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Short Communication

Becoming an insectivore: Results of an experiment

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ABSTRACT

In many parts of the world, people consume insects due to their nutritive value and low environmental production costs. However, Western societies rarely experience insects as a food source. To overcome initial resistance, researchers have suggested introducing insects into the market in a processed form so that those characteristics which are repellent to Western consumers are no longer readily visible. Thus far, the success of this strategy is untested. For the present experiment, we used two kinds of tortilla chips. One was made with a traditional corn flour recipe, while the other included cricket flour as an ingredient. People from the general population ($N = 104$) were randomly assigned to consume either the traditional chips (control condition) or the cricket chips (experimental condition). After answering questions related to their eating behaviours, the participants tasted the chips. Both groups were informed prior to the tasting what kind of chips they would be sampling. After the tasting, the participants were questioned again to assess their willingness to eat unprocessed insects. Multiple linear regression showed that the experimental condition ($\beta = .16$) had a significant effect on willingness to eat unprocessed insects, while simultaneously controlling for the impact of previous insect consumption ($\beta = .36$), food neophobia ($\beta = -.33$) and animal-based food contamination disgust ($\beta = -.17$). People in the experimental condition reported a higher willingness to eat unprocessed insects than people in the control condition. The present experiment showed that exposure to processed insect products can increase consumers' willingness to consume unprocessed insects.

1. Introduction

The New Yorker published "Eating bugs to save the planet" (August 15, 2011). The Guardian asked "Is the US ready to stomach eating bugs?" (August 28, 2015). Nature stated "Time to eat insects" (May 9, 2014) and "Eating insects for fun, not to help the environment" (May, 2015). Interest in insect consumption has been high for some time now, but in many European countries, the sale of insects for human consumption is presently illegal. Next year, however, the government of Switzerland plans to legalise the sale of four insect species as foods though only unprocessed insects will be allowed. Will consumers be willing to buy them?

According to previous studies, willingness to eat insects is very low among European and US consumers (Hartmann, Shi, Giusto, & Siegrist, 2015; Ruby, Rozin, & Chan, 2015; Verbeke, 2015). Unlike regions such as Africa, Latin America and Asia (Van Huis et al., 2013), entomophagy, or the eating of insects, is not rooted in the traditional diet of Western societies, and so insects are rarely thought of as edible. However, there are good reasons, both environmental and nutritive, why insects might be a more valuable source of protein than conventional animal protein. Some insect species seem to be superior to conventional meat-based animal products due to their good macro- and micronutrient composition (Belluco et al., 2013; Verkerk, Tramper, van Trijp, & Martens, 2007). Even though some researchers question the oft-postulated efficient feed conversion rate of insects (Lundy & Parrella, 2015), the environmental benefit of entomophagy can be seen in the relatively low environmental pollution and water and space requirements of insect food production (Van Huis et al., 2013), not to mention the moral reprehensibility of conventional animal protein production. However, the advantages of insects relative to other animals may be insufficient for public acceptance of insects as food.

The acceptance or rejection of food is influenced by the characteristics of the food (e.g., sensory properties), the consumer's environment (e.g., cultural region, availability), and the consumer himself (e.g., ideational notions, personality traits, or psychological states). Insects are an unfamiliar food source for most European consumers, and food sources that deviate from cultural norms can attract consumers who constantly sample new and unusual

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foods while potentially alienating others who are less adventurous. The latter behavioural tendency is commonly denoted as food neophobia, a personal characteristic that accounts for the great variability among consumers in terms of their attitudes towards novel foods (Pliner & Hobden, 1992). Underlying motivations for the rejection of foods can be based on perceived dangerousness, negative taste expectations (Fallon & Rozin, 1983), low levels of expected enjoyment (Raudenbush, & Frank, 1999), and uncertainty about the origin of the product (Tuorila, Meiselman, Bell, Cardello, & Johnson, 1994).

The idea of eating insects can also result in a strongly affect-laden disgust response in consumers. Disgust is considered to be a component of the behavioural immune system as it can prevent contact with and ingestion of potentially noxious and pathogen-laden substances and disease vectors (Chapman & Anderson, 2012). Disgust reactions are unlikely to be changed by education, although such reactions may be the result of conditioning (Borg, Bosman, Engelhard, Olatunji, & de Jong, 2015). Thus, simply informing people about the nutritive and environmental benefits of insect consumption has proven insufficient to convince various consumer groups to accept insects as a new food source (Hartmann et al., 2015; Verbeke, 2015). Likewise, the perceived nutritive value was not a significant predictor of willingness to eat silkworms and crickets (Hartmann et al., 2015). Rather than recognising the nutritive benefits, consumers consider insects to be health risks and food contaminants (Ruby et al., 2015) as well as culturally inappropriate (Tan, Fischer, van Trijp, & Stieger, 2016). In fact, culture plays an important role since it determines both the foods to which people are exposed and the food sources deemed socially acceptable. The perception of insects as a primitive food source typically eaten by people of low economic wealth is thus a factor in consumers' rejection of them (Hartmann et al., 2015).

People who have no experience with a food item draw inferences about the food's characteristics from its visual appearance, its perceived texture, and the consumer's knowledge about its origin. Expected distaste is a barrier to the establishment of insects as a food source (Hartmann et al., 2015), and so overcoming such negative attitudes and expectations is vital. How can we convince consumers that insects can be pleasurable to eat? Researchers have proposed different strategies. Offering insects in a processed form so that their origin is no longer visible is one strategy for overcoming initial rejection (Hartmann et al., 2015). Presenting insects on a plate prepared with techniques more commonly associated with high gastronomy is another way to change people's expectations (Deroy, Reade, & Spence, 2015). Other techniques might include flavouring insects with familiar spices such as paprika (Caparros Megido et al., 2014), incorporating them into familiar dishes like salads (Schosler, de Boer, & Boersema, 2012), or renaming insects to symbolise their edibility and consumption purpose (Deroy et al., 2015). Different consumer groups might be attracted by different strategies. For example, people who seek new food experiences and variety might be attracted by restaurants that offer meals involving the fancy presentation of whole insects. However, this is unlikely to be a promising strategy for overcoming reluctance to eat insects among the general population. Those whose insect aversion is driven by strong feelings of disgust resulting from visual cues or similar factors might be more willing to consume the processed alternative.

Could processed foods like cookies or chips made with a small amount of cricket flour be used to increase the general acceptance of insects as a food source? It certainly seems plausible that people who have positive experiences with processed insect food may be more willing to try the unprocessed alternatives. However, whether or not a willingness to eat whole insects increases as a consequence of positive experiences with a processed insect product has not previously been explored. This study aims to answer that question.

2. Methods

The study took place in the German-speaking part of Switzerland at the research facilities of ETH Zurich.

2.1. Participants

A convenience sample was recruited by means of web-based advertisements, flyers in supermarkets, and an internet panel of people who regularly agreed to participate in experiments and surveys. The recruitment started in September and ended in November 2015. To prevent selection bias towards adventurous eaters, the recruitment process communicated only that the study's aim was to assess consumers' attitudes towards food. Study participation was financially rewarded. All participants signed an informed consent form in which they agreed to voluntarily participate in the study. They also confirmed that they did not suffer from any kind of food allergies or intolerances. From all those recruited ($N = 107$), two persons were excluded because they self-reported a clinically manifested eating disorder. Another person who arrived at the experiment in an intoxicated condition was also excluded. The final sample therefore consisted of 104 persons from the general population (53 persons in the control group and 51 persons in the experimental group).

2.2. Experimental procedure

A between-subject design was used involving the tasting of two different types of tortilla chips (corn meal vs. insect flour) as experimental conditions. Participants were randomly assigned to one of the two conditions. Participants in both conditions answered a computer-administered questionnaire. Following that, the investigator presented a bowl with either a tortilla chip made with corn flour (El Sol, Switzerland) (control condition) or a tortilla-shaped insect chip made with a mixture of cricket flour, corn flour, beans and chia seeds (Six Foods, USA) (experimental condition). The exact percentage of insect flour in the chips was neither provided on the package nor on the home page of the company, but it is assumed to be small. Participants in the experimental group were fully aware that the sample chips included cricket flour. Tasting of the chips was voluntary, and participants had the opportunity to refuse consumption. After tasting the chips, participants completed the second part of the questionnaire which involved questions concerning the participant's willingness to eat unprocessed insects.

2.3. Questionnaire

A German version of the *Food Neophobia Scale* (Pliner & Hobden, 1992) was used to assess participants' tendencies to avoid unfamiliar, novel foods. The German version was validated in a previous study (Siegrist, Hartmann, & Keller, 2013). Participants answered on a seven-point response scale ranging from −3 ('do not agree at all') to +3 ('totally agree'). The extreme categories were verbally anchored, while the other categories were only numerically anchored. Cronbach's alpha was $\alpha = .78$ and thus satisfactory.

2.4. Previous consumption of insects

The participants responded to the following statement: 'I have eaten insects in the past' (yes/no). Participants who answered 'yes' were coded 1, indicating that they had been exposed to