

Chapter 4

Bugs on the Menu: Drivers and Barriers of Consumer Acceptance of Insects as Food



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Abstract Our daily food choices have a huge impact on the environment and on climate change. Animal based protein production in particular is very resource consuming. To satisfy the growing meat hunger in the world, alternative protein sources are needed that both have a smaller environmental impact and are readily accepted by consumers. Compared to beef and pork, plant and insect proteins can be produced more sustainably, although consumer acceptance may pose a particular challenge for the latter. In this chapter, we will explore Western consumers' acceptance of insects as food source and influencing factors. In particular, the role of emotional reactions towards insects, such as disgust and motivational barriers for the acceptance of insects as food will be discussed. Furthermore, the role of concepts taken from risk research, such as risk and benefit perception and trust, will be explored. Relevant characteristics of the insect product itself in terms of processing degree for consumers' willingness to eat will be highlighted. To further increase the sustainability of the insect production, food waste could be used as insect feed instead of more resource intensive feeds. The impact of different insect feeding styles on consumer acceptance and risk perception will be explained based on recent study results. Lastly, research gaps will be emphasized and strategies to overcome rejection of insects as food will be suggested.

Keywords Entomophagy · Consumer behavior · Novel food · Sustainable protein · Risk perception · Feed · Emotion

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Sustainable Protein Consumption

At the beginning of the nineteenth century, frequent meat consumption was an indicator of wealth and economic status (Bogueva et al. 2018; Teuteberg 1994). Today, meat is a cheap mass product, and meat consumption rates in Western countries are very high; the per-capita intake of meat (i.e. beef/veal, pork, poultry, sheep) in the European Union in 2016 was around 70 kg (retail weight) (OECD 2018). Therefore, intake rates of a substantial part of the population exceed dietary recommendations. To satisfy this hunger for meat in developed countries, there has been an evolution of animal husbandry systems and production methods that are based on efficiency and profit, where the environmental impacts and animals' natural needs and behavioral tendencies are often ignored (Rochlitz and Broom 2017; Steinfeld et al. 2006; Sumner et al. 2018). Our daily food choices have a huge impact on the environment. Production of meat has a much larger impact compared with the production of vegetable-based proteins, for example. To feed a growing population worldwide, researchers around the world are searching for new food technologies and resources. Interest in alternative protein sources of high nutritional value, such as edible insects, has increased remarkably in recent years (van Huis et al. 2013). New food technologies (e.g. cultured meat, genetic modification) and new food sources (e.g. insects) may help reduce the environmental impact of people's food behaviour (Bonny et al. 2015; Smetana et al. 2015). However, consumer acceptance of these new food sources is a challenge and a positive attitude toward such novel foods is a prerequisite for consumer acceptance.

Insects are in fact, depending on species, metamorphic stage and feeding style, rich in protein and essential amino acids, have a high vitamin and mineral content and low cholesterol concentrations compared to some meat-based animal products (Belluco et al. 2013; Verkerk et al. 2007). At the same time, their farming requires little water, space and their biomass conversion rate is better than that of most animals (van Huis et al. 2013). Both of these aspects, high nutritional value and smaller environmental footprint than traditional red meat production, makes insects particularly interesting as 'mini-livestock' (DeFoliart 1995) suitable for human and animal nutrition all over the world (van Huis et al. 2013). Thus, insects are a valuable food source in many parts of the world, including Africa, Latin America and Asia (van Huis et al. 2013). However, acceptance ratings for insects is low among Western consumers (Hartmann and Siegrist 2017), and even in countries where entomophagy is part of the traditional diet such as China, it has started to disappear (Chen et al. 2009; Hartmann et al. 2015). Shelomi (2016) highlighted this at the World Exhibition Expo 2015 in Milan, entomophagy appeared to be presented as an alternative for regions suffering from starvation, rather than as a modern, novel food option. But why is it so difficult to establish insects as a new protein source within Western dietary behaviour? In the following chapter we are going to introduce individual factors that influence Western consumers' acceptance of insects as food. We further highlight recent evidence about the importance of creating positive eating experiences and the potential of using role models and personality impressions for

creating positive perceptions of insect food product consumers. Lastly, we present results from a new study about the impact of insect feeding style on consumer acceptance.

Individual Factors that Influence Acceptance of Insects as Food

Consumers who pay attention to the environmental impact of food choices reported a higher willingness to adopt insects as meat substitute (Verbeke 2015). However, insects are not a stable part of modern cuisines in most European countries and willingness to eat insects among the general population is rather low (Hartmann and Siegrist 2017). Especially women (Hartmann et al. 2015; Ruby et al. 2015; Schösler et al. 2012; Verbeke 2015) and those who value nutritional and health benefits of meat as well as those who focus on taste as a key component of meat quality, are less ready to adopt insects as meat replacement (Verbeke 2015). Another consistent finding across studies is that food neophobia, an individual's tendency to reject new and unfamiliar foods, is a negative correlate of willingness to eat insects (Hartmann et al. 2015; Hartmann and Siegrist 2016; Sogari et al. 2019; Tan et al. 2016a, b; Verbeke 2015). Food neophobia was once an important survival mechanism to prevent the ingestion of potentially poisonous substances (Pliner and Hobden 1992). It is associated with decreased levels of willingness to eat novel foods (Tuorila et al. 2001) and a barrier for the acceptance of insects as a new food source. Food rejection can be motivated by negative taste expectations and uncertainty about the origin of the product (Fallon and Rozin 1983; Tuorila et al. 1994). A typical reaction to things which people have learned are inedible or which are unfamiliar is disgust.

Disgust is a basic human emotion that prevents us from having contact with something that might be pathogenic, because it triggers behavioral avoidance of the stimulus. Thus, researchers consider it to be a component of the so called behavioral immune system (Terrizzi et al. 2013). People can vary in their tendency to react with disgust towards disgust elicitors that indicate the presence of pathogens such as certain odors (e.g. smell of decayed food) or visual cues (e.g. mold, runny nose). This disgust sensitivity was linked to a broad range of behavioral and attitudinal concepts in previous research. Disgust was by far the most frequently mentioned reason for rejecting eating insects in a study with Indian and US adults (Ruby et al. 2015). Results of that study further showed that those persons who scored high on the core disgust subscale – i.e. disgust based on a sense of offensiveness and threat of disease – (Haidt et al. 1994; revised by Olatunji et al. 2007) were less willing to eat insects. Food disgust sensitivity – disgust responsiveness towards certain food-related cues – and food neophobia together explained 37% of the variance in the willingness to eat insect products in another study with Swiss adults (Hartmann and Siegrist 2018). When considering hygiene, another important disgust domain, insects were long rather considered as an indicator for food contamination and a

health risk than as a valuable food source in most Western societies (Kellert 1993; Lockwood 2013 p. 62; Looy et al. 2014). The presence of insects might even be considered as an indicator for low hygienic standards. Accordingly, an individual's susceptibility to be disgusted by poor food hygiene was a significant predictor for willingness to eat foods containing insects as an processed ingredient (Hartmann and Siegrist 2018). The majority of the aforementioned studies focused on a hypothetical willingness to eat insects on the one hand and disgust sensitivity on the other hand. But what about actual eating behavior? In a behavioral experiment conducted in our group, consumers were confronted with chocolate, which was decorated with dried mealworms. Again, participants' food disgust sensitivity strongly correlated with the amount consumed of the insect chocolate (Ammann et al. 2018). Therefore, (food) disgust sensitivity in previous research was not only linked to the hypothetical consumption of insect products, but also proved to be a significant predictor for actual eating behavior. These results nicely correspond with the finding by Sogari et al. (2019). In their experiment, they found out that intention to eat the insect products (processed and unprocessed) was strongly influenced by food neophobic tendencies, sociodemographic characteristics, sensory expectations and past exposure to insects as food; and intention to eat was highly correlated with actual eating of the insect products. Thus, they added further evidence for the link between the constructs discussed above and people's actual eating behavior.

Creating Positive Eating Experiences

Consumers' previous experiences with insects as food is one of the strongest predictor for its acceptance (Hartmann et al. 2015). For creating such positive experiences and overcoming initial reluctance, various researchers proposed different strategies. For instance, it was suggested that insects are prepared and presented with techniques that can usually be found in high gastronomy and by renaming them negative associations with the insect origin could be prevented (Deroy et al. 2015). Another proposed strategy is that insects are flavored with familiar spices (Caparros Megido et al. 2014) or incorporated into familiar dishes. Generally speaking, research showed that processed insects receive higher acceptance ratings than unprocessed insects, because evocative cues such as long legs that remind consumers on the insect origin of the food are not visible anymore (Hartmann et al. 2015). Consequently, a lot of recent research focused on insect products and dishes with grounded insects.

In one study with Swiss adults, study participants in the intervention group sampled insect-based tortilla chips while those in the control group ate traditional tortilla chips (Hartmann and Siegrist 2016). In both conditions, participants then indicated their willingness to eat unprocessed insects such as deep-fried silkworms and deep-fried crickets which were presented with a picture of those items. Results of that study showed that participants who ate the insect-chips before, reported a higher willingness to eat the unprocessed insects while simultaneously controlling

for the impact of food neophobia, disgust and previous insect consumption which all had a significant influence. The fear of bad taste and negative textural properties play an important role in the rejection of unfamiliar foods (Pelchat and Pliner 1995). Thus, results of the aforementioned study support the notion that positive experiences with a processed insect food can lead to a higher willingness to consume the unprocessed counterparts as well (Hartmann and Siegrist 2016). Even though it might provoke false expectations concerning the taste of unprocessed insects, it might help to overcome the first hurdle to insect consumption and acceptance (Hartmann and Siegrist 2016).

Verneau et al. (2016) investigated with students from Denmark and Italy the effect of video-based information provision on consumers' intention to eat insect products. Information about societal and individual benefits of introducing insect proteins into human diet were tested. Results showed that information provision did raise the intention to eat insects, and information about societal benefits appeared to be more stable over time than the effect of information on individual benefits. Noteworthy, intention was also reflected in participant's willingness to eat an insect-containing chocolate bar.

In another study (Looy and Wood 2006), educational presentations of "bug banquets" were carried out in order to alter negative attitudes towards insects as food. Students from different age levels were questioned concerning their attitudes towards insects before and after they had attended such a "bug banquet". The "bug banquet" included among other things whole cooked crickets and mealworms, roasted crickets and roasted seasoned mealworms and vegetable-based items such as spring rolls filled with carrots. Results showed that such an educational approach has subtle effects on attitudes. Nevertheless, the authors concluded that these occasions might help to increase familiarity with insects among consumers (Looy and Wood 2006). Unfortunately, even though results of these two studies suggested that information provision and creating insect-eating occasions could increase willingness to eat, people who react with disgust towards insects are less likely to even go to such events (Hamerman 2016).

Such negative emotional reactions towards insects are a barrier for a successful market introduction. A study conducted in Switzerland investigated whether emotional reactions towards insects differs as a function of the processing degree of the insect ingredient (Gmuer et al. 2016). Again, researchers suggested to make insect products with grounded insects instead of unprocessed insects, because consumer acceptance is higher. The snacks used in the mentioned study were presented alongside pictures in an online survey. The insect snacks differed in their degree of processing of the insect ingredient: tortilla chips made of cricket flour, tortilla chips containing deep-fried cricket bits, a snack consisting of tortilla chips and deep-fried crickets, and deep-fried crickets alone. Respondents made 39 emotional evaluations, rated willingness to eat and expected liking of these snack products. Results showed that the insect snacks evoked various negative emotional expectations that went beyond expectations of disgust. Respondents did not expect positive emotional responses in the prospect of eating the snacks. Furthermore, expectations related to disgust/uneasiness and inertia/dissatisfaction were significant predictors of

willingness to eat. The most negative evaluation received the mix product, which might point to food contamination associations. Overall, results highlighted that when it comes to the marketing of insects negative initial expectations need to be overcome such as disgust and dissatisfaction in the prospect of eating the foods, but also positive emotions should be generated (Gmuer et al. 2016).

A promising argument for the consumption of insects could be the high nutritional value of insect protein. Thus, health motivated consumers might be willing to eat insects for health reasons. However, it is not quite clear how consumers evaluate the healthiness of insect products anyway. One study compared healthiness perception of a menu containing either a vegetarian schnitzel, a pork schnitzel or an insect schnitzel (Hartmann et al. 2018). It turned out that consumers acknowledged higher nutritional benefits to the insect than to the pork menu, but compared to the vegetarian option, no difference was observed. The question arises why health motivated consumers then should consume insect products in the first place, when they do not see a nutritional benefit in insect consumption. In addition, various studies showed, however, that the taste of insects and insect products is not evaluated that positive, which makes it rather difficult to attract a stable consumer group (e.g. House [in press](#); Schouteten et al. 2016). House ([in press](#)) conducted a qualitative study in the Netherlands where insect products are sold in some supermarkets as meat replacer (e.g. a schnitzel containing of 14% buffalo worms). The targeted market segment for these products were flexitarians who consciously try to reduce meat intake for environmental reasons. However, study participants' evaluations of the available products were rather negative. Problematic aspects mentioned were mediocre taste, high prices and low availability. These aspects make it rather difficult that insect products are preferred over comparable meat-replacer alternatives and make it rather unlikely that these products become a stable part of one's diet. In general, intention for repeated consumption of insect-based meat replacer was low (House [in press](#)) and these insect-based alternatives seem to suffer from the same problems like the traditional meat replacement products, mediocre taste and high price. In addition, it is not clear whether people eat such insect products in addition to meat or whether they in fact are eaten as meat replacers. When insects are just eaten as an additional source for protein, the goal to increase sustainability of food choices is not reached.

Creating Positive Impressions

Studies on impression management suggest a link between how people eat and how they are perceived by others. For example, a fictional woman was evaluated as more socially attractive when her meal was described as regularly sized and with a regular fat content as opposed to a high fat meal (Yantcheva and Brindal 2013). Moreover, Vartanian et al. (2007) concluded in their review of consumption stereotypes that people who eat "good" or low-fat foods are generally perceived as "better" people – that is, more attractive, intelligent, and conscientious. Prior research has also

suggested that people who primarily consume plant proteins may be seen as more moral, more feminine, and more socially difficult than people who consume animal proteins (Ruby 2012; Ruby and Heine 2011). A person's food choices and eating behaviors are seen as reflections of lifestyle decisions, attitudes, and values, and this information is often used to form an impression of their personality. Prior results suggest that people who follow a vegetarian diet or consume meat alternatives, such as insects, might be perceived negatively. This would be an obstacle for increasing the sale of these products. In two experimental studies, both the shopping list method and a vignette approach were used to assess underlying impressions of these consumer groups. The aim of the first study was to explore how someone with insect-based or vegetarian burgers on their shopping list is perceived compared to someone purchasing beef burgers. Study participants ($N = 598$) were randomly assigned to one of three shopping list conditions and evaluated the owner of the list on 16 bipolar attributes (e.g., disciplined, health-conscious, popular). In the second study, a new set of participants ($N = 617$) was randomly assigned to one of three conditions. They read a short description about a hypothetical person who either chose a lunch menu with insect schnitzel, vegetarian schnitzel or pork schnitzel to elicit an evaluation of this person. The same personality attributes as in Study 1 were assessed. The results of both studies showed that consumers of insect and vegetarian products were perceived as more health-conscious, environmentally friendly, imaginative, brave, interesting, and knowledgeable than meat consumers. Both studies showed that insect consumers in Switzerland were evaluated positively. Given the relatively positive image of people who consume alternatives to traditional meat proteins identified in the present study, the social influence of people who visibly consume such products may be high. To increase the acceptance of insects as a food source, it is vital to recognize the importance of role models who demonstrate that eating alternative protein sources, such as insects, is a popular, environmentally friendly, and good-tasting option. This is especially important considering that social influences exert robust modelling effects on people's food intake (Spanos et al. 2015; Vartanian et al. 2007).

Insect Feeding Styles: Does It Matter for Acceptance?

In another recent experiment of our group, a question regarding the sustainability of insect breeding, was tackled: How relevant is the insect's menu for consumer perceptions? The environmental impact of edible insects depends largely on the insect feeding style (Smetana et al. 2016; van Huis and Oonincx 2017) and most insects species are highly efficient at bio-converting organic waste (Offenberg 2011). Life Cycle Assessments suggest that feeding insects with food waste, for example from restaurants and supermarkets, instead of rye, maize or soybean meal, could be a promising approach for more sustainable feed production (Offenberg 2011; Smetana et al. 2016). However, this raises some additional research questions, as consumers might be even more disgusted by insects that were fed food waste and thus,

acceptability might be even lower. In an experiment we wanted to test this and presented consumers with a short introductory text on insects as high-quality and sustainable protein. Participants ($N = 613$, 52% female, $M = 45$, range: 20–69 years of age) were randomly distributed into four groups and received either a text describing that insects get fed with food waste from gastronomy, the supermarket, rye meal or other feedings stuff. Subsequently, they were asked to respond to four questions regarding their willingness-to-eat these insects, their risk and benefit perceptions and elicited disgust. Results suggest that consumers do not differentiate significantly between the insects fed with food waste from gastronomy, the supermarket, rye meal or other feedings stuff and exhibit similar values regarding willingness-to-eat, risk and benefit perceptions and disgust. Given the low overall willingness-to-eat ($M = 25.1$, $SD = 29.0$; range: 0–100) and high overall disgust ($M = 64.2$, $SD = 34.0$; range: 0–100), the difference in insect feeding style might not have been that salient for or important to consumers. Similarly, feeding style did not lead to different estimations of risk and benefit. In conclusion, feeding insects with food waste might not necessarily have detrimental effects on consumers' acceptance and might even have positive implications for consumers, as food waste is currently a much-discussed topic in need of consumer-oriented solutions (e.g., Hannibal and Vedlitz 2018; Stockli et al. 2018). Environmentally inclined consumers might perceive the possibility of converting food waste into high-quality protein as beneficial. This issue should be investigated further in future consumer studies that manipulate claims regarding sustainability of the edible insects with different feeds.

Concluding Remarks

Recent research has made much progress in understanding the psychology of eating insects. A lot of studies were published in the last couple of years that try to explain and provide strategies to overcome reluctance to eat insects in Western cultures. As daily food choices are embedded in cultural and social norms, food traditions and contexts, new food sources are difficult to establish as a stable part of Western diets. A lot of studies focused on individual factors that are linked to acceptance of insects as food. Factors such as food neophobic tendencies, previous experiences with eating insect, male gender and attention to the environmental impact of food influence consumers readiness to eat insects (Hartmann et al. 2015; Hartmann and Siegrist 2017; Sogari et al. 2019; Verbeke 2015). Another key driver for the acceptance of insects as food are of course positive first eating experiences, which increase future willingness to eat them. Especially those persons who seek for novelty and sensation in their diet are early adopters of food innovations like insects. Another underlying consumer motivation are environmental benefits of substituting traditional animal protein with insect protein. However, sustainability of insects as food highly depends on the insects' diet during breeding. Feeding insects with food waste substantially decreases their ecological footprint but might pose another challenge for consumer acceptance. Preliminary study results, however, showed that the feeding

style of the insects is not of fundamental relevance for benefit and risk perception concerning insect consumption as well as evoked disgust and willingness to eat them. Next to low availability and price of insect products, which are barriers for repeated consumption, it is questionable whether meat enthusiasts can be convinced to substitute meat with insects without providing them with additional benefits. In that it might be necessary to give insects new functions (e.g. snack), new application forms (e.g. on a spit) and eating contexts (e.g. barbecue) instead of marketing them as a supplement to the traditional meat replacers. Overcoming lack of cultural appropriateness of insects for Western consumers by providing new functionality and eating contexts might pave the way for a wider acceptance.

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