

Entomophagy and Italian consumers: an exploratory analysis

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Summary. *Background and aim of the work:* the consumption of insects by humans, entomophagy, is a food practice followed by 2 billion people worldwide. However, in Western countries the majority of the population rejects the idea of adopting insects as food, predominantly for cultural reasons. This study aims to investigate the main reasons behind this in order to stimulate the consumption of edible insects in the future. *Methods:* the experiment involved a mixed group of Italian individuals (n=46) – in terms of age and gender – who tasted three species of edible insects (cricket, honeycomb moth and grasshopper) and afterwards were handed a questionnaire to explore their opinions on the subject of entomophagy. *Results:* the analysis shows that curiosity and environmental benefits are the most important factors in motivating the consumption of insects in the future. Furthermore, the majority of respondents stated that entomophagy would not be endorsed and supported by family and/or friends. *Conclusions:* although the results of this study are exploratory, it seems that other peoples' negative opinions might represent a significant barrier to introducing edible insects to the Western diet. For the moment, it is difficult to predict whether edible insects will become the "food of the future".

Key words: consumer, entomophagy, edible insects, Italy

Introduction to entomophagy

The Food and Agriculture Organization of the United Nations (FAO) has estimated that consumption of edible insects by humans, the entomophagy, is a food practice followed by about 2 billion people worldwide (1).

From prehistory to the present day, insects as food have always been a traditional source of nutrients in many countries of Asia, Central America and Africa, and more than 2,000 species are known to be edible for human consumption (1-4). On the other side in the Western countries most of the population rejects the idea to adopt insects as food, mainly for cultural reasons (1, 5-8). Insects are eaten in all the growth stages (eggs, larvae, pupae and adults) and most of them collected in nature. For this reason, few data are available on the actual amount of edible insect consumed.

According to Jongema (9), most of 2,037 species consumed are within the Coleoptera group, i.e. bee-

flies (634), followed by the Lepidoptera, i.e. caterpillars (359), then the Hymenoptera represented by bees, wasps and ants (302), then the Orthoptera, i.e. grasshoppers, locusts and crickets (279), followed by the Hemiptera, i.e. true bugs (220). Finally among the least consumed species we find the groups of Isoptera, i.e. termites (63), the Odonata, i.e. dragonflies (60) and the Diptera, i.e. flies (25) (Figure 1).

Although several social, environmental, and nutritional benefits about the use of insects in the human diet, especially if replacing other protein products, have been identified (1), Western society generally considers these animals as a food of emergency, associated to a low prestige and belonging exclusively to poor countries (10).

Some authors (11, 12) have tried to explain factors responsible for the aversion of edible insects: from the sensory properties (unpleasant taste and texture) to the perception of health risks. However, as pointed out by

van Huis (13), food preferences are not permanent and may change over time, as it happened in the past with the acceptance of the Japanese sushi in the Western world. Therefore, as suggested by Martins and Pliner (11) in order to motivate the consumer's willingness to eat a new product (e.g. edible insects), the perception of disgust, especially for sensory characteristics, need to be reduced.

After an extensive literature review, few experimental studies on this topic associated with a tasting session have been identified (3, 8, 14, 15). Therefore, there is a need to carry out for further researches focussed on social aspects of entomophagy in the Western countries (16) considering the growing interest in recent years (17).

The aim of this study is to investigate the reasons for eating edible insects in the future and to explore the sensory aspects after a tasting session.

The benefits of entomophagy

The world population is constantly increasing and it is likely to reach 9 billion people by 2050 (1, 18). This significant growth will require a large food demand to meet the nutritional needs for a balanced diet worldwide (19). Edible insects used as a food source could help to feed individuals in the developing countries and in the same time to be a food/comple-

mentary ingredient in the diet of Western countries (3, 20). As reported by van Huis et al. (1) the potential use of edible insects seems extremely important in terms of global food security. In addition, the breeding of insects as a feed ingredient for livestock, especially as a replacement of fishmeal and fish oil, could significantly help to reduce the environmental impact of livestock production (13). For such reasons, in recent years, the FAO established a program called "Edible Insects" aimed to promote the use of edible insects for food production and valorize the benefits for the environment and the human health.

Nutritional benefits

Although so far only few studies have analyzed the nutritional characteristics of edible insects and their metabolism in humans (1), this group of animals is generally recognized as a nutritious food source. In general, insects provide energy, proteins (many species have values above 60%), amino acids and essential fatty acids which are beneficial for human health; while the fat content can vary widely between 7 and 77g/100g based on dry weight (2, 7, 21). Finally, also the fiber and micronutrients content (vitamins and minerals) is very high (22). However, as it happens for many other animals, the nutritional values may vary significantly basing on the species, the stage of life and the substrate by which they are fed.

Environmental aspects

The most common edible insect species farmed (crickets, locusts and mealworms) seem to have greater environmental benefits than traditional breeding animals (15). FAO data (Figure 2) shows how greenhouse gas emissions of insects are lower than domestic animals with an average of 1 g/kg of weight gain compared to the 2,850 g of cattle and 1,300 g of pigs. The soil used to produce 1 kg of protein is usually 20 square meters compared to the 45-70 of pigs. Furthermore, insects have a nutritional conversion efficiency rate significantly greater than beef; they might be fed with organic waste streams and use less quantity of water (6, 13, 16, 17, 23).

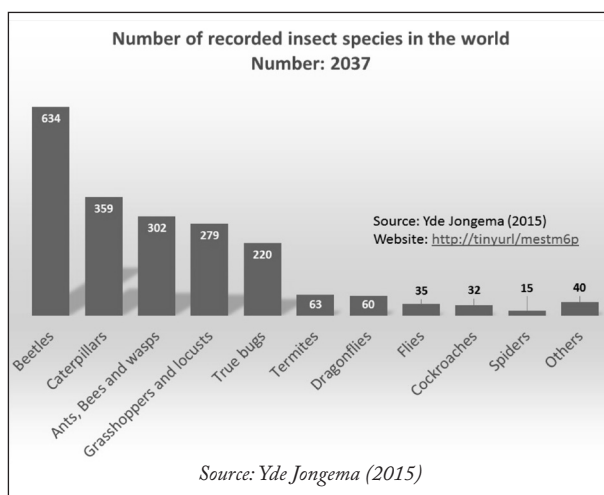


Figure 1. Number of known edible species in the world.

Methodology

Data collection was carried out in Italy in April 2015 and involved 46 individuals, a mixed group by

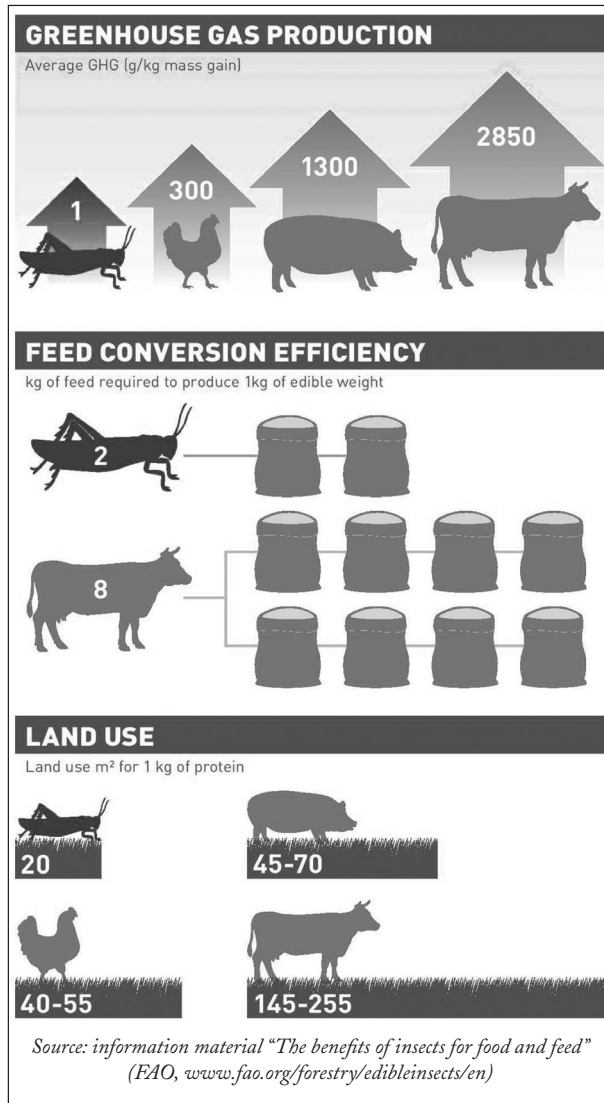


Figure 2. Environmental benefits of farmed insects

Table 1. List of open questions.

No.	Question
1	What insects have you eaten? (If you have not, please explain the reasons)
2	Which insect have you preferred?
3	What sensory characteristics have you tasted (flavor and texture)?
4	On your opinion how it would be perceived the introduction of eating edible insects into your diet by family members and friends?

Source: own elaboration

age and gender, who answered a questionnaire with semi-structured open-ended responses. The sample was recruited among the participants at a "bug banquet" event in which the nutritional and the environmental benefits of entomophagy were explained followed by a tasting experiment. Before starting the tasting sessions, the participants were informed about the safety aspects and the potential allergenic risks of eating an arthropod. The species of insects used in the experiment were (1) the house cricket (*Acheta domestica*), (2) the wax moth larvae (*Galleria mellonella*) and (3) the grasshoppers (*Calliptamus italicus*). All insects were cooked by roasting process in the oven and only salt was added during the preparation. This choice was taken in order to avoid the alteration of the taste and to permit the participants to better judge the sensory characteristics of the insects.

Afterwards, the respondents had to answer a number of structured open questions about which species of insects were being preferred, their sensory characteristics and general expectations about the introduction of entomophagy (Table 1).

The second part of the questionnaire was constituted by a battery of items (with Likert scale from one to five) used to understand the reasons which might influence the decision to consume insects in the future (Table 2).

Results of explorative analysis

The qualitative results were analyzed using the content analysis technique which allows to review in detail the answers and to identify key messages. In addition, considering that our sample consists of a limited number of respondents, the interpretation of the results should not be generalized.

Table 2. List of choices to eat insects in the future.

No.	Item	Likert scale				
1	Curiosity	1	2	3	4	5
2	Taste and appeal	1	2	3	4	5
3	Nutritional benefits	1	2	3	4	5
4	Environmental benefits	1	2	3	4	5

Source: own elaboration

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

First, more than half of the sample who tasted the insects preferred wax moth larvae (63%), followed by locusts (19%) and crickets (12%). Only a small part of the sample (6%) indicated that none of the three species above indicated was preferred.

Second, sensory characteristics of the three species were asked. The majority of subjects compared the flavor of moth larvae with pine nuts and hazelnuts, while the texture was considered soft. The taste of crickets was mainly described as dried fruit, especially almonds, while the texture was described as “crispy”. Finally, the taste of locusts has been described similar to the flavor of the fish, and the texture defined “crispy”.

One of the most interesting results focused on family members and friends’ opinion regards the introduction of insects in the diet. More than half of the sample has indicated that this practice would not be approved and supported, while only few respondents believe that would receive consensus. These results seem to underline the importance of others’ opinions (especially a negative attitude) as a strong barrier to approach and to introduce entomophagy in the Western diet. Whereas, the most important factor to trigger the consumption of insects in the future is curiosity, followed by environmental and nutritional benefits (see Table 3).

Discussion and final considerations

This study gives an overview on the expectations of entomophagy’acceptance in Italy and the potential reasons to consume edible insects in the future. Although this research is exploratory, the results highlight some relevant aspects which will be explained in

this section. First of all, the willingness to try a new food is determined more by curiosity and disgust than the expectation about the sensory experience (11). In addition, the consideration of family members and friends becomes a relevant aspect to facilitate or not the introduction of edible insects in the diet.

The results indicate that insect’s taste is generally well accepted by the participants. However, the authors are aware that these respondents (participants of a “bug banquet”) are probably more interested and open in trying to eat insects than the general population. Moreover, in the period preceding the data collection, several scientific reports and newspaper articles have been published in Italy and national media on the subject of entomophagy and they probably helped to increase consumers’ attention.

Events about the tasting of edible insects carried out by experts in food fairs, schools, museums and other special occasions (so-called “bug banquet”) should facilitate the integration of edible insects in the eating habits of Western society (15). Furthermore, information on this subject could facilitate the acceptance of this practice in Italy, and especially to reduce prejudice, fear and negative attitude that most of consumers have towards insects’ consumption (17).

Table 3. Importance of factors in choosing to eat insects.

No.	Item	Mean
1	Curiosity	4.0
2	Taste and appeal	2.6
3	Nutritional benefits	3.7
4	Environmental benefits	4.0

Source: own elaboration

Nowadays, one of the major barriers to the development of a EU market for edible insects is the lack of a clear and comprehensive legislation framework which regulates the entire supply chain (20, 22). However, recently, the European Food Safety Authority (EFSA) published the opinion “Risk profile related to production and consumption of insects as food and feed” (24) in which the potential biological, chemical, allergenicity and environmental hazards associated with farmed insects for food and feed purposes are investigated. The main conclusions highlight the lack of systematically collected data on animal and human consumption of insects and therefore further data generation is recommended.

Therefore, at the moment, it is difficult to predict whether edible insects will become from the traditional source of food in tropical and subtropical countries the “food of the future” worldwide. However, in Italy and in other Western countries the consumption of edible insects will primarily depend on the availability on the market, product category (whether whole or processed) and the type of communication to the consumers.

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