



Scientific paper

Exploring young foodies' knowledge and attitude regarding entomophagy: A qualitative study in Italy[☆]

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ABSTRACT

Edible insects as a food source might help feeding poor developing countries and at the same time be a complementary food/ingredient for developed countries. However, in the Western countries the majority of people refuse the idea of eating insects, for mainly cultural reasons. The main purpose of this study is to investigate the expectations about entomophagy from a specific target group (foodies) composed by people studying Gastronomy and Food Science. The study was held at the University of Parma (Italy) in April 2015 and consisted in a student engagement with a so-called "bug banquet" with a cookie made with "insect flour". Results show that almost all the sample tasted the product and is willing to try other edible insects in the future. Curiosity is the most important reason to choose to try the cookie made with cricket flour; whereas negative opinions of family members and friends and the disgust factor may prevent Western consumers from eating insects in the future. However, whether edible insects will increase their acceptability will also depend heavily on market availability (regulatory framework), food category (e.g., bakery product with insect flour) marketing strategies, gastronomy (preparation), culinary trends and education.

Introduction

The potential use of edible insects seems extremely important in terms of ensuring both global food and feed security (van Huis et al., 2013). If properly managed and consumed, edible insects are considered safe for human consumption and extremely beneficial for high-quality diets when other common food recommendations (e.g. diet variation and portion control) are respected (Belluco et al., 2013). For such reasons, several studies (Schösler et al., 2012; Tan et al., 2015; Vanhonacker et al., 2013; Verbeke, 2015) have investigated whether Western consumers are ready to adopt insects as a substitute for other food products. Recently, the European Food Safety Authority (EFSA) showed an interest on such topic, publishing a scientific opinion on the risk related to the production consumption of insects as food and feed (EFSA Scientific Committee, 2015).

Since prehistory, insects have been a food resource in many different cultures around the world (Yen, 2009; Kouřimská and Adámková, 2016). They have been collected from forests, freshwater ecosystems, deserts, agricultural fields or even from farms (van Huis et al., 2013; Vantomme, 2015; Yen, 2015). At present, nearly 2000 species are known to be edible for human consumption (Jongema, 2015). Entomophagy is a traditional food practice for at least two

billion people in many Asian, Central America, Oceania and African regions (van Huis et al., 2013). On the other hand in the Western countries the majority reject the idea of eating insects, for mainly cultural reasons (DeFoliart, 1999; Mlcek et al., 2014; Sogari and Vantomme, 2014; Tan et al., 2015; Yen, 2010).

Several factors responsible for triggering the aversion towards eating insects as food have been identified: from unique sensory properties and health safety issues (Kouřimská and Adámková, 2016) as well as the reminders of something alive (Martins and Pliner, 2006; Schösler et al., 2012). In fact, as reported by Cardello (2003) food acceptance strongly depends both on intrinsic (sensory characteristics) and extrinsic factors such as cognitive, cultural and social aspects. However, as pointed out by van Huis (2013) food preferences are not permanent and can change over time (e.g. sushi acceptance in Western countries).

Even though entomophagy has been always considered as "rural" and "barbarian" by Western society, recently there has been growing interest toward insect-based products in US and Europe due to the increasing attention from research institute, food industry and legislators to the production process of these animals (Caparros Megido et al., 2014; van Huis, 2013).

As suggested by Martins and Pliner (2006) one way to increase

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willingness to consume novel animal foods (e.g. edible insects) is to decrease individuals' perceptions of the disgusting attributes of these foods (i.e. negative perception of sensory characteristics).

To our knowledge, very few experimental studies with a “bug banquet” have been done so far on this topic in the Western countries, (Caparros Megido et al., 2014; Lensvelt and Steenbekkers, 2014; Looy and Wood, 2006; Tan et al., 2015). Thus, due to the growing interest in entomophagy in westernized countries, after an extensive literature review, the authors organized an experiment to engage students. The main purpose of this study is to investigate the expectations and knowledge about entomophagy from a specific target group who enjoy food (the so-called “foodies”) composed by people studying Gastronomy and Food Science (food chemistry and technology, microbiology, culinary trends, gastronomy history, etc.). The insect-based product chosen was a cookie because is considered a typical food in the Western; however, in our study it was enriched by a percentage of cricket flour. This experiment provides some insights into gastronomic and food science students current opinion about entomophagy and its implications for future gastronomic and culinary trends.

Methods

The study was held at the University of Parma (Italy) in April 2015 and consisted in an engagement with young “foodies”, a term referred to people very interested in food. All the participants, students enrolled to a Gastronomy and Food Science courses of the Department of Food Science, 109 people (53% female and 47% male), aged between 18 and 25 years old, were invited to this public engagement thanks to a flyer distributed at the University Campus.

The engagement was structured in five parts. The first was a brief introduction of culture aspects about entomophagy. This short text was aimed to give to all participants some basic information on the subject, taking into account the low level of knowledge on the topic.

“Entomophagy” is a dietary regime which includes eating edible insect species in their various stages of life (larva, adult, ...), even in a very small amount and not necessarily as a daily consumption. Insects can be cooked with different culinary preparations (e.g. fried, pickled, roasted) or become the ingredient for processed food (e.g. insect flour). Their consumption is already widely practiced among several cultures and regions in Central America, Africa and Asia. In recent years, interest in entomophagy has increased in Western countries, and since 2014 some European countries (Belgium and The Netherlands) have started to sell edible insects in supermarkets.

In the second part, the students were asked to answer a short structured questionnaire consisting of questions to elicit open responses regarding the expectations and knowledge on specific aspects of entomophagy (environmental, nutritional, sensory, and social) and its introduction in Italy, and gender attribute. Moreover, respondents were asked if they were willing to taste an edible insect and the reasons for their decision.

Then, the third part consisted in a seminar about several aspects of entomophagy in the Western world, held by two experts, followed by a “bug tasting session”. Participants were also informed about the safety of the product, the fact that the biscuit was made with insect flour and the potential allergenicity of arthropods. Each participant was free to decide whether to taste the insect-based cookie or not.

One species of insects was used for the experiment, the house cricket, *Acheta domestica* (L.) (Orthoptera: Gryllidae). The final cookie product was made by replacing 10% of the traditional flour with “cricket flour”.

The last part of the engagement was carried out after the “bug banquet”. Using a set of items scored on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree” (Mazzocchi, 2008), the aim was to understand the specific factors that have the greatest influence

Table 1

List of the statements for choosing to taste/not to taste a cookie with cricket flour. Source: own elaboration.

No.	Item	Likert scale				
1	I am curious about the taste/texture	1	2	3	4	5
2	It is an alternative source of protein	1	2	3	4	5
3	It seems inviting and appetizing	1	2	3	4	5
4	I do not trust the health and hygiene safety aspects	1	2	3	4	5
5	It does not seem inviting and appetizing	1	2	3	4	5
6	The idea that cricket flour has been used is disgusting	1	2	3	4	5

Note: 1= Strongly disagree; 2= Disagree; 3= Neither agree or disagree; 4= Agree; 5= Strongly agree.

on choosing to taste or not to taste the insect-based cookie. Every respondent had also the opportunity to add other reasons in a special section (“Other”). (Table 1).

Finally, the last two questions aimed to understand (1) respondent' willingness to taste other insects in the future and (2) whether they would recommend this experience to other people.

- (1) *After this experience (“bug banquet”), would you be willing to taste other insect food products?*
- (2) *Would you recommend to your family members/parents to attend a similar experience with the tasting of insect food products?*

Results

Due to the sociological nature of entomophagy, both qualitative and quantitative data were collected and analyzed. The qualitative data obtained in the first part of the questionnaire were processed using a content analysis technique that examines text information and identify its key messages. Specifically, the answers were analyzed by means of content analysis that implies coding and categorizing the questions and counting the number of times a particular utterance was obtained. A list of codes was compiled and grouped in several response categories which have been discussed among the authors (van Rijswijk et al., 2008; van Rijswijk and Frewer, 2008).

Results show that students' opinion is divided in two different directions. Half of our sample (47%) foresees that entomophagy might become a culinary trend in Italy, while the other half states that it would not be “successful”, “appropriate” or “exciting”.

More than one fourth of the participants indicated that the practice of entomophagy would be more sustainable for the environment than traditional animal breeding, while the majority had no opinions or believed no effects would occur.

When asked about tasting expectations, 65.0% of the respondents thinks the taste of edible insects is closely related to other ingredients used in the preparation. Also the cooking preparation method used (i.e. fried, boiled) is considered to significantly influence the final taste. In general (73.0% of the sample), insects are considered “flavorless”, “odorless” and “crunchy”.

More than half of those surveyed indicated the practice of introducing insects in the diet would not be approved and supported by their family members and/or friends. While, 22.0% of the respondents believed that even if not accepted and understood this practice would be at least supported. Finally, only a minority (around 18.0%) believed that people close to them would be in favor. Some participants even stated that “my family members would be shocked”, “I would be making a fool of myself”.

Most of our sample (67.5%) indicated they would taste edible insects if they had the opportunity, 25.0% would not and only 7.5% would be undecided. Some negative comments were reported, such as “Humans are not supposed to eat insects” and “How disgusting!”.

Table 2

Results of statements for choosing to taste a cookie with cricket flour (1= strongly disagree; 5= strongly agree), on the total sample and by gender.
Source: own elaboration.

Statement	Total mean (sd)	DF	t-Value	p-Value	Male (sd)	Female (sd)	F-Value ^a	Sign.
I am curious about the taste/texture	4.44 (0.66)	102	20.75	0.000	4.45 (0.73)	4.50 (0.58)	0.116	0.734
It is an alternative source of protein	3.79 (1.01)	102	7.73	0.000	4.07 (0.99)	3.47 (0.95)	8.516	0.004**
It seems inviting and appetizing	3.68 (0.99)	102	6.77	0.000	3.76 (0.93)	3.65 (1.04)	0.307	0.581

DF: degree of freedom.

Signif. codes: **** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

^a One-way ANOVA test on gender differences.

In this first part, based on the responses obtained from the open questions no relevant difference was observed between genders.

When participants received the tasting sample (“bug experience”) almost all of the students (94%) agreed to eat the insect-based food product, as already seen in other similar experiments carried out in other countries (Caparros Megido et al., 2014).

Table 2 shows the results of statements for choosing to taste a cookie with cricket flour. The one-sample *t*-test indicates that the participants scored significantly higher than the neutral option on both the three statements. The mean score on “curiosity” (*I am curious about the taste/texture*) was 4.44; the mean score on the “alternative protein source” was 3.75, and the mean score on the “appetizing food” (*It seems inviting and appetizing*) was 3.68; all means are significantly higher than three. These findings indicate that the most frequent reason for this decision is curiosity about the taste and texture. One-way ANOVA analyses revealed in the Likert scale (from 1 to 5) a significant difference for the statement “*I would taste a cookie made with cricket flour as an alternative source of protein*” with a mean value of 4.07 for males and 3.47 for the female group. Therefore, males might be more open to consider insect as a substitute of traditional protein source products.

On the other hand, one of the strongest barriers for refusing to taste the insect-based cookie is the disgust factor. However, it was not significant considering that only 6% ($n=5$) of our participants decided not to taste the product.

When asked if they would be willing to taste other edible insects in the future, 74.0% of the respondents agreed, with a significant difference between gender (chi-square trend, 6.55; $P=0.01$), more for males (86.0%) than females (64.0%). While 94.0% of the sample would recommend this tasting experience to other people.

In the final open comments, the majority of the respondents did not find any specific sensory differences between our insect-based cookie (with 10.0% of cricket flour) and a traditional biscuit on the market.

Discussion and conclusions

The present study gives an overview and provides insight on attitude and knowledge of entomophagy acceptance in Italy among young foodies, students enrolled to courses of Gastronomic and Food Science, and investigates the factors (stimuli or barriers) for trying/not trying to taste an insect-based product.

The authors are aware that respondents, students belonging to a Department of Food Science, are usually more familiar and interested in trying new food products, and might therefore present a lower degree of neophobia (the fear of eating unfamiliar food) than the broader population. In fact, this exploratory study helped the authors to develop further research on eating insects and define which are the next research questions to focus on (i.e. Theory of Planned Behaviour model, see Menozzi et al. (2016)).

This type of engagement (presentation and tasting experience of edible insects), as indicated by other authors (see Looy et al. (2014)), proves that before attempting to introduce insects into diet, one of the main issues is to normalize entomophagy by educating the Western population that insects are a legitimate food source.

Considering the current state of knowledge, more and better information could lead to better acceptance of entomophagy in Italy, and also help to reduce prejudice, fear and negative attitude of the general public towards the consumption of edible insects (Sogari and Vantomme, 2014).

Generally, respondents considered insects as a food source rich in proteins and other nutritional elements. This positive perception of the healthy characteristics of eating insects might be a strong incentive for people more concerned about their diet. Moreover, in the period preceding our data collection, there had been considerable press and mass media coverage of entomophagy, which probably attracted consumer attention and created interest in the topic of eating insects.

Reactions to the introduction of entomophagy in Italy tended to be strongly in favor or against, and rarely neutral (see Looy and Wood (2006)). As suggested by several authors (Balzan et al., 2016; Yen, 2009), the results signal an increasing curiosity towards the practice of entomophagy and the willingness to try to eat product with edible insects. Tasting sessions led by experts at food fairs, schools, museums and other special events (e.g. “bug banquets”) would strongly facilitate the integration of entomophagy into the West (Lensvelt and Steenbekkers, 2014). In specific, also University courses related to Gastronomic and Food Science should be taken in consideration as opportunities for public engagement in order to explain and give the possibility to taste edible insects because these students will have a relevant role to shape knowledge and trends in the future of gastronomy.

This study confirms that the most common reason for refusing to taste an insect-based product is the disgust factor (see van Huis et al. (2013) and Sogari (2015)).

One of the most useful findings is that willingness to taste edible insects on future occasions increased after the tasting experiment; in fact the percentage of participants who stated that they will not eat insect-based product decreases from 23.7% to 7.0% (chi-square trend, 8.85; $P=0.001$). This confirms that the first exposure to a new food affects the likelihood of consuming it in the future (Tuorila et al., 1994). In addition, males rather than females were more willing to eat insects.

Our results seem to emphasize that the negative opinions of family members and friends on the practice is relevant, and may prevent consumers from approaching and introducing entomophagy in the diet; this social influence has been also seen in other studies involving both edible insects (Balzan et al., 2016; Sogari, 2015) and different food categories (Anderson et al., 1998; Menozzi et al., 2015).

The authors are aware that consumers’ positive intention to eat insects depends on the form and appearance of the products. Insects can be either visible or unrecognizably processed as ingredients. It is known that visual appearance and food texture are closely related to food acceptance (Logue et al., 1981), so it is not possible to assume that the perception of eating an insect-based food (i.e. cricket flour in bakery products) is the same as the perception of eating a visible insect (i.e. a whole cricket). It seems reasonable to assume that the invisible insect inside a processed food might have more positive acceptance (Materia and Cavallo, 2015; Tan et al., 2015). Further research could investigate tasting a whole edible insect.

Finally, it is difficult to say whether edible insect, a traditional food

source in tropical and subtropical countries, will become the “food of the future”. Whether people will buy and eat edible insects will also depend heavily on market availability (regulatory framework), food category (e.g., bakery product with insect flour), gastronomy (preparation), culinary trend, marketing strategies and education.

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References

- Anderson, a.S., Cox, D.N., McKellar, S., Reynolds, J., Lean, M.E., Mela, D.J., 1998. Take five, a nutrition education intervention to increase fruit and vegetable intakes: impact on attitudes towards dietary change. *Br. J. Nutr.* 80 (2), 133–140 (<http://doi.org/10.1017/S0007114598001032>).
- Balzan, S., Fasolato, L., Maniero, S., Novelli, E., 2016. British food Journal. *Br. Food J.* 118 (2) (<http://doi.org/10.1108/eb011783>).
- Belluco, S., Losasso, C., Maggioletti, M., Alonzi, C.C., Paoletti, M.G., Ricci, A., 2013. Edible insects in a food safety and nutritional perspective: a critical review. *Compr. Rev. Food Sci. Food Saf.* 12 (3), 296–313 (<http://doi.org/10.1111/1541-4337.12014>).
- Caparros Megido, R., Sablon, L., Geuens, M., Brostaux, Y., Alabi, T., Blecker, C., Francis, F., 2014. Edible insects acceptance by belgian consumers: promising attitude for entomophagy development. *J. Sens. Stud.* 29 (1), 14–20 (<http://doi.org/10.1111/joss.12077>).
- Cardello, A.V., 2003. Consumer concerns and expectations about novel food processing technologies: effects on product liking. *Appetite* 40 (3), 217–233 ([http://doi.org/10.1016/S0195-6663\(03\)00008-4](http://doi.org/10.1016/S0195-6663(03)00008-4)).
- DeFoliart, G.R., 1999. Insects as food: why the western attitude is important. *Annu. Rev. Entomol.* 44 (80), 21–50 (<http://doi.org/10.1146/annurev.ento.44.1.21>).
- EFSA Scientific Committee, 2015. Risk profile related to production and consumption of insects as food and feed EFSA scientific committee. *EFSA J.* 13, (October) (<http://doi.org/10.2903/j.efsa.2015.4257>).
- Jongema, Y., 2015. Number of recorded insect species in the world. Available at (<http://tinyurl.com/mestm6p>). (Last accessed 21,09. 2016).
- Kouřimská, L., Adámková, A., 2016. Nutritional and sensory quality of edible insects. *NFS J.* 4, 22–26 (<http://doi.org/10.1016/j.nfs.2016.07.001>).
- Lensvelt, E.J.S., Steenbekkers, L.P. a., 2014. Exploring consumer acceptance of entomophagy: A survey and experiment in Australia and The Netherlands. *Ecol. Food Nutr.* 53 (5), 543–561 (<http://doi.org/10.1080/03670244.2013.879865>).
- Logue, A.W., Ophir, I., Strauss, K.E., 1981. The acquisition of taste aversions in humans. *Behav. Res. Ther.* 19 (4), 319–333 ([http://doi.org/10.1016/0005-7967\(81\)90053-X](http://doi.org/10.1016/0005-7967(81)90053-X)).
- Looy, H., Dunkel, F.V., Wood, J.R., 2014. How then shall we eat? Insect-eating attitudes and sustainable foodways. *Agric. Hum. Values*, 1–11 (<http://doi.org/10.1007/s10460-013-9450-x>).
- Looy, H., Wood, J.R., 2006. Attitudes toward invertebrates: are educational “Bug banquets” effective? *J. Environ. Educ.* 37 (2), 37–48 (<http://doi.org/10.3200/JOEE.37.2.37-48>).
- Martins, Y., Pliner, P., 2006. “Ugh! That’s disgusting!”: identification of the characteristics of foods underlying rejections based on disgust. *Appetite* 46 (1), 75–85 (<http://doi.org/10.1016/j.appet.2005.09.001>).
- Materia, V.C., Cavallo, C., 2015. Insetti per l’alimentazione umana: barriere e drivers per l’accettazione da parte dei consumatori. *Riv. Econ. Agr.*, Anno LXX (2) 139–161.
- Mazzocchi, M., 2008. *Statistics for Marketing and Consumer Research*. Publications, Sage, London.
- Menozzi, D., Sogari, G., Mora, C., 2015. Explaining vegetable consumption among young adults: an application of the theory of planned behaviour. *Nutrients* 7 (9), 7633–7650 (<http://doi.org/10.3390/nu7095357>).
- Menozzi, D., Sogari, G., Veneziani, M., Simoni, E., Mora, C., 2016. Eating Novel Foods: An Application of the Theory of Planned Behaviour to Predict the Consumption of an Insect-Based Product. Submitted for publication.
- Mlecek, J., Rop, O., Borkovcova, M., Bednarova, M., 2014. A comprehensive look at the possibilities of edible insects as food in Europe – a review. *Pol. J. Food Nutr. Sci.* 64 (3), 147–157 (<http://doi.org/10.2478/v10222-012-0099-8>).
- Schösler, H., Boer, J. De, Boersema, J.J., 2012. Can we cut out the meat of the dish? Constructing consumer-oriented pathways towards meat substitution. *Appetite* 58 (1), 39–47 (<http://doi.org/10.1016/j.appet.2011.09.009>).
- Sogari, G., 2015. Entomophagy and Italian consumers: an exploratory analysis. *Prog. Nutr.* 17 (4), 311–316.
- Sogari, G., Vantomme, P., 2014. *A tavola con gli insetti*. Mattioli, Fidenza, 1885.
- Tan, H.S.G., Fischer, A.R.H., Tinchan, P., Stieger, M., Steenbekkers, L.P.A., van Trijp, H.C.M., 2015. Insects as food: exploring cultural exposure and individual experience as determinants of acceptance. *Food Qual. Preference* 42, 78–89 (<http://doi.org/10.1016/j.foodqual.2015.01.013>).
- Tuorila, H., Meiselman, H.L., Bell, R., Cardello, A.V., Johnson, W., 1994. Role of sensory and cognitive information in the enhancement of certainty and linking for novel and familiar foods. *Appetite* 23 (3), 231–246 (<http://doi.org/10.1006/appe.1994.1056>).
- van Huis, A., 2013. Potential of insects as food and feed in assuring food security. *Annu. Rev. Entomol.* 58 (1), (120928130709004) (<http://doi.org/10.1146/annurev-ento-120811-153704>).
- van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., Halloran, A., Muir, G., Vantomme, P., 2013. Edible insects. Future prospects for food and feed security. *Food Agric. Organ. U. Nations* 171.
- van Rijswijk, W., Frewer, L.J., 2008. Consumer perceptions of food quality and safety and their relation to traceability. *Br. Food J.* 110 (10), 1034–1046 (<http://doi.org/10.1108/00070700810906642>).
- van Rijswijk, W., Frewer, L.J., Menozzi, D., Faioli, G., 2008. Consumer perceptions of traceability: a cross-national comparison of the associated benefits. *Food Qual. Prefer.* 19 (5), 452–464 (<http://doi.org/10.1016/j.foodqual.2008.02.001>).
- Vanhonacker, F., Van Loo, E.J., Gellynck, X., Verbeke, W., 2013. Flemish consumer attitudes towards more sustainable food choices. *Appetite* 62, 7 (<http://doi.org/10.1016/j.appet.2012.11.003>).
- Vantomme, P., 2015. Way forward to bring insects in the human food chain. *Journal of Insects as Food and Feed* 1 (2), 121–129.
- Verbeke, W., 2015. Profiling consumers who are ready to adopt insects as a meat substitute in a Western society. *Food Qual. Prefer.* 39, 147–155.
- Yen, A.L., 2009. Edible insects: traditional knowledge or western phobia? *Entomol. Res.* 39 (5), 289–298 (<http://doi.org/10.1111/j.1748-5967.2009.00239.x>).
- Yen, A.L., 2010. Edible insects and other invertebrates in Australia: future prospects. In: Durst, P.B., Johnson, D.V., Leslie, R.N., Shono, K. (Eds.), *Forest Insects as Food: Humans Bite Back*, 65–84.
- Yen, A.L., 2015. Insects as food and feed in the Asia Pacific region: current perspectives and future directions. *J. Insects Food Feed* 1 (1), 33–55 (<http://doi.org/10.3920/JIFF2014.0017>).