applied system innovation

MDPI

Article

Exploring Consumer's Propensity to Consume Insect-Based Foods. Empirical Evidence from a Study in Southern Italy

Elena Arena, Agata Mazzaglia, Roberta Selvaggi *, Biagio Pecorino, Biagio Fallico, Mattia Serranò and Gioacchino Pappalardo

Department of Agricoltura, Alimentazione e Ambiente (Di3A), University of Catania, via Santa Sofia, 98-100, 95123 Catania, Italy; earena@unict.it (E.A.); agata.mazzaglia@unict.it (A.M.); pecorino@unict.it (B.P.); bfallico@unict.it (B.F.); serrano.mattia@gmail.com (M.S.); gioacchino.pappalardo@unict.it (G.P.)

* Correspondence: roberta.selvaggi@unict.it

Received: 17 July 2020; Accepted: 3 September 2020; Published: 8 September 2020

Abstract: While admitting that neophobia and sociocultural factors negatively affect consumers' propensity to consume insect-based foods, other aspects related to food values that consumers attach to these foods could have an influence on consuming decision. In order to identify the motivations and determinants that influence the propensity to consume insects and then to explore the drivers behind consumers' willingness to consume insect-based foods, the data collected through the questionnaire were processed. After a descriptive analysis of the data, ANOVA was performed. Moreover, Student's t test and pairwise correlation indices were estimated in order to determine statistically significant correlation. Our findings show that information about edible insects brought about an increase in food neophobia and appearance affected the expected liking levels. In addition, we have shown that respondents' propensity to consume insect-based foods also depends on consumers' subjective beliefs about food values such as healthiness, naturalness and environmental impact. We also found that respondents' beliefs about food values associated with insect-based foods do not depend on the degree of information provided but are probably due to pre-existing prejudices about them.

Keywords: entomophagy; food neophobia; food values; sustainable food; innovative food

1. Introduction

The search for new food sources and innovative methods that allow the production of high-quality proteins while respecting animal welfare and the planet is based on the latest estimates of the growth prospects of the world population. According to the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (DESA), by 2050, the world population will be 9.7 billion and, for these reasons, the search for new solutions to meet the growing food needs of the population is becoming increasingly important.

In this context, the food use of insects, both for human consumption and to produce animal feed, has been indicated by the FAO as the most promising way to achieve new sustainable production of food [1]. Insects represent a significant part of the diet of both many animals fed to humans and humans themselves, as reported by studies conducted by FAO in several emerging and third world countries [2]. In Europe, from a regulatory point of view, in 2015, the European Food Safety Authority (EFSA) seemed to be positive about the consumption of insects and issued new legislation on novel foods (Regulation EU 2015/2283), including whole insects and parts thereof in the category "novel foods" [3].

In recent years, the European Union has also strongly supported the research on new protein sources within the H2020 program and several scientific works have shown that insect consumption produces

beneficial effects in nutritional, environmental and economic terms [4–7]. However, the consumption of insect-based foods, especially in western countries, is still very limited due to prejudices that are difficult to overcome [8]. As reported in the literature, such prejudices are mainly attributable to cultural traditions showing insects as dirty and harmful creatures and communities consuming insects as poor and wild [9].

Many studies have investigated the willingness to consume insects, but the results are highly variable. This variability varies from 5% up to 78% for Belgium consumers [10–12], around 64% for American consumers [13] and 31% for Italian consumers [4]. These differences can be attributable both to the country of study and the research design. A cross-cultural comparison between German and Chinese consumers highlighted a more favorable willingness to eat insect-based foods in Chinese rather than German consumers. Moreover, Germans, similarly to Dutch consumers [14], reported higher willingness to eat processed insect-based foods while, for Chinese consumers, no differences in rating were observed. Significant predictors of consumers' willingness to eat insects in both countries were low score of food neophobia (FN), positive taste, high score of social acceptance and experiences with eating insects in the past [15]. In Poland, Orkusz et al. [16] suggest that there is low willingness to adopt edible insects as a meat substitute among Polish students due to the psychological barriers, such as neophobia and disgust. They also confirmed what was supposed by Sogari et al. [17] for Australian consumers: a positive sensory experience can improve the acceptability of insects as food.

In Italy, appearance and taste are the main barriers to the insect consumption, gender and education play a significant role in the acceptance of insects as food [4]. High food neophobia score was a key factor for the acceptance of insects as food in Belgian [11] and Hungarian consumers [18]. Other factors were stronger convenience orientation and higher interest in environmental impact. Schlup et al. [19] found, in addition to food neophobia, eight other strong significant predicting variables of willingness to eat insects for Switzerland consumers. Consumers in Northern Europe had a more positive attitude to entomophagy than consumers in Central Europe, and subjective and objective knowledge predict the willingness to buy (WTB) in Northern Europe, while, in Central Europe, food neophobia was a stronger predictor. In both regions, the insect-related experience was a good predictor [20].

The "disgust" factor, often related to entomophagy, is linked to cultural barriers, experiences, income, education, fashion and social trends [16,17,21–23]. However, although the feeling of disgust is universal and ancient, it varies in intensity between different individuals and during a lifetime depending on previous experiences [24]. At a pioneering level, some studies and experiments related to the inclusion of insects in western diets have already been carried out [10,25,26], but these studies have shown that the main obstacle is mostly related to the initial approach and to the first taste. Once this obstacle is overcome, the consumer recognizes in the taste of some insects some notes of hazelnut, which brings back the idea of food to which one is commonly accustomed [27].

Some studies have shown that, in some areas of the planet where the entomophagy culture was widespread in the past, there are prejudices today [28,29], as if to deny the past. Food choices change over time and can be driven by socioeconomic reasons such as agro-food innovations, trends launched by great chefs or TV shows, culinary innovation and reasons related to ecological ideals or health [30–32]. Thus, the importance of the degree of awareness, information and education of western consumers towards edible insects is clear. Although, in western countries, there is an increasingly cosmopolitan atmosphere due to the wide development of eastern ethnic places offering dishes far from western food culture, consumers may be reticent towards these new foods [33].

Previous studies on entomophagy have focused their attention on certain aspects such as food neophobia or sociocultural barriers that hinder the consumption of insect-based foods. However, it is undeniable that, in recent years, public interest in entomophagy has increased and, for this reason, the scientific debate has sought to understand what factors could be conducive to the consumption of insect-based foods. It has been shown that consumers would be more accepting of insects as food if they are incorporated into familiar products (biscuits, pasta, bread and others) [16,26,34]. However, as demonstrated by Tan et al. [26], reducing the visibility of insects does not necessarily improve

product appreciation. In any case, not seeing insects on the plate increases consumer acceptance by focusing their attention on the perception of the combination of ingredients.

Despite the broad scientific literature which has explored factors that influence the propensity to consume food with insects, understanding the factors that affect consumer behavior in consuming insect-based foods remains an unresolved issue. An interesting aspect that, to our knowledge, no study has still examined relates to whether consumers link consumption of insect-based foods with specific "food values" [35–37]. Values are a potentially powerful driver of consumer behavior in a wide range of situations, including purchasing decisions [38]. Food values have been proposed in previous research as a method of identifying stable constructs of consumer preference (e.g., Adalja et al. [39], McCluskey et al. [40], Pappalardo and Lusk [41]). Consuming a particular product attribute is conceptualized as a means to obtain some desirable end-state [36,42], and linking the concept of "value", as defined by Rokeach [37], might provide new insights into the drivers that affect the consumption of insect-based foods.

In this vein, we conducted an exploratory study on the effects of food values on the willingness to consume insect-based foods. The aim of the research is to assess the effects of these food values on consumers' evaluation of insect-based foods. In fact, while a substantial body of research has analyzed factors affecting the consumption of insect-based foods such as consumers' neophobia, sociodemographic and psychographic characteristics (e.g., Verneau et al. [5] and Lombardi et al. [43]), no other known study has examined the effects of food values explicitly applied to insect-based foods. About entomophagy, food values can involve a range of components related to the products themselves (e.g., taste, naturalness, origin, price, appearance, convenience, etc.). Hence, food values in the entomophagy sector could influence consumers' decision-making with potential implications for the valuation of these products.

The other aim of this research is to solve the problem of the existing literature regarding the entomophagy sector: it is not clearly distinguished the effect of food values related to insect-based foods and other factors like neophobia or sociocultural barriers on consumers' willingness to consume. Therefore, we have considered all aspects in order to evaluate the effects of different factors.

2. Materials and Methods

2.1. Data Collection and Participants

An online survey using the www.sondaggio-online.com platform was conducted on consumers from Southern Italy. Through links on social media, mailing lists and advertisements in public facilities, the questionnaire was distributed during a period of two months. A total of 255 subjects were interviewed in the second semester of 2018, but only 210 complete questionnaires were recorded. Incomplete questionnaires were excluded from the database. We chose to focus the survey on Southern Italy since it has been previously deemed as a representative area of Italy due to the food purchasing behaviors and attitudes of its population, as reported by previous studies [44–46]. To be sure that consumers were from Southern Italy, the authors introduced a preliminary question in the questionnaire about their residential region.

Moreover, all participants were informed about the absence of anticipated risks to participating in this study. Their participation in the research was completely voluntary, and everyone was free to refuse to participate in the research and to stop filling out the survey at any time.

The questionnaire of screening made it possible to exclude those who had allergies/intolerance towards the products under investigation. All these categories of subjects would have risked altering the results of the investigation.

To test the effect of detailed information about entomophagy on consumers' willingness to consume insect-based foods, the interviewees were randomly divided into two subgroups, called "non-informed" and "informed", depending on the level of information provided on the topic of

entomophagy. In fact, Barsics et al. [47] showed that information about insect-based products could change consumers' perceptions of such products.

In particular, participants in the "non-informed" subgroup were not provided with any information on edible insects; instead, the participants in the "informed" subgroup were provided with detailed information about entomophagy. Specifically, the information provided was related to the prospects for the spread of insects as protein foods to replace traditional foods and also as a consequence of global phenomena such as overpopulation and the consequent need for new food sources. In addition, participants in this group were given lists of the main edible entomological species and their nutritional value. Finally, we provided information on the legislation currently in force in Italy on the consumption of insect-based foods and the commercial activities in this sector already running in Italy and outside Italy.

2.2. Questionnaire

The same questionnaire was supplied in both non-informed and informed groups. At the beginning, demographic data, education level, monthly spending on food items and eating habits were collected. After food neophobia was measured using ten items (five positively and five negatively) rated on a 7-point scale from disagree to agree, developed by Pliner and Hobden [48] and validated in the Italian language by Laureati et al. [49].

The sum of the rate given to ten statements (reversing the neophilic items) provide the individual food neophobia scale (FNS) scores. FN levels both for non-informed and informed conditions, and the segmentation of respondents as low, medium and high, were determinate according to Laureati et al. [49]. Participants responded also to statements on the meaning of entomophagy and previous consumption of insects.

As, in Italy, it is not allowed to sell edible insects, four images (F1-4) representing different kinds of edible insect and insect-based products were presented to participants and they were asked for each product to indicate the hedonic liking on a 9-point scale (1 = extremely dislike and 9 = extremely like) and the evoked sensations between curiosity, disgust, appetite and "other", with the possibility to indicate other sensations.

The insect products were selected at four levels of visibility: whole and visible (F1, mix of edible insect), whole and coated (F2, chocolate-coated grasshopper and scorpions), ground and invisible (F3, crickets and silkworm flour), processed and invisible (F4, protein bars). All the images were displayed to participants with a short description of the product [26].

In addition, 9 food values similar to those used in previous studies were identified [34,39,40]. For each of these food values, we assessed how they could influence the propensity to consume insect-based foods. This assessment was carried out by giving the participants four questions, in Likert format, for each of the 9 food values identified. The 9 food values and their definitions are given in Table 1, while the Likert format questions used for each of them are given in Appendix A (Table A1). For each question, respondents were asked to express their evaluation on a scale from 1 (always true) to 5 (never true).

Table 1. Food values.

Food Values	Definition
Healthiness	When a product is good for health
Naturalness	Extent to which food is produced without modern technologies
Taste	Extent to which consumption of the food is appealing to the senses
Price	The price that is paid for the food
Safety	Extent to which consumption of food will not cause illness
Convenience	Ease with which food is cooked and/or consumed
Appearance	Extent to which food looks appealing
Origin	Where the agricultural commodities were grown (local, national or abroad)
Environmental impact	Effect of food production on the environment

2.3. Statistical Analysis

In order to identify the motivations and determinants that influence the propensity to consume insects and, then, to explore the drivers behind consumers' willingness to consume insect-based foods, the data collected through the questionnaire were processed in distinct phases, using the Stata integrated statistical software.

In the first phase, descriptive analyses of the data were conducted in order to define the sociodemographic characteristics of the sample and the consumers' behavior.

Then, the significant differences were evaluated by variance analysis (ANOVA) and results were considered significant at $p \leq 0.05$.

Comparisons of the mean scores of each food value between the informed and non-informed group were examined using Student's t test.

Moreover, pairwise correlation index values were estimated for both groups to determine statistically significant correlations between food values considered in the survey and the pictures shown to the consumers. This is based on the method of covariance. It gives information about the magnitude of the association, or correlation, as well as the direction of the relationship.

3. Results and Discussion

3.1. Sample Characteristics and Food Neophobia Levels

In total, 210 sample units were collected over two months, which were randomly divided into two groups: 105 "non-informed" and 105 "informed" subjects. Their sociodemographic characteristics are summarized in Table 2.

With reference to gender, the sample showed a prevalence of female (>60%) in both subgroups compared to male (>30%). With regard to the age of the interviewees, in both groups, the prevalence is between 18–30 years and 40–60 years. The least represented age group, in both groups, is the over 60 age group. The education level is high in both groups. Most of the respondents are in possession of a degree (45.3% of the "informed" and 61.9% of the "uninformed"). However, several authors report that an imbalance towards females as well as young and educated participants in online survey methodologies' samples are common [20,50].

As regards the average monthly household expenditure on food, most respondents spend between 200 and 400 euro per month in both groups. Only a small proportion of respondents spend more than 600 euro/month on food supply. Regarding eating habits, in both groups, we found a prevalence of omnivores, with more than 90% of participants, and a low component of vegetarians and other forms of eating habits. Moreover, most respondents were unfamiliar with the term "entomophagy". Finally, in both groups, almost all respondents stated that they had never tasted or consumed insects as such or their derivatives.

Table 2 shows the results of the food neophobia level in non-informed and informed conditions. The calculated FNS scores of quartiles were different for non-informed and informed conditions. In non-informed condition, the group with low FN had an FNS score (18.6) within the lowest quartile (FNS score ≤ 22), the group with medium FN had an FNS score (28.4) within the second and the third quartile (22 < FNS score < 36), and the high neophobic group had an FNS score (42.9) within the highest quartile (FNS score ≥ 36). In the informed condition, the FNS scores of quartiles were the following: the lowest quartile had an FNS score of ≤26 and the nephilic group an FNS mean score of 20.0; the medium FN group with an FNS score of 31.8 was within the second and third quartiles (26 < FNS score < 39); the high neophobic group with a FNS score of 44.4 was within the highest quartile (FNS score ≥ 39). Data determined in the non-informed condition were similar to those reported by Laureati et al. [49], with some minor differences. Laureati et al. [49] report the lowest FNS scores for the first three quartiles (low ≤ 18 < medium < 36 ≥ high) and the lowest FNS mean score for low and medium FN levels (14.2, 26.1, respectively).

In the informed group, the information about edible insects brings about a slight increase in FNS mean score in each FN level, a decrease in low neophobic subjects (24.8%) and an increase in respondents displaying high FN levels (30.5%).

Table 2. Characteristics of the participants and food neophobia levels.

	Informed (105 Units)	Non-Informed (105 Units)	Full Sample (210 Units)
Gender			
Male	39.0%	31.4%	35.2%
Female	61.0%	68.6%	64.8%
Age			
18–30 years	37.2%	53.3%	45.2%
31–40 years	27.6%	37.1%	32.4%
41–60 years	31.4%	7.6%	19.5%
>60 years	3.8%	1.9%	2.9%
Educational Rate			
Middle school	3.8%	-	1.9%
High school	41.0%	22.9%	31.9%
Degree	45.7%	62.9%	54.3%
Post degree	5.7%	12.4%	9.0%
PhD	3.8%	1.9%	2.9%
Average Monthly Food Expenditure			
Up to 200 euros	21.0%	20%	20.5%
From 201 to 400 euros	54.3%	56.2%	55.2%
From 401 to 600 euros	21.0%	13.3%	17.1%
Over 600 euros	3.8%	10.5%	7.1%
Food Habits			
Omnivorous	94.3%	95.2%	94.8%
Vegetarian	3.8%	3.8%	3.8%
Vegan	-	-	-
Other	1.9%	1.0%	1.4%
Knowledge of the Meaning of the Term "Entomophagy"			
Yes	65.7%	75.2%	70.5%
No	34.3%	24.8%	29.5%
Previous Experience of Tasting/Consumption of Insects or their Derivatives			
Yes	2.9%	12.4%	7.6%
No	97.1%	87.6%	92.4%
Food Neophobia Levels			
Low	24.8%	27.6%	26.2%
Medium	44.8%	44.8%	44.8%
High	30.5%	27.6%	29.0%

(Source: Data collected).

3.2. Impacts of Edible Insect and Insect-Based Product Images on Expected Liking and Evoked Emotions

The expected liking for edible insects and insect-based product images is reported in Table 3. In both non-informed and informed conditions, the expected liking for all product images was similar and very low. No significant differences in liking were found among the product images with visible edible insects (F1 and F2); when the insects in the insect-based products images were invisible, the hedonic rate increased slightly, particularly in the processed products (F4). When a consumer chooses a food product, they expect it to perform its expected functions, such as immersing him in a sensory experience and yielding nutritional benefits [51], but the physical appearance of insects is very

far from the appearance of food products in western consumers [52] and edible insects are perceived as a gross food source and are associated with strong feelings of disgust [53]. When subjects were asked to report the evoked emotions, disgust was the first feeling for the images showing visible edible insects (F1 and F2).

Table 3. Impacts of edible insect product images on liking and frequency of evoked emotions.

Images		Liking [1]	Curiosity [2]	Disgust	Appetite	Inappetence	Indifference	Perplexity	Amaze	Fun	Fear
F1	NON-INFORMED	3.21 ^{a}	41 ^{d}	60 ^{e}	0 ^{a}	-	2	2	-	-	-
F2		3.20 ^{a}	35 ^{b}	64 ^{f}	2 ^{b}	-	1	3	-	-	-
F3		3.96 ^{b}	46 ^{e}	45 ^{c}	12 ^{e}	-	2	-	-	-	-
F4		4.62 ^{c}	64 ^{h}	28 ^{a}	10 ^{d}	-	3	-	-	-	-
F1	INFORMED	3.02 ^{ab}	36 ^{c}	66 ^{g}	0 ^{a}	-	-	-	2	1	-
F2		2.66 ^{a}	32 ^{a}	71 ^{h}	0 ^{a}	1	-	-	-	-	1
F3		3.57 ^{bc}	51 ^{f}	48 ^{d}	2 ^{b}	1	2	-	1	-	-
F4		4.09 ^{c}	62 ^{g}	33 ^{b}	8 ^{c}	-	2	-	-	-	-

Different letters in the same column indicate significant differences for $p \leq 0.05$. [1] Data are the mean value of the liking score. [2] Data are reported as frequency of citation.

Moreover, the image with whole and coated insects (F2, chocolate-coated grasshopper and scorpions) was more disgusting than the other, probably due to the chocolate–insect association. As reported by Hurling and Shepherd [54], differences in food product appearance affect the expected liking levels. As the edible insects become invisible in the product images, the feeling of disgust decreases and curiosity increases as well as appetite (F3 and F4). As expected, the image of the protein bars (processed and invisible edible insect product F4) shows curiosity as the first feeling.

Although the topic of entomophagy is starting to become increasingly popular among consumers, our findings have shown that some aspects of insect consumption need to be further investigated. Increasing knowledge about the nutritional aspects of insect-based food seems to be necessary and the degree of information provided to the consumer on these foods is also of importance.

In this vein, the findings of our study can be associated with those of previous studies on insect-based foods. Analogously to the results obtained in other studies [11,18], our results confirmed that the information about edible insects brought about an increase in food neophobia among respondents displaying high food neophobia levels. Surprisingly, contrary to what Barsics et al. [47] observed, our results showed that information about insect-based foods did not change consumers' perceptions of these products. In fact, no differences were noted between the "informed" and "non-informed" groups interviewed in our survey. Moreover, in line with Hurling and Shepherd [54], appearance affects the expected liking levels. Our results showed that the expected liking was very low when showing pictures containing visible edible insects. Conversely, the hedonic rate increases when insects are invisible, such as in the processed products. It is likely, as highlighted by Martins and Pliner [53], that this result is associated with a strong feeling of disgust and consumers perceive edible insects as a gross food source.

3.3. Food Values

Table 4 shows the descriptive statistics of the food values used in our survey. Since the evaluation scale was between 1 and 5, it can be noted that, for some food values, such as healthiness, naturalness and environmental impact, the mean score is higher than the average value of the used scale (i.e., 2.5) both in the "informed and "non-informed" groups. Regardless of the level of information provided to participants, these results show positive consumers' perceptions for these food values associated with

insect-based foods. For the other food values, the scores obtained were below the average values of the assessment scale.

Table 4. Mean scores for food values.

Food Values	Informed (105 Units)		Non-Informed (105 Units)		Full Sample (210 Units)	
	Mean Score	SD	Mean Score	SD	Mean Score	SD
Healthiness	2.70	0.62	2.67	0.68	2.69	0.65
Naturalness	2.73	0.55	2.74	0.50	2.74	0.53
Taste	2.50	0.37	2.49	0.43	2.50	0.40
Price	2.27	0.60	2.25	0.56	2.27	0.58
Safety	2.25	0.62	2.24	0.64	2.25	0.63
Convenience	2.37	0.59	2.30	0.59	2.33	0.59
Appearance	1.91	0.51	2.05	0.51	1.99	0.51
Origin	1.96	0.69	2.13	0.68	2.05	0.69
Environmental impact	2.77	0.65	2.81	0.60	2.79	0.62

Note: values of the used scale were from 1 to 5. SD—standard deviation.

We carried out a *t*-test to highlight any differences between the "informed" and "non-informed" groups (Table 5). The results obtained show that there are no significant differences between the two groups in the mean scores of food values, except for appearance and origin. However, the latter differences were negative, i.e., the average value decreased from the "non-informed" group to the "informed" group. Therefore, providing information would appear to have had a negative influence on the participants' judgement of certain food values associated with insect-based food consumption.

Table 5. *t*-test for equality of mean between "informed" and "non-informed" groups.

Food Values	Mean Differences	*p*-Value
Healthiness	0.029	0.751
Naturalness	−0.005	0.948
Taste	0.007	0.897
Price	0.017	0.836
Safety	0.010	0.913
Convenience	0.071	0.382
Appearance	−0.140	0.046 **
Origin	−0.169	0.074 *
Environmental impact	−0043	0.619

Note: *, ** and *** denote significance at 10%, 5% and 1% levels, respectively. Sample size = informed: 105 units; non-informed: 105 units.

Trying to go further the existing literature, our findings highlighted new interesting aspects that are still unexplored in the current scientific debate. As shown in the analysis of food values (Table 4), respondents' propensity to consume insect-based foods also depends on consumers' subjective beliefs about food values. As regards the importance given by consumers to food values, our analysis showed that consumers consider healthiness, environmental impact and naturalness important positive drivers in consuming insect-based foods whereas origin and appearance are the least recognized food values in insect-based foods. An interesting result in the analysis of food values is the lack of differences between the two subgroups (informed and non-informed). This could mean that food values associated with insect-based foods do not depend on the degree of information provided but are probably due to pre-existing prejudices or respondents' beliefs about them.

3.4. Correlation Index for Food Values and Products Images

In this section, correlations of food values considered in the survey and the pics showed in the questionnaire are presented. Table 6 shows pairwise correlations index values, in which any

correlations with a statistic significance are highlighted. Correlation index values were estimated through STATA for both groups, "informed" and "non-informed" ones.

Table 6. Pairwise correlation index values for "informed" group.

Food Values	F1	F2	F3	F4
Healthiness	0.33 ***	0.34 ***	0.34 ***	0.39 ***
Naturalness	0.14	0.25 *	0.27 ***	0.33 ***
Taste	0.26 **	0.25 **	0.21 **	0.35 ***
Price	0.30 **	0.28 ***	0.23 **	0.26 **
Safety	0.31 ***	0.34 ***	0.33 ***	0.26 **
Convenience	0.32 ***	0.35 ***	0.28 ***	0.19 **
Appearance	0.37 ***	0.29 ***	0.20 **	0.14
Origin	0.13	0.22 **	0.12	0.04
Environmental impact	0.16	0.30 ***	0.37 ***	0.32 ***

Note: *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively. F1—Mix of edible insect (whole and visible insects). F2—Chocolate-coated grasshopper and scorpions (whole and coated insects). F3—Crickets and silkworm flour (ground and invisible insects). F4—Protein bars (processed and invisible insects).

Most of the index estimated for the "informed" group are statistically significant and a lot of them have a high level of significance (1%).

Origin is the food value with less statistically significant index: only the correlation index with the second pic (whole and coated insect products) is significant at 5% level.

The correlation index for naturalness, appearance and environmental impact is not significant only in correlation with one picture shown to the participants.

All the correlations are positives, but none is very strong. The highest value (0.39) is for the correlation index between healthiness and "F4" (protein bars with processed and invisible insects). This means that those think that products with insects are useful for health appreciate all proposed pictures, but F4 more than others.

Moreover, F4 has also the highest correlation index with naturalness and taste. This result shows that consumers that believe food with insects have natural origin appreciate the picture F4 more than others. For the food values taste, the result obtained seems to be logical: those who appreciate the pleasant taste of insect-based food prefer the pictures with invisible insects more than other pictures, even if he/she appreciates also the others pictures (all indexes are statistically significant).

As expected, the picture F1 (whole and visible insects) has the highest correlation index with the food value appearance. Therefore, those who think that insect-based foods promote appetite and are attractive prefer the foods with visible insects.

The indices for the food value price are all statistically significant, but they have low intensity. Therefore, the relevance of the price is not different for the different kinds of edible insect shown.

As regards the "non-informed" group, most of the estimated indexes are statistically significant and, as for the informed group, a lot of indexes have a high level of significance (less than 1%) (Table 7). For the "non-informed" group, all indexes are positive, but the range of values is wider. The highest value (0.52) is for the correlation index between taste and "F4" (protein bars with processed and invisible insects). This means that those who appreciate the taste of edible insect-based foods also appreciate foods with invisible insects. Not seeing the insects is better than seeing them.

Again, for this group, origin is the food value with less statistical significance, but the index is statistically significant at the 5% level for two different pictures, F1 (whole and visible mix of insects) and F4 (processed and invisible insect products in protein bars). Price is the only food value with one correlation index that is not statistically significant, estimated for the correlation with the third picture (F3: ground and invisible insect products). Moreover, the correlation with the first and second pictures has a low level of statistical significance (around 10%). As for the "informed group", the indices for the food value price have low intensity.

The results for the food value appearance confirm the logical idea expressed previously: those who are attracted by the appearance of edible insect-based foods appreciate whole and visible insects to eat.

Finally, the indices for environmental impact are all similar. Consumers who consider the production process of insect-based foods with low environmental impact appreciate every kind of edible insect.

Table 7. Pairwise correlation index values for "non-informed" group.

Food Values	F1	F2	F3	F4
Healthiness	0.34 ***	0.19 **	0.34 ***	0.47 ***
Naturalness	0.27 **	0.21 **	0.30 ***	0.37 ***
Taste	0.40 ***	0.35 ***	0.48 ***	0.52 ***
Price	0.18 *	0.18 *	0.15	0.28 **
Safety	0.37 ***	0.22 **	0.34 ***	0.48 ***
Convenience	0.37 ***	0.25 **	0.24 **	0.31 ***
Appearance	0.48 ***	0.32 ***	0.32 ***	0.33 ***
Origin	0.19 **	0.14	0.14	0.23 **
Environmental impact	0.36 ***	0.35 **	0.35 ***	0.40 ***

Note: *, ** and *** denote significance at 10%, 5% and 1% levels, respectively. F1—Mix of edible insect (whole and visible insects). F2—Chocolate-coated grasshopper and scorpions (whole and coated insects). F3—Crickets and silkworm flour (ground and invisible insects). F4—Protein bars (processed and invisible insects).

The pairwise correlation indices showed that the liking scores for the pictures shown to the participants are closely related to the importance that consumers attach to food values. For instance, the pairwise correlation index of appearance was statically significant regardless of the four levels of insect visibility in the pictures (whole and visible in the mix of edible insects; whole and coated in the chocolate-coated grasshopper and scorpions; ground and invisible in the crickets and silkworm flour; processed and invisible in the protein bars). Appearance is also the food value with the highest value of intensity both in the "informed" and "non-informed" groups for the picture F1 (food with visible insects). This means that those who attach great importance to appearance have also given a high liking score to the picture with visible insects. This result is in accordance with the studies cited in the References.

We also found similar results for healthiness and environmental impact values. This means that consumers think insect-based foods useful for healthy and environment preservation. Interesting results are also those concerning safety and convenience. The pairwise correlation indices confirm that consumers recognize insect-based food as safe and convenient. Again, we did not notice any significant differences for the aforementioned food values between the two interviewed groups.

However, curiosity about something new and nostalgia for rural life [30] are beginning to push the consumer to rethink his mental limits and prejudices and to break away from traditional patterns.

As stated by Hartmann et al. [15], low scores for food neophobia, positive taste expectations, high levels of social acceptance and experience with insects in the past are all significant predictors of consumer acceptance of insects in the future. In addition to these discussions, our findings suggest that certain food values such as healthiness, naturalness and environmental impact may also play an important role in promoting the consumption of insect-based foods in the future. Indeed, although there are still social, cultural and psychological barriers, some food values are recognized in insect-based foods in the same way as foods traditionally present in the diet of western consumers.

4. Conclusions

While it is good that the debate on insect-based foods is increasingly developing, the prejudice about these foods in western countries is strongly present among consumers and it is anchored in the mindset of consumers to such an extent that it is still difficult to imagine insects as food in the normal diet. In fact, these foods are still perceived as something filthy if not unnecessary, marginal and superficial.

Generally speaking, our results could have important implications for the actors involved in the entomophagy sector. For example, for managers, the adoption of marketing practices explicitly related to the food values could increase consumers' valuation of insect-based foods. For producers, food values can lead to an increase in insect-based food product demand that could enhance firm income.

Finally, since this study has some limitations due to the limited number of observations and to the specific regional geographical context, our findings should be generalizable in theoretical terms with certain caution. Before extending our results to all Italian or European consumers, future research should test the robustness of our findings by assessing the effects of the food values that we have examined in this study in other geographical and sociocultural contexts.

Author Contributions: All authors have drafted the work and substantively revised it. M.S. collected data. B.P. coordinated the working group. E.A., A.M. and B.F. focused on aspects related to food technology and FNS; while R.S. and G.P. focused on food value aspects. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Food values: Likert scale and definition.

Food Value	Definition	Likert Questions
Healthiness	When a product is good for health	Do you think that foods made with insects are beneficial for health? Do you think that foods made with insects are healthier than traditional foods? Do you think that foods made with insects are worthless for a healthy person? Do you think that foods made with insects are harmful to health?
Naturalness	Extent to which food is produced without modern technologies	Do you think that foods with insects are made from natural sources? Do you think that foods with insects are made with simple and real ingredients? Do you think that foods made with insects decrease the natural quality of foods? Do you think that foods made with insects alter traditional consumption patterns?
Taste	Extent to which consumption of the food is appealing to the senses	Do you think that foods made with insects have an enjoyable taste? Do you think that taste of foods made with insects is better than conventional foods? Do you think that foods made with insects do not differ from conventional foods as regards the smell, the taste and flavor? Do you think that foods made with insects sacrifice taste for their nutritional properties?
Price	The price that is paid for the food	Do you think that price of foods made with insects makes your money well spent? Do you think that the price of foods made with insects guarantees the claimed health benefits? Do you think that foods made with insects are more expensive than conventional foods? Do you think that foods made with insects are too expensive given their claimed health benefits?

Table A1. *Cont.*

Food Value	Definition	Likert Questions
Safety	Extent to which consumption of food will not cause illness	Do you think that consumption of foods made with insects prevents disease? Do you think that consumption of foods made with insects repairs the damage caused by an unhealthy diet? Do you think that consumption of foods made with insects has not been deeply studied with regard to the aspect of food safety? Do you think that consumption of foods made with insects can cause health problems in the short or long term?
Convenience	Ease with which food is cooked and/or consumed	Do you think that foods made with insects are easy to consume or prepare? Do you think that foods made with insects allow you to easily have a balanced diet compared to conventional foods? Do you think that foods with insects are made with ingredients that you hardly recognize while shopping for food? Do you think that it is easy to understand if foods made with insects can satisfy your dietary needs?
Appearance	Extent to which food looks appealing	Do you think that the look of foods made with insects increases your appetite prior to consumption? Do you think that the look of foods made with insects is appealing for their optical properties and physical forms? Do you think that the look of foods made with insects is similar to that of conventional foods? Do you think that the appearance of foods made with insects reduces your interest in them?
Origin	Where the agricultural commodities were grown (local, national or abroad)	Do you think that local well-known companies produce foods made with insects? Do you think that companies who use local and seasonal ingredients produce foods made with insects? Do you think that unfamiliar multinational companies from around the world produce foods made with insects? Do you think that foods made with insects are made with ingredients whose origins are unknown?
Environmental impact	Effect of food production on the environment	Do you think that the production of food based on insects helps to meet the food needs of the world population? Do you think that foods made with insects are minimally processed foods with low environmental impact? Do you think that the food technologies in the production process of foods made with insects may have long-term negative environmental effects? Do you think that foods made with insects alter traditional agricultural production patterns with a negative impact on the agro-environment?

References

1. FAO. *Rap Publication 2010/02-Forest Insects as Food: Humans Bite Back*; FAO: Bangkok, Thailand, 2010.
2. FAO. *FAO Forestry Paper 171-Edible Insects: Future Prospects for Food and Feed Security*; FAO: Rome, Italy, 2013.
3. Regulation (EU) 2015/2283 of the European Parliament and of the Council of 25 November 2015 on novel foods, amending Regulation (EU) No 1169/2011 of the European Parliament and of the Council and repealing Regulation (EC) No 258/97 of the European Parliament and of the Council and Commission Regulation (EC) No 1852/2001. Available online: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32015R2283 (accessed on 7 September 2020).
4. Cicatiello, C.; De Rosa, B.; Franco, S.; Lacetera, N. Consumer approach to insects as food: Barriers and potential for consumption in Italy. *Br. Food J.* **2016**, *118*, 2271–2286. [CrossRef]
5. Verneau, F.; La Barbera, F.; Kolle, S.; Amato, M.; Del Giudice, T.; Grunert, K. The effect of communication and implicit associations on consuming insects: An experiment in Denmark and Italy. *Appetite* **2016**, *106*, 30–36. [CrossRef] [PubMed]
6. Feng, Y.; Chen, X.M.; Zhao, M.; He, Z.; Sun, L.; Wang, C.Y.; Ding, W.F. Edible insects in China: Utilization and prospects. *Insect Sci.* **2018**, *25*, 184–198. [CrossRef]
7. Manditsera, F.A.; Lakemond, C.M.M.; Fogliano, V.; Zvidzai, C.J.; Luning, P.A. Consumption patterns of edible insects in rural and urban areas of Zimbabwe: Taste, nutritional value and availability are key elements for keeping the insect eating habit. *Food Secur.* **2018**, *10*, 561–570. [CrossRef]
8. Shelomi, M. The meat of affliction: Insects and the future of food as seen in Expo 2015. *Trends Food Sci. Technol.* **2015**, *56*, 175–179. [CrossRef]
9. Harris, M. Buono da mangiare. In *Enigmi del Gusto e Consuetudini Alimentari*; Giulio Einaudi Editore: Turin, Italy, 1990.
10. Megido, R.C.; Sablon, L.; Geuens, M.; Brostaux, Y.; Alabi, T.; Blecker, C.; Drugmand, D.; Haubruge, E.; Francis, F. Edible insects' acceptance by Belgian consumers: Promising attitude for entomophagy development. *J. Sens. Stud.* **2014**, *29*, 14–20. [CrossRef]
11. Verbeke, W. Profiling consumers who are ready to adopt insects as a meat substitute in a Western society. *Food Qual. Prefer.* **2015**, *39*, 147–155. [CrossRef]
12. Vanhonacker, F.; van Loo, E.J.; Galynck, X.; Verbeke, W. Flemish consumer attitudes towards more sustainable food choices. *Appetite* **2013**, *62*, 6–17. [CrossRef]
13. Ruby, M.B.; Rozin, P.; Chan, C. Determinants of willingness to eat insects in the USA and India. *J. Insects Food Feed* **2015**, *1*, 215–225. [CrossRef]
14. Elzerman, J.E.; van Boekel, M.A.; Luning, P.A. Exploring meat substitutes: Consumer experiences and contextual factors. *Br. Food J.* **2013**, *115*, 700–710. [CrossRef]
15. Hartmann, C.; Shi, J.; Giusto, A.; Siegrist, M. The psychology of eating insects: A cross-cultural comparison between Germany and China. *Food Qual. Prefer.* **2015**, *44*, 148–156. [CrossRef]
16. Orkusz, A.; Wolańska, W.; Harasym, J.; Piwowar, A.; Kapelko, M. Consumers' Attitudes Facing Entomophagy: Polish Case Perspectives. *J. Environ. Res. Public Health* **2020**, *17*, 2427. [CrossRef] [PubMed]
17. Sogari, G.; Bogueva, D.; Marinova, D. Australian Consumers' Response to Insects as Food. *Agriculture* **2019**, *9*, 108. [CrossRef]
18. Gere, A.; Székely, G.; Kovács, S.; Kókai, Z.; Sipos, L. Readiness to adopt insects in Hungary: A case study. *Food Qual. Prefer.* **2017**, *59*, 81–86. [CrossRef]
19. Schlup, Y.; Brunner, T. Prospects for insects as food in switzerland: A tobit regression. *Food Qual. Prefer.* **2018**, *64*, 37–46. [CrossRef]
20. Piha, S.; Pohjanheimo, T.; Lähteenmäki-Uutela, A.; Křečková, Z.; Otterbring, T. The effects of consumer knowledge on the willingness to buy insect food: An exploratory cross-regional study in northern and central Europe. *Food Qual. Prefer.* **2018**, *70*, 1–10. [CrossRef]
21. Rozin, P. Human food intake and choice: Biological, physiological, and cultural perspectives. In *Food Selection: From Genes to Culture*; Anderson, H., Blundell, J., Chiva, M., Eds.; Danone Institute: Levallois-Perret, France, 2002; pp. 7–24.
22. Menozzi, D.; Sogari, G.; Veneziani, M.; Simoni, E.; Mora, C. Eating novel foods: An application of the Theory of Planned Behaviour to predict the consumption of an insect-based product. *Food Qual. Prefer.* **2017**, *59*, 27–34. [CrossRef]

23. La Barbera, F.; Verneau, F.; Amato, M.; Grunert, K. Understanding Westerners' disgust for the eating of insects: The role of food neophobia and implicit associations. *Food Qual. Prefer.* **2018**, *64*, 120–125. [CrossRef]
24. Douglas, M. *Questioni di Gusto. Stili di Pensiero Tra Volgarità e Raffinatezza*; Il Mulino: Bologna, Italy, 1999.
25. Sogari, G. Entomophagy and Italian consumer: An exploratory analysis. *Prog. Nutr.* **2015**, *17*, 311–316.
26. Tan, H.S.G.; Fischer, A.R.H.; Tinchan, P.; Stieger, M.; Steenbekkers, L.P.A.; van Trijp, H.C.M. Insects as food: Exploring cultural exposure and individual experience as determinants of acceptance. *Food Qual. Prefer.* **2015**, *42*, 78–89. [CrossRef]
27. Sogari, G.; Vantomme, P. *A Tavola Con Gli Insetti*; Mattioli 1885: Fidenza, Italy, 2014.
28. de Foliart, G.R. *The Human Use of Insects as a Food Resource: A bibliographic Account in Progress*; University of Wisconsin: Madison, Wisconsin, 2002.
29. Paoletti, M.G. Ecological Implications of Minilivestock: Potential of Insects, Rodents, Frogs and Snails. *Exp. Agric.* **2006**, *42*, 251–257.
30. Coppola, A.; Verneau, F.; Caracciolo, F. Neophobia in food consumption: An empirical application of the FTNS scale in southern Italy. *Ital. J. Food Sci.* **2014**, *26*, 81–90.
31. Halloran, A.; Münke-Svendsen, C.; Vantomme, P.; Van Huis, A. Insects in the human food chain: Global status and opportunities. *Food Chain* **2014**, *4*, 103–118. [CrossRef]
32. Shelomi, M. Why we still don't eat insects: Assessing entomophagy promotion through a diffusion of innovations framework. *Trends Food Sci. Technol.* **2015**, *45*, 311–318. [CrossRef]
33. van Huis, A. Potential of Insects as Food and Feed in Assuring Food Security. *Annu. Rev. Entomol.* **2013**, *58*, 563–583. [CrossRef] [PubMed]
34. Wilkinson, K.; Muhlhausler, B.; Motley, C.; Crump, A.; Bray, H.; Ankeny, R. Australian Consumers' Awareness and Acceptance of Insects as Food. *Insect* **2018**, *9*, 44. [CrossRef] [PubMed]
35. Piqueras-Fiszman, B.; Spence, C. Sensory expectations based on product-extrinsic food cues: An interdisciplinary review of the empirical evidence and theoretical accounts. *Food Qual. Prefer.* **2015**, *40*, 165–179. [CrossRef]
36. Lusk, J.; Briggeman, B.C. Food values. *Am. J. Agric. Econ.* **2009**, *91*, 184–196. [CrossRef]
37. Rokeach, M. *The Nature of Human Values*; Free Press: New York, NY, USA, 1973.
38. Gutman, J. A means-end chain model based on consumer categorization processes. *J. Mark.* **1982**, *46*, 60–72. [CrossRef]
39. Adalja, A.; Hanson, J.; Towe, C.; Tselepidakis, E. An examination of consumer willingness to pay for local products. In Proceedings of the Agricultural and Applied Economics Association Annual Meeting, Washington, DC, USA, 4–6 August 2013.
40. McCluskey, J.J.; Grimsrud, K.M.; Ouchi, H.; Wahl, T.I. Bovine spongiform encephalopathy in japan: Consumers' food safety perceptions and willingness to pay for tested beef. *Aust. J. Agric. Resour. Econ.* **2005**, *49*, 197–209. [CrossRef]
41. Pappalardo, G.; Lusk, J. The role of beliefs in purchasing process of functional foods. *Food Qual. Prefer.* **2016**, *53*, 151–158. [CrossRef]
42. Lusk, J. External validity of the food values scale. *Food Qual. Prefer.* **2011**, *22*, 452–462. [CrossRef]
43. Lombardi, A.; Vecchio, R.; Borrello, M.; Caracciolo, F.; Cembalo, L. Willingness to pay for insect-based food: The role of information and carrier. *Food Qual. Prefer.* **2019**, *72*, 177–187. [CrossRef]
44. Caracciolo, F.; D'Amico, M.; Di Vita, G.; Pomarici, E.; Dal Bianco, A.; Cembalo, L. Private vs. collective wine reputation. *Int. Food Agribus. Manag. Rev.* **2016**, *19*, 191–210.
45. D'Amico, M.; Di Vita, G.; Monaco, L. Exploring environmental consciousness and consumer preferences for organic wines without sulfites. *J. Clean. Prod.* **2016**, *120*, 64–71. [CrossRef]
46. Di Vita, G.; Caracciolo, F.; Brun, F.; D'Amico, M. Picking out a wine: Consumer motivation behind different quality wines choice. *Wine Econ. Policy* **2019**, *8*, 16–27. [CrossRef]
47. Barsics, F.; Caparros Megido, R.; Brostaux, Y.; Barsics, C.; Blecker, C.; Haubruge, E.; Francis, F. Could new information influence attitudes to foods supplemented with edible insects? *Br. Food J.* **2017**, *119*, 2027–2039. [CrossRef]
48. Pliner, P.; Hobden, K. Development of a scale to measure the trait of food neophobia in humans. *Appetite* **1992**, *19*, 105–120. [CrossRef]

49. Laureati, M.; Spinelli, S.; Monteleone, E.; Dinnella, C.; Prescott, J.; Cattaneo, C.; Proserpio, C.; de Toffoli, A.; Gasperi, F.; Endrizzi, I.; et al. Associations between food neophobia and responsiveness to "warning" chemosensory sensations in food products in a large population sample. *Food Qual. Prefer.* **2018**, *68*, 113–124. [CrossRef]
50. Duffy, B.; Smith, K.; Terhanian, G.; Bremer, J. Comparing data from online and face-to-face surveys. *Int. J. Mark. Res.* **2005**, *47*, 615–639. [CrossRef]
51. Baker, M.A.; Shin, J.T.; Kim, Y.W. An Exploration and Investigation of Edible Insect Consumption: The Impacts of Image and Description on Risk Perceptions and Purchase Intent. *Psychol. Mark.* **2016**, *33*, 94–112. [CrossRef]
52. Tucker, C.A. The significance of sensory appeal for reduced meat consumption. *Appetite* **2014**, *81*, 168–179. [CrossRef] [PubMed]
53. Martins, Y.; Pliner, P. "Ugh! That's disgusting!": Identification of the characteristics of foods underlying rejections based on disgust. *Appetite* **2006**, *46*, 75–85. [CrossRef] [PubMed]
54. Hurling, R.; Shepherd, R. Eating with your eyes: Effect of appearance on expectations of liking. *Appetite* **2003**, *41*, 167–174. [CrossRef]