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Exploring Consumer Acceptance of Entomophagy: A Survey and Experiment in Australia and the Netherlands

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Insects are nutritious and suitable for human consumption. In this article an overview of research on consumer acceptance of entomophagy is given. This study furthermore provides insight into which factors are effective to influence consumer acceptance of entomophagy among Dutch and Australian participants. Based on the findings of this study, information about entomophagy and providing the participants with the opportunity to try insect food, both seem to be equally important when trying to positively influence their attitude toward entomophagy. The outcomes of this study show that "educating" consumers about entomophagy should be practiced in its broadest sense.

KEYWORDS consumer acceptance, edible insects, entomophagy, insect food, western consumers

According to the UNFAO (2009) the overall food production needs to be increased by 70% in order to be able to feed everyone in 2050. However, due to the growing population and the environmental degradation providing adequate animal based proteins will become harder in the future (Yen 2009). A transition to a diet with less animal protein and more plant protein would "simultaneously benefit the conservation of biodiversity, land, water, energy, climate, human health and animal welfare" (Aiking 2011, 112).

Insects can be used as alternative or additional source of animal protein (Yen 2009), which would have several advantages. Van Huis and colleagues (2013) state that entomophagy can be promoted for three reasons: health, environment, and livelihood (economic and social factors). First of all, insects

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are nutritious; they are a good source of protein, good fats, calcium, vitamins, and energy (Bukkens 1997, cited by Verkerk et al. 2007; Rumpold and Schlüter 2013; van Huis et al. 2013). Insects also have several benefits for the environment compared to other sources of protein. For example, insects intended as food emit fewer greenhouse gases than most livestock and can be fed on organic waste streams (van Huis et al. 2013). Furthermore, a huge number of edible insects are already available (Cazaux, van Gijseghem, and Bas 2010; Durst et al. 2010; Gahukar 2011) and insects can be reared and multiplied easily in small spaces in a short period of time (Gahukar 2011). Yen (2010) concludes that the use of insects as human food can thus result in more energy-efficient food production and facilitate environmental conservation. Finally, insect harvesting and rearing can offer livelihood opportunities for poorer sections of society since insect harvesting/rearing is a low-tech, low-capital investment option (van Huis et al. 2013).

The main problem with using insects as a "new" source of animal-based protein is the fact that there is a major attitudinal barrier to the use of insects as food in Western societies (DeFoliart 1999). This barrier is primarily caused by cultural factors (Yen 2010); the attitude in Western societies toward insect food is either one of fear and abhorrence or one of curiosity (Yen 2009). Looy and colleagues (2013) mention that a view of insects as dirty, disgusting, and dangerous is deeply embedded in the Western psyche. Van Huis and colleagues (2013) furthermore mention the "disgust factor" and state that "insects are still viewed as pests by a large majority of people, despite the increasing literature pointing to their valuable role in the diets of humans and animals" (van Huis et al. 2013, 141).

The objective at this stage should thus not be to encourage the direct use of insects as food, but to change Western attitudes toward entomophagy (Yen 2009). Looy and colleagues (2013) mention that "social scientists can provide insights to help transform our attitudes toward insects as human food, thereby illuminating our unconscious values around food, hospitality, and consideration of 'the other'". In reaction to these claims, this study aims to provide insight into which factors play a role in positively influencing the consumer acceptance of entomophagy among Dutch and Australian consumers. This article will explore respondents' attitudes toward eating insects—both consumed whole, as well as unrecognizably incorporated into another product—in the hopes of answering the research question, *Which factors are most effective to positively influence the consumer acceptance of entomophagy among Dutch and Australian consumers?*

THEORETICAL FRAMEWORK

Consumer acceptance is a broad concept; there is no single theory that can explain why consumers do or do not accept a product. Consumer acceptance

can be used in different fields; in this study it is applied to the field of innovative food technologies and food products, as described by Siegrist (2008). Insects as food in Western societies can be seen as a new or innovative type of food, although it should be kept in mind that various products can be made with insects or insect-based ingredients. People already consume insects without realizing it; red scale insects are used as food coloring agent E120 in, among others, Smarties candy, yogurt, and the alcoholic beverage Campari. Research is also being done on extracting protein from insects as food additive (Verkerk et al. 2007). Insects are thus not just "one type of food" but can be made into different types of foods.

Three categories with factors that influence the consumer acceptance of innovative food technologies and products are identified by Siegrist (2008): (1) factors related to the product, (2) social trust and norms, and (3) psychological factors. Siegrist's theory forms the basis of the conceptual model used in this study; however, this theory focuses on the consumer acceptance of new food technologies and products in general. This study also looked at factors influencing the consumer acceptance of novel protein foods (NPF's) and entomophagy.

In figure 1, an overview of factors influencing the consumer acceptance of entomophagy is provided. This figure illustrates a combination of factors found in the literature. The categories and factors identified by Siegrist (2008) are used as the basis of the figure. The factors mentioned by Siegrist (2007), Hoek (2010), Yen (2010), and van Itterbeeck (2008) have been added to the figure.

Siegrist (2008)	Siegrist (2007)	Hoek (2010)	Yen (2010)	Van Itterbeeck (2008)
Factors related to product				
Price and quality		Product quality of the substitute		
Perceived benefits	Benefits of the novel foods are tangible to the consumer	Needs to offer additional value		
Perceived risks				
Perceived naturalness	Confidence in 'natural food'			
Information about manufacturing process				
		Fit with consumers needs		
		Availability		Availability of product
Social trust and norms				
Trust in (claims made by) institutions and producers				
Trust in persons doing research				
Trust in persons using the product				Social influence
Prior attitude			Reputation of insects (e.g. unhygienic)	Feelings of fear, dislike and indifference
Psychological factors				
			Cultural factors	Culture (taboos)
Personal importance of naturalness				
Food neophobia			Novelty approach	Neophobia
Environmental attitudes				
Available information about hazards				

FIGURE 1 Factors influencing consumer acceptance of entomophagy.

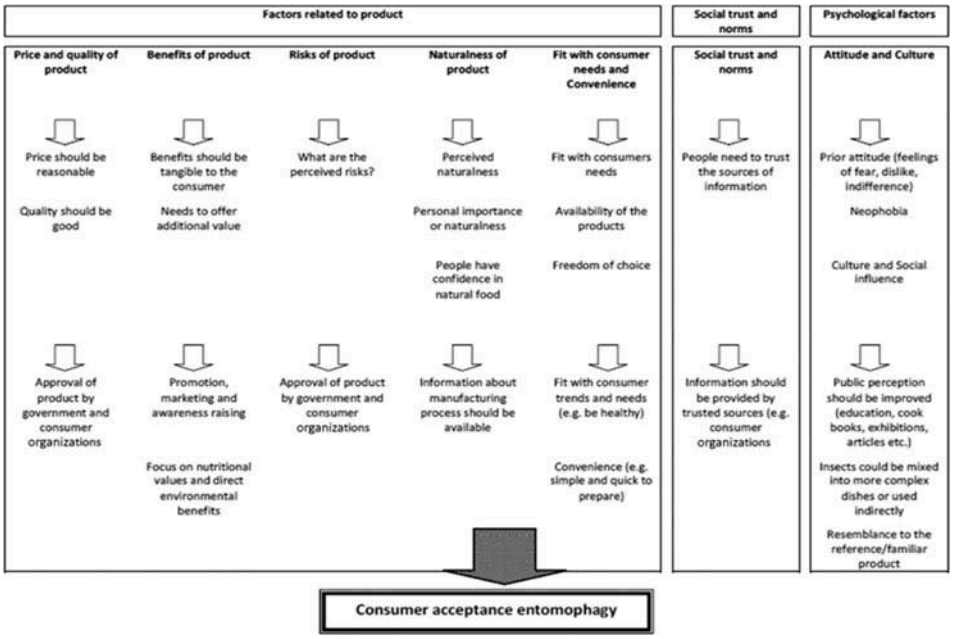

FIGURE 2 Conceptual model of consumer acceptance of entomophagy,

Figure 2 shows the conceptual model of the research. The model was derived by identifying the factors that influence the consumer acceptance of entomophagy mentioned in the literature (e.g., Mignon 2002, cited by Yen 2009; van Itterbeeck 2008; Verkerk 2007) and by studying the introduction of other novel food products. As Looy and colleagues (2013) mention, the acceptance of insects as human food faces additional barriers that few other novel foods share. To identify some of those barriers an analogy by Hoek (2010) was used to identify factors that can play a role in the success or failure of a new food substitute. The introduction of the novel protein food (NPF) Quorn was furthermore studied as an example of an accepted, successful and fungal-based food product.

Siegrist's (2008) categories are used to organize the information in the conceptual model. At the top of the figure the factors influencing the consumer acceptance of entomophagy are displayed, and at the bottom are the "actions" that could be taken to increase consumer acceptance. The literature revealed seven factors that are expected to play a role in the consumer acceptance of entomophagy: (1) price and quality of the product, (2) benefits of the product, (3) risks of the product, (4) naturalness of the product, (5) social trust and norms, (6) attitude and culture; and (7) fit with consumer needs and convenience. In addition, seven sources that could provide trustworthy information about entomophagy were identified: (1)food producers, (2) scientific researchers, (3) persons using the product, (4) the government, (5) consumer

organizations, (6) well known relatives, and (7) famous persons (Henson, 2001 cited by: Lobb, 2005).

The first factor is the combination of price and quality—it is important to consumers that a product be "reasonably" priced and of good quality (Hoek 2010; Siegrist 2008).

Second, tangible product benefits can increase consumer acceptance. However, consumers need to be aware of the benefits in order to increase the chance of them accepting the new product (Siegrist 2007, 2008).

Third, the perceived risk of a product has a negative influence on consumers' willingness to purchase it (Siegrist 2008; Siegrist et al. 2007).

Fourth is the perceived naturalness of the product. Western consumers also seem to have a strong desire for natural foods, since they relate these with better looks and a better taste compared to foods containing additives or artificial ingredients (Siegrist 2007).

The fifth factor is the factor "trust"; trust is a very important aspect for consumers when it comes to accepting a product, Siegrist (2008) found that consumers rely on trust to make their decision easier. Related to the sixth factor, attitude and culture, research showed that the psychological factor of culture influences food preference, food choice, and food liking (Mela 1999, cited by van Itterbeeck 2012) and that the shunning of entomophagy is primarily cultural (Gullan and Cranston 2005, cited by Yen 2010). Finally, the seventh factor relates to the fit with consumer needs, convenience plays an important role when a consumer has to decide whether to buy a certain food product or not. The product should, amongst others, be easily available, easy to store, available for use at any time and be simple and quick to cook. When trying to create consumer acceptance of a new food product it is furthermore important that the product fits with the consumers' trends and needs (Hoek 2010).

MATERIALS AND METHODS

Survey

An online survey was conducted among Dutch ($N = 134$) and Australian ($N = 75$) consumers after having obtained consent from the persons involved. Since both Australia and the Netherlands are Western countries, it was expected that Dutch and Australian participants would have similar attitudes toward entomophagy. The responses from Dutch and Australian participants were combined when an independent *t*-test indicated that the samples were not significantly different from each other.

The survey was conducted to: (1) endorse the findings from the literature, (2) provide insight into the consumers' current opinion about and attitude toward entomophagy, (3) provide insight into the factors that have the most chance to positively influence the consumer acceptance

of entomophagy, and (4) provide insight into any possible difference between Dutch and Australian consumers regarding their attitudes toward entomophagy.

The data for the survey was collected online. Respondents were selected by using the social network of one of the researchers, an email was sent to contacts containing a link to the survey. In the email the rationale of the survey was briefly explained. People were furthermore asked to forward the survey to their social network, creating a snowball effect. A link to the survey with a brief explanation of the aim of the study was also placed on Facebook.

The sampling method used to distribute the survey had as consequence that referrals were not made randomly, and it is thus likely that the email mainly reached people that are similar in age, education, and social class (McPherson and Smith-Lovin 1987, cited by Heckathorn 2002).

Before distributing the survey a pilot survey was conducted among four Australian consumers. The survey was divided into nine sections. The first section consisted of seven statements regarding the respondents' attitude toward entomophagy. After that, there were seven sections; these related to the factors identified in the conceptual model of consumer acceptance of entomophagy. In the survey, sections 2–8 were randomized, meaning that the order of the sections was different for each respondent. This minimized the chance of bias caused by the order of the sections. After these seven sections, the same questions that were asked at the start were asked again in order to compare the answers from the beginning and end of the survey, and to see whether attitudes changed after completing the survey. The questionnaire ended with the ninth section asking several questions regarding the demographics of the respondent.

The survey mainly consisted of statements that could be rated on a Likert scale; only a few open questions were used. There are several reasons for this choice. First, open-ended questions require a lot of effort from the respondents and can therefore be seen as burdensome; and second, the responses generated by an open-ended questionnaire are more likely to be vague and sometimes useless (Synodinos 2003). A 5-point rating scale was used for all statements apart from the general questions at the start and end of the questionnaire. For those statements, a 9-point rating scale was used because it was expected that the changes in attitude (from the start to the end of the survey) might be too subtle to measure with a 5- or 7-point scale. The 5- and 9-point Likert scales were chosen because the odd number allows the respondent to choose a neutral option. Garland (1991) mentions, for example, that not including a mid-point could either result in more positive or more negative results, which could influence the outcomes of the research. In this research, a neutral opinion is valuable, as it shows that while a participants' attitude may not be positive, it is also not negative.

Experiment

An experiment took place at the Mount Claremont farmers market in Perth, Western Australia, after having obtained consent from the market manager and participants.

A total of 138 consumers participated in the experiment; however the data of five participants was removed ($N = 133$) because the answers of those participants did not seem genuine or were too incomplete to be useful.

Participants in the experiment could sample a roasted cricket and a savory biscuit made with "insect flour," which contained a combination of ground crickets, mealworms, and pupae. The biscuits were made by replacing one-third of the flour in a recipe for "cheese and sesame biscuits" with the insect flour. Both the roasted crickets and the insect flour were purchased from a commercial supplier in Australia.

The products used in the experiment were chosen for several reasons. The most important reason was the fact that the participants were able to try a "whole" insect (the roasted cricket) and a product in which the insects were unrecognizably incorporated (the savory biscuit). The roasted cricket was selected for a practical reason; this was the only "whole insect" product available from the supplier. The choice to use the insect flour to bake a savory biscuit was based on a finding by Du (2012). She noted that the participants in her study found the combination of insects and a sweet biscuit somewhat odd, and suggested that a savory biscuit instead of a sweet biscuit might be more in line with consumers' expectations of the flavor from a biscuit made with insect flour. The aim of the experiment was to determine whether providing different types of information, and the opportunity to try (food with) insects, would have an immediate influence on the participants' general attitude toward entomophagy.

Before and after eating the product, participants were asked the same set of questions about their general attitude toward entomophagy.

Participants were randomly assigned to one of four research designs. In the first design, participants were given information about factors related to the product; in the second, about social norms and trust; in the third, about physiological factors; and in the fourth design, they were not given any information. Participants in every design were aware of the fact that the biscuit was made with insect flour. After reading the information, the participants could indicate whether they wanted to eat a roasted cricket, a savory biscuit made with insect flour, both products, or none of the products. After eating the product(s), those who chose to do so were also asked to rate the taste on a 7-point Likert scale.

A few limitations of the experiment should be noted. First of all, most participants did not have a lot of time to participate in the research. Unfortunately, this caused some people to "scan" the information, rather than read it thoroughly. Also, the experiment set-up made it possible for people

to get information on the study before deciding whether or not to participate. Some people did not want to participate because they did not like the idea of eating insects; instead of only filling out the first part of the questionnaire, they chose not to participate at all, which likely biased the results. Furthermore, "social pressure" or "peer pressure" could have influenced the findings of the experiment. Participants might have been encouraged or discouraged to try the insect food by others and/or by seeing other participants trying the food.

Statistical Analyses

The closed-ended questions were analyzed using IBM SPSS Statistics version 19 (Coakes 2005). Cronbach's alpha tests were used to determine whether the constructs that were used in the survey were homogeneous. When the alpha was higher than 0.7 the statements were combined and there was assumed that the statements together gave an indication of the topic measured.

One sample *t*-tests were used to determine whether the mean score on a construct of the survey sample was the same as the hypothesized mean. As mentioned previously, independent samples *t*-tests were used to check whether the averages of the Dutch and Australian sample were significantly different from each other. When the samples were not significantly different they were combined into one group. Paired-samples *t*-tests were used to check whether "general attitude" toward entomophagy had changed from before completing and after completing the survey in order to determine whether completing the survey and reading about entomophagy changed people's attitudes toward eating insects. One-way analysis of variance (ANOVA) tests were used to analyze the experiment results.

A 5-point Likert scale is used for most statements in the questionnaires. It is important to note that the level of measurement for Likert scales is ordinal. This means that that the response categories have a rank order, but the difference between the categories is not equal (Jamieson 2004). However, researchers frequently assume that the difference between the options can be assumed as equal (e.g., Blaikie 2003, cited in Jamieson 2004). Norman (2010) reviewed the assumptions of various statistical methods and the problems that are said to occur when the assumptions are violated. In his paper he states: "One of the beauties of statistical methods is that, although they often involve heroic assumptions about the data, it seems to matter very little even when these are violated" (Norman 2010, 626). Norman refers back to the paper by Jamieson (2004) and states that even though, strictly spoken, it is true that the descriptive and inferential statistics differ from ordinal and interval variables; this does not mean that the changes of an erroneous conclusion are increased. When this chance is not increased, it means the tests can still be done, even though the data is of ordinal level. The paper ends

with the following conclusion: "Parametric statistics can be used with Likert data, with small sample sizes, with unequal variances, and with non-normal distributions, with no fear of 'coming to the wrong conclusion'. These findings are consistent with empirical literature dating back nearly 80 years. The controversy can cease (but likely won't)." (Norman 2010, 631).

Parametric tests have been used to analyze the data in this research because non-parametric tests are usually less powerful than parametric tests. However, to reinforce the findings from the parametric tests a non-parametric test was conducted after each parametric test. These tests include the one-sample Wilcoxon signed-rank test, the Mann-Whitney U test, the Kruskal-Wallis test, the Spearman's Rank Order Correlation, the Chi-square test for goodness of fit and the Cramér's V test. The outcomes of the non-parametric tests were the same as the parametric tests in every case; therefore, the results of the non-parametric tests are not mentioned or displayed in the results.

RESULTS

Survey

A total of 209 people completed the survey; this included 75 Australian and 134 Dutch participants. One Australian participant did not complete the demographics section and one Dutch participant did not answer the question related to education level. These participants were still included in the analysis. In table 1, an overview of the participants' demographics can be found.

The samples are not representative for the Dutch and Australian population for the characteristics gender, age, and education. When interpreting the results it should thus be kept in mind that generalizations cannot be made.

General Attitude

At the start and end of the survey the respondents were presented with seven "general" statements about entomophagy. These statements were used to

TABLE 1 One-sample *t*-test Statement: "When a product is approved and/or promoted by [source], I believe it will be of good quality"

Statement	Mean	*DF*	*t*	*p*
Food producers	2.88	208	−2.268	.000
Scientific researchers	4.00	208	19.359	.000
Persons using the product	3.36	208	8.834	.000
The government	3.38	208	6.634	.000
Well-known relatives	3.68	208	12.545	.000
Famous persons	2.30	208	−12.489	.000

get a first insight into the participant's attitude toward entomophagy. These statements formed the constructs "general start" ($\alpha = 0.857$ and $\alpha = 0.890$, for the Dutch and Australian sample, respectively) and "general final" ($\alpha = 0.882$ and $\alpha = 0.909$, for the Dutch and Australian sample, respectively). The mean score 4.85 of the combined sample on this construct was not significantly different from the neutral score of 5 (*neither agree nor disagree*), $t(208) = -1.174$, $p = .242$. This indicates that the "general attitude" the participants had towards entomophagy at the start of the survey was not significantly positive or negative. The mean score on the construct "general final" was 5.38, which is significantly higher than the neutral score of 5, $t(208) = 2.81$, $p = .005$. This finding indicates that the attitude of the participants toward entomophagy became more positive after participating in the survey. However, when interpreting these results it should be kept in mind that at the end of the survey the participants saw those questions for the second time. This could have influenced their answers.

It should be noted that 73 participants had eaten insects before and 134 had not. An independent samples *t*-test showed that there was a significant difference between the scores of the people that had and had not eaten insects before. The people that had eaten insects before had a mean score of 5.61, whereas the people that had not eaten insects before had a mean score of 4.46. These means are significantly different from each other, indicating that people who have eaten insects before have a significantly more positive attitude toward entomophagy than the people who have not; $t(205) = 4.497$; $p = .000$ (equal variances assumed).

Price and Quality

The price of a product was significantly important to the combined sample of participants, the mean score of 3.63 on a 5-point Likert scale was significantly higher than the "neutral" option (*neither important nor unimportant*) of 3, $t(206) = 15.70$, $p < .001$. The same can be said for the quality of food; it is significantly important to the participants that the food they eat on a typical day is of good quality. The mean score for this statement, 4.22 was significantly higher than the neutral score of 3, $t(208) = 4.22$, $p < .001$.

Benefits

The survey showed that the participants do not consider entomophagy to be beneficial for them personally. The mean score of 3.08 is not significantly different from the neutral score of 3, $t(208) = 0.65$, $p = .52$.

However, the participants did see the fact that insects as food are environmentally friendly as a benefit, their mean score on this statement 3.98 is significantly higher than the neutral score of 3, $t(207) = 16.83$, $p < .001$.

They also associate insects with health, the mean score on this construct was 3.2 which is significantly higher than the neutral score of 3, $t(208) = 3.44$, $p = .001$.

Risks

The results from the survey showed that the Dutch participants did not see eating insects as a risk. The mean score of 3.36 was significantly higher than the neutral score of 3, $t(133) = 6.03$, $p < .001$. The mean score of the Australian participants, 3.15, was not significantly different from the neutral score of 3, indicating that they think eating insects is neither risky nor not risky, $t(73) = 1.29$, $p = .2$.

In an open question the participants were asked to explain the risks they associate with eating insects. Of the 167 participants that answered this question, 50 participants mentioned not to associate any risks with eating insects. Two risks that were mentioned most commonly were that insects could carry diseases, bacteria or infections ($n = 35$) and that people might get sick after eating them or think eating insects is too "scary" ($n = 27$). Interestingly, numerous participants listed factors that would not normally be seen as "risks" when answering this question. For example the fact that the idea of eating insects is unattractive and the "*Yucky taste, texture in the mouth*". One participant stated: "*I have always experienced insects as being pests and hazardous to your health, so seeing them in food makes me think that eating it could make me sick.*"

Naturalness

The survey results showed that it is important to the participants that a product is natural. The mean score of 3.59 was significantly higher than the neutral score of 3 for the construct "naturalness general," $t(208) = 9.55$, $p < .001$.

In order to determine whether the participants see insects as a natural product they were presented with the statement: *"I associate insects with natural food, without any additives or artificial ingredients"*. The one-sample *t*-tests on this statement showed that the participants scored significantly higher than the neutral option on this statement. The mean score on for this statement was 3.48 which is significantly higher than 3, $t(208) = 7.79$, $p < .001$. This indicates that the participants "agreed" with this statement and associate insects with natural food.

Fit with Consumer Needs and Convenience

The construct convenience included statements about the availability of the product, the convenience of the preparation process and the fit with the

consumers' needs. The convenience of a product is significantly important to the participants, the mean score of 3.76 is significantly higher than the neutral score of 3 on this construct, $t(208) = 18.08$, $p < .001$.

Trust

In order to determine which of the seven sources would be trusted most when providing information about entomophagy, the participants were provided with the statement *"How trustworthy would you think information about entomophagy is when it is provided by . . . [source]"* for each of the sources. The results of the one-sample *t*-test indicate that the combined sample of participants believe information is trustworthy when provided by (1) scientific researchers, mean 4.00, $t(208) = 19.36$, $p < .001$; (2) well-known relatives, mean 3.68, $t(208) = 12.55$, $p < .001$; (3) the government, mean 3.38, $t(208) = 6.63$, $p < .001$; and (4) persons using the product, mean 3.36, $t(208) = 8.83$, $p < .001$; but not when it is provided by (5) food producers, mean 2.88, $t(208) = -2.27$, $p < .001$; or (6) famous persons, mean 2.30, $t(208) = -12.49$, $p < .001$. An independent sample t-test showed that the mean score of the Dutch participants was significantly higher than the mean score of the Australian participants for the statement "How trustworthy would you think information about entomophagy is when it is provided by consumer organization"; $t(207) = 3.967$; p= 0.00 (equal variances assumed). This indicates that Dutch participants have significantly more trust in consumer organizations than Australian participants. Because of this difference the data of the two samples were not combined.

Attitude and Culture

The results indicate that it is not important to the participants that the food they eat on a typical day be familiar. The mean score of 2.62 is significantly lower than the neutral score of 3, $t(207) = -6.97$, $p < .001$.

The participants were also presented with two statements related to the way insects are incorporated into the dish: (1) *"I would be more likely to eat insects if they were mixed into a dish than if I had to eat them individually"* and (2) *"I would be more likely to eat insects if they were unrecognizably incorporated in a product (for example as a paste or as flour)."*

Both the Dutch and the Australian participants scored significantly higher (3.34 and 3.75, respectively) than the neutral score of 3 on the first statement, $t(133) = 3.24$, $p = .002$; and $t(74) = 7.05$, $p < .001$, respectively. An independent samples *t*-test showed that the Australian participants score significantly higher than the Dutch participants on the first statement $t(190.32) = -2.69$, $p = .008$ (equal variances not assumed). The datasets have therefore not been combined for the first statement

There was no significant difference between the scores of the Dutch and Australian participants on the second statement, $t(207) = -0.69$, $p = .491$ (equal variances assumed); and thus these two datasets have been combined. The combined sample had a mean score of 3.71 on the second statement, which is significantly higher than the neutral score of 3, $t(208) = 8.94$, $p < .001$. The participants are thus more likely to eat insects mixed into a dish than to eat them individually. Participants are also more likely to eat insects when they are unrecognizably incorporated in a product.

The comments of the participants indicated that most participants preferred not seeing the insects they ate, especially the heads and eyes. However, several participants also mentioned being willing to eat whole insects out of curiosity or for the novelty value. Incorporating insects unrecognizably into products could reduce this value.

EXPERIMENT

A total of 133 Australian consumers participated in the experiment. In table 2, an overview of the demographics is given. The sample was not representative for the Australian population on the characteristics gender, age and education level.

General Attitude

The statements from the start and end of the experiment were combined to form the constructs "general attitude start" ($\alpha = 0.800$) and "general attitude final" ($\alpha = 0.714$). The mean score of 4.36 at the start of the experiment was significantly lower than the neutral score of 5 $t(132) = -4.32$, $p < .001$. At the end of the experiment the mean score was 5.7, which is significantly higher than the neutral score of 5, $t(82) = 4.49$, $p < .001$.

The results indicate that the general attitude towards entomophagy was significantly negative at the start of the survey and significantly positive at the end. The negative attitude is likely to be caused by being unfamiliar with "insect food". When interpreting these results, it should be noted that 133 consumers rated the first set of statements and only 83 rated the second set. This is because only the consumers that chose to eat (a product containing) insects were asked to rate both sets of statements. It is likely that participants with a negative attitude at the start were less inclined to eat the insect food and were thus less likely to fill out the second set of statements.

In order to see whether the attitude of the people that rated both sets changed, the same test was conducted including only the participants that ate the insect food and rated both sets of statements. The results show that the people who decided to try insects did not have a significantly positive or negative attitude when rating the first set of statements; the mean score

TABLE 2 Demographics Experiment

Category	*n*
Gender ($N = 131$)	
Male	48
Female	83
Total	131
Missing	3
Age category ($N = 131$)	
< 10	5
11–20	7
21-30	17
31-40	22
41-50	23
51-60	29
61-70	22
71-80	5
>80	1
Total	131
Missing	3
Education level ($N = 133$)	
No education/primary school	9
Secondary school	13
Apprenticeship/TAFE	19
University degree – Bachelors	70
University degree – Master or PhD	22
Total	133
Missing	1
Questionnaire version ($N = 133$)	
1	33
2	34
3	33
4	33
Total	133

of 4.92 was not significantly different from the neutral score of 5, $t(81) = -0.49$, $p < .629$. The participants did have significant positive attitude after eating (a product containing) insects, the mean score of 5.73 was significantly higher than the neutral score of 5, $t\ (82) = 4.73$, $p < .001$. This indicates that eating the insect food did change their attitude toward entomophagy in a positive way. However, it should be noted that on a 9-point scale an average score of 5.73 still leaves significant room for improvement. Interestingly, it did not make a difference which kind of version of the questionnaire the participants had. In other words, the type of information and even having no information about entomophagy at all, did not seem to influence the attitude when participants also ate the insect food. This will be discussed more in-depth in the next paragraph.

In order to check whether the attitude of the participants that decided not to eat the insect food was more negative at the start than the people that did decide to eat the insect food, another one-sample *t*-test is conducted.

In this test only the participants that ticked the box "I would not like to eat either of the products" have been included. The results show that the people that did not want to try the insects had a significantly negative attitude toward entomophagy, the mean score of 2.99 was significantly lower than the neutral score of 5, $t(34) = -9.05$, $p < .001$.

Participants that ate insect food on previous occasions were more likely to try the insect food in this experiment. In total 46 participants had eaten insects before and 39 of them ate the insect food on this occasion. In comparison, 87 participants had not eaten insects before and "only" 55 of them tried the insect food on this occasion.

Type of Information

A one-way ANOVA test was used to determine whether the research design (information about factors related to the product, information about social norms and trust, information about physiological factors or no information) influenced how the participants liked the savory biscuit and the roasted cricket. The results of the ANOVA show that the F ratio is not significant for either of the products; $F(3, 80) = 1.344$, $p = .266$; and $F(3, 62) = 1.776$, $p = .161$, respectively. This means that the null hypothesis "there is no difference in the mean scores for how the products were liked between the people with different questionnaire versions" cannot be rejected. In other words, the participants did not like the biscuit and cricket different when they had different questionnaire versions.

A similar test was conducted in order to compare the scores on the set of statements related to the general attitude at the end of the questionnaire. The results of the ANOVA test show that the F ratio is not significant, $F(3, 79) = 0.345$, $p = .793$. This means that the null hypothesis "there is no difference in the mean scores on the construct "general final" between the people with different questionnaire versions" cannot be rejected. The attitude toward entomophagy at the end of the questionnaire is thus not different among the participants with different questionnaire versions.

Taste

A one-sample t-test was used to determine whether the mean scores on the constructs about the taste of the roasted cricket and biscuit were significantly higher or lower than the neutral score of 4. The tests show that the participants significantly liked the taste of the roasted cricket, the mean score of 5.02 was significantly higher than 4, $t(65) = 7.62$, $p < .001$. The participants also significantly liked the taste of the biscuit, the mean score of 5.4 was significantly higher than 4, $t\ (83) = 10.06$, $p < .001$.

DISCUSSION

In most studies about entomophagy it is stated that changing consumer attitudes toward entomophagy is vital and the main challenge when introducing entomophagy to Western societies. For example, Yen (2009) states that changing attitudes to eating insects is paramount to success, Du (2012) concludes her thesis by stating that consumers need to be educated about insect food, Looy and Wood (2006) mention that future research is needed to gain more insight into the effect of educational "bug banquets" and finally, Rumpold and Schlüter (2013) mention that education of the public needs to be performed to establish and increase consumer acceptance.

This article presents a clear overview of research done on consumer acceptance of entomophagy. Several factors influencing consumer acceptance of entomophagy are tested for both Australian and Dutch participants. Both a survey and an experiment were used to gain insight into the participants' attitudes toward entomophagy and this knowledge can be used to "tailor" the type of information that can and should be used to educate consumers about entomophagy. The outcomes of this study are worth of further exploration. For example, the fact that participants in the experiment that were given no information about entomophagy at all were not less likely to try the insect food than participants that were given information might be an interesting argument to promote more encounters with edible insects.

The outcomes of this study show that "educating" consumers about entomophagy should thus be practiced in its broadest sense. When conducting future research it is worth exploring whether providing information about entomophagy might not be necessary as long as consumers have the opportunity to try insect food.

CONCLUSIONS

This study provides insight into which factors might play a role in positively influencing the consumer acceptance of entomophagy. Based on a literature study, seven factors were identified as factors influencing the consumer acceptance (price and quality, benefits, risks, naturalness, trust, attitude and culture, and fit with consumer needs). These factors were tested using a survey and experiment among both Dutch and Australian consumers to identify the importance of these factors and how they play a role in influencing the consumer acceptance.

The survey results show that first of all, both the price and quality of a product are significantly important to the Dutch and Australian survey participants. Secondly, regarding the factor benefits, the results show that people might not yet be aware of the benefits of entomophagy. However, the experiment showed that the participants did significantly like the taste of

the roasted cricket and biscuit with insect flour, and thus the taste of insects might become a benefit to consumers. The survey participants did not think eating insects proposed a risk to them. When they were asked to list any risks they associated with entomophagy, the majority of them said they did not think any risks are associated with eating insects. Fourthly, the results of the survey show that it is important to the participants that the food they eat on a typical day is natural. The participants also associate insects with natural food. Related to the fifth factor (trust), the results from the survey indicate that information is seen as trustworthy when provided by scientific researchers, persons using the product, the government and well known relatives, but not when it is promoted by food producers or famous persons.

It does not seem important to the survey participants that the food they eat on a typical day is familiar. This might indicate that, even though people might not be highly willing to try new things, they do not mind changing their diet when they have accepted something new. Finally, the results from the survey are in line with the findings from the literature regarding the last factor, convenience is significantly important to the Dutch and Australian survey participants.

Some participants in the survey associated insects with being unhygienic and some participants were afraid insects might carry diseases, bacteria or infections. This indicates how important it is that consumers know that the products are safe to eat. Trusted sources, like scientific researchers, should thus be involved in promoting entomophagy. The survey participants indicated in the "comments section" that it is also important to them that it that those sources are independent.

The results of the experiment showed that the type or topic of information does not seem to have a significant influence on the consumers' attitude or willingness to try the insect food. Interestingly, even participants that were given no information about entomophagy at all were *not* less likely to try the insect food than participants that were given information. This could indicate that just being able to try the food makes people more likely to do so and thus emphasizes the importance of the encounter with edible insects.

In general, it can be said that the participants in this study did not know a lot about entomophagy. A suggestion to increase the consumer acceptance of entomophagy is to provide information about entomophagy or to provide people with the opportunity to try insects. As an addition to this it is suggested to make insects, or products with insects, easily available for the main public. Insects could be (unrecognizably) mixed into other dishes or products in order to make insects less "scary" to eat (to decrease the barrier that people may encounter when having to eat whole insects). However, consumers also seem interested in trying the insects as a whole and seem to like the taste and texture of the roasted crickets.

Based on the findings of this study, information about entomophagy and providing people with the opportunity to try insect food both seem

to be equally important when trying to positively influence the consumers' attitude toward entomophagy. The findings of the experiment show that it might not be necessary to provide both information about entomophagy and the opportunity to try insect food, since the participants that did not get any information about entomophagy were not less likely to try the food. People who have eaten insects before have a significantly more positive attitude toward entomophagy than people who have not and are more likely to eat them again. It thus seems to be important to encourage people to make "the first step" and get them acquainted with eating insects.

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