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Functional food characteristics in organic food products—the perspectives of Italian consumers on organic eggs enriched with omega-3 polyunsaturated fatty acids

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Abstract Innovation in organic food products plays an important role in further developing its competitiveness in the market and meeting the emerging consumers' needs. However, few studies have analysed consumers' points of view of innovations on organic food, limited to the change in the natural food composition or the enrichment of the nutritional contents of the product. This study, using experimental auctions, aims to overcome this gap by enriching the knowledge on organic consumers' preference for organic food with functional characteristics. Specifically, this study analyses the willingness to pay (WTP) of 110 Italian consumers for organic eggs enriched with omega-3 polyunsaturated fatty acids (PUFA), compared to standard organic eggs, and the factors underlying this choice. Findings of the study reveal that over 73% of the sample is willing to pay an average price premium of €0.16 for functional organic eggs. This choice is mainly due to both selfish factors and a high attitude towards the environment. From a theoretical perspective, these findings enrich the literature on consumers of organic food with functional characteristics. At the same time, from a managerial point of view these results could be of interest for those breeding of laying hens that want to innovate and be competitive on the market segment of functional food. Finally, this study also contributes to the political discussions regarding the organic agriculture of the future which may also include health claims.

Keywords Innovations · Consumers' preference · Willingness to pay · Food choice · Experimental auctions · Linseeds

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Introduction

In the economic theory, innovation in the food sector represents a key tool for a company's growth, allowing access to new markets and competitiveness in the long term (Mandolesi et al. 2015). Among the

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innovations developed on the food market, there are those relating to functional foods that contain specific health claims on the label. Recent trends in food demand show that consumers are increasingly aware of the link between diet and health, recognising that a diet that includes innovative products containing healthy claims can reduce their risk of disease (Vecchio et al. 2016; Annunziata and Vecchio 2013). These innovations are also of great importance for the organic food sector to further develop its competitiveness. Given consumers' growing interest and demand for healthy and nutritious products, the organic food sector is presented with the opportunity to explore a new and ever-expanding market segment. However, it is unclear whether organic consumers might reject these innovations. Organic consumers perceive health as a more holistic concept (Aschemann-Witzel et al. 2013). Previous research shows that consumers that express a preference for organic products perceived them as a more natural and healthier alternative than the conventional counterparts (Hashem et al. 2018; Lombardi et al. 2015; Migliore et al. 2015). However, in functional food, the concept of health is associated with a change in the natural food composition or an enrichment of the nutritional contents of the product, which might be perceived by organic consumers as less natural product (Aschemann-Witzel et al. 2013). Therefore, the success of this innovation in the organic food sector essentially depends on the acceptance of new products or new processes by consumers (Grunert et al. 1997). Numerous studies have analysed innovations in the food sector from a consumer's perspective, including convenience foods, irradiated processed products and enriched food (see, for example, Asioli et al. 2019; Galati et al. 2019a, 2019b; Caracciolo et al. 2019). However, while in the conventional food sector, many of these innovations have been accepted by consumers, as they respond to consumers' desires and needs, few studies have analysed consumers' points of view of such innovations in the organic food sector (Hüppe and Zander 2021; Asioli et al. 2019; Aschemann-Witzel et al. 2013). In particular, only Aschemann-Witzel et al. (2013) analysed organic food consumers' preferences for organic food with health claims, finding a positive preference for these claims. However, this study is limited to a specific geographical context (Germany), limiting its generalisation to other countries. Therefore, further research is needed to have a clearer picture of organic food consumers in diverse cultural contexts. This study aims to contribute to the literature of this topic by analysing Italian consumers' preference for innovations that further improve the product from a health and nutritional perspective. More specifically, this study objective is to analyse Italian consumers' willingness to pay for organic food products with natural enrichment and their factors behind this choice. An experimental auction is developed by comparing consumers' preference for standard organic eggs and organic eggs naturally enriched with functional molecules, such as omega-3 (PUFA), by modifying the diet of the hens. The main omega-3 long-chain (PUFA) contained in the yolk are represented by eicosapentaenoic (EPA, C20:5 n-3) and docosahexaenoic acids (DHA, C22:6 n-3) which are formed through reactions of elongation and desaturation of the α-linolenic acid (ALA, C18-3 n-3) present in the hen's diet (Fraeye et al 2012). Either ALA or long-chain EPA and DHA are known to effectively prevent the risks of cardiovascular diseases. According to the Regulation (EC) 432/2012 establishing a list of permitted health claims for foods, ALA contributes to the maintenance of normal blood cholesterol levels, DHA contributes to the maintenance of normal brain function, and the association EPA + DHA contributes to the normal function of the heart. In order to achieve these beneficial effects, the daily intake equal to 2 g of ALA and 250 mg of EPA + DHA are suggested to consumers. In addition, the Regulation (EC) 1924/2006 on nutrition and health claims for foods, amended by Regulation (EU) 116/2010, establishes that foods can be claimed 'omega-3 enriched' if contain at least 0.6 g of ALA per 100 g or 100 kcal, or at least 80 mg of EPA + DHA per 100 g or 100 kcal. This legislation properly supports the possibility that a widely used food, such as the egg, could be enriched with omega-3 (PUFA) and offered to consumer as a 'functional food'. This could be of great interest to the organic food sector as it can expand its market offer by reaching a segment of consumers potentially interested in organic food products with functional characteristics.

The study is organised as follows: after this introduction, the trend towards healthy foods is discussed, followed by a methodological section in which the enrichment in omega-3 (PUFA) is described in organic eggs, and an experimental auction is designed. Then, results and discussions are

developed followed by some concluding remarks and recommendations.

The trend towards healthy foods

Current trends in food demand show that consumer' preferences have changed in favour of foods that contain health-related messages (Gok and Ulu 2019; Hoek et al. 2017; Goetzke et al. 2014). Consumers recognise that food affects their health state and want to use it as a tool to achieve or maintain physical well-being (Aschemann-Witzel 2015). The increase in the consumption of food products with health-related messages seems to be also linked to consumers concerns regarding the growing incidence of non-communicable diseases related to unhealthy lifestyles (including diabetes, cancer and stroke), partially preventable through improved food consumption behaviours (WHO 2011).

This has stimulated the growing presence on the market of innovative products with additional health properties, commonly defined as a functional food (Caracciolo et al. 2019). More generally, they are considered foods that may be eaten as part of the normal diet and contain biologically active components that can improve health or reduce the risk of disease (Diplock et al. 1999; Poulsen 1999). In the market, functional food products are enriched with components such as vitamins, probiotics or omega-3 (PUFA), and contain messages claiming health benefits (Caracciolo et al. 2019). Such food products may contain a variable amount of information. However, the typical information on which health claims can be based is related to the components/ingredients of the food that generate physiological and psychological benefits (Lähteenmäki 2013; Diplock et al. 1999). According to the International Food Information Council (2011), most American citizens are convinced that functional foods bring particular health benefits and play an important role in maintaining and improving health in general. About 30% of Americans declared to routinely purchase products that have health claims on the label (Sloan 2012).

According to the literature on the topic, women are more likely to purchase foods with health claims than men (De Jong, et al. 2003). Even the benefits deriving from the consumption of these products are perceived differently depending on the gender: women prefer information about bone health, while men prefer information related to lower blood cholesterol levels (Ares and Gàmbaro 2007; Dean et al. 2007; Urala and Lähteenmäki 2003).

Age plays an important role in consumer's food choice. Studies have shown that health concerns increase with increasing age, as does attention to foods with health claims (Ares et al. 2009; Herath, et al. 2008; Siegrist et al. 2008). However, consumer responses to these claims vary greatly depending on consumers' geographical area, the demographic, economic and social characteristics (Bech-Larsen and Grunert 2003).

Moreover, familiarity with the product plays an important role in how consumers respond to these messages (Aschemann-Witzel, et al. 2013; Lähteenmäki 2013; Bech-Larsen and Grunert 2003). In general, health claims are preferred in those products that already possess a healthy image, such as in the case of yoghurt enriched with omega 3 (PUFA), or for fruit juices enriched with vitamins (Annunziata and Vecchio 2013; Van Kleef et al. 2005). Lähteenmäki (2013) emphasised that the preference of functional food products also depends on the production method and how the products were enriched with active components. Functional food products are often perceived with suspicion as they are associated with complicated processes based on scientific and technological innovations (Kahl et al. 2012). In line with this, a recent survey conducted by Euromonitor International (2018) highlighted that a growing number of European consumers are looking for foods naturally rich in proteins, minerals or vitamins, without adding them artificially. This foreshadows important sales opportunities, especially for those products rich in healthy components obtained without resorting to scientific-technological innovations, which, in common perception, are often associated with a loss of naturalness of food (Aschemann-Witzel, et al. 2013; Lähteenmäki 2013). Consumers of organic products perceive the loss of naturalness in functional foods with greater suspicion, as they are more attentive to the naturalness of food (Hashem et al. 2018). However, when food is enriched naturally, without compromising the requirements of the principles that characterise organic farming, it is still not clear how consumers react to the addition of active components. To understand consumers' preference of organic products naturally enriched with additional

components, we analyse the consumers' WTP by comparing organic eggs with eggs naturally enriched with omega 3 (PUFA). Among the various foods on the market, eggs were chosen because consumers perceive them as high-quality, natural and healthy products (Van Loo et al. 2021). This could eliminate preconceptions that consumers might have towards less familiar products (Lähteenmäki 2013). Furthermore, the egg, in addition to its natural supply of bioactive molecules, lends itself very well to being naturally enriched with functional molecules, such as omega-3 (PUFA), by modifying the hens' diet without compromising the standards of organic farming. This could create new market opportunities for organic products, in which in addition to the known beneficial effects on the environment and animal welfare, products could include health claims according to Reg. (EC) 1924/2006, positioning them also in the functional food market segment.

Methodology

Experimental auction on organic consumers

The methodological approach used involves the development of experimental auctions. During these economic experiments, real products are purchased by the participants. This means that consumers express their real WTP as they are involved in a realistic market (Lusk et al. 2004).

The experiment was conducted between September and October 2019, at the University of Palermo (Italy). Eleven 30-min experimental sessions were carried out, with the participation of ten consumers at a time who had previously declared to consume both organic food and eggs. Participants were recruited via the snowball sampling technique. The sample size chosen stems from careful comparison with existing literature (e.g. Olivola and Wang 2016; Lee et al. 2011; Neugebauer and Perote 2008). Briz et al. (2017) state that because studies with experimental auctions aim to test the effect of a stimulus on consumer preferences, large sample sizes are not strictly necessary (Briz et al. 2017). It follows that also considering budget constraints, it is safe to say that our sample size is typical for studies of this type.

The mechanism used was the 'random n-th price auction' (Shogren et al. 2001), which combines two classic experimental auction mechanisms: the 'BDM mechanism' and the 'Vickrey auction' (Grether and Plott 1979). This auction model was chosen because the randomness of drawing the winning number favours the continuous involvement of all participants and reduces the possibility of creating a stable market price that could influence the various bids. In this way, every consumer will make a sincere and real bid because they cannot use a random market price as an indicator. In addition, mechanism incentives also low-involved bidders as no anticipation of the number of winners can be made (Shogren et al. 2001).

After sitting in the laboratory, each participant was given a monetary endowed of 5 euros for participation in the experiment. Subsequently, participants were introduced to the auction mechanism and presented the characteristics of the standard organic eggs and those enriched with omega-3 (PUFA). Specifically, the following information was presented: (1) *The package of eggs that I am showing you is a certified organic product, the production method requires that natural substances and processes are used to protect the environment, human health and animal welfare*; (2) *The egg package that I am showing you is a certified organic product, however unlike the organic eggs that are usually found on the market, these are rich in omega-3 s, obtained by integrating flax seeds into the hens' diet. Omega-3 s contribute to the maintenance of normal blood cholesterol levels*.

All products were presented anonymously, in packs of four eggs, to avoid brand and label effects (Rousu et al. 2017). Participants wrote their bids on anonymous cards and, finally, a pack of eggs and a price (market price) was raffled off to determine the winners, who paid for the selected product.

At the end of the auction, all participants also completed a questionnaire, which included some socio-demographic information (e.g. age, income, education and gender), food consumption habits and attitudes towards the environment and health. Furthermore, to understand if consumers' health problems affect participants' WTP for functional food characteristics on organic eggs, we asked if they are dealing with diseases, such as celiac disease, obesity, hypertension, and cholesterol and diabetes.

Participants' organic food consumption habits were also inquired, including consumption intensity of organic products. Respondents were also asked to report the importance of the health attribute in

organic food products by asking them if it was the most important attribute among the other organic food attributes (such as animal welfare and environmental protection).

With appropriate psycho-attitudinal scales, consumers' attitudes can explain their food choices and purchases (Tuorila et al. 1997). With this in mind, the present study used two specific scales: a modified version of the New Ecological Paradigm (NEP) scale was used to assess people's environmental activism and actual environmental behaviour (Dunlap et al. 2000), while the Perceived Reward for the Use of Functional Foods (FFREW) scale was also included as it contains statements expressing personal satisfaction with the use of functional foods as a means of improving health and taking care of oneself (Urala and Lähteenmäki 2004). The two validated scales were collected using seven-point Likert scales, ranging from 1 (totally disagree) to 7 (totally agree), to capture and quantify the variables.

The data obtained from the auctions were processed using Stata 15.0 (Italy). The first descriptive analyses of the data were conducted to outline the characteristics of the reference sample. Subsequently, the WTPs for both egg products were decoded. Then, after a description of the two psycho-attitudinal scales, the Breusch-Pagan test and Tobit regression were performed to verify the independence of the WTPs and to measure how the individual variables included in the analyses could influence the supplement.

Using the Tobit regression model, the expected value of the dependent variable y is:

$E\_y = X\beta F(z) + \sigma f(z)$.

where X is a vector of independent variables, β is a vector of unknown coefficients, z is the unit normal density, $F(z)$ is the cumulative normal distribution function and $f(z)$ is the normal probability density function.

Tobit regression is suitable for studying dependent variables with some observations that have to be censored. This study focused on the factors influencing the willingness to pay a price premium for enriched organic eggs with omega-3 compared to standard organic eggs. Therefore, the observations to censor will be those of individuals who expressed a price premium equal to zero (since it matches that of standard organic eggs). In the presence of a censored dependent variable, the usual ordinary least squares regression does not provide consistent parameter estimates, as it fails to account for the qualitative difference between limit (zero) and non-limit (continuous) observations (Greene 2003 p. 762). Conversely, the estimates obtained from the Tobit regression are consistent and allow us to analyse the entire sample (Cameron and Trivedi 2015).

Stimuli: enhancing eggs with omega-3 (PUFA)

To provide basic information on the enriched eggs used in the experimental auctions, the procedures used for the enrichment of eggs with omega-3 are summarised here. Specifically, the approaches to enrich eggs with omega-3 long-chain (PUFA), notably EPA and DHA, consist mainly of the integration of hens' diet with feeding sources high in α-linolenic acid (ALA, C18-3 n-3), such as linseeds, or directly rich in EPA and DHA, as fish oil or microalgae (Fraeye et al 2012).

Although ALA from plant-based sources is elongated and desaturated to EPA and DHA, this conversion is not particularly efficient in both hens and humans (Sirri and Meluzzi 2011).

Nevertheless, the whole or ground linseeds are used mainly for eggs fortification since they do not compromise the sensory profile of yolk, as occurs with fish oil. At present, they result less expensive than microalgal products (House et al 2015). Moreover, linseeds of organic origin can be easily found on the market.

Accordingly, the enrichment approach proposed in this study was based on integration of hens' feed with 10% of ground linseeds, in line to Fraeye et al. (2012) who report in their review how this inclusion level is enough to increase the content of ALA, EPA and DHA in the eggs. In this regard, Scheideler and Froning (1996) observed an increase of about 0.4 g/100 g of egg for ALA and 190 mg/100 g egg for EPA + DHA, due to the inclusion of 10% linseeds in hens' diet. On this basis, the linseeds at 10% ensure the achievement of an amount of EPA + DHA higher than the minimal level, equal to 80 mg/100 g, that eggs have to contain to be claimed 'omega-3 enriched' and marketed as 'functional food', according to the European legislation (Regulation EC 1924/2006 and Regulation EU 116/2010).

Results

Sample characteristics

The sample consisted of 110 observations. Table 1 summarises participants' characteristics, taking into account socio-demographic variables (gender, age and education), purchasing habits (responsible for family food purchases and organic consumption intensity), and information about the state of health and the importance attributed to it by the consumer (presence of diseases and importance of health attribute).

The willingness to pay a price premium

The average WTP for standard organic eggs was €1.64, while the average WTP for organic eggs enriched with omega-3 was €1.80. Thus, the average price premium was + €0.16 (from €0 to €1.60). Specifically, 73.65% of the sample (81/110 consumers) were willing to pay a price premium for omega-3-enriched organic eggs, compared to standard organic eggs, while 29 consumers showed the same willingness to pay for both types of eggs. *t*-Tests confirmed that the two mean WTP were significantly different from each other.

Psycho-attitudinal scales

Tables 2 and 3 show the descriptive statistics of the psycho-attitudinal variables analysed in this study.

The mean value of the psychological scales proposed for each participant was obtained. Then, Cronbach's alpha was also calculated in order to verify the validity of the two proposed scales, as it measures the internal consistency of scores obtained in the tests. Since only values greater than or equal to 0.70 can be accepted (Taber 2018), it is possible to confirm a good internal consistency for the proposed scales (Table 4).

Due to the low presence of participants in the experimental auctions with specific diseases, the variable 'Presence of diseases' was made dichotomous (dummy), i.e. 1 = presence of diseases; 0 = no disease. Similarly, to avoid loss of degrees of freedom,

Table 1 Participants' characteristics

Variable	Category	Percentages
Gender	Male—1	55%
	Female—0	45%
Age	20–34 years	43.64%
	35–48 years	22.75%
	49–62 years	21.84%
	63–76 years	11.77%
Education	Primary school	0.00%
	Lower secondary school	3.64%
	Upper secondary school	37.27%
	University degree	45.46%
	Master degree or PhD	13.64%
Responsible for family food purchases	Yes—1	84%
	Not—0	16%
Presence of diseases	Celiac disease	5%
	Hypertension	1%
	Cholesterol	4%
	More than one	1%
	No disease	89%
Organic consumption intensity	Intensive—1	56.34%
	Occasional—0	43.66%
Importance of health attribute	Yes—1	38.18%
	Other—0	61.82%

Table 2 Descriptive statistics of NEP scale

	New Ecological Paradigm (NEP)	Mean	Std. Dev	Min	Max
NEP_1	We are approaching the limit of the number of people the earth can support	3.70	1.0	1	7
NEP_2	Humans have the right to modify the natural environment to suit their needs	2.02	1.0	1	7
NEP_3	When humans interfere with nature it often produces disastrous consequences	4.34	0.9	1	7
NEP_4	Human ingenuity will ensure that we do NOT make the earth unlivable	2.70	1.1	1	7
NEP_5	Humans are severely abusing the environment	4.70	0.7	1	7
NEP_6	The earth has plenty of natural resources if we just learn how to develop them	4.47	0.8	1	7
NEP_7	Plants and animals have as much right as humans to exist	4.50	0.8	1	7
NEP_8	The balance of nature is strong enough to cope with the impacts of modern industrial nations	2.11	1.0	1	7
NEP_9	Despite our special abilities humans are still subject to the laws of nature	4.35	0.8	1	7
NEP_10	The so-called 'ecological crisis' facing humankind has been greatly exaggerated	2.25	1.1	1	7
NEP_11	The earth is like a spaceship with very limited room and resources	3.99	1.0	1	7
NEP_12	Humans were meant to rule over the rest of nature	1.97	1.0	1	7
NEP_13	The balance of nature is very delicate and easily upset	4.30	0.8	1	7
NEP_14	Humans will eventually learn enough about how nature works to be able to control it	2.61	1.0	1	7
NEP_15	If things continue on their present course, we will soon experience a major ecological catastrophe	4.29	0.7	1	7
NEP_mean_score		3.17	0.25	1	7

Table 3 Descriptive statistics of FFREW scale

	Reward From Using Functional Food (FFREW)	Mean	Std. Dev	Min	Max
FFREW_1	I get pleasure from eating functional foods	6.00	1.2	1	7
FFREW_2	The idea that I can take care of my health by eating functional foods gives me pleasure	6.10	1.1	1	7
FFREW_3	Functional foods make me feel more energetic	4.91	1.4	1	7
FFREW_4	Functional foods help to improve my mood	4.50	1.5	1	7
FFREW_5	My performance improves when I eat functional foods	5.07	1.5	1	7
FFREW_6	I actively seek out information about functional foods	5.14	1.6	1	7
FFREW_7	I willingly try even unfamiliar products if they are functional	5.02	1.5	1	7
FFREW_mean_score		5.28	1.04	1	7

and not being interested in studying the influence of individual schooling categories, the variable 'Education' was also made a dummy (1 = graduate; 0 = not graduated); also the literature shows that on average organic consumers are highly educated (e.g. Kesse-Guyot et al. 2013). Finally, from the correlation analysis, it is possible to notice no correlation between all the variables (Table 5).

Table 4 Cronbach's alpha for psycho-attitudinal scales

	Cronbach's alpha
NEP scale	0.73
FFREW scale	0.86

Determinants of WTP for the egg types

To understand which consumer characteristics and attitudes influence their price premium for organic eggs enriched with omega-3, a Tobit regression model was implemented (Table 6).

In Table 7, marginal effects are shown. They are the variation of the dependent variable *y* when one explanatory variable *x* varies of one unit, considering all the other *x* variables to the average. If the independent variable *x* is a dummy, the marginal effect indicates the variation in the dependent variable *y*, in the passage of the *x* variable from 0 to 1.

The WTP for organic eggs enriched with omega-3 (PUFA) is influenced by multiple factors, such as presence of diseases in the consumer, perception that consuming organic food is good for health, and perceived reward of using functional foods (FFREW scale). Specifically, all the variables positively influence the consumers' WTP, and thus, as they increase, the likelihood that the consumer pays a price premium for organic eggs enriched with omega-3 also increases.

Discussions

Innovations in the organic market have also been studied in relation to processing technologies applied to organic convenience foods and to microwave drying technologies, returning mixed results (Hüppe and Zander 2021; Asioli et al. 2019). While some innovations are well accepted by consumers, as long as they do not alter the nutritional composition of

Table 5 Correlation analysis

	Age	Gender	Org. cons. intensity	Education	Presence of diseases	Imp. of health attribute	FFREW mean score	NEP mean score
Age	1.000							
Gender	−0.041	1.000						
Org. cons. intensity	0.177	0.152	1.000					
Education	−0.115	−0.001	−0.087	1.000				
Pres. of diseases	0.007	−0.038	−0.085	−0.647	1000			
Imp. of health attr	−0.002	0.064	0.187	−0.145	−0.215	1000		
FFREW mean score	−0.081	−0.109	0.192	−0.135	−0.090	0.145	1000	
NEP mean score	−0.050	0.281	0.079	0.217	0.175	0.026	0.195	1000

Table 6 Tobit regression model

Dependent variable: price premium for omega-3-enriched organic eggs; limits: lower = 0 and upper = + inf; number Obs = 110 (81 uncensored; Prob > *F* = 0.0027; pseudo $R.^2 = 0.2160$)

Variable	Coef	Std. Err	*t*	*p* > |*t*|
Age	−0.0009	0.0019	−0.49	0.63
Gender	0.0682	0.0798	0.86	0.39
Organic consumption intensity	−0.0302	0.0583	−0.52	0.60
Education	−0.0778	0.0770	−1.01	0.31
Presence of diseases	0.3038	0.1244	2.44	0.02
Importance of heath attribute in organic	0.1794	0.0904	1.98	0.05
FFREW mean score	0.0868	0.0377	2.30	0.02
NEP mean score	0.2329	0.1558	1.49	0.14
_cons	−1.011	0.4661	−2.17	0.03

Table 7 Marginal effect

Variable	dy/dx	Std. Err	*Z*	*p* > |Z|
Age	−0.0006	0.0013	−0.48	0.63
Gender	0.0444	0.0501	0.87	0.38
Organic consumption freq	−0.0197	0.0377	−0.52	0.60
Education	−0.0514	0.0497	−1.03	0.30
Presence of diseases	0.2275	0.1007	2.26	0.02
Importance of heath attribute in organic	0.1206	0.0629	1.92	0.05
FFREW mean score	0.0568	0.0226	2.51	0.01
NEP mean score	0.1524	0.1018	1.50	0.13

dy/dx is for discrete change of dummy variable from 0 to 1

the products (Hüppe and Zander 2021), Asioli et al. (2019) found that consumers who showed a positive attitude towards organic, natural and ecological products were more sceptical about innovations using microwave drying technologies. In this study, we analysed how consumers of organic products react to product innovations that involve enrichment of the nutritional composition of foods without compromising the standards and principles underlying organic farming. This research curiosity is also fuelled by the organic consumer literature, which has highlighted that egoistic motives attributable to health concerns are more important for the consumption of organic food than altruistic motives such as environment and animal welfare (Goetzke et al. 2014; Magnusson et al. 2003). In line with this, our results highlighted that more than 73% of the 110 consumers participating in the experimental auctions would purchase eggs enriched with omega-3 (PUFA) to maintain or improve their health state. This is in contrast to Kahl et al. (2012) who found that the concept of functional food cannot be applied to organic food production.

Furthermore, in order to create a full picture of consumers' preference of organic functional foods, our study took into account a set of factors that the literature on consumers of functional and organic foods has highlighted as possible determinants of this choice. Relatively to the variable buying intensity, no differences have been found among participants in the experimental auctions. In other words, the WTP for organic eggs with omega-3 (PUFA) is not affected by the organic food consumption intensity. In fact, both intensive and occasional organic consumers are willing to pay a price premium for functional organic eggs. This is consistent with what was evidenced by Aschemann-Witzel et al. (2013). In their study, they found no indication that 'organic food consumers –not even intensive organic consumers – are less likely to choose organic functional food' (p. 73), although occasional organic food consumers were more receptive to functional organic food.

In our study, we analysed the factors that may influence the Italian consumers' WTP for organic eggs enriched with omega-3 (PUFA). An important driver of this choice is the perceived reward from using functional food to improve health and take care of oneself. This is in line with Urala and Lähteenmäki (2004) , highlighting that consumers are increasingly interested in consuming functional food products as they considered themselves as being responsible for their health and well-being. The presence of diseases among consumers participating in experimental auctions is also an important factor influencing the decision to pay a price premium for eggs enriched with omega-3 (PUFA). This is consistent with Childs's study (2012) highlighting that functional foods are used by consumers also in disease therapy, and particularly in the USA, in weight loss. Similarly, Aschemann-Witzel and Hamm (2010) found that organic consumers involved with health problems showed a more positive attitude towards functional foods and are less sceptical towards their consumption.

The WTP for organic eggs with omega-3 (PUFA) is also affected by the health attribute, intrinsic in organic food products, by highlighting that this attribute is recognised by consumers as an important driver for the choice of organic functional food. This is also quite in agreement with the functional food literature which points out that consumers are more willing to prefer enrichments with functional molecules in foods that already have a healthy image, as in the case of organic products (Vecchio et al. 2016; Lähteenmäki 2013; Annunziata and Vecchio 2013; Van Kleef et al. 2005).

Studies on organic food consumers highlighted that environmental awareness is strictly linked to the consumption of organic food (Chen 2020; Atalay et al. 2017), as they are made from sustainable production techniques (Pacho 2020; Aschemann-Witzel 2015; Goetzke et al. 2014; Shafie and Rennie 2012). In our results, environmental awareness measured

through the NEP scale was statistically non-significant, to point out that higher price premiums for omega-3-enriched eggs (PUFA) are not supported by increased environmental sensitivity.

Finally, no differences have been found among consumers regarding gender, age and education, although some studies have emphasised that women are more likely to prefer functional food than men (De Jong et al., 2003). Also, age was found as a predictor of functional food choice, highlighting that elderly consumers are more receptive to functional foods (Ares et al. 2009; Herath, et al. 2008; Siegrist et al. 2008). Furthermore, some scientific researches state that functional food consumers generally have a high level of education (Kraus et al. 2017; Urala and Lähteenmäki 2013), which allows them to recognise the potential of active molecules in providing health benefits. On the contrary, Kahl et al. (2012) argued that the more educated consumer of organic products might not recognise the need to add functional elements to organic food, which is already considered a healthy product in itself. However, as Bech-Larsen and Grunert (2003) emphasised consumers' preference for functional food varies widely and this is due to several factors, including geographical area, the demographic, economic and social characteristics of consumers, as well as the type of product (Lähteenmäki 2013).

Conclusions

Innovations represent an engine for the economic growth of all farms. However, organic farms face important challenges for the future, including the need for providing healthy and nutritional foods that take into account emerging trends in the consumption of food products without compromising organic principles. Consumers' preference of innovation in food products has been analysed in a few studies showing that organic consumers could be a target group for innovations in food as well (Hüppe and Zander 2021; Asioli et al. 2019; Aschemann-Witzel et al. 2013). The present study analysed consumers' WTP for organic eggs enriched with omega-3 (PUFA) and the factors behind this choice. Specifically, a large group of experimental auction participants were willing to pay a price premium for this type of eggs, regardless of their intensity of organic food consumption. The factors underlying this choice were mainly attributable to selfish attitudes towards organic and functional food consumption. These findings suggest that organic consumers could represent a target group for this type of product naturally enriched with omega-3 (PUFA), by modifying the hens' diet. Such enrichment, in fact, is not opposed to what is emphasised by the principles on which organic agriculture is based, since it does not include technological manipulations of the product.

These findings could have theoretical, managerial and policy implications. From a theoretical point of view, the present study could enrich the literature on the topic by highlighting that functional food characteristics may be added to organic eggs, provided that these enrichments have taken place without compromising the ethical principles underlying organic farming. Furthermore, the study's findings try to reduce the gap on the topic by emphasising some of the determinants that affect the choice of consumers for organic food products with functional food characteristics. From a managerial perspective, our results could be of interest to those breeding of laying hens that want to innovate and being competitive also on the market segment of functional food as it provides them with useful elements about consumers' preferences to design effective communication and marketing strategies.

The results of this study are in line with what Aschemann-Witzel et al. (2013) found for the German population and if confirmed by further studies, could contribute to the political discussions regarding the organic agriculture of the future whose products on the label may include health claims, pursuant to Regulation (EC) 1924/2006. However, the study has some limitations. The most important limitation is the convenient and small sample used in the experimental auctions, not a statistically representative sample of the reference population. Furthermore, we did not consider how the consumers interviewed understood the concept of healthiness in the foods they buy and how, and to what extent, the two concepts of health in organic and functional food are overlapping. Another limitation is that the study took into consideration only consumers from southern Italy; thus, the resulting information may be limited only to a specific geographical context.

Recommendations

From the present study results, some general recommendations could be drawn. Firstly, to be innovative organic agriculture will have to face important challenges for the future (Zanoli et al. 2018). One of these challenges is related to the inclusion of specific health claims in the labels of organic products under the regulations (EC) 432/2012 and 1124/2006. This would make it possible to take advantage of important market opportunities that emerge from increasing consumers' awareness of the link between diet and health, allowing organic food to satisfy new consumers' segments. However, it is important to note that, as in the product under consideration, the functional characteristics added to the organic product do not compromise the standards and principles underlying organic farming. This is basically in line with the challenges that were discussed by some of the world's most active scientists in organic agriculture during the International Society of Organic Agricultural Research (ISOFAR) Symposium 'Organic 3.0 is Innovation with Research', held on September 2015, in the Republic of Korea (Rahmann et al. 2017). In this context, has emerged that among the challenges that organic farming will have to face there is certainly the task of providing healthy and nutritional foods that take into account current and emerging food habits, lifestyles and consumer needs, while implementing innovations that do not compromise the ethical principles and standards that underlie organic farming (Rahmann et al. 2017).

Further recommendations encourage future research on this topic. Specifically, future studies have to take into account a larger sample of organic consumers from diverse cultural and geographical contexts to confirm or not the findings of the present study. This could enrich this study's information on the Italian population and those of Aschemann-Witzel et al. (2013) carried out for the German population. This will allow to generate a full picture of the organic consumers in other geographical contexts where organic food products generate interesting sales.

Furthermore, future research could further explore the relationship between organic and functional food characteristics by considering various categories of organic food products and innovations, to measure the effects of different health claims on consumers' perceptions. This could be of interest to understand which category of organic product with functional characteristics is more preferred by consumers and how far product and process innovations can go to prevent the product from being rejected.

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Declarations

Conflict of interest The authors declare no competing interests.

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