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The willingness to consume insect-based food: an empirical research on Italian consumers

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Abstract: Nowadays, scholars, entrepreneurs and policy makers focus their attention on food-related health challenges, nutritional value and food safety. Among these themes, the use of processed animal protein developed from insects as alternative food source is increasingly debated. The main goal of this paper is to contribute to filling this gap with an empirical analysis focused on the willingness of Italian potential consumers to eat insect-based food. By applying the conjoint analysis technique, the study identifies the cause of consumers' reactions to novel food based on cultural bias rather than on 'neophobia in itself' or on knowledge about the product. In this new scenario, the companies operating in the food sector could reduce this bias by devising effective marketing strategies that are oriented to underline the link between consumption of insect-based food and the associated nutritional benefit. In other terms, consumption based on cultural elements can be seen as the result of a strategic dynamic process.

Keywords: cultural bias; familiar food; food neophobia; insect-based food; nutritional value; sustainable attributes

Researchers, entrepreneurs and policy makers discuss the use of insects as food, despite the fact that in most developed countries, few insect-based foods are consumed. Food-related health challenges, nutritional value and food safety have recently received a growing deal of attention, and insect-based food consumption seems to meet these main factors as sustainable food ingredients (Belluco et al. 2013; Annunziata and Scarpato 2014; Dossey et al. 2016). In this scenario, interesting studies (Verbeke 2015; Gmuer et al. 2016; House 2016) have identified a number of factors affecting the degree of consumers' openness or acceptance of 'radical innovations', such as insect-based food, with respect to traditional national food. In Western cultures in particular, insects are not considered appropriate for consumption (Tan et al. 2017), and the likelihood of their acceptance in an ordinary diet decreases with their visibility (Hartmann and Siegrist 2016). In Italy, the phenomenon is strategically approached to analyse consumers' willingness to include insects or their derivatives in the daily menu, as researchers are aware that consumers are especially attached to the Italian culinary tradition.

In particular, even if insects are not yet available in Italian market, there are a lot of recipes and show-cooking tutorials on the web, where lovers of this novel food can find ready-to-prepare dishes. Among the others, some instance of the most surrounding recipes could be either fried grasshoppers or toasted ants served with roasted potatoes.

However, there is nothing to prevent people from creating new dishes by combining old-school kitchen based on traditional and local ingredients with these new curious, protein additions. In fact, a growing number of online blogs show typical Italian cooking courses with a range of insect meats, as witnessed by a type of spaghetti carbonara prepared with locusts instead of the usual pork jowl (Ceroni 2019).

Notwithstanding, the issue is quite controversial because an Italian study about the willingness to adopt insects as part of animal and human diets, has revealed that Italian consumers are clearly not ready to accept insects as food, whereas a major positive trend was observed regarding their use as feed (Laureati et al. 2016). This study points out the existence of a literature gap and attempts to fill it with an empirical analysis

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to investigate Italian consumers' behaviours with respect to food made with novel ingredients, specifically insects-based food. In particular, the concept of 'neophobia in itself' is rejected, while it is assumed that the causes of consumers' reactions to the novel food are to be found in cultural bias based on lack of objectivity rather than on knowledge (Johnson et al. 2013; Marshall et al. 2013).

To support this thesis, the study investigated the misalignment between what the consumer would do based on the objective attributes of the product (e.g. based on its nutritional benefits) and what the consumer would do based on his mere cognitive reaction (rejection) when he is aware of the ingredients in the product.

Specifically, to investigate consumers' judgement of novel food, in the experiment, a combination of Italian familiar food (pizza) and novel food as an ingredient (cricket flour and *spirulina algae*) was used. To get the 'revealed preferences', a questionnaire was submitted to a random sample of potential buyers using popular social media. The existence of a strong barrier to the adoption of insect-based food emerged due to the cultural distance between a country where insect-based food has already been traditionally adopted and another where it should be adopted.

TACKLING FOOD NEOPHOBIA: RELUCTANCE TOWARDS NEW FOOD OR TOWARDS 'DISGUSTING' FOOD?

Theoretical background

In recent years, one of the most investigated food issues is a phenomenon known as 'neophobia', often described as the reluctance to eat or the rejection of novel or unfamiliar food (Pliner 1994; Rubio et al. 2008; Kaiser et al. 2012).

Specifically, 'novel food' is any food that was not produced or used in the EU before May 15, 1997 when the first Regulation on novel food came into force. This category includes food originating from plants, animals, microorganisms, cell cultures, minerals, specific categories of foods (insects, vitamins, minerals, food supplements), foods resulting from production processes and practices, and state of the art technologies (e.g. intentionally modified or new molecular structure, nanomaterials), as well as food which is or has been traditionally eaten outside of the EU. The European regulatory framework for novel food is represented by the EU Regulation (EU) 2015/2283. It repeals and replaces Regulation (EC) No 258/97 and Regulation (EC) No 1852/2001 which were in force until December 31, 2017.

Some authors (Milton 1993; Knaapila et al. 2007) suggest that food neophobia is an individual behavioural characteristic with a strong genetic influence that starts during childhood because it refers to the mechanism through which the child naturally rejects potential food sources that he has no experience with (Lafraire et al. 2016).

However, for some subcategories of novel foods – such as gene-modified and functional foods – the relationship between a consumer's attitude and food neophobia may not be so straightforward (Tuorila et al. 2001).

This indicates a need to a further investigation on food neophobia in relation to food types – possibly with subcategories of novel foods.

As neophobia is based on the complex interplay of innate and acquired taste preferences, cultural norms, parental dietary preferences and eating behaviours, some studies (Dovey et al. 2008; van Huis 2013; Lafraire et al. 2016) highlight its strong cultural basis, particularly when food is of animal origin or contains insects as ingredients.

Starting from this consideration, some researchers have focused their studies on the strategies needed to reduce the cognitive bias causing neophobia. For example, repeated taste exposure lowers the cultural barrier, enhancing the preference for initially unfamiliar food and the willingness to taste other unfamiliar food (Loewen et al. 1999). In addition, information concerning the origin, the ingredients of the product, or suggesting the good taste or beneficial nutritive value of unfamiliar food tends to increase positive responses to such food (Pelchat et al. 1995). For some scholars (Looy et al. 2014; Capponi 2016), insect acceptance is a matter of presentation. In fact, in Western countries, the reduction of insects to flour, or the addition of familiar flavours, such as cacao, increases acceptance (Gmuer et al. 2016; Gere et al. 2017), while in regions where entomophagy is accepted, consumer acceptance is higher for visible insects compared to when they are invisible (Pambo et al. 2016).

Research hypotheses

The literature overview offers some hints about the research theme. Specifically, neophobia is the first cause of the rejection of novel food, and consumers' choices are driven by the information about new food nature. This concept does not represent a valid logical

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category to determine the success or the failure of an innovation in the food sector. To demonstrate this thesis, a comparison between the reaction of a panel of potential consumers to two different innovative products, was made:

i) Cricket flour – in accordance with the prevailing literature, this innovative product would be affected by a cultural bias and, therefore, could receive negative reactions by the sample investigated, which is not accustomed to consuming insect-based food.

ii) Spirulina – a vegetable – specifically, a functional food – with nutritional characteristics that are very similar to those of the cricket flour. Because it is a vegetable, this product would not be affected by the cultural bias.

If neophobia is the cause of the rejection of these two innovative food, the investigation should demonstrate a substantial indifference in the consumers' reactions.

The research hypotheses for this work are listed below:

H_{1a}: Consumer positively responds to rational benefits derived from the adoption of the innovative ingredient 1 (cricket flour), expressed in terms of nutritional value and where the ingredient's nature is unknown (Innovation Un-Knowledge condition).

H_{1b}: Consumer positively responds to rational benefits derived from the adoption of the innovative ingredient 2 (*spirulina algae*), expressed in terms of nutritional value and where the ingredient's nature is unknown (Innovation Un-Knowledge condition).

H_{2a}: Consumer expresses a negative response to the product made with innovative ingredient 1 (cricket flour) where the ingredient's nature is known (Innovation Knowledge condition).

H_{2b}: Consumer positively responds to the product made with innovative ingredient 2 (*spirulina algae*) where the ingredient's nature is known (Innovation Knowledge condition).

METHODOLOGY

The study adopted the conjoint analysis technique that is based on the preferences expressed by consumers regarding a set of alternatives as a combination of attributes (Carroll and Green 1995; Hauser and Rao 2004). It consists of breaking down a product or service into useful values that are different in each product/service characteristic, through which global preferences can be expressed (Green and Srinivasan 1978; Green et al. 2001). Starting from the consumers' opinion with regards to the different product profiles, the conjoint analysis determines the importance of the different attributes in the consumer's choice, simultaneously evaluating the best alternatives (levels) among those proposed for each characteristic adopted.

The undisputed advantage of this technique consists of aligning the theoretic decision-making process with the rational decision-making process put in place by the consumer when choosing the product to be purchased. The respondent formulates his judgments with respect to the product profile, not specifying his preferences on each attribute that characterises it or on each product as a bundle.

Sample and questionnaire survey

To better understand the Italian consumers' attitudes and to get the 'Revealed Preferences', a questionnaire survey was distributed using popular social media (Academia.edu, LinkedIn, Twitter and Facebook's personal and academic pages) to a random sample of Italian potential customers. With a random sample, the channels used to submit the questionnaire influence the composition; however, it offers interesting insights for the scientific community.

In particular, the sample shows a good distribution of the gender item, while the vehicle of delivering of the survey questionnaire (web-based) affects the age one. In particular, the sample can be described as follows: the largest proportion is aged 18 to 25 years (43%); around 16% is aged 26 to 35 years; 20% is aged 36 to 45 years; 15% for 46 to 55 years, and only 6% is over 56 years old.

Therefore, the sample is characterised by young age and a high education level. The questionnaire was structured in three sections (https://goo.gl/forms/RAl9jtYVYduD3AcM2): the first section presents general information and descriptive items, and the second and the third sections present 15 comparisons among pairs. In particular, between the second and third sections, the hidden ingredients are shown and a filter question is brought to the attention of the respondent: 'Now that you know the secret ingredients, do you want to review your choices?' In fact, although the second section includes the 15 pairwise comparisons in the 'Innovation Un-knowledge condition' of the nature of the ingredient, the last section presents the same pairwise comparison in the 'Innovation Knowledge condition' of ingredient nature, and only those respondents willing to review their previous answers have access to it.

The findings are based on 587 (of the first and second sections, with hidden ingredients) and 175 (of the third section, with the ingredients showing) correct and com-

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plete answers collected in 15 days. It should be noted that the number of respondents who reviewed the answers corresponds to about 30% of the total respondents.

Pizza as a bundle of attributes submitted for evaluation

To facilitate a consumer's attitude formation and his decision-making with regards to the product profiles, the study aims to investigate the willingness to consume a 'familiar' food, such as pizza, made with innovative ingredients.

This product choice is motivated by the fact that pizza is a widely known and consumed product in Italy, it is also well-known abroad and because the scientific debate suggests that the exposure to familiar food made with an unfamiliar ingredient 'may enhance the familiarity with the novel ingredient increasing the likelihood of repeating the behaviour in the future' (Menozzi et al. 2017).

Different varieties of pizza made with 'alternative' ingredients, either derived from insects or from functional ingredients, were submitted to the random sample of consumers. Each pizza-product combination represented a basket of attributes – protein, carbohydrates, fat, and price – starting from their ingredients – Protected Designation of Origin (PDO) mozzarella cheese, PDO San Marzano tomato (in all combinations), flour 00, gluten-free flour (healthy food), cricket flour (insect-based food) and *spirulina algae* (functional food).

In particular, cricket flour and *spirulina algae* are two innovative ingredients that are eco-sustainable and hygienically safe food for humans, although they are extremely expensive. At the same time, their nutritional values are characterised by high protein content and low fat.

As a difference, although cricket flour is typically mixed with other flours (to increase the protein content of the preparation), the *spirulina algae* flour could be used as an additional dietary ingredient.

With particular regard to the *spirulina algae*, it is possible underline that this ingredient is classified as a novel food. In recent years, *spirulina algae* has become very popular due to its nutritional characteristics. Scientifically proven, spirulina contains 65–71% complete protein, that is the highest amount of proteins found in any naturally-cultivated food ingredient in the world (Piccolo 2012).

For its characteristics, the spirulina market shows growing trend. According to Persistence Market Research (2019), over 128 000 tons of spirulina were globally consumed in 2016. Increasing applications of spirulina as a core ingredient in production of food and beverages, animal feed and nutraceuticals will continue instrumenting the growth of global spirulina market: through 2026, the global spirulina consumption will account for sales of more than 321 000 tons.

In the years to come, spirulina will continue to be in great demand across several regions in the world. In Italy the spirulina consume trend is growing: in 2017 it has increased by 8.2% compared to 2016; 2018 shows an increase of 24.5% on the launches of superfood based products. Growing awareness about nutritional benefits of spirulina serves as a key driver for the market's growth.

Specifically, because the *spirulina algae* is a novel food, its use in the structure of this empirical research is aimed to demonstrate how neophobia does not represent a valid logical category for the success or failure of innovations in the food field (H_{1b}; H_{2b}).

An innovation produces certain emotional reactions (positive or negative) due to the sign (positive or negative) of the association with the basis of the individual's culture. This associative result is also called the 'ideomotor effect' and is due to the fact that each individual considers the consistency between the stereotypes (i.e. what is right or wrong, good or bad) and what he experiences in everyday life (Morewedge and Kahneman 2010).

To test the research hypotheses, it is useful to point out the different alternative pizza-product combinations and the specific nutritional benefits of the different types of flour (Table 1). In particular, cricket

Table 1. Flours nutritional values

Ingredient	Quantity (g)	Protein (g)	Carbohydrates (g)	Fat (g)
Flour 00	100	9.71	76.22	1.48
Flour gluten free	100	2.80	83.00	0.20
Cricket flour	100	58.36	0.80	2.00
Spirulina algae	100	57.00	24.00	8.00

Source: our elaboration

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Table 2. Product-pizza profiles

Profile	Flour	Mozzarella cheese	Tomato	Protein (g)	Carbohydrates (g)	Fat (g)	Additional ingredient (spirulina)
P1	00	PDO	PDO	29.730	168.69	14.176	no
P2	00	PDO	PDO	32.850	170.09	14.576	yes
P3	gluten free	PDO	PDO	14.536	183.72	10.486	no
P4	gluten free	PDO	PDO	17.386	184.92	10.886	yes
P5	cricket	PDO	PDO	35.576	160.45	15.124	no
P6	cricket	PDO	PDO	38.426	161.65	15.525	yes

PDO – Protected Designation of Origin

Source: our elaboration

flour and *spirulina algae* (called 'additional ingredients' in Table 2) are combined.

From the combination of attributes, six (6) different pizza-product profiles (from a total of 72 potential combinations) were obtained (Table 2). The pizzas containing cricket flour are the P5 and P6 profiles. The difference between them depends on the presence of the additional ingredient (*spirulina algae*).

Analysis model

Each prolife was compared with the others, obtaining a total of 15 comparable couples. Thus, a respondent asked for his preferences from among the two profiles could have chosen a profile by using this ranking scale:

– Surely the Profile X $\left[CodeS_{p_X}\right]$

– Oriented to Profile X $\left[CodeO_{p_X}\right]$

– None of them [no value]

– Oriented to Profile Y $\left[CodeO_{p_Y}\right]$

– Surely the Profile Y $\left[CodeS_{p_Y}\right]$

Starting from Table 2 and coherently with the adopted ranking scale, the part-worth scores for each profile and attribute were calculated, where 'Surely to Profile' has a double weight compared to the 'Oriented to Profile':

$$Score\_Profile_{n,i} = \sum_{n=1}^{6}\sum_{i}\left(CodeO_{P_{n,i}} + 2 \times CodeS_{P_{n,i}}\right) \quad (1)$$

where: n – pizza profile; i – respondent; $CodeO_{p_{n,i}}$ – 'Oriented' preference for Profile n on the ranking scale; $CodeS_{p_{n,i}}$ – 'Sure' preference for Profile n on the ranking scale.

The utility (part-worth or *Score_Attribute*) of a single attribute/level is the sum of the part-worths for those specific configurations in which the attribute is.

The empirical research was carried out to verify which predictors/factors would affect the behaviours of consuming food made with innovative ingredients. In particular, the reference is just to the production of insect-based food.

The research also tried to verify whether and to what extent the insect-based food resistance referred to intrinsic characteristics of the product or to aspects of other natures (mainly psychological and cultural) exists. For this purpose, the empirical research verified the Revealed Preferences referred to the different pizza profiles before and after sharing the information about the innovative ingredient's nature and, therefore, of the additional ingredients' natures.

FINDINGS AND DISCUSSION

The empirical research was structured in two phases: the first foresaw that the consumer would decide which pizza profile to consume in the 'Innovation Un-knowledge condition' of the ingredients; the second phase envisaged that the consumer could choose to review his choices once he was aware of the ingredients' natures. After the data collection and coding process, the data were ready for the statistical analysis. For the analysis, the IBM SPSS statistical package was used.

The results of the comparative analysis between the profile scores before and after revealing ingredients is in Table 3.

The first survey compares the profiles chosen by the respondents before knowing the nature of the innovative ingredients used to make the pizza–product profiles. This elaboration – in the Innovation Un-knowledge condition of ingredients – reveals how the product profiles most chosen by respondents are P1 and P5. The traditional product remains

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Table 3. Product-pizza profile's score before and after revealing ingredients

Profile's score	Before		After	
	mean	standard deviation	mean	standard deviation
P1 (pizza with flour 00)	5.0819	2.65	3.7895	2.49
P2 (pizza with flour 00 and spirulina)	3.4327	2.42	4.5439	2.97
P3 (pizza with gluten free flour)	4.0409	3.00	3.2164	2.51
P4 (pizza with gluten free flour and spirulina)	2.9474	2.69	3.5322	3.00
P5 (pizza with cricket flour)	4.7368	3.06	2.0351	2.69
P6 (pizza with cricket flour and spirulina)	2.3041	3.05	2.0994	3.25

Source: our elaboration

the most chosen, followed by the innovative product. This first result could point to the confirmation of H_{1a}: the product is widely chosen by the respondents in the Innovation Un-knowledge condition. This response should not be underestimated; in fact, it is highly probable that this choice is linked to the higher protein content of the configured product.

At the same time, the least-chosen product profile is P6, which corresponds to the totally innovative product made with both cricket flour and *spirulina algae* (Table 3 – before).

After the revelation about the type of innovative food (ingredients) and their characteristics – in Innovation Knowledge condition of ingredients – the analysis recorded a high rate of respondents' rethinking (about 30% of respondents) (Table 3 – after).

The respondents' attitudes suggest the behavioural change of the potential consumer, which can be understood as a different degree of openness towards the innovative product. In fact, in this second case, the preferred product profile is P2; the second selected product profile is P1. The most relevant aspect is that, contrary to the results obtained before the revelation, the least-chosen product profile is P5, while the most-chosen product profile was obtained by adding the additional ingredient (*spirulina algae*) to a traditional pizza. The results obtained verify H_{2a} and H_{2b}. The respondents changing their choices emphasises an actual consumer's substantial attention to psycho–physical well-being, which leads to a conscious choice. This condition pushes the conscious consumer to associate the added value of a functional component to the traditional product; his choice is the P2 profile.

Consumers changing their choices is even more evident with regards to the product profile containing cricket flour (P5). It is highly likely that renouncing an unconsciously chosen product is linked to the sense of disgust/aversion towards insect-based food, to the extent to which consumers prefer gluten-free wheat, characterised by low-nutrition and high-carbohydrate flour.

The second step of the analysis provides a comparison of the different options of choice while taking into account the attributes of the product profiles (Table 4). In this case, the consumers' possible rethinking with respect to the chosen option before and after the revelation about the innovative product attributes was investigated.

The responses previously obtained were confirmed in this investigation based on the attributes of the product profiles. In fact, the respondents, before knowing the attributes of the adopted innovative food, were willing to buy and consume a pizza with flour 00, more carbohydrates (165 g), a greater amount of protein (about 34 g) and a lower amount of fat.

The responses based on nutritional attributes, after the revelation about the innovative products, confirm the findings recorded in the first step of the analysis. The traditional consumer is adverse to cricket flour, while the consumer who is attentive to their lifestyle opts for a product with high protein value and a low level of carbohydrates (pizza with the addition of *spirulina algae*).

The verification of the research hypotheses supports the following thesis: the low willingness to eat insect-based food of Italian consumers is not due to neophobia, but to the adoption of an anchored behavior. In fact, if neophobia were the unique driver in the decision-making process of the consumer, the product profile P2 after the revelation would have registered the same trend inverse to consumer preferences of the product profile P5. This did not happen; instead, the opposite condition was verified. The respondents showed increasing attention to the product profile P2, probably due to the benefits derived from the use of additional

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Table 4. Attributes score before and after revealing ingredients

Attributes*	Before		After	
	mean	standard deviation	mean	standard deviation
ATT01_Flour 00	8.5146	3.86288	8.3333	4.14729
ATT02_GluFree	6.9883	4.89536	6.7485	4.50633
ATT03_Cricket	7.0409	5.08673	4.1345	5.33573
ATT04_Spirul	8.6842	4.80499	10.1754	6.16095
ATT05_Car165	1.5556	5.76002	12.4678	5.71508
ATT06_Car184	6.9883	4.89536	6.7485	4.50633
ATT07_Prot16	6.9883	4.89536	6.7485	4.50633
ATT08_Prot34	15.5556	5.76002	12.4678	5.71508
ATT09_Fat11	6.9883	4.89536	6.7485	4.50633
ATT10_Fat15	15.5556	5.76002	12.4678	5.71508

*ATT – different attributes of the six product profiles (01 – flour 00; 02 – gluten free flour; 03 – cricket flour; 04 – *spirulina algae*; 05 – carbohydrates 165 g; 06 – carbohydrates 184 g; 07 – protein 16 g; 08 – protein 34 g; 09 – fat 11 g; 10 – fat 15 g)

Source: our elaboration

ingredients (as 'functional' novel food). That is to say that Italian consumers show a tendency to decide based on a cultural reference. The decision-making process, in this case, tends to neglect absolutely cognitively rational or emotionally impulsive aspects in favor of adopting 'mental shortcuts' linked to cultural assumptions.

CONCLUSION

Actually, the paper does not focus at all on any kind of willingness to eat, to consume, to pay, that could be valuable objectives of future research. The study has highlighted that neophobia in itself does not exist because it depends on the nature of the novel food rather that on the 'novelty' of food.

Specifically, the analysis revealed a clear reticence of consumers about the consumption of insect-based food in prevalent literature called entomophagy. On the contrary, consumers show increasing attention to functional food and to their physical well-being. This is the reason why we have compared pizza made with spirulina algae flour and pizza with 'cricket' flour. At the same time, the survey has a number of limitations. First is the random composition of the sample, which was influenced by the channels used to submit the questionnaire. Furthermore, with respect to the content of the questionnaire, the sustainability attributes associated with the ingredients made with insects were not communicated to respondents. This is of relevance, given the role of sustainability-sensitive consumers regarding novel food and the acceptance of food made from insects. In addition, we are aware that the use of a survey has the major disadvantage of hiding the difference between the stated and revealed preferences. However, considering that these products are not on the Italian markets yet and our interest in investigating the factors (drivers and barriers) that affect the consumption of novel food, the only way to achieve reliable results was to elicit the stated preferences.

The suggestion to send the ingredients to food sector operators who want to win over consumers with innovative products consisted of developing food products close to the western dietary pattern or modifying Italian traditional food products while signalling, through the communication process, the positive effects of their nutritional value. In this way, consumers are positively introduced to trying a new product.

In fact, if willingness to eat insect-based food depends on adopting mental shortcuts linked to cultural assumptions, it is suggested that the practitioners invest in a gradual strategic process aimed at putting one small segment of society in contact with new food first. This should be done before diffusing the new food products further through adopting educational campaigns to make people more conscious about eating insect-based food.

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