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Eat'em or not? Insects as a Culinary Delicacy

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Introduction: The world's population is increasing and thus the pressure on the earth's resources. To ensure food supply and sustainability, food habits in western societies have to change. By reducing the ecological footprint of food consumption, e. g., decrease meat consumption, significant contribution to global sustainability can be achieved¹. We are facing major challenges in terms of food production and new approaches are necessary. With a consumer demand for high quality food, it is necessary to find and use new sources for the production of essential nutrients and to inform consumers about alternatives to meat and fish, i. e., alternatives rich in proteins².

Advantages concerning nutrition and sustainability have been found by inclusion of insects in the diet³. Protein from insects is a good source of essential amino acids⁴. Further, insects contribute only to a very small extent to greenhouse gases, and insect breeding requires much less resources than livestock⁵. It has to be taken into consideration that in most Western cultures, eating insects is taboo, as these are regarded as disgusting by a majority of the population⁶. This is in line with a recent study, which showed that an insect-based hamburger was well accepted due to its sensory characteristics; however, information that the hamburger contained insects had a negative impact on the overall liking⁷. Concerning both nutritional value and sensory aspects, insects as food has a large potential, and the "culinary way" might be an effective way to reach consumer acceptance for novel foods such as insect-based food products⁸.

A common way to survey reluctance to novel foods is to use the food neophobia scale⁹. Using this, the aim of this study was to examine consumer acceptance and food neophobia related to the use of insects as ingredients in food.

Methods: Food neophobia⁹, attitudes and acceptance were surveyed using a web-based questionnaire, and by discussions in focus groups¹⁰. The survey and focus group discussions were performed in Sweden, in October 2016. A total of 150 respondents answered the web-based questionnaire. They were all asked questions related to food neophobia. The respondents were divided into three groups, with 50 in each group. The first group did not receive any information, the second was informed about insects as invisible ingredients (“insect-flour”) in food and the third group was informed about visible insects as a food ingredient. The questionnaire contained background questions of age, gender etc. Further, the food neophobia questionnaire⁴ was included, the two groups receiving information were also given questions of willingness to eat and to buy insects as invisible (“insect-flour”) or as visible food ingredients. The scale used was a 7-point scale ranging from “definitely not willing to eat/buy” to “definitely willing to eat/buy”, the questions were asked in the same order for all respondents.

Focus group discussions were performed in two groups, with participants recruited via the web and via oral information. One younger group, which consisted of four women, 20-30 years of age. The other group was an older group, consisting of five women and one man, 40- 65 years old. The discussions were based on a semi-structured interview guide starting to discuss environmental issues due to food consumption, then to discuss attitudes and interest of novel food and insects as a food ingredient. Finally, there were discussions on insects as visible and invisible ingredients in foods and willingness to buy and eat food with insect- based ingredients. Statistical analysis was done by calculations of mean values and standard deviations. Two- sided Student’s t-tests were performed to check whether significant differences ($p < 0.05$) occurred between groups. All calculations were performed in Excel (Microsoft Office 2013).

Results: Web-based questionnaire. There were no significant differences ($p < 0.05$) between the composition of the three groups regarding factors such as gender, age, etc. In total, out of the 150 respondents 113 (75%) were women and 37 (25%) were men. Approximately one third (32%) of the respondents were considered as “younger” (<41 years) and two thirds (68%) as “older” (>40 years). The main part of the participants (66%) had a university education, while the rest had not (34%). 10 (7%) respondents were vegetarians, while a majority, 103 (69%) respondents, considered themselves as eating a small or medium amounts of meat. 37 (25%) of the respondents were frequent (three or more occasions per day) meat eaters.

In total, 24 (16%) of the respondents could be considered as neophobic as judged, from the neophobia part of the questionnaire, with no significant differences between the three groups. The overall results showed a significantly ($p < 0.05$) higher acceptance for insects added to foods as invisible “insect-flour” than for added visible insects in a food, see figure 1. The interest of buying insects as food ingredient as a “flour”, where the insects or parts of them could not be seen, was higher than of buying whole or visible insects.

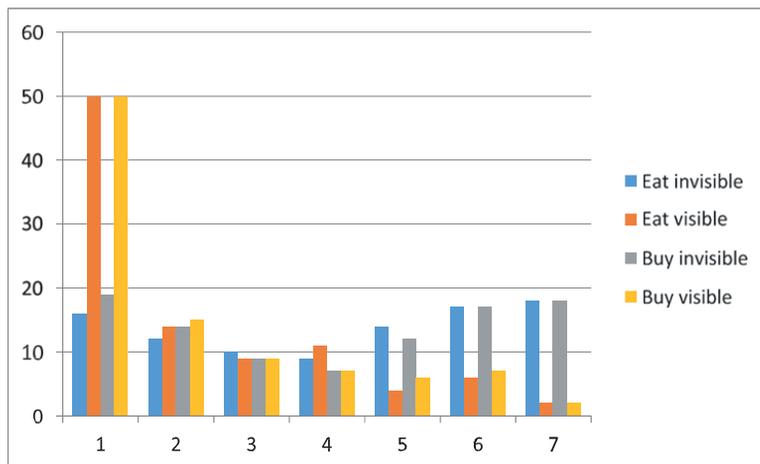


Figure 1. Number of answers on a scale where 1=Definitely not willing to eat/buy and 7= Definitely willing to eat/buy

Statistical analysis showed that respondents considered as neophobic also were significantly ($p < 0.05$) less willing to eat and buy insects as food ingredients than non-neophobic respondents, regardless of whether the food ingredient consisted of invisible or visible insects. Further, it was noted that within each of the groups, neophobic and non-neophobic, they were more positive to eat and buy invisible “insect-flour” than visible insects as food ingredients, see table 1.

Table 1. Mean values (m) and standard deviations (std), neophobic and non-neophobic respondents

	Non-neophobic m+/-std	Neophobic m+/-std
Eat invisible	4.52 +/- 2.13	2.36 +/- 1.78
Eat visible	2.41 +/- 1.79	1.50 +/- 0.76
Buy invisible	4.35 +/- 2.24	2.29 +/- 1.73
Buy visible	2.45 +/- 1.85	1.85 +/- 0.76

Further statistical analysis showed that men are significantly ($p < 0.05$) more positive to both eat ($m = 3.07$) and buy ($m = 3.04$) visible insects as food ingredients than women ($m = 1.98$ and 2.3 respectively). No significant differences ($p < 0.05$) in the willingness to eat or buy insects as food ingredients due to age, education or meat intake could be shown; mean values and standard deviations are given in table 2.

Table 2. Results from the web based questionnaire: Mean values (m) and standard deviations (std) due to age, education and meat intake

	Eat invisible m+/-std	Eat visible m+/-std	Buy invisible m+/-std	Buy visible m+/-std
Younger group	4.03 +/- 2.01	1.88 +/- 1.36	3.73 +/- 2.11	1.91 +/- 1.42
Older group	4.30 +/- 2.25	2.49 +/- 1.84	4.22 +/- 2.35	2.52 +/- 1.89
No university education	4.81 +/- 2.09	2.62 +/- 1.51	4.81 +/- 2.16	2.64 +/- 1.64
University education	4.14 +/- 2.04	2.24 +/- 1.56	3.84 +/- 2.17	1.92 +/- 1.53
No meat intake	3.00 +/- 1.91	1.43 +/- 1.13	3.00 +/- 2.00	1.86 +/- 1.57
Low/medium meat intake	4.27 +/- 2.17	2.37 +/- 1.76	4.11 +/- 2.34	2.37 +/- 1.82
Frequent meat intake	4.37 +/- 2.17	2.30 +/- 1.71	4.19 +/- 2.18	2.30 +/- 1.71

Focus group discussions, Younger group: The participants were all well educated and had at least three years of university studies. The younger group were aware of environmental connections to food and they were very positive to insects as food. However, they were of the opinion that if the insects were visible, the food looked either grey and dull or disgusting. One of the participants expressed it as: "As long as there are no whole and visible insects I do not mind eating them". Another participant said: "Yes, it does not look appetizing, however some more colour would make it more

appetizing". The group compared insect dishes with meat dishes and agreed that minced insects could be as good as minced meat. The comparison between meat and insects contained statements as: *"You do not want to see the cow you are eating"* and *"It is convenient to make insect foods, sausages and hamburgers, since we are used to that in these kind of foods whatever could be added"*. Further, they said that food containing insect ingredients have to be tasty in order to become accepted: *"It [the food] has to smell and taste good, with added spices."* The acceptance was also thought to increase if someone, e.g. authorities, could have convincing arguments to why insects are good as food: *"I think that if someone, e.g. trustworthy authorities or a company, could provide information and facts. It is my feeling that most people are afraid of new things, there is a kind of scariness."*

Focus group discussions, Older group: All in the group had at least three years of university studies, they were aware of food and its relation to the environment. They were slightly positive to insects as food, even though the willingness to eat insects varied between the participants. Most participants were of the opinion that the insects should be processed or milled before eating them. Eating whole or visible parts of insects was something that only one in the group would like to do. *"They [the insects] should probably be processed before I can eat them"*. The participant who was most unwilling to eat insects had a positive attitude towards eating insects, but could not force herself to do it. *"It is all about what you are used to. Besides, some people are more open than others. I am unfortunately not that open, which is something that I am not at all proud of!"*The participants agreed that a culinary approach would increase positive attitudes towards eating insects. *"I think it would be a super success if a Michelin restaurant would start to serve it [insects]"*.

Discussion: In many countries insects are considered as delicious and sometimes valued higher than meat⁵. This is in contrast to the results in this study, where a majority of the respondents were not willing to eat or buy insects if the insects were visible or whole. However, if the insects were invisible the attitudes became significantly more positive. The attitudes towards insects as food seemed to be slightly more positive in the younger focus group than in the older one. The web based study showed, however, that it was the older group who had a tendency of being more positive, although the differences were not significant. As expected it was shown that neophobic respondents were significantly less willing to eat and buy insects as food ingredients than non-neophobic respondents, independently if the food ingredient consisted of invisible or visible insects. According to the theory, neophobia and reluctance towards novel food varies individually over the course of a lifetime¹¹.

Contrary to a study by Schouteten et al (2016)⁷, the present study did not show significant differences in attitude between groups that had received different information about whether the food contained insects or not.

A significantly clear result is that invisible insects or "insect-flour" as a food ingredient was accepted to a higher extent than visible or whole insects, which is in line with earlier studies⁸. Further it was interesting to note a gender difference. Men were significantly more willing than women to eat and buy visible insects. This could be compared with other studies, showing that men and women differ in attitudes towards food intake and nutrition¹².

Conclusions: The use of insects in food could be considered as slightly positive, with men significantly more positive than women. The results showed that use of "insect-flour" with non-visible insects has a significantly higher acceptance than the use of whole and visible insects as food or food ingredient. 16% of the respondents were considered as generally neophobic, concerning food.

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