Consumer approach to insects as food: barriers and potential for consumption in Italy

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1. Introduction

The use of edible insects for human nutrition is gaining much attention in the debate about food security and the environmental challenges of food production. Indeed, while the growing world population demands more food production, intensive livestock production and over-grazing are the source of a major pollution of land and water, leading to forest degradation and, at the global level, strongly contributing to climate change. Domesticating and rearing insects can help tackling the challenge of food security in the next future while also limiting the environmental impact of human activities related to food production (van Huis et al., 2013).

While the European Commission is strongly supporting the research on new protein sources within the H2020 program (https://ec.europa.eu), considerable scientific work concerning the nutritional value of edible insects, compared to traditional protein sources, is already available (Bukkens, 2005; Finje, 2002; Rumpold & Schluter, 2013a; Womeni et al., 2009; Xiaoming et al., 2010). On the environmental side, the production of insects for human consumption, when compared to livestock production, implies lower greenhouse gases emission, lower nitrogen compounds production and nearly any rearing discard (Oonincx et al., 2010; Oonincx & De Boer, 2012). In the countries where they are commonly eaten, insects play an important role in the local diets. In these countries there are already some basic, but efficient, rearing systems that could represent the basis to start studying rearing techniques for insects production and processing all over the world.

One of the main challenges of the diffusion of entomophagy in Europe is to improve consumer acceptance of insect-based food products (Rumpold & Schlüter, 2013b). Indeed, although entomophagy is a common habitude in many countries of the world (mostly located in Africa, Asia and Latin America), it is still looked at with some prejudice in Europe as well as in other industrialized countries, where major attitudinal barriers to entomophagy have been identified (Lensvelt & Steenbekkers, 2014). Studies carried out in countries with different cultural exposure and individual experience with insects showed that curiosity is the main driver pushing consumers to try insect-based food preparations where entomophagy is uncommon (Yen, 2009). Contrarily, familiarity with insects has a key role in shaping consumers' preference in the countries where insects are largely consumed as food (Tan et al., 2015). In Western societies, insects are still viewed as pests by a large majority of the people (Van Huis et al., 2013) and they are associated with a sense of dirty, disgust and danger (Looy et al., 2014). This attitude is far from being overcome, rather some reluctance to insect consumption was recently noticed even in countries where insects are traditionally eaten: for instance, the consumption of insects is now decreasing in Botswana (Obopile & Seeletso, 2013), in India (Chakravorty et al. 2013) and in Cameroon (Sneyd, 2013), probably due to the willingness of the people to emulate the food habits of Western societies and to reject the image of insect-eating as a "*primitive peoples' practice*" (Verbeke, 2015).

Several experiments were conducted in Western countries to study the drivers of consumers' preference for these products. Within a wider analysis on meat substitutes in the Netherlands, Schösler et al. (2012) found that consumer acceptance of insect-based meals was lower when insects were visible, whereas the use of insect-derived protein in other preparation (e.g. a fictive pizza) was rated more positively. This suggests that the view of entire insects may induce to the consumers a sense of disgust linked to the "Western feeling" of insects as pests. However, among different types of environmental-friendly proteins proposed to Dutch consumers, the insect-based ones were found to be the least popular (de Boer et al., 2013). The readiness of Belgian consumers to adopt insects in their diet was also studied with negative results, as a very low willingness to consume insects was observed, even among the people with higher environmental awareness (Vanhonacker et al., 2013). In contrast, sensory studies conducted in Belgium and in The Netherlands showed that the taste of insect-based preparations was well accepted by consumers that had already declared their interest towards entomophagy or to healthier dietary patterns (Megido et al., 2014; Elzerman et al., 2013).

The discrepancy between attitudes and behavior (Padel & Foster, 2005; Magnusson et al., 2001; Vermeir & Verbeke, 2006) may even lower the actual willingness of consumers to taste and purchase insect-based

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products. Indeed, it is likely that a certain gap between the intention to eat insects and the actual purchase of insect-based products exists, even among the consumers who have declared an interest towards entomophagy. Such gap may be particularly relevant for products with sustainable attributes, as consumers have to face the contrast between ethical and individual aspects (Vermeir & Verbeke, 2006).

Despite the general reluctance of Western consumers to include insects in their diet, some first niche markets for insects as food are developing (van Huis et al., 2013). Namely, there seem to be opportunities to introduce insects in the diet of Western consumers as a delicacy or as an ingredient in convenience foods (Schösler et al., 2012). Indeed, insect-based delicacy are served in an increasing number of restaurants (Verkerk et al., 2007) and insect-based recipes are starting to be reported in cookery books and are promoted by dedicated insect food festivals (Verkerk et al., 2007; Cunningham & Marcason, 2001).

In Italy as well, a certain interest in entomophagy has raised both among researchers and practitioners. Not by chance, entomophagy was the theme of the annual meeting of the Italian Academy of Entomology in 2015, where the discussion focused on the way insects are farmed (Colombo, 2015; Bellozza & Saviane, 2015), the features of the few firms that have already started to produce insects in Italy (Valvassori, 2015) and the challenge of food safety in insect based production (Belluco et al., 2015). Other signs of attention towards this topic are the financing – e.g. through the Rural Development Programs, 7th Framework Program and local foundations – of projects related to the exploitation of insects for food production (Valvassori, 2015) and the start of some businesses related to insects rearing, such as Microvita (insects for animal breeding and fishing purposes, www.microvita.bo.it), Italbugs (production of extracts and active compounds from insects, www.italbugs.com), Diptera (insect-based foods for pet feeding, www.dipteranutrition.com) and Smartbugs (insect-based foods for pet feeding, www.smart-bugs.com).

All these initiatives gained more attention in the context of the EXPO 2015 held in Milan, where food security and food innovations were the key themes of the exhibition. However, a gap of knowledge exists about the willingness of Italian consumers to accept insect-based products in their diet. The only study tackling this issue is Sogari (2015), where a tasting experiment on 46 Italian individuals participating to a "bug banquet" event was conducted. Consistently with other studies conducted in Europe, the results indicated that insect's taste was generally well accepted, although most of the respondents stated that entomophagy would not be accepted by family and friends. However, participants were self-selected within an event focused on entomophagy, thus it is likely that they were more open to eating insects than the average population. Instead, in order to evaluate the acceptance of insect-based products on the market, a better understanding of "ordinary consumers" attitude towards entomophagy is envisaged (Verbeke, 2015).

Within this context, the aim of this research was to explore the willingness of Italian consumers to taste insect-based products in order to profile a potential target for marketing insect-based products. This study has thus a twofold implication. On the one hand, we wish to understand whether the approach to entomophagy in Italy is consistent with the evidences observed in other European countries. On the other hand, we aim to explore the drivers of insect-based products acceptance by Italian consumers.

Now the question is: why should it be relevant to know what's happening in Italy with respect to entomophagy? We are convinced that, since entomophagy is destined to start as a niche market, it should concern as many countries as possible, to make it a sustainable business in economic terms as well. Instead, the research on consumer acceptance of insect-based products, despite it started as much as 10 years ago, is still concentrated in The Netherlands and in Belgium. We believe that to widen the analysis to other European countries may fasten the understanding of the potential market, thus highlighting whether entomophagy can actually be promoted on the market as "*the food of the future*" (Sogari, 2015).

2. Materials and methods

2.1 Data collection and sample

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Data were collected during an exploratory survey held in the town of Viterbo, 66,000 residents in Central Italy. Even if carrying out the survey in only one town is limiting, we judged it appropriate for a first study on the topic. We chose a medium-sized town because in Italy there is a long-standing trend of migration to medium-sized urban centres (50,000 to 250,000 residents), which can thus be considered, although with some caution, more representative than metropolitan areas (Alvisi et al., 1996). The survey was conducted during 4 days in February-May 2015 at the main shopping mall of the city. The mall includes 43 stores, among which one hypermarket; it is very popular among the local citizens and people with very different social and cultural features visit it. We thus considered that an appropriate sample of the people entering the shopping mall would have provided a good representation of the local population.

Respondents were selected through a systematic sampling technique; it is widely used in consumer behaviour research and it provides a probabilistic sample of consumers, so that the results may be more easily generalised (Rödiger & Hamm, 2015). Starting from the opening time of the mall (9.00 a.m.), customers were systematically chosen by approaching, every 5 minutes, the first consumer entering the mall and proposing him/her to participate in the survey; if the answer was negative, the second consumer was approached and so on, until a positive response. In this way, all the people entering in the mall had the same probability to be selected in the sample. In order to avoid self-selection, while approaching the customers the interviewers did not mention that the survey was about entomphagy, rather it was introduced as "a survey on food habits". When a couple or a group was sampled, it was specified that only one person should answer to the questions, so that interrelation among the respondents was minimal.

Sampling was stopped as the target sample size of 200 was reached. The only constraint to the selection of the sample was the age: only consumers older than 14 years were approached.

2.2 Questionnaire

The questionnaire was made up by selecting the items that, in previous studies on entomophagy, were found to be significant for insect consumption. It comprised 14 items, divided into 3 sections (see Appendix for the whole text of the questionnaire).

The first section included 6 items concerning food purchasing and eating habits of the consumers: types of animal proteins most often consumed (Elzerman et al., 2013), drivers of food choice (Verbeke, 2015), frequency of meals away from home and at ethnic restaurants (Tan et al., 2015)[1]. A question on the appreciation of unusual foods (snails, offals, frogs) was added to check for food enophobia (Verbeke, 2015). Most of these questions requested consumers to provide their answers in a Likert scale from 1 to 5.

The second section included 4 closed-ended questions and it was focused on the attitude towards the consumption of insects. Here, consumers were asked whether they had ever eaten insects and, if not, five pictures of insects-based preparations were shown and respondents had to state whether they would be available to taste them. Namely, the first picture was an insect-based preparation comparable to sushi made with different species and stages of insects (both larvae and adult); the second one portrayed a street food stand with different types of fried insects; skewers with pupae were the focus of the third picture; the fourth image showed a plate with some larvae and pupae with some vegetables (some respondents reported that it looked like a very healthy dish); the last one was a meat burger with some larvae on the top (some respondents argued that seeing larvae together with meat gave them a sense of rank food). The choice of pictures where the whole insect was visible followed the need to understand whether the respondents could overcome the common sense of disgust linked to entomophagy; in this way, we meant to reduce the attitude-behaviour gap, under the hypothesis that who stated to be ready to eat one of the proposed insect-based preparation was more likely to be really willing to do so.

[1] The definition of ethnic restaurant was not specified in the questionnaire as they are generally meant as restaurants where typical dishes from a foreign country are served. In the unlikely case the respondent did not understand the question, some examples were provided, mentioning Chinese, Mexican and Lebanese restaurants as examples.

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Afterwards, both consumers who had already eaten insects and those who had not were asked to evaluate the importance of 4 possible barriers to insects' consumption, that had already been found to be significant in previous studies conducted in Western countries (Schösler et al., 2012; Verbeke, 2015; Megido et al., 2014).
The final section was made up of 3 closed-ended questions aimed at defining the demographic profile of the respondents, in particular asking about their age, gender and degree of education.
Within the questionnaire sheet, there was some place for interviewers to take note of any comment provided by the respondents and/or aspects that might have an influence on their response, e.g. whether they were foreigners.
The questionnaire was administered through face-to-face interviews.

2.3 Data analysis

The sample consisted of 201 observations, 55% of which were females, with an average age of 43 years old; the youngest respondent was aged 14 whilst the oldest was 78 years old. About one third of the respondents had a university degree, a quite high figure compared to the Italian national average (about 10%; www.istat.it). This difference may be explained with the stronger interest that highly educated people may have with research and surveys in general. Three of the respondents were employed at the University located close to the mall. Two of the respondents were farmers. Three migrants were included in the sample; they all came from Eastern Europe, thus none of the respondents had family ties to Asia, Africa or Latin America, where entomophagy is a tradition.
The descriptive statistics of the sample are presented in Table 1.

Table 1 – Descriptive statistics (*n=201*)

With regard to the food purchasing behaviour of the sample, taste and nutritional value turned out to be the most important cues that consumers take into account in the buying decision, while the least important is the preparation time. Consumers declared to eat an average of 2.4 meals per week outside home, to buy organic products rather often (2.9 on a 5-point Likert scale) and to rarely go to ethnic restaurants (1.6 on a 5-point Likert scale). Ten respondents (5% of the sample) declared they had already eaten insect-based products, although most of them tried these products during travels abroad and did not consume insects on a regular basis. All the other respondents were asked whether they would be willing to try insect-based food products: fifty-three (26% of the sample) answered positively. These information were combined in order to get a variable "Willing" describing the willingness of consumers to try insect-based products, with 31% of the sample with a positive attitude towards eating insects and 69% of the sample rejecting the idea of entomophagy. The two main barriers to insect consumption were the idea that food safety is not guaranteed in insect-based products, as well as the appearance of the insect-based preparation. Consistently, the least preferred option among the insect-based preparations shown to consumers was the burger with larvae.

2.4 Statistical analysis

The data on the 201 observations were inputted in a Microsoft Excel database and the statistical analysis was performed with the XLStat software.
Following Verbeke (2015), the attitude towards insect consumption was analysed as a binary decision (yes: having already eaten insects or declaring to be willing to do so; no: declaring not to be willing to try insects). This choice is justified with the evidence that the insect-based products are not common in Western countries, thus the focus of the analysis is to study the willingness of consumers to taste them for the first time (Verbeke, 2015).
To explore the drivers of the consumers' inclination to eat insects a binary logistic regression model was used. In the model, the binary dependent response y_i for the respondent i takes a value of 1 if the respondent i stated he/she would like to try insects as food or he/she declared to have already tried insects, whereas y_i

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takes a value of 0 if the respondent stated he/she was not willing to try insects. This choice is assumed to depend on a set of explanatory variables including: gender, education, main animal protein in the diet (expressed as categorical variables introduced by means of dummy variables), age, cues observed in food choice, number of meals out of home, frequency of buying organic products and of attending ethnic restaurants, appreciation of unusual foods, perception of barriers to insect consumption (expressed as quantitative variables). The logistic regression was thus used to assess the association between the selected factors and the positive inclination of the consumers to eat insects. Indeed, the probability of success $p_i = P(Y_i = 1|x)$, representing the probability that an individual is willing to try insects as food, can be modelled as (Hosmer & Lemeshow, 2013; Malhotra, 2010):

$$\ln\left(\frac{p_i}{1-p_i}\right)=z_i=\beta_0+\sum_{k=1}^{K}\beta_k x_{ki}+\varepsilon_i$$

where: x_{ki} is the explicative variable *k* (k=1, … K) observed for the individual *i* (i=1, … N); $\beta_0, \beta_1, \ldots \beta_k$ are the coefficients to be estimated; ε_i the error term.

For the single observation *i*, the empirical specification of the model is thus:

$$\begin{aligned}\text{Willing}_i=&\beta_0+\beta_1\text{AGE}_i+\beta_2\text{FCprice}_i+\beta_3\text{FCtaste}_i+\beta_4\text{FCprep}_i+\beta_5\text{FCnutr}_i+\beta_6\text{FCnewp}_i+\beta_7\text{Mealout}_i+\beta_8\text{Buyorg}_i\\&+\beta_9\text{Ethnic}_i+\beta_{10}\text{APPoffal}_i+\beta_{11}\text{APPsnail}_i+\beta_{12}\text{APPfrog}_i+\beta_{13}\text{BAappe}_i+\beta_{14}\text{BAtaste}_i+\beta_{15}\text{BAtext}_i\\&+\beta_{16}\text{BAsafe}_i+\beta_{17}\text{EDUsec}_i+\beta_{18}\text{EDUuni}_i+\beta_{19}\text{Gmale}_i+\beta_{20}\text{APveg}_i\end{aligned}$$

Among the parameters of the model, we looked at the β values and at the significance of each factor. The significant factors were then interpreted according to the odds ratio, which shows the increase (decrease) of the probability to be willing to try insects when the variable increases (decreases) by a unit.

3. Results

3.1 Descriptive statistics

Nearly two-thirds of respondents declared that the main animal protein in their diet is meat or fish, whilst one-third of the sample stated that mainly consumed dairy products, eggs or even that did not consume any type of animal protein (2% of the sample). Taste and nutritional values were the cues that respondents rated as most important in food decision, with a respective average evaluation of 4.6 and 4.3 on a 1-to-5 scale.

The correlation analysis (Table 2) showed that attention to price was negatively correlated with the number of meals consumed out of home (-0.149) and with the frequency of buying organic products (-0.234). The age of the respondents was negatively correlated with the attention to novelties (-0.180), whereas it was positively correlated with the attention to preparation time (+0.266) and nutritional values (+0.273). Older respondents were also found to be less likely to have meals out of home (-0.277) and to go to ethnic restaurants (-0.174).

Table 2 – Correlation matrix

As for the barriers to insect consumption, Figure 1 shows the ranking given by the respondents to the four issues that may discourage entomophagy. In general, the four variables were positively correlated to each other. However, older respondents ranked higher the issue of safety (correlation +0.159), whilst those who consume many meals out of home ranked it lower (-0.139), showing less concern for the safety of insect-based products. The familiarity with ethnic foods was also found to be able to decrease respondents' perception of the barriers to insect consumption. Namely, the higher the frequency in ethnic restaurants, the

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lower insects' appearance, taste and safety were perceived as disincentives for eating insect-based products (correlations coefficients are, respectively, -0.149, -0.184, -0.222).

Figure 1 – Respondents' evaluation of the barriers to insect consumption

Appearance was rated as the most important barrier to insect consumption, with an average ranking of 4.19 on a 1-to-5 Likert scale, where 1 corresponds to "it is not discouraging at all" and 5 corresponds to "it is strongly discouraging". Respondents also showed to be uncertain of the safety of insect foods: this issue was rated 4.18 on average. Instead, taste and texture (with an average evaluation of, respectively, 3.60 and 3.90) seemed to be relatively accepted by consumers. Namely, almost half of the respondents rated taste with a 1-to-3 score, showing that most consumers did not have prejudices about this issue.

Some respondents mentioned the importance of traditions and food habits on their acceptance of insect-based food products. Indeed, one respondent said "*if I was born somewhere in China and I had been eating insects since I was a child, I would certainly like them*"; another one instead mentioned that "*if I was travelling in a country where typical dishes contain insects, I would certainly taste them*"; as for the willingness to eat uncommon products, two respondents mentioned that they love snails because they are part of the local food tradition, whilst insects are not. Two respondents were vegetarian and another one was vegan, they all disliked the general idea of eating animals.

3.2 Logistic regression model

The model regression showed a R^2 (McFadden) of 0.403 and the Hosmer-Lemeshow statistic confirmed that the model fits well the data, as the test was not significant (p=0.451) (Hosmer & Lemeshow, 2013).

The parameters of the model are reported in table 3.

Table 3 – Parameters of the logistic regression

Going to ethnic restaurants highly increased the probability to be willing to eat insects. Namely, every additional score given on the 1-to-5 Likert scale increased such probability by 2.27 times. Instead, feeling the appearance of the insect food as a barrier was able to decrease such probability by (1-0.669) = 0.331 for each unit of the given score[2]. A similar effect was recorded for taste, while the parameters of texture and safety were not significant.

In interpreting such results, it should be noted that, treating the Likert scores as quantitative variables, an unitary distance among the five scores of the scale is assumed. Namely, it was hypothesised that the difference among 1 and 2 is equal to the difference among 2 and 3, which might not always be the case. However, in order to minimize this bias, which is quite common using Likert scales, in the questionnaire the scores were accompanied by a semantic explanation (see the text of the questions reported in the Appendix).

Interesting results also concerned the demographic variables. Education showed an important role in shaping responders' willingness to eat insects. Indeed, consumers owning a university degree had a probability 8.37 times higher than those with a lower education to be willing to try insects. Finally, men were more likely to be open to insect consumption: namely, the probability they showed is 2.55 times higher than women.

4. Discussion and conclusions

Our survey reports that 31% of the respondents were willing to try insects. Similar studies conducted in other European countries report diverse figures: Vanhonacker et al. (2013) found only 5% of consumers willing to try insects; Megido et al. (2014) reported that 78% of the study participants claimed to be "really interested

[2] When odds ratio < 1 the increase/decrease in the probability is calculated as (1-odds ratio) (Hosmer & Lemeshow, 2013)

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in eating insects"; Verbeke (2015) found 19% of respondents being "willing or ready" to adopt insects as a meat substitute. This high variability among these results can be explained with the different way the researches were organized. Indeed, Megido et al. (2014) interviewed self-selected consumers, which might have had a positive attitude towards entomophagy, whilst the study by Vanhonacker et al. (2013) was conducted before the growth of the general interest on the idea of using insects as a meat substitute. The results observed in our study, which were probably beyond our expectations, might have been influenced by the event of the EXPO 2015 held in Milan in the same period of the survey, which pushed the discussion over the social and environmental sustainability of the Western diets. Within this discussion, entomophagy was directly addressed in several events preceding the exposition as well as during the EXPO.

As we expected, consumers familiarity with food from other countries – here measured through the frequency of ethnic restaurants – had a positive effect on their willingness to try insects, which, in Western cultures, are actually perceived as an unfamiliar food item. This was consistent with the findings of Tan et al. (2015) that investigated individual perception of insects-based food in countries with different cultural exposure with regard to this issue.

In our analysis, insects' appearance was one of the main barriers to entomophagy. This was consistent with the results obtained by Schösler et al. (2012) in the Netherlands, where consumers' acceptance of insect-based meals was lower when insects are visible. In the survey conducted by Elzerman et al. (2013) in the Netherlands, insects' appearance was also listed among the negative aspects of insect-based meat substitutes. De Magistris et al. (2015) reported that consumers are not willing to pay for a product with a visualized insect. Italian consumers as well may then more easily accept insect-based food if insects are "invisible" in the final preparations.

Respondents of our sample also claimed to be discouraged to try insects because of their taste, in contrast with some sensory studies conducted in Belgium that showed a wide acceptance of the taste of insect-based preparations (Megido et al., 2014). However, in our study consumers did not actually taste the insects, so their ranking was only based on their expectations, which might be influenced by many social and psychological factors.

The role of socio-demographic factors in shaping the acceptance of insect-based food is not clearly defined in the literature. In our research, high education came out as a strong factor improving the likelihood of willing to try insects. Males were more likely to try insects as well. Instead, age was not significant. In the recent study by Verbeke (2015), none of these factors showed a significant effect over insects' acceptance, although some of them were associated with food neophobia in previous studies (e.g. Siegrist et al., 2013). In the Italian case, the link between education and willingness to eat insects may be explained with the stronger environmental awareness that high educated people usually have, with respect to the less educated. Instead, we could not really find a consistent explanation for men being more ready for entomophagy than women. We can may be explain the significance of gender considering that in Italy, like in other Mediterranean countries, women have a very high commitment to housework activities, among which cooking (Eurostat, 2008); they could therefore feel the introduction of insects in the diet as an issue in the household management.

Although several results were consistent with previous studies carried out in other countries, it seems that the degree of familiarity of Italian consumers with entomophagy is still very low. Demographic aspects, such as gender and education, appear to play a significant role in insect-based food acceptance, differently from what is commonly observed elsewhere. Nonetheless, the current movement towards the attention to food sustainability seems to have touched Italian consumers, if nearly one-third of the surveyed sample claims to be willing to try insects as food. Anyway, since we did not conduct a tasting experiment, we were not able to assess how many of them would actually eat insects. Indeed, the attitude-behaviour gap may be very relevant for products with ethical and sustainable attributes (Vermeir & Verbeke, 2006). The study by Sogari (2015) suggests however that as Italian consumers are faced with a real insect tasting experience, they are likely to appreciate taste and texture of the products, just as it has already been demonstrated in other European countries (Megido et al., 2014; Elzerman et al., 2013).

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Of course, these are very preliminary results coming from an exploratory research, so they should be taken with some caution. A major limitation of this study is the limited dimension of the sample both from the size and the geographical point of view; it implies that a deeper investigation of this topic requires further surveys involving more consumers coming from different areas of the country. A methodological limitation concerns the use of the Likert scale in the evaluation of consumers' answers: indeed, while the Likert scale allows a greater understanding of the phenomenon as a whole, it may cause some bias in the results of logistic regression, because of the different perception consumers may have of the single scores proposed in the scale. However, given the exploratory aim of the study, these biases seem acceptable to draw some first insights of the phenomenon.

Despite these limitations, some useful indications may be drawn from this study. Namely, the acceptance of insects-based food by Italian consumers seems to be driven by (largely) similar issues as in other European countries, such as exposure to foreign food, local food traditions and education. Appearance and taste of the insect-based products are instead the main barriers to face in order to start reasoning about the introduction of entomophagy in the Italian context.

These first indications may be useful especially to plan further studies on the topic. The perception of insects as food by Italian consumers should still be deepened, by studying more broadly the underpinning motivations of the people willing to try entomophagy, as well as the acceptance of different insect-based preparation. Another issue that may be developed in future research is the willingness of consumers to introduce insects in the daily diet; indeed, in most of the studies tackling this topic, including this one, entomphagy is addressed as a novelty, and willingness of the people to eat insects for the first time is addressed. However, there is no clue about whether the people, once tried (and, hopefully liked) insect-based preparations the first time, will be willing to really let these products become part of their diet. This is a much more significant change than just tasting them once, and it is likely to be influenced by several issues related to habits and traditions.

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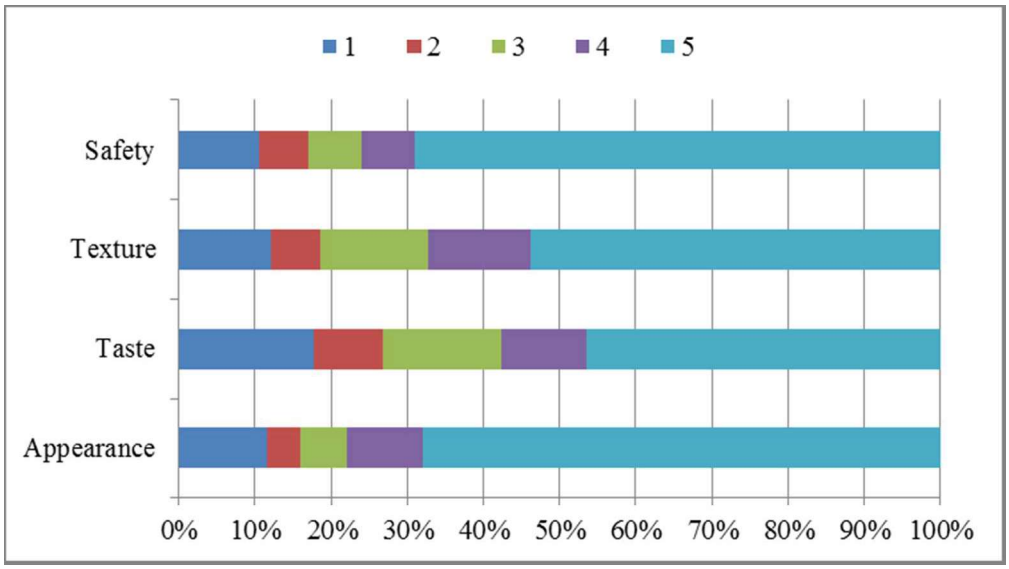

Figure 1 – Respondents' ranking of the barriers to insect consumption
Source: own elaboration on survey data

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Table 1 – Descriptive statistics (n=201)

Source: own elaboration on survey data

Variable	Options	Label	Quota of sample
Education	Lower education	EDUlow	19%
	Secondary education	EDUsec	49%
	University degree	EDUuni	32%
Gender	Male	Gmal	45%
	Female	Gfem	55%
Animal protein most often consumed	Meat or fish	APmeat	63%
	Dairy products/eggs/vegan	APveg	37%
Variable	**Options**	**Label**	**Frequency of YES**
Direct experience with insect-based food	0 = no; 1 = yes	Willing	0.05
Willingness to try insect-based food	0 = no; 1 = yes	Willing	0.26
Variable	**Options**	**Label**	**Mean (std. dev.)**
Age	Years	Age	42.8 (16.2)
Importance of food cues in food choice (5-point scale)	Price	FCprice	3.5 (1.1)
	Taste	FCtaste	4.6 (0.6)
	Preparation time	FCprep	2.9 (1.3)
	Nutritional value	FCnutr	4.3 (0.9)
	Newness of product	FCnewp	3.4 (1.3)
Meals consumed out of home	Number of meals per week	Mealout	2.4 (2.3)
Frequency of buying organic products (5-point scale)	-	Buyorg	2.9 (1.3)
Frequency of eating in ethnic restaurants (5-point scale)	-	Ethnic	1.6 (1.0)
Appreciation of unusual food products (5-point scale)	Offal	APPoffal	1.8 (1.1)
	Snail	APPsnail	1.4 (0.9)
	Frog	APPfrog	1.1 (0.4)
Barriers to insect consumption (5-point scale)	Insect appearance	BAappe	4.2 (1.4)
	Taste	BAtaste	3.6 (1.6)
	Texture	BAtext	3.9 (1.4)
	Safety	BAsafe	4.2 (1.4)

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Table 2 - Correlation matrix

Source: own elaboration on survey data

Variables	AGE	FCprice	FCtaste	FCprep	FCnutr	FCnewp	Mealout	Buyorg
AGE	**1**							
FCprice	0.064	**1**						
FCtaste	-0.006	-0.002	**1**					
FCprep	**0.266**	0.031	0.116	**1**				
FCnutr	**0.273**	0.094	0.091	0.114	**1**			
FCnewp	**-0.180**	-0.054	**0.193**	0.063	0.121	**1**		
Mealout	**-0.277**	**-0.149**	-0.108	-0.056	-0.128	**0.218**	**1**	
Buyorg	0.023	**-0.234**	0.031	0.062	0.064	0.138	0.020	**1**
Ethnic	**-0.174**	-0.067	0.114	**-0.150**	-0.008	**0.299**	**0.343**	0.112
APPoffal	-0.064	-0.124	0.014	-0.111	-0.064	**0.153**	**0.215**	0.057
APPsnail	0.122	-0.125	0.066	0.039	0.035	0.062	0.123	0.007
APPfrog	0.005	-0.077	0.004	-0.017	0.045	**0.186**	**0.226**	0.120
BAappe	0.025	**0.206**	0.119	0.119	0.005	-0.003	-0.051	0.035
BAtaste	0.109	0.072	0.125	**0.151**	0.023	0.025	**-0.167**	-0.110
BAtext	0.012	0.106	**0.217**	**0.155**	0.103	0.037	-0.081	-0.021
BAsafe	**0.159**	0.129	**0.175**	**0.169**	0.103	0.016	**-0.139**	-0.085

Coefficients in bold are significant for $\alpha<0.05$

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Ethnic	APPoffal	APPsnail	APPfrog	BAappe	BAtaste	BAtext	BAsafe
1							
0.315	**1**						
0.227	**0.522**	**1**					
0.268	**0.467**	**0.498**	**1**				
-0.149	**-0.220**	**-0.185**	**-0.159**	**1**			
-0.184	-0.097	**-0.157**	-0.095	**0.336**	**1**		
-0.222	-0.116	-0.107	**-0.158**	**0.500**	**0.585**	**1**	
-0.101	-0.117	-0.100	-0.113	**0.266**	**0.571**	**0.483**	**1**

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Table 3 - Parameters of the logistic regression

Source: own elaboration on survey data

Variable	β value	Standard Error	Significance (Pr > Chi²)	Odds ratio
AGE	-0.021	0.017	0.227	0.980
FCprice	-0.058	0.236	0.807	0.944
FCtaste	0.116	0.374	0.757	1,123
FCprep	0.216	0.193	0.263	1,241
FCnutr	-0.011	0.238	0.964	0.989
FCnewp	0.083	0.194	0.670	1,086
Mealout	-0.064	0.098	0.512	0.938
Buyorg	0.068	0.178	0.704	1,070
Ethnic***	0.818	0.242	0.001	2,265
APPoffal	0.139	0.214	0.516	1,149
APPsnail	0.156	0.318	0.624	1,169
APPfrog	0.249	0.664	0.707	1,283
BAappe**	-0.402	0.165	0.015	0.669
BAtaste**	-0.411	0.179	0.022	0.663
BAtext	-0.139	0.209	0.506	0.870
BAsafe	-0.032	0.169	0.851	0.969
EDU-low	0.000	0.000		
EDU-sec	0.619	0.735	0.400	1,857
EDU-uni***	2,124	0.802	0.008	8,368
G-fem	0.000	0.000		
G-male*	0.936	0.495	0.059	2,550
AP-meat	0.000	0.000		
AP-veg	0.104	0.495	0.834	1,110

* *significant for α<0.10;* ** *significant for α<0.05;* *** *significant for α<0.01*

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Appendix – Questionnaire administered in the survey

Section 1 – Food consumption behaviour

1. What's the animal protein you consume most often?
□ meat (fresh or cured) □ milk and dairy □ eggs □ fish □ I do not eat animal protein

2. Score the importance that the following cues of a food product have in your food choices.
(1 = not important at all; 5 = very important)

Price	□ 1	□ 2	□ 3	□ 4	□ 5
Taste	□ 1	□ 2	□ 3	□ 4	□ 5
Preparation time	□ 1	□ 2	□ 3	□ 4	□ 5
Nutritional value	□ 1	□ 2	□ 3	□ 4	□ 5
Newness of product	□ 1	□ 2	□ 3	□ 4	□ 5

3. How often do you buy organic or eco-friendly products?
(1 = never; 5 = very often)
□ 1 □ 2 □ 3 □ 4 □ 5

4. How many meals do you eat outside home every week? ----------

5. How often do you eat in ethnic restaurants?
(1 = never; 5 = very often)
□ 1 □ 2 □ 3 □ 4 □ 5

6. Score your level of appreciation of the following unusual products.
(1 = I don't like it at all; 5 = I like it very much)

Offal	□ 1	□ 2	□ 3	□ 4	□ 5
Snail	□ 1	□ 2	□ 3	□ 4	□ 5
Frog	□ 1	□ 2	□ 3	□ 4	□ 5

Section 2 – Attitude towards entomophagy

7. Have you ever eaten insects or insect-based products?
□ YES *(go to question n.9)* □ NO *(go to question n.8)*

8. *(Show to the respondent 5 pictures of insect-based preparations)*
Would you like to try one of the food preparations you have just seen? Which one?
□ Pic 1 □ Pic 2 □ Pic 3 □ Pic 4 □ Pic 5 □ None of them

9a. Which type of insect preparation have you tried?
9b. Did you try this food in Italy or abroad? In which country? ----------
9c. Where did you eat insects?
□ restaurant □ at friends' home □ in the street □ other (specify)
9d. How did you like it? *(1 = not at all; 5 = a lot)*
□ 1 □ 2 □ 3 □ 4 □ 5

10. If you think about eating insect-based products, do you think that the following issues may be discouraging?
(1 = it is not discouraging at all; 5 = it is strongly discouraging)

□ insect appearance	□ 1	□ 2	□ 3	□ 4	□ 5
□ taste	□ 1	□ 2	□ 3	□ 4	□ 5
□ texture	□ 1	□ 2	□ 3	□ 4	□ 5
□ safety	□ 1	□ 2	□ 3	□ 4	□ 5

Section 3 - Demographics

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11. How old are you?.....

12. What your education?

□ Primary □ Lower secondary □ Upper secondary □ University degree

13. Gender

□ M □ F

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