations can produce differences in the main characteristics of the traditional production of extra-virgin olive oil. Such characteristics concern the olive orchards and their landscape values, olive harvesting, oil extraction, quantity of oil extracted, presence of healthy substances, bitterness and spiciness of taste, packaging, shelf-life, and production cost.
Please read carefully the description of each innovation and then answer some questions about them.

Extraction assisted by ultrasound. Compared to traditional extra-virgin olive oil production, ultrasound EVOO extraction uses an ultrasound-assisted treatment apparatus. Therefore, the production cost and both product bitterness and spiciness are lower than those of the traditional product. Moreover, the quantity of oil extracted, the amount of healthy substances, and the shelf-life exceed those of traditional EVOO. In this case, olive harvesting and packaging do not differ from those of the traditional production.

Extraction assisted by microwaves. Compared to traditional extra-virgin olive oil production, such EVOO extraction uses microwave-assisted treatment apparatus. With this technique, more oil is extracted, and the production cost is lower. However, the amount of healthy substances and shelf-life are lower than those measured in traditional production. In this case, the olive harvest, packaging, and both the bitterness and spiciness of taste do not differ from those of the traditional production of extra-virgin olive oil.

Bottling with nitrogen. Compared to traditional extra-virgin olive oil, nitrogen bottling conserves healthy substances throughout shelf-life, which is longer than that of traditional EVOO. However, the production cost is higher. The olive harvest, oil extraction and quantity of extracted oil, the amount of healthy substances, packaging, and both the bitterness and spiciness of taste do not differ from those of traditional EVOO production.

Packaging with bag-in-box. Compared to traditional extra-virgin olive oil, bag-in-box packaging may be described as a box with a dispenser and an inner envelope that prevents contact of the product with oxygen. Hence healthy substances are preserved throughout product shelf-life, which exceeds that of traditional extra-virgin olive oil. However, the production cost is higher. The olive harvest, EVOO extraction and quantity of the extracted oil, the amount of healthy substances, and both the bitterness and spiciness of taste do not differ from those of traditional EVOO production.

3.2. Data and design

Traditionally, in choice experiments, attributes and levels are specified in advance according to the researcher's knowledge, but for consumers there may be no noticeable difference between some of them, which can lead to heteroskedasticity problems (Caputo, Van Loo, Scarpa, Nayga, & Verbeke, 2018). To allow for this situation, we used a D-optimal design, which identifies the most informative points within a probability distribution and improves parameter estimates (Kanninen, 2002). D-optimality entails maximization of the determinant of the Fisher information matrix, which is equivalent to minimizing the asymptotic joint confidence sphere surrounding the parameter estimates (Carson et al., 1994).

In order to account for the modulation of the D-optimal design, a pre-test was conducted on a sample of 150 respondents. The experimental design was created according to an algorithm which maximizes the D-efficiency of the design based on the covariance matrix of the conditional logit model (Carlsson & Martinsson, 2003; Cook & Nachtrheim, 1980; Zwerina, Huber, & Kuhfeld, 1996). The design with the highest D-Efficiency coefficient (1.25) was chosen after several iterations.

Table 2
Attributes of the choice experiment.

Attributes	Levels
Country of origin	Italy; EU countries; *extra-EU countries*
Innovation	microwave; ultrasound; nitrogen-packed; bag-in-box; *none*
Quality scheme	PDO; organic; *none*
Sensory property	pungent; sweet; fruity, *bitter*
Price (per liter)	€4.10; €5.70; €7.50; €10.80

The choice experiment was divided into two blocks, each with four rounds of choice. In each round, four profiles were presented, together with the "no-choice" option. Table 2 reports the selected attributes with related levels and Fig. 1 shows an example of choice card.

3.3. Latent class model

Econometric analysis was carried out through the latent class model (LCM) (Lazarsfeld & Henry, 1968), which simultaneously allows sample segmentation and segment-specific estimation of parameters. In particular, LCM captures preference heterogeneity across classes, i.e. consumer segments, but assumes homogeneous parameters within each class.

In formal terms, LCM investigates preference heterogeneity through both estimation of the probability of individual i belonging to class c, and the structure of preferences within each class (Swait, 1994). For class c, individual i's utility (U) for alternative j in choice situation s is specified by class-specific preference coefficients (α_{cj}, β_c), defined as:

$$U_{ijs|c=\alpha_{cj}+\beta_c \boldsymbol{x}'_{ijs}+\varepsilon_{cijs}} \tag{1}$$

where α_{cj} is an alternative-specific constant (ASC) for consumers in class c, which captures the mean effect of unobserved utility for EVOO choice j. Vector $\mathbf{x}$ describes attributes, while the unobserved component of utility ε is independently and identically distributed (IID) extreme value type 1. The probability of individual i choosing alternative j is conditional on his/her belonging to class c, such that (Greene & Hensher, 2003):

$$P(y_{is}=j|c) = \frac{\exp(\alpha_{cj} + \beta_c \boldsymbol{x}'_{ijs})}{\sum_{q=1}^{J_i} \exp(\alpha_{cj} + \beta_c \boldsymbol{x}'_{ijs})} \tag{2}$$

Respondents' class membership is defined by a vector z_i of their observable characteristics. If H_{ic} is the prior probability of membership of class c for individual i, and for which θ_c are parameters indicating the impact of z_i on class membership:

$$H_{ic} = \frac{\exp(Z_i\theta_c)}{\sum_{c=1}^{C} \exp(Z_i\theta_c)} \quad c = 1, \ldots, C \;\; \theta_C = 0 \tag{3}$$

then the probability of individual i choosing alternative j is:

$$P_i = \sum_{c=1}^{C} H_{ic} P_{j|c} \tag{4}$$

Finally, the values of coefficients that maximize log-likelihood through maximum likelihood estimation are calculated as (Greene & Hensher, 2003):

$$\ln L = \sum_{i=1}^{N} \ln P_i = \sum_{i}^{N} \ln\left[\sum_{c=1}^{C} H_{ic}\left(\prod_{s=1}^{S_i} p_{is|c}\right)\right] \tag{5}$$

WTP was computed according to $\mathrm{WTP_a} = -(\beta_a/\beta_{COST})$, where WTP of attribute a is the negative ratio between the coefficient of the attribute β_a and the cost coefficient β_{COST}. The confidence intervals were estimated by the Krinsky and Robb simulations based on 1000 replications (Creel & Loomis, 1991; Haab & McConnell, 2002; Park, Loomis, & Creel, 1991).

	Product A	Product B	Product C	Product D	No choice
Country of origin	Italy	Extra-EU countries	EU countries	EU countries	I would not realistically purchase any of these alternatives
Innovation	Microwaves	Nitrogen-packed	Bag-in-box	Ultrasound	
Quality scheme	PDO	Organic	PDO	None	
Sensory property	Bitter	Fruity	Pungent	Sweet	
Price	€ 7.50	€ 4.10	€ 7.50	€ 7.50	
	○	○	○	○	○

Fig. 1. Example of choice card.

Table 3
Estimation results of the latent class model.

CHOICE	*Cluster 1 - Innovative*			*Cluster 2 - Traditionalist*			*Cluster 3 - Cautious*		
	coeff.		*S.E.*	*coeff.*		*S.E.*	*coeff.*		*S.E.*
Italy	2.52	***	0.28	1.43	***	0.17	0.11	*	0.06
Extra-EU	−2.29	***	0.36	−1.33	***	0.20	−0.28	***	0.05
Microwave	−1.06	***	0.28	−0.75	***	0.26	−0.13	*	0.06
Nitrogen-packed	0.92	***	0.33	−0.58	*	0.32	−0.15	*	0.08
Bag-in-box	0.03		0.17	0.56	***	0.17	0.20	***	0.06
Ultrasound	0.65	***	0.17	−0.34	***	0.10	−0.09		0.07
PDO	0.41	***	0.16	−0.23		0.193	0.14	***	0.05
Organic	0.53	***	0.20	0.74	***	0.13	0.04		0.05
Pungent	−0.80	***	0.21	−0.82	***	0.19	−0.24	***	0.06
Sweet	0.48	***	0.18	0.47	***	0.17	0.28	***	0.05
Fruity	0.29		0.22	0.35	**	0.16	0.24	***	0.06
Price	−0.25	***	0.08	−0.28	***	0.08	−0.13	***	0.03
ASC	−1.15	**	0.47	1.22	***	0.42	−3.00	***	0.35
LC probabilities	***0.32***	***	***0.02***	***0.25***	***	***0.017***	***0.43***	***	***0.02***

Note: ***, **, * = = > Significance at 1%, 5%, 10% level.

4. Results

LCM analysis highlighted three segments of consumers (Table 3). Each consumer segment was profiled according to all the socio-economic and psychographic variables collected in the study, as explained above (Table 4).

4.1. Cluster 1 - innovative

The first consumer segment, identified as *Cluster 1*, accounted for 32% of the respondents. These consumers, compared to the other two clusters, are those who showed the highest preference for the EVOO of Italian origin and with the PDO label. They also appreciated the organic

Table 4
Profiling of segments [Mean (St. Dev.)].

Variable	Description	*Cluster1 - Innovative*		*Cluster2 - Traditionalist*		*Cluster3 - Cautious*	
male	Share of male respondents	0.52	(0.50)[b]	0.68	(0.47)[a]	0.47	(0.50)[b]
age	Average age (years)	43.96	(13.57)[b]	46.65	(12.81)[a]	41.02	(13.41)[c]
direct_channel	Share of respondents who buy mainly in direct channels (i.e. farmers, oil mills)	0.26	(0.44)[a]	0.32	(0.47)[a]	0.19	(0.39)[b]
supermarket	Share of respondents who buy mainly in large retailers	0.62	(0.49)[b]	0.58	(0.49)[b]	0.73	(0.44)[a]
other channels	Share of respondents who buy mainly in other channels (e.g. traditional retailers, specialty shops)	0.12	(0.32)[a]	0.10	(0.30)[a]	0.08	(0.27)[a]
low_income	Share of respondents with an income perceived as below average	0.21	(0.41)[b]	0.30	(0.46)[a]	0.29	(0.45)[a]
average_income	Share of respondents with an income perceived as average	0.69	(0.46)[a]	0.61	(0.49)[b]	0.62	(0.49)[b]
high_income	Share of respondents with an income perceived as above average	0.10	(0.30)[a]	0.08	(0.28)[a]	0.09	(0.29)[a]
household	No. of household members	3.04	(1.11)[a,b]	2.95	(1.07)[b]	3.14	(1.10)[a]
tertiary_edu	Share of respondents with a tertiary education level	0.35	(0.48)[a]	0.30	(0.46)[a]	0.37	(0.48)[a]
secondary_edu	Share of respondents with a secondary education level	0.56	(0.50)[a]	0.54	(0.50)[a]	0.51	(0.50)[a]
primary_edu	Share of respondents with a primary education level	0.09	(0.29)[b]	0.16	(0.37)[a]	0.11	(0.32)[a,b]
urban area	Share of respondents living in an urban area	0.58	(0.49)[a,b]	0.51	(0.50)[b]	0.63	(0.48)[a]
sub-urban	Share of respondents living in a suburban area	0.23	(0.42)[a]	0.29	(0.45)[a]	0.24	(0.43)[a]
countryside	Share of respondents living in a rural area	0.18	(0.39)[a]	0.20	(0.40)[a]	0.12	(0.33)[b]
AFTNS*	*Average score for the Abbreviated Food Technology Neophobia Scale*	4.65	(1.30)[b]	5.20	(1.19)[a]	4.73	(1.23)[b]
GHI**	*Average score for General Health Interest*	4.94	(0.99)[a]	4.86	(0.98)[a]	4.64	(0.98)[b]
FP***	*Average score for Food as Pleasure*	4.83	(0.97)[a]	4.80	(0.94)[a]	4.58	(0.86)[b]
FDI****	*Average score for the Food Decision Involvement Scale*	4.84	(0.70)[a]	4.65	(0.78)[b]	4.78	(0.70)[a,b]

* Schnettler et al. (2017).
** Roininen and Tuorila (1999).
*** Roininen and Tuorila (1999).
**** Levi et al. (2006).
[a,b,c] : values with the same letter as the superscript indicate no statistically significant differences between the segments (columns) based on the two sample Wilcoxon rank sum (Mann-Whitney) test, $p < 0.05$.

labels, but less than *Cluster 2*. The highest aversion, instead, can be supposed towards EVOO of extra-EU origin. As regards preferences for organoleptic attributes, this segment liked EVOO with sweet and fruity attributes and disliked pungency. Focusing on the possible acceptance for the proposed innovations, this group showed the most openness to innovations. Indeed, this was the only segment that showed a positive rating for EVOO extracted by ultrasound or packed under nitrogen-flushed atmosphere. By contrast, their opinion toward bag-in-box packaging appeared neutral, the coefficient being extremely low (0.03). However, the cluster showed the highest aversion to EVOO extracted by microwave. With regard to socioeconomic characteristics (Table 4), a few differences were detected with respect to the other two groups, the most important being middle age and the highest share of respondent with medium-high income. The psychometric profile showed the lowest score for the AFTNS scale but no significant difference from *Cluster 3*, the highest scores for the GHI and the FP scales but both similar to *Cluster 2,* and the highest scores for the FDI scale but close to the score of *Cluster 3*.

4.2. Cluster 2 - traditionalist

The second consumer segment, called *Cluster 2*, comprised 25% of the respondents. They revealed a liking for Italian EVOO and a disliking for EVOO of extra-EU origin, but both are lower than in *Cluster 1*. They exhibited the highest inclination for organic label EVOO, compared to the other two clusters. Instead, PDO certification did not affect their choices. Preferences for sensory attributes were similar to those of *Cluster 1* with a slightly higher propensity for a fruity flavor and a slightly lower propensity for sweet EVOO. They showed the least openness to the proposed innovations. Only bag-in-box packaging was generally accepted, while all other innovations were rejected. They were the most averse to EVOO packed under nitrogen-flushed atmosphere and EVOO extracted by ultrasound. Their aversion to microwaves was also very high. This segment included elderly women, but all other socioeconomics were not relevant. The psychometric profile showed the highest scores for the AFTNS; the scores for the GHI and FP scales were similar to *Cluster 1;* the score for the FDI scale was similar to that of *Cluster 3*.

4.3. Cluster 3 - cautious

The third segment, called *Cluster 3*, consisted of 43% of respondents. These consumers showed a slight positive propensity for Italian origin of EVOO and a moderate aversion to non-EU origin. They liked the PDO label slightly more than Italian origin, but were uninterested in the organic label. They showed preferences for EVOO organoleptic attributes similar to the other two segments but with a somewhat lower intensity. The only accepted innovation is EVOO packed in bag in box, but aversion to other innovations is slight (microwave and nitrogen) or not statistically significant (ultrasound). This group included the youngest respondents, most prone to buying EVOO at supermarkets rather than on direct channels. Respondents in this cluster live mainly in urban or sub-urban areas. The psychometric profile showed an intermediate score for the AFTNS scale but not statistically differing from the least neophobic *Cluster 1*; the lowest scores for the GHI and FP scales; and an intermediate score for the FDI scale but not statistically differing from the other two segments.

Comparing the two innovative extraction techniques, the use of microwaves was not accepted by the whole sample, while ultrasound technology was preferred by *Cluster 1* and rejected by *Cluster 2*; *Cluster 3* appeared to be indifferent to the above innovation. The first consumer group was also interested in nitrogen-flushed packaging. Conversely, bag-in-box packaging was preferred by the other two segments.

5. Discussions and conclusions

This study started with the assumption that innovation of TFP has to be investigated in detail before the innovation arrives on the market, to prevent failure. For this purpose, we conducted a choice experiment to investigate consumer acceptance of the use of ultrasound technology for the EVOO production process, in order to provide producers with useful insights. In particular, the technology was compared to other new technologies in order to simulate a competitive scenario.

Our results showed that consumer attitudes towards emerging technologies in EVOO production varied considerably according to the type of technology, as well as among different consumer segments. Latent class analysis helped to group consumers into four segments with different opinions about EVOO purchase and quality. Among these groups, ultrasound extraction obtained a heterogeneous reaction among consumer segments, but the segment of “innovative” consumers, which accounted for 32% of respondents, appeared to highly appreciate ultrasonically assisted extraction, together with other certified quality labels of EVOO, such as geographical origin and organic method.

Overall, we obtained general indications about consumers' preferences and their distribution across groups of consumers. The most important element, according to consumer's opinion, seemed to be the *Italian* attribute: it was preferred by all the clusters highlighted by this study. The importance of this attribute has been extensively explained by previous research (Del Giudice, Cavallo, Caracciolo, & Cicia, 2015).

Similarly, homogeneous were preferences regarding the taste profile of EVOO: a sweet, fruity flavor is positively rated by consumers, while the opposite applies to pungent, bitter notes. This confirms previous investigations showing that consumers' aversion to bitterness and pungency affects preferences for EVOOs. This particularly seems to affect the market success of those that are rich in polyphenols (Caracciolo et al., 2020; Cavallo, Cicia, Del Giudice, Sacchi, & Vecchio, 2019).

With regard to innovations, the least neophobic cluster showed a preference for ultrasound-assisted EVOO extraction, while other clusters only seemed to accept the bag-in-box innovation. This is hardly surprising, since such packaging looks exactly like the boxes used for wine, which are extremely common on the Italian market. Hence more neophobic consumers have no aversion to such boxes.

With regard to the profile of the respondents in the first cluster, the one that best represents the target market of ultrasound-extracted EVOO, such consumers would appear to be not only the least neophobic of the sample, but also those most concerned about health and involved with food decisions. This suggests that they are those who devote more time and effort to their food choices (Kamrath, Bidkar, & Bröring, 2019). They are also those who would benefit most from the use of a product with an increased content in polyphenols. However, EVOOs richer in polyphenols currently have a high bitterness and pungency (Vitaglione et al., 2013), which are not liked by such consumers, as emerged from the questionnaire. This gap would be easily filled by ultrasound- extracted EVOO which, together with a high content in polyphenols, has a low level of bitterness (Clodoveo et al., 2017), bringing a tangible benefit to this cluster of consumers.

Our findings were as follows: first, the new technologies which tend to deviate considerably from traditional production practices without providing benefits in terms of improvement/preservation of product quality are widely rejected by consumers (e.g. microwave-assisted extraction), while the opposite applies to more familiar technologies (e.g. bag-in-box); secondly, other new technologies such as ultrasound-assisted extraction or nitrogen flushing), albeit deviating considerably from traditional production, provide tangible benefits and may be accepted by groups of consumers who are more willing to accept innovation than others.

The main managerial implications concern the finding that, despite a general consumer's reluctance to accept new technologies in EVOO production, a non-negligible consumer segment (32% of the sample)

proved to be innovation-oriented, which suggests promising prospects for the development of new technologies in EVOO production. According to recent statistics, 90% of households in Italy are regular consumers of EVOO, which corresponds to as many as fifty million consumers, an undeniably large number (Coldiretti, 2020).

However, the attempt to profile the different consumer segments in terms of socio-demographic and psychometric characteristics showed dissimilarities that can be considered only moderately significant.

Ethical Statement

All subjects gave their informed consent for inclusion before they participated in the study. It has been performed in accordance with the Declaration of Helsinki and it did not need approval by any ethics committee as the survey only posed hypothetical questions to respondents with no further action required to them.

CRediT authorship contribution statement

L. Roselli: Conceptualization, Methodology, Formal analysis, Writing - original draft, Writing - review & editing. **G. Cicia:** Conceptualization, Writing - review & editing. **T. Del Giudice:** Conceptualization, Writing - review & editing. **C. Cavallo:** Writing - original draft, Writing - review & editing. **R. Vecchio:** Conceptualization, Methodology, Formal analysis. **V. Carfora:** Methodology, Formal analysis. **D. Caso:** Methodology, Formal analysis. **R. Sardaro:** Methodology, Formal analysis, Writing - original draft. **D. Carlucci:** Methodology, Formal analysis, Writing - original draft. **B. De Gennaro:** Conceptualization, Methodology, Formal analysis, Supervision.

Declaration of Competing Interest

None.

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References

Almli, V. L., Næs, T., Enderli, G., Sulmont-Rossé, C., Issanchou, S., & Hersleth, M. (2011). Consumers' acceptance of innovations in traditional cheese. A comparative study in France and Norway. *Appetite, 57*(1), 110–120.

Aprile, M. C., Caputo, V., & Nayga, R. M., Jr. (2012). Consumers' valuation of food quality labels: The case of the European geographic indication and organic farming labels. *International Journal of Consumer Studies, 36*(2), 158–165.

Buda, R., & Zhang, Y. (2000). Consumer product evaluation: the interactive effect of message framing, presentation order, and source credibility. *Journal of Product Brand Management, 9*(4), 229–242.

Caporale, G., Policastro, S., Carlucci, A., & Monteleone, E. (2006). Consumer expectations for sensory properties in virgin olive oils. *Food Quality and Preference, 17*(1–2), 116–125. https://doi.org/10.1016/j.foodqual.2005.07.011.

Caporaso, N., Savarese, M., Paduano, A., Guidone, G., De Marco, E., & Sacchi, R. (2015). Nutritional quality assessment of extra virgin olive oil from the Italian retail market: Do natural antioxidants satisfy EFSA health claims? *Journal of Food Composition and Analysis, 40*, 154–162.

Caputo, V., Sacchi, G., & Lagoudakis, A. (2018). Traditional food products and consumer choices: a review. *Case studies in the traditional food sector* (pp. 47–87). Elsevier.

Caputo, V., Van Loo, E. J., Scarpa, R., Nayga, R. M., Jr., & Verbeke, W. (2018). Comparing serial, and choice task stated and inferred attribute non-attendance methods in food choice experiments. *Journal of Agricultural Economics, 69*(1), 35–57. https://doi.org/10.1111/jage.2018.69.issue-110.1111/1477-9552.12246.

Caracciolo, F., Amani, P., Cavallo, C., Cembalo, L., D'Amico, M., Del Giudice, T., ... Cicia, G. (2018). The environmental benefits of changing logistics structures for fresh vegetables. *International Journal of Sustainable Transportation, 12*(4), 233–240.

Caracciolo, F., Cavallo, C., Del Giudice, T., Panico, T., Vecchio, R., & Cicia, G. (2020). Consumers (Dis) Preference for Bitterness in Extra Virgin Olive Oil: A Field Experiment. *International Journal on Food System Dynamics, 11*(1), 14–25.

Carlsson, F., & Martinsson, P. (2003). Design techniques for stated preference methods in health economics. *Health Economics, 12*(4), 281–294.

Carson, R. T., Louviere, J. J., Anderson, D. A., Arabie, P., Bunch, D. S., Hensher, D. A., ... Swait, J. (1994). Experimental analysis of choice. *Marketing Letters, 5*(4), 351–367.

Castriota, S., & Delmastro, M. (2015). The economics of collective reputation: Evidence from the wine industry. *American Journal of Agricultural Economics, 97*(2), 469–489. https://doi.org/10.1093/ajae/aau107.

Cavallo, C., Caracciolo, F., Cicia, G., & Del Giudice, T. (2018). Extra-virgin olive oil: Are consumers provided with the sensory quality they want? A hedonic price model with sensory attributes. *Journal of the Science of Food and Agriculture, 98*(4), 1591–1598.

Cavallo, C., Cicia, G., Del Giudice, T., Sacchi, R., & Vecchio, R. (2019). Consumers' perceptions and preferences for bitterness in vegetable foods: The case of extra-virgin olive oil and brassicaceae—a narrative review. *Nutrients, 11*(5), 1164.

Cavallo, C., & Materia, V. C. (2018). Insects or not insects? Dilemmas or attraction for young generations: A case in Italy. *International Journal on Food System Dynamics, 9*(3), 226–239.

Cavallo, C., & Piqueras-Fiszman, B. (2017). Visual elements of packaging shaping healthiness evaluations of consumers: The case of olive oil. *Journal of Sensory Studies, 32*(1), e12246.

Cicia, G., Del Giudice, T., & Scarpa, R. (2002). Consumers' perception of quality in organic food: A random utility model under preference heterogeneity and choice correlation from rank-orderings. *British Food Journal, 104*(3/4/5), 200–213. https://doi.org/10.1108/00070700210425660.

Clodoveo, M. L. (2012). Malaxation: Influence on virgin olive oil quality. Past, present and future–An overview. *Trends in Food Science & Technology, 25*(1), 13–23.

Clodoveo, M. L., Dipalmo, T., Crupi, P., Durante, V., Pesce, V., Maiellaro, I., ... Corbo, F. (2016). Comparison between different flavored olive oil production techniques: Healthy value and process efficiency. *Plant Foods for Human Nutrition, 71*(1), 81–87.

Clodoveo, M. L., Moramarco, V., Paduano, A., Sacchi, R., Di Palmo, T., Crupi, P., ... Tamburrano, P. (2017). Engineering design and prototype development of a full scale ultrasound system for virgin olive oil by means of numerical and experimental analysis. *Ultrasonics Sonochemistry, 37*, 169–181.

Coldiretti (2020). Crescita record dei consumi di olio d'oliva nel mondo (+49%). Accessed March, 4. https://www.coldiretti.it/economia/crescita-record-dei-consumi-olio-doliva-nel-mondo-49.

Cook, R. D., & Nachtrheim, C. (1980). A comparison of algorithms for constructing exact D-optimal designs. *Technometrics, 22*(3), 315–324.

Cornara, D., Saponari, M., Zeilinger, A. R., de Stradis, A., Boscia, D., Loconsole, G., Bosco, D., Martelli, G. P., Almeida, R. P. P., & Porcelli, F. (2017). Spittlebugs as vectors of Xylella fastidiosa in olive orchards in Italy. *Journal of Pest Science, 90*(2), 521–530. https://doi.org/10.1007/s10340-016-0793-0.

Creel, M. D., & Loomis, J. B. (1991). Confidence intervals for welfare measures with application to a problem of truncated counts. *The Review of Economics and Statistics, 73*(2), 370–373.

Dauchet, L., Amouyel, P., & Dallongeville, J. (2009). Fruits, vegetables and coronary heart disease. *Nature Reviews Cardiology, 6*(9), 599.

Del Giudice, T., Cavallo, C., Caracciolo, F., & Cicia, G. (2015). What attributes of extra virgin olive oil are really important for consumers: A meta-analysis of consumers' stated preferences. *Agricultural and Food Economics, 3*(1), 1–15.

Del Giudice, T., Cavallo, C., & Vecchio, R. (2018). Credence attributes, consumers trust and sensory expectations in modern food market: Is there a need to redefine their role? *International Journal on Food System Dynamics, 9*(4), 307–313.

Delgado, C., & Guinard, J.-X. (2011). How do consumer hedonic ratings for extra virgin olive oil relate to quality ratings by experts and descriptive analysis ratings? *Food Quality and Preference, 22*(2), 213–225. https://doi.org/10.1016/j.foodqual.2010.10.004.

der Lans, V., Ivo, A., Van Ittersum, K., De Cicco, A., & Loseby, M. (2001). The role of the region of origin and EU certificates of origin in consumer evaluation of food products. *European Review of Agricultural Economics, 28*(4), 451–477.

Dijksterhuis, G. (2016). New product failure: Five potential sources discussed. *Trends in Food Science & Technology, 50*, 243–248.

EFSA (2011). Scientific Opinion on the substantiation of health claims related to polyphenols in olive and protection of LDL particles from oxidative damage (ID 1333, 1638, 1639, 1696, 2865), maintenance of normal blood HDL-cholesterol concentrations (ID 1639), maintenance of normal blood pressure (ID 3781), "anti-inflammatory properties" (ID 1882), "contributes to the upper respiratory tract health" (ID 3468), "can help to maintain a normal function of gastrointestinal tract" (3779), and "contributes to body defences against external agents" (ID 3467) pursuant to Article 13(1) of Regulation (EC) No 1924/2006. 9 (4):2033.

Garrido-Delgado, R., del Mar Dobao-Prieto, M., Arce, L., & Valcárcel, M. (2015). Determination of volatile compounds by GC–IMS to assign the quality of virgin olive oil. *Food Chemistry,* (187), 572–579.

Giannoccaro, G., Carlucci, D., Sardaro, R., Roselli, L., & De Gennaro, B. C. (2019). Assessing consumer preferences for organic vs eco-labelled olive oils. *Organic Agriculture, 9*(4), 483–494. https://doi.org/10.1007/s13165-019-00245-7.

Greene, W. H., & Hensher, D. A. (2003). A latent class model for discrete choice analysis: Contrasts with mixed logit. *Transportation Research Part B: Methodological, 37*(8), 681–698.

Guerrero, L., Guàrdia, M. D., Xicola, J., Verbeke, W., Vanhonacker, F., Zakowska-Biemans, S., ... Hersleth, M. (2009). Consumer-driven definition of traditional food products and innovation in traditional foods. A qualitative cross-cultural study. *Appetite, 52*(2), 345–354. https://doi.org/10.1016/j.appet.2008.11.008.

Haab, T. C., & McConnell, K. E. (2002). *Valuing environmental and natural resources: The econometrics of non-market valuation.* Edward Elgar Publishing.

Hersleth, M., Lengard, V., Verbeke, W., Guerrero, L., & Næs, T. (2011). Consumers' acceptance of innovations in dry-cured ham: Impact of reduced salt content, prolonged

aging time and new origin. *Food Quality and Preference, 22*(1), 31–41.
The refence should reworded as follow: ISTAT (2020). Resident population, http://demo.istat.it/index_e.html, Accessed February 13, 2020.
Kalogianni, E. P., Georgiou, D., & Hasanov, J. H. (2019). Olive oil processing: Current knowledge, literature gaps, and future perspectives. *Journal of the American Oil Chemists' Society, 96*(5), 481–507. https://doi.org/10.1002/aocs.2019.96.issue-510.1002/aocs.12207.
Kamrath, C., Bidkar, S., & Bröring, S. (2019). Is food involvement in purchasing decisions always low? A consumer study from Germany. *PharmaNutrition, 9*, 100157. https://doi.org/10.1016/j.phanu.2019.100157.
Kanninen, B. (2002). Optimal design for multinomial choice experiments. *Journal of Marketing Research, 39*(2), 214–227.
Lazarsfeld, P. F., & Henry, N. W. (1968). *Latent structure analysis.* Houghton Mifflin Co.
Levi, A., Chan, K. K., & Pence, D. (2006). Real men do not read labels: The effects of masculinity and involvement on college students' food decisions. *Journal of American College Health, 55*(2), 91–98.
Liang, R.-D. (2016). Predicting intentions to purchase organic food: The moderating effects of organic food prices. *British Food Journal, 118*(1), 183–199. https://doi.org/10.1108/BFJ-06-2015-0215.
Lolis, A., Badeka, A. V., & Kontominas, M. G. (2019). Effect of bag-in-box packaging material on quality characteristics of extra virgin olive oil stored under household and abuse temperature conditions. *Food Packaging and Shelf Life,* (21), 100368.
Lutz, M., Fuentes, E., Ávila, F., Alarcón, M., & Palomo, I. (2019). Roles of phenolic compounds in the reduction of risk factors of cardiovascular diseases. *Molecules, 24*(2), 366.
Menapace, L., Colson, G., Grebitus, C., & Facendola, M. (2011). Consumers' preferences for geographical origin labels: Evidence from the Canadian olive oil market. *European Review of Agricultural Economics, 38*(2), 193–212.
Park, T., Loomis, J. B., & Creel, M. (1991). Confidence intervals for evaluating benefits estimates from dichotomous choice contingent valuation studies. *Land Economics, 67*(1), 64. https://doi.org/10.2307/3146486.
Petty, R. E., & Cacioppo, J. T. (1986). The Elaboration likelihood model of persuasion. *Advances in Experimental Social Psychology, 19*, 123–205. https://doi.org/10.1016/S0065-2601(08)60214-2.
Peyrol, J., Riva, C., & Amiot, M. J. (2017). Hydroxytyrosol in the prevention of the metabolic syndrome and related disorders. *Nutrients, 9*(3), 306.
Piqueras-Fiszman, B., Ares, G., & Varela, P. (2011). Semiotics and perception: Do labels convey the same messages to older and younger consumers? *Journal of Sensory Studies, 26*(3), 197–208.
Piqueras-Fiszman, B., & Spence, C. (2015). Sensory expectations based on product-extrinsic food cues: An interdisciplinary review of the empirical evidence and theoretical accounts. *Food Quality and Preference, 40*, 165–179.
Pomarici, E., & Vecchio, R. (2013). The Italian olive oil industry in the global competitive scenarioThe Italian olive oil industry in the global competitive scenario. *Agriculture Economics – Czech, 59*(No. 8), 361–372. https://doi.org/10.17221/AGRICECON10.17221/AGRICECON-810.17221/8/2013-AGRICECON.
Raghunathan, R., Naylor, R. W., & Hoyer, W. D. (2006). The unhealthy = tasty intuition and its effects on taste inferences, enjoyment, and choice of food products. *Journal of Marketing, 70*(4), 170–184.
Rickard, B. J., McCluskey, J. J., & Patterson, R. W. (2015). Reputation tapping. *European Review of Agricultural Economics, 42*(4), 675–701. https://doi.org/10.1093/erae/jbv003.
Roininen, K., Hely Tuorila, E. H., Zandstra, C. D., Graaf, K. V., Stubenitsky, K., & Mela, D. J. (2001). Differences in health and taste attitudes and reported behaviour among Finnish, Dutch and British consumers: A cross-national validation of the Health and Taste Attitude Scales (HTAS). *Appetite, 37*(1), 33–45.
Roininen, K., Lähteenmäki, L., & Tuorila, H. (1999). Quantification of consumer attitudes to health and hedonic characteristics of foods. *Appetite, 33*(1), 71–88.
Roselli, L., Cicia, G., Cavallo, C., Del Giudice, T., Carlucci, D., Clodoveo, M. L., ... De Gennaro, B. C. (2018). Consumers' willingness to buy innovative traditional food products: The case of extra-virgin olive oil extracted by ultrasound. *Food Research International, 108*, 482–490. https://doi.org/10.1016/j.foodres.2018.03.070.
Roselli, L., Clodoveo, M. L., Corbo, F., & De Gennaro, B. (2017). Are health claims a useful tool to segment the category of extra-virgin olive oil? Threats and opportunities for the Italian olive oil supply chain. *Trends in Food Science & Technology, 68*, 176–181.
Roselli, L., Giannoccaro, G., Carlucci, D., & De Gennaro, B. (2018). EU quality labels in the Italian olive oil market: How much overlap is there between geographical indication and organic production? *Journal of Food Products Marketing, 24*(6), 784–801. https://doi.org/10.1080/10454446.2017.1413473.
Rosenblatt, D. H., Dixon, H., Wakefield, M., & Bode, S. (2019). Evaluating the influence of message framing and graphic imagery on perceptions of food product health warnings. *Food Quality and Preference, 77*, 32–42.
Sanmartin, C., Venturi, F., Sgherri, C., Nari, A., Macaluso, M., Flamini, G., ... Zinnai, A. (2018). The effects of packaging and storage temperature on the shelf-life of extra virgin olive oil. *Heliyon, 4*(11), e00888. https://doi.org/10.1016/j.heliyon.2018.e00888.
Schnettler, B., Grunert, K. G., Miranda-Zapata, E., Orellana, L., Sepúlveda, J., Lobos, G., ... Höger, Y. (2017). Testing the Abbreviated Food Technology Neophobia Scale and its relation to satisfaction with food-related life in university students. *Food Research International, 96*, 198–205.
Shimp, T. A., & Sharma, S. (1987). Consumer ethnocentrism: Construction and validation of the CETSCALE. *Journal of Marketing Research, 24*(3), 280–289. https://doi.org/10.1177/002224378702400304.
Soliha, E., & Dharmmesta, B. S. (2012). The effect of source credibility and message framing on consumer risk perceptions with consumer product knowledge as a moderating variable: A literature review. *Educational Research, 3*(2), 108–117.
Swait, J. (1994). A structural equation model of latent segmentation and product choice for cross-sectional revealed preference choice data. *Journal of Retailing and Consumer Services, 1*(2), 77–89.
Tamborrino, A., Romaniello, R., Zagaria, R., & Leone, A. (2014). Microwave-assisted treatment for continuous olive paste conditioning: Impact on olive oil quality and yield. *Biosystems Engineering, 127*, 92–102. https://doi.org/10.1016/j.biosystemseng.2014.08.015.
Tuorila, H., Recchia, A., Monteleone, E., & Langstaff, S. (2014). Sensory perception and other factors affecting consumer choice of olive oil. In E. Monteleone, & S. Langstaff (Eds.). *Olive oil sensory science* (pp. 55–80). New York: Wiley.
van Kleef, E., van Trijp, H. C. M., & Luning, P. (2005). Consumer research in the early stages of new product development: A critical review of methods and techniques. *Food Quality and Preference, 16*(3), 181–201. https://doi.org/10.1016/j.foodqual.2004.05.012.
Vecchio, R., Cavallo, C., Cicia, G., & Del Giudice, T. (2019). Are (All) consumers averse to bitter taste? *Nutrients, 11*(2), 323.
Vecchio, R., Lombardi, A., Cembalo, L., Caracciolo, F., & Cicia, G. (2016). Consumers' willingness to pay and drivers of motivation to consume omega-3 enriched mozzarella cheese. *British Food Journal, 118*(10), 2404–2419.
Vitaglione, P., Savarese, M., Paduano, A., Scalfi, L., Fogliano, V., & Sacchi, R. (2013). Healthy virgin olive oil: A matter of bitterness. *Critical Reviews in Food Science and Nutrition, 55*(13), 1808–1818. https://doi.org/10.1080/10408398.2012.708685.
Wang, X., Ouyang, Y., Liu, J., Zhu, M., Zhao, G., Bao, W., & Hu, F. B. (2014). Fruit and vegetable consumption and mortality from all causes, cardiovascular disease, and cancer: Systematic review and dose-response meta-analysis of prospective cohort studies. *BMJ, 349*, g4490.
Zwerina, K., Huber, J., & Kuhfeld, W. F. (1996). *A general method for constructing efficient choice designs.* Durham, NC: Fuqua School of Business, Duke University.