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Insects as a replacement for meat

The intention and preparedness of consumers to eat insects as a replacement for meat

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Bachelor Thesis

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Abstract

This study examines to what extent meat consumers are ready to accept insects as a replacement for meat. In a questionnaire, ‘acceptance’ is measured by the ‘intention’ and the ‘preparedness’ to eat insects. One hundred sixty-six participants were randomly exposed to one of the four conditions. Each condition contained an image of a familiar or unfamiliar product with crickets. The crickets were visible in two conditions and invisible in the other two conditions. Then the intention and preparedness to eat the product were asked.

Overall, results indicated that the intention and preparedness to eat insects is not high. However, the strength of habit to eat meat and the visibility of insects do have an effect on the acceptance. When the strength of habit is stronger, the acceptance is lower and the visibility of insects in a product has a negative effect on the acceptance of the product. Implications and future directions for research are also discussed.

Content

1. Introduction

The world population is currently growing faster every year, and all these people need food. This trend leads to some major food challenges. Meat for instance is an important part of the everyday meal and is seen as a luxury product. When the population is growing, more meat will be consumed. The current demand for meat is therefore getting larger than ever, which leads to an increase in meat production.
In 2002, the total meat consumption of developing and developed countries is 137 million tonnes, and in 2005 it is 155 million tonnes for the developing countries. This consumption is expected to be doubled in 2030.
This increase is a problem because the production of meat is a major contributor to the pollution of the environment and the current impact is already above limits. The production of meat pollutes the environment directly and indirectly. For example, meat production requires substantial land and water resources, which pollutes the environment directly. Indirectly, the meat production is affecting the eco system services by deforestation and desertification, but the largest effect on nature has the feed that is used for the production animals. To help the environment, the production of meat needs to be reduced (FAO, 2006).

The impact of meat production on the environment differs a lot between the different production animals. The beef of cows has the largest impact on the environment. For the production of 1 kg of beef, most land and energy is used when compared to other animals. Pork follows after beef, and chicken has the lowest impact (de Vries & de Boer, 2010). Choosing the product with the lowest environmental impact can reduce the overall environmental impact. However, there is no need to all switch to chicken, as there are other possibilities for eating products that have less impact on the environment than meat.

There are a few requirements for the products that need to replace meat. First of all, consumers need protein in their meal. Consumers today eat a lot of meat and other products for their protein. So when replacing meat with other products, these other products have to contain enough high quality protein. Also the taste, smell and appearance needs to be similar to the meat products (Hoek, van Boekel, Voordouw & Luning, 2011).
In the case of the protein intake of the consumers, this is nowadays larger than it needs to be. Consumers in the Netherlands could reduce their overall protein intake by one third, and their nutrition will remain healthy (Aiking, de Boer & Vereijken, 2006).

Products that contain less protein and could replace meat are products like plant-derived products. This is healthier than meat and the production of these products are less taxing for the environment than the production of meat (Aiking, de Boer & Vereijken, 2006).
Another option to replace meat, is the consumption of insects. Insects have a high nutritional content and the production has a very low contribution to the pollution of the environment. Insects have more in common with meat than any plant-derived products, so it could be even a better replacement for meat. This is because consumers are more willing to try products that have familiar aspects (de Vries, 2011).

There are many reasons to eat insects instead of meat. For example, it would be better for human health and the environment. Some animals that are used for the meat production share diseases with the human being. A pig virus itself can sometimes infect humans, but it is also possible that a pig virus and a human virus combine and produce a new virus. In this way, an even more deadly virus can arise. This is a good reason to replace the meat with substitutes. Because insects and humans are so distantly related, there is no problem for humans when consuming insects considering infectious diseases.
When looking at the environmental aspects of eating insects, insects need less food than the animals that are used in meat production. Also, insects produce less manure and contribute therefore just a little to the pollution of the air and the environment. And very important, the nutritional value of insects is similar to meat (Dicke, 2010).

Humans are habitual meat eaters. As mentioned before, humans have a larger protein intake than needed. While meat at first may have been needed for extra energy during the day, humans do not need meat for energy anymore because the energy expenditure is much smaller nowadays (Henneberg, Sarafis & Mathers, 1998; Hladik & Pasquet, 2002). However, the habit remained and people do not seem to change their eating habits.
That people do not change their meat eating habit can also be blamed on the fact that only little attention is paid to the solutions that can help to reduce the environmental impact of the livestock sector. The media does not pay much attention to the relation between climate change and the meat production so few people know that there is a link between them. Consumers need to know that their diet choice matters and that it has consequences for the environment (Almiron & Zoppeddu, 2015).

So how do we get people to eat insects? Extra attention is necessary for the image of the consumption of insects because this is an important reason that the demand is still low. Before companies can raise production of insects largely, there has to be a demand for it.
Consumers are overall aversive towards eating insects. They often look at insects with disgust and find them creepy (de Vries, 2011; Tan, Fischer, Tinchan, Stieger, Steenbekkers & van Trijp, 2015). This image needs to be changed.
Insects as treats should persuade the consumer to eat insects. For instance, when insects are covered in chocolate and strawberries. These are often offered to consumers at meetings and informational sessions about insects (Hendriks, 2010). Insects can also be secretly offered in a dish with a nice sauce. When people try these products, most of them like it but there is still a large proportion of the consumers that has not tried insects and remain aversive.

It can take a while before consumers can adjust to the idea of eating insects. More information needs to be available to the consumer about eating insects and more opportunities need to be given to get comfortable with the consuming of insects. Consumers, especially in the western countries, do not know much about insects and how to prepare them. Further knowledge about eating insects like how to cook them is also necessary (de Vries, 2011). Overall, insects need to be seen as an alternative to meat wherefore people are willing to change their meat eating habit and replace their meat with insects.

To achieve this, we need to know when consumers consider to accept insects in their meal. When the consumers' position towards eating insects is known, further research can be done to find out how marketing can be used to trigger any demand. Then further steps can be taken to produce insects massively and try to reduce eating meat under the population after which meat can be replaced by insects and eating insects can become a habit of daily life.

The goal of this study is to give an insight in to what extent meat consumers are ready to accept insects as a replacement for meat. A central research question is derived from the literature study mentioned above. It is important to find out for different products if consumers are willing to try the product. In every product the meat will be replaced by insects. By finding out what their intentions and their preparedness to eat the products are, the readiness of the consumer to accept insects as a replacement can be measured.

The central research question is: *To what extent are consumers ready to accept insects as a realistic replacement of meat for the meat consumer?*

First, an overview of the theory was secured. In the literature study below, a broader study was done on consumers and eating insects. For instance, when consumers consider to eat meat replacing products and how this products can be presented to the consumer. With an experiment is this investigated. In the experiment an image of a product with insects was shown and the intention of the participant to eat the product and their preparedness to accept the product was measured. Familiarity with the product and the strength of the habit of the respondent were also taken into account. Then, there could be determined what effects these variables have on the acceptance of insects as a meat substitute.

2. Literature

2.1 New Product Placement

A way to reduce the ecological impact of today's food products, is to shift to more sustainable product choices. It is up to both the market and the consumers to make this step. The market needs to keep innovating all the time to keep their profit as high as possible. Therefore these innovations need to be in line with the needs and desires of the consumer. The success of new products development relies on consumer acceptation and adoption (Lee, 2014).

To know how the consumer accepts and adopts a new product that replaces meat, information about new product placement is needed. The success of a new product depends on the product attributes. Especially originality and usefulness are important for a new product. New product originality and new product usefulness go hand in hand. The consumer is more willingly to accept and adopt a new product when both attributes are present, but this is not the same for every consumer, as consumer demands differ. Purchase intentions of a new product depend on the characteristics of the consumer. Acceptance and adoption lead to purchase, which is considered when product attributes and consumer characteristics are connected (Guoxin, Zhang & Wang, 2015).

Another aspect to be considered are consumer attitudes, because consumer attitudes also have an effect on new product adoption. Consumer attitudes can be divided in visionary and pragmatic attitudes. Consumers with visionary attitudes adopt products earlier, which is favourable for a new product. When applied in product marketing, the launch of a new product can be more effective because it is more attractive to the consumer (Langley, Bijmolt, Ortt & Pals, 2012).

Before launching new substitutes for meat, this information needs to be taken into account and to make it effective, it should be in a way that the meat consumers accept and adopt these substitutes.
Before a strategy on how to launch a new substitute is considered, more information is needed about the alternatives that can replace meat.

2.2 Replacing meat with alternatives

2.2.1 Meat alternatives

The production and consumption of meat has the biggest contribution to the world wide pollution of the environment. The best solution would be to move meat consumers in a direction where meat is (partly) replaced by alternatives.
Products like, hybrid meat products, plant-based meat substitutes, organic meat and insects can be alternatives for meat. Other solutions are eating less meat (a moderate meat consumption), eating only the meat types with the lowest environmental impact (chicken) or sustainable farmed fish. The best option for a better environment is when the consumption of protein is derived from plants or insects instead of animals (Bakker & Dagevos, 2010).

2.2.2 Segmentation of the meat consumer

When zooming in on the consumers who eat meat, it is found that the ‘meat consumer group’ can be divided into smaller segments. Meat consumers can be segmented into heavy-users, medium-users and light-users (Hoek, Luning, Weijzen, Engels, Kok & de Graaf, 2011b). This can be linked to their eating habits. When a consumer eats a lot of meat, he can be divided into the ‘heavy-users’ group. A meat consumer can also consume a ‘medium’ or a ‘light’ amount of meat per day.

Consumers can also be classified by their characteristics. Consumers with comparable characteristics can be placed in a segment together, because of similar attitudes, motivations, eating habits or lifestyles. The theory of planned behaviour provides more information on the attitudes of consumers. When the attitudes are known, an intention to follow a certain diet can be predicted. For instance, when a consumer cares about the environment, he has a more positive attitude towards a diet without meat (Hoek et al, 2011b).

Overall, consumers have positive attitudes towards their own diet and negative attitudes toward other diets, while meat consumers have less positive attitudes towards their own diet compared to the others. This can probably explained by the fact that eating meat is not a diet that was an informed decision for many consumers (Povey, Wellens & Conner, 2001).
The attitude from consumers towards more sustainable food choices is mostly negative. When it comes to changing their meat eating diet, most consumers would rather reduce their meat consumption a little than ban meat out of their diet and replacing it with something else. A small step could be made towards replacing meat by introducing hybrid meat products.

2.2.3 Habits

Habits and attitudes can be linked. A positive attitude towards a product is usually associated with using the product on a regular basis. When a food product is consumed on a regular basis, the consumer is more likely to be familiar with the product and that he is using it out of habit.
When a new product is on the market and it looks like a familiar product to the consumer, it can more easily be accepted than an unfamiliar product. The acceptance and liking of the new product is best predicted by the expectations of the consumer. The expectation of a product is based on the liking and frequency of use of familiar products, so how an unfamiliar product relates to a familiar product is important for its acceptance. When a product lacks of familiarity, the consumer is more likely to stick to the familiar product, which in this case is meat. In this way consumers feel the 'need' to stick to their meat eating habit and when this habit is strong, consumers are less willing to accept new products (Birch & Lawley, 2014). It is like a downward spiral.

Product marketing needs focus on the consumers who are willing to change their meat eating habit. The meat eating habit can be changed, but this is not easy. There are different motives to change a habit. For instance, consumers want to change their habit when they want to control their weight, or because it is better for their health. In this case, replacing meat with substitutes is a good option. Other reasons like animal welfare and the pollution of the environment are also great motivators to change a diet with meat into a diet that contains less or no meat (Hoek, Luning, Stafleu & de Graaf, 2004; Vanhonacker, van Loo, Gellynck & Verbeke, 2013).
When changing a habit, a change in behaviour is also needed. The Stages of Change model considers changes in consumption behaviour over time (Prochaska, DiClemente & Norcoss, 1992). A behaviour can be changed through those stages. The stages are precontemplation (not interested in change), contemplation (thinking about changing), decision or preparation (making plans to change), action (changing behaviour) and maintenance. For example, when

applied to heavy-users of meat, they could change their eating habits and become medium-users, but heavy-users are probably not very willingly to try products that replace meat.

Insights in consumers' opinions and how they make product choices are important to obtain when a new product is going to be produced. It is important to know what the different opinions are about the meat consumption alternatives. With this information consumer profiles can be distinguished and sustainable food products can be better positioned in the market. Then, sustainable food choices could be better communicated to the consumers (Vanhonacker et al, 2013).

The interaction between habit and familiarity

It can be concluded that when a new product is unfamiliar to the consumer, the effect of an increasing habit on acceptance is less than with familiar products. So habit has less effect on acceptance by unfamiliar products. Then, the acceptance and adoption of the product is more successful when the product is unfamiliar to the consumer (Tuorila, Meiselman, Cardello & Lesher, 1998; Birch & Lawley, 2014).

2.2.4 Demand

The demand for meat alternatives is low. One reason for this is that consumers are not willing to pay more for alternatives than they pay for meat.
Also, plant-derived products as alternatives cannot be compared to meat, when considering taste, smell and structure. Consumers who always eat meat (their habit is strong) and want to switch to alternatives, desire small differences between the meat and the alternatives to make the switch easier (Vanhonacker et al, 2013).

Over the last years, the market has developed more and better products that can replace meat. These alternatives meet the requirements that consumers have for meat alternatives. These new meat substitutes have a certain resemblance with meat. Its taste can be similar even as its appearance or its application in meals. A growing share of all meat eaters is now more willing to include alternative products in their diet (Hoek, van Boekel, Voordouw & Luning, 2011). Concluding, it can be stated that the process, where consumers are triggered to leave meat aside sometimes and eat a replacement of meat instead, has started.

2.3 Replacing meat with insects

2.3.1 Eating insects

In many regions of the world eating insects is already a part of local culture. The insects are part of the traditional diet there, for example in Thailand. In Thailand is a large commercial insect sector, consuming insects is there normal. Some examples of insects that are consumed are crickets, giant water bugs, larva and ants. These insects are mostly produced on insects farms, but some are also wild (Bakker & Dagevos, 2010).

2.3.2 Benefits of eating insects

Eating insects is a new innovative idea in the western culture for replacing meat. Insects are a good replacement for meat because they are healthy and nutritious alternatives. Insects are rich of calcium, iron and zinc. The amount of proteins that can be derived from insects is even larger than the proteins that can be derived from meat.

There are also some environmental reasons to eat insects instead of meat. The production of insects leads to less greenhouse gases than the production of meat. They need less land and feed than pigs, cows and chickens (van Huis et al, 2013).

Insects need to be promoted to the big public as a healthy and environmental friendly replacement for meat.

2.3.3 The visualization of insects

The situation now is that insects are not processed in food for their nutritional value. Insects can only be legally marketed and eaten if not processed. They can only be sold when they are visible. The EU commission is trying to make insect-based food products legal. Then it can be studied what is more profitable, insects that are visible or invisible (Halloran, Vantomme, Hanboonsong & Ekesi, 2015).

Insects are linked to disgust and/or neophobia (Rumpold & Schlüter, 2013). When an insect is visualized in food products, consumers show rejection. This disgust mainly depends on the culture people live in. In the Netherlands, insects are getting increasing attention.

Insects hidden in fried products or in cake and chocolate is popular. People are more willing to try insects when they are hidden.

Insects hidden in products is a good way to present insect food. Consumers show less rejection in this case.

The appearance of a product gives the consumer an understanding of the product. For instance an understanding of the flavour and the structure. Therefore appearance is a large factor in products.

When products with insects should be a replacement for meat, the product should have similarities with meat products. Especially the overall appearance should have a lot in common with meat products. Consumers are less afraid of eating insects when it looks like a familiar product. Insects could for instance be processed into a burger. In the Netherlands they put mealworms in a famous snack called ‘bitterbal’ (fried meat ball). This made it a much smaller step for the visitors to try insects (Yeomans, Chambers, Blumenthal & Blake, 2008; Tuorila et al, 1998).

2.3.4 Information

Information about a product is needed when making the choice to consume it. Attributes like the visualization of insects on the products and the use of a logo or a health claim are things the consumer takes into account when making the decision to buy the product (Pascucci & Magistris, 2013).

In the case of insects, consumers need more knowledge about edible insects. When more information is known about a particular insect, they show more understanding for the product with the insect. When the consumer knows which insects are edible, they are more willing to try the product. Information about possible positive effects on the environment and social life are also important, because this can be linked to their personal values in life (Pascucci & Magistris, 2013). All of this can push consumers even more towards the acceptation and adoption of insects as meat substitutes.

2.4 Hypotheses

The first hypothesis that can be derived from the previous information is:
Insects as a replacement for meat are harder to accept when the habit to eat meat is stronger.

The second hypothesis that can be derived from the previous information is:
Invisible insects in products are easier to accept as a replacement for meat than visible insects.

The third hypothesis that can be derived from the previous information is:
Insects in familiar products are easier to accept as a replacement for meat than insects in unfamiliar products.

The fourth hypothesis that can be derived from the previous information concerns the interaction between the familiarity of a product and the strength of the meat eating habit:
The effect of increasing habits on decreasing acceptation of insects is stronger for familiar products than unfamiliar products.

3. Method

3.1 Participants & design

A convenience sample of students of the age of 18 or higher who study at an university in the Netherlands is used.
Most students live on their own and need to do their own groceries and prepare their own meals. Choices that represent their eating behaviour are made.
It is convenient that students have access to social media and they spend some time on it every day. The link of the experiment was spread through social media. Because of this, there were enough people who filled in the questionnaire.

The design is a 2 (familiar versus unfamiliar) x 2 (visible versus invisible) design. 166 People participated in the experiment. Every participant was randomly assigned to one of the four conditions. Some questions about their habits were asked. The variable habit was used as a continuous predictor in this experiment.

3.2 Pilot Study

To find out which meat products are familiar and unfamiliar, a pilot study was done. A number of meat products was given to ten people. They needed to rate the products for their familiarity on a 7-point scale. An example question (in Dutch) is in the appendix. The products that the participants rated are burger, dumplings, pot roast, meatballs and quiche. These products are chosen because the meat is dominant.
The product that rated the highest on familiarity was used in the familiar condition, and the product that rated the lowest on familairity was used in the unfamiliar condition.

The pilot study showed that dumplings are the least familiar product (mean of 1) and burgers the most familiar product (mean of 5.3). An overview of the means of the pilot study can be seen in the appendix.

3.3 Measuring instrument & manipulations

With a digital questionnaire students were asked how they view insects as a replacement for meat. With this information it was analysed what the preparedness and intention is to replace meat by insects. It contained questions with statements and 7-point scales.
There were four manipulations. Each condition contained a product that was unfamiliar or familiar, and with insects which were visible or invisible.

The images of the conditions with visible insects contain the same sort of insect. In this way only the familiarity has an effect on the choice of the participant. Crickets were chosen because this is a well-known insect and it can be used in many dishes.
The pictures below show visible insects which are adapted with Photoshop to make sure that the products are exactly the same (except for the visible insects) in the visible and invisible condition.

3.3.1 The four conditions

1. *Familiar and visible condition*

This condition contained an image of a familiar meat product, a burger, in which the meat was partially replaced by crickets. The insects were visible in the product.

2. *Familiar and invisible condition*

This condition contains an image of a familiar meat product, a burger, in which the meat was partially replaced by cricket flour. The insects were not visible.

3. Unfamiliar and visible condition

This condition contains an image of an unfamiliar meat product, dumplings, in which the meat was partially replaced by crickets. The insects were visible in the product.

4. Unfamiliar and invisible condition

This condition contains an image of an unfamiliar meat product, dumplings, in which the meat was partially replaced by cricket flour. The insects were not visible.

3.3.2 Measures

Per condition by three questions was asked on the intention of the respondent to eat the product. These questions were the same for each respondent and are based on Armitage and Conner (1999) to measure the overall intention of the consumer to eat a new product. The questions contained 7-point scales were the participants could state their intention from 'definitely not' to 'definitely'. An additional question was about the consumers' preparedness to adopt insects as a meat substitute. This question was based on Verbeke (2015) and it contained a 7-point scale by agree/disagree.

Information about the eating habits of the respondent were also needed. These questions were based on Verplanken & Orbell (2003) about habits. The twelve questions contained items with response scales by agree/disagree. A 7-point response scale was used.
General questions were asked about age and gender, and if the respondent has eaten insects before (never, once or twice or often).

3.4 Procedure

The questionnaire was distributed with Qualtrics. The link of the questionnaire was distributed online by social media. When a respondent clicked on the link, the questionnaire began. It started with a small introduction on the research and after that each participant was randomly assigned to one of the four conditions. After seeing the product, questions about their intention to eat the product are asked. After that there were questions about their eating habits. In the final part there were some general questions about their age and gender.

3.5 Preparation data analysis

To analyse the acceptance of the participants of insects as meat replacement two regression analysis were computed to model the relationships between the variables. The reason the two analysis were done is that *Acceptance* could be measured by the *Intention* of the respondent to eat insects and also by the *Preparedness* of the respondent to eat insects.

Intention was computed by the sum of the questions of the first part. These were about the acceptation of insects as a replacement for meat. It consisted of three questions, intend to eat the insect, plan to eat the insect and want to eat the insect.

The three parts ‘intend’, ‘plan’ and ‘want’ needed to be computed in an *overall intention* to eat insects. This was done by taking the average of all answers. First was checked if it would be reliable (Cronbach α=0.86) to compute these parts. Then it was averaged in ‘intention overall’.
Preparedness was computed by the sum of the second part. This question was if the respondent is willing to replace meat by products with insects. This variable was called ‘prepared overall’.

The independent variables were *visibility* (of the insects) and *familiarity* (of the product). Another independent variable was *habit*. In the questionnaire the strength of the habit to eat meat was measured with twelve questions. These twelve questions were computed into one variable, after checking the reliability (Cronbach α=0.94) and centring the variable. This was done after the mean of all answers was determined.
The last independent variable was the *interaction* between the computed variable habit and familiarity.

3.6 Data Analysis

The questionnaires were analysed with *IBM Statistics SPSS 22*. Linear regression analysis were computed to model the relationships between the variables.

First, a linear regression was done where the dependent variable ‘acceptance’ was retrieved from the overall *intention* of the respondents to eat insects.

Second, a linear regression was done where the dependent variable ‘acceptance’ was predicted by the overall *preparedness* of the respondents to eat insects.

The independent variables were habit, familiarity, visibility and the interaction between familiarity and habit. Familiarity and visibility where measured by the 4 conditions.
The interaction term was computed by familiarity and habit. These two variables were multiplied.

4. Results

4.1 Sample

166 People answered the questions of the experiment and 38 of them did not fill in the last sheet with questions about their age, gender and if they have eaten insects before.

The respondents who did fill in the last questions can be divided into 44 men (26.5 %) and 84 women (50.6%). The mean of age is 20. The respondent with the lowest age has the age of 17 and the respondent with the highest age has the age of 32. The most questionnaires are filled in by respondents between the age of 19 and 22.

Furthermore, 47 respondents stated that they have not eaten insects. 64 Respondents said they have eaten insects one or two times and 17 respondents have eaten insects several times.

Table 4.1 Description sample results

	N= 166	**Percentage**
Gender		
Men	44	26.5
Women	84	50.6
Missing	38	22.9
Age mean	20	-
Eaten insects before		
No	47	28.3
Yes, one or two times	64	38.6
Yes, several times	17	10.2
Missing	38	

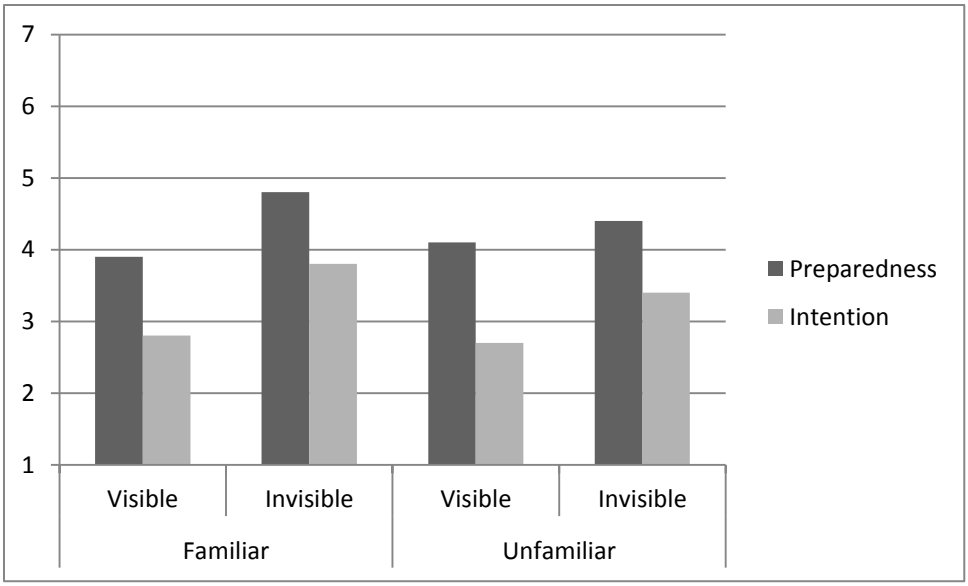

Figure 4.1: The means of intention and preparedness per condition

In figure 1 the means are presented of all four conditions for the intention and the preparedness to eat insects. The preparedness to eat insects was the highest in every condition. It can also be concluded that the means are overall higher for the two conditions who presented products where the insects where invisible.

4.2 Linear regression

Table 4.2 Overview results

Hypothesis	**Intention**		**Preparedness**	
	Beta	*P-value*	*Beta*	*P-value*
H:1 *Effect of Habit*	-.017	.845	-.198	.025
H:2 *Effect of Visibility*	-.266	.002	-.171	.051
H:3 *Effect of Familiarity*	.083	.337	.034	.696
H:4 *Interaction of Familiarity and Habit*	.131	.131	.056	.520

A linear regression analysis was done to find the effect of habit, familiarity, visibility and the interaction between habit and familiarity on intention and preparedness. In the overview above the beta coefficients and p-values are presented for both regressions. The output was checked for multicollinearity and there is no reason to believe that there is cause for concern (VIF values close to 1).
The overview shows that the effect of visibility on intention is significant and the effect of habit on preparedness is significant. Close to being significant is the effect of visibility on preparedness (p=.051).

The Effect of Habit on Acceptance

The effect of habit on the intention to eat insects is not significant (t(126)= -.196; p= .845; B= -.017).
However, the effect of habit on the preparedness to eat insects has a significant effect on the acceptance of insects as a replacement of meat (t(126)= -2.125; p=.036; B=-,198). This means that there is a negative main effect of habit on acceptance. Consistent with H1, it can be concluded that when the habit gets stronger, the acceptance to eat the insect meat goes down.

The Effect of Visibility on Acceptance

The effect of visibility on the intention to eat insects is significant (t(126)=-3.102; p=.002; B=-.266). This means that there is a negative mean effect of visibility on acceptance. It can be stated that there is a negative relationship between the visibility of insects and the acceptance of insects as a replacement for meat.
The effect of visibility on the preparedness to eat insects is close to being significant (t(126)=-1,968; p= .051; B= -.171).
Consistent with H2, it can be concluded that when insects are more visible in the product, the acceptance to eat the insect meat goes down.

The Effect of Familiarity on Acceptance

The effect of familiarity on the intention to eat insects (t(126)=.965; p=.337; B=.083), as the effect of familiarity on the preparedness to eat insects (t(126)=.392; p=.696; B=.034) is not significant. There is no significant relationship between the familiarity of a product and the acceptance of that product with insects as a replacement for the meat.
No evidence was found for H3, that the familiarity of a product has an effect on the acceptance of a product where the meat is replaced by insects.

The Effect of the interaction of Familiarity and Habit on Acceptance

The effect of the interaction of familiarity and habit on intention to eat insects is not significant (t(126)=1.520; p=.131; B=.131).

The effect of the interaction of familiarity and habit on preparedness to eat insects is also not significant (t(126)=.646; p=.520; B=.056). So there is no significant relationship between the interaction of familiarity and habit on acceptance.

No evidence was found for H4, that the interaction between familiarity of a product and the increasing strength of habit has an decreasing effect on the acceptation of insects.

The Effect of Age and Gender

When the age of the respondents was included in the analysis, it showed that the older the respondents were, the more prepared the respondent was to replace meat products with products where the meat is replaced by insects. The effect of visibility is now significant (t(126)= -2.278; p= .038; B= -.181). The SPSS output can be found in the appendix.

There was no effect of gender on intention or preparedness when the gender of the respondents was included. The SPSS output can be found in the appendix.

5. Discussion and Conclusion

In this research it was studied whether insects can replace meat in dishes. When consumers have the choice to eat insects or meat for dinner, what would they choose? From the study it can be concluded that consumers are not completely ready to accept insects as a replacement for meat yet.

It investigated to what extent meat consumers are ready to accept insects as a replacement for meat. Only a few respondents have the intention to eat insects as a replacement for meat (3.6%) and a large group has no intention to do so at all (20%). There is a small number of respondents that is prepared to eat insects as a replacement for meat. Below, the other findings will be discussed.

The Effect of Habit

There is found that habit is an important factor for the acceptance of insects as a replacement for meat. From the literature study it was found that habit has a negative effect on the acceptance of a new product. The stronger the habit to eat meat, the harder it is to accept insects as a replacement for meat. This study supports hypothesis 1, that insects as a replacement for meat are harder to accept when the habit to eat meat is stronger.

The stronger the habit to eat meat, the less people are willing to eat insects. Meat cannot be easily replaced in consumer's routine.

The Effect of Visibility

The findings were conform with the second hypothesis, that insects as a replacement for meat are harder to accept when the insects are visible in the product. As mentioned in the literature, consumers are more scared to eat the product when the insect is visible.

The Effect of Familiarity

It was hypothesized that when a person is familiar with a product, the same product with insects is easier to accept than an unfamiliar product with insects.

The results showed that there was no significant difference between unfamiliar and familiar goods. This can be explained by the way 'familiarity' is interpreted.

Familiarity can also be interpreted as something the respondent is familiar with, as awareness of what eating insects is about.

Most of the students of Wageningen were already familiar with eating insects. The difference that was made in the experiment between familiar or unfamiliar products in the four conditions, did not matter to the students because of this.

In another study, familiarity was interpreted this way. The findings were that, when assuming familiarity is the information that is received, the participants were generally favourably receptive when eating of insects was mentioned (Verbeke, 2015).

Crickets were used in the four conditions. Crickets are for the most part familiar to the majority of the consumers. Also, it was good for the internal validity to use the same insects across the four conditions. There could be a difference between familiar and unfamiliar insects in combination with different dishes.

The Effect of Age

The readiness to accept the insects as a meat replacement was stronger among older respondents. In this case, the older students are the students that study the longest. It can also be explained by growing publicity for eating insects. In Wageningen and especially at its University, there is a growing interest for the consumption of insects as a replacement for conventional meat consumption. The longer a student is studying in Wageningen, the more information about insects is obtained and the more the respondent is exposed to insects and the consumption of insects. In this way he or she could create a more favourable attitude towards eating insects.

The Intention & Preparedness to eat Insects

A reason for the lower average of the intention than the average of preparedness can be procrastination. The questions about the intention to eat insects are about eating the insects now or next week. The questions about preparedness are about how prepared the participant would be to eat insects further in the future. In further research this difference in time can be taken into account. Both intention and preparedness could be asked in questions that are stated in present simple and in simple future. Then, it can be seen if procrastination really is the reason for the fact that the average of the intention is lower than the average of the preparedness.

What also needs to be taken into account is that the scale of preparedness could be different than the scale of intention, when looking relatively.

Therefore it could be that the overall preparedness is higher than the intention to eat insects.

Implications for Companies

In the light of the results, consumers are not yet ready to replace their meat with insects. Possibly because meat is still a big part of the everyday meal. As mentioned in the literature study, when changing the behaviour of eating meat for heavy-users of meat, they would change their habits a little and become medium-users of meat (Hoek et al, 2011b).

Medium-users consume a ‘medium’ amount of meat per day. To make a step towards an overall acceptance of insects, it would be more profitable to focus on medium-users first.
Furthermore, insects should not be visible. Insect flour could be used in the product so the consumer is not able to see something of the insects. The appearance of the substitutes should be similar to meat products. There can also be considered to keep the packaging similar to the packages of meat dishes. This could make it easier for consumers to accept the insects.
If it is studied whether there is a difference in which insect is used, this can also be taken into account for the product development.

Limitations and Further Research
In the questionnaire a few control questions were asked. For further research it is important to ask if the respondent is a vegetarian or a meat eater. In this questionnaire some people dropped out when they found out the questions were about meat. Maybe other vegetarians continued and they filled the habit questions in as having a low meat eating habit. This could have an influence on the variable ‘habit’.
Then, when consumers are segmented in the medium-users group, more research could be done about what the product should look like or what information should be given to the consumer to convince them to replace meat more often by insects.

This project did not allow us to make real dishes of the products. When using real dishes, questions could be asked about the sensory aspects. The sensory aspects of the substitutes are important because consumers are driven by these aspects, particularly when eating meat (Hoek et al, 2011). These aspects could not be transferred through the computer screen in this project. Therefore the external validity was low. It would be more valid when the dishes are prepared and consumers are asked whether they would eat it.
Moreover, a difference could be made in familiar and unfamiliar insects. It is possible that the familiarity of the insect has an effect on the acceptance of it. Also interesting for further research is to find out if it matters which insects are used.

The growing publicity about the effects of meat on the human health and on the environment is likely to have an impact on the consumption of meat and on the level of interest people have in possible substitutes.
In Wageningen there is already a lot of research about the possibility to eat insects. The experiment is covered by students in Wageningen, which means that most of them possibly had more information than the average student in the Netherlands and that they already had formed an attitude towards eating insects.

In sum, the evidence suggests that the strength of habit to eat meat of a meat consumer and the visibility of insects in the meal have an important influence on the intention and preparedness to replace meat (partly) with insects. Overall, there is some intention to replace meat with insects and this is certainly a good start. When companies start focussing their marketing on medium meat consumers, insects could become the food of the future!

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Appendix

I: Pilot study

Example Question of Pilot study

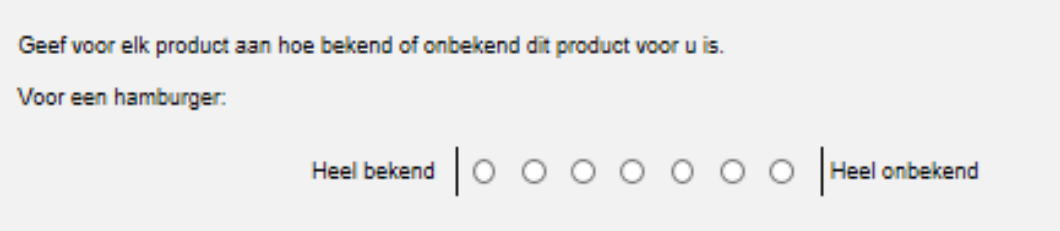

Table 3.1 Means of Pilot study

Product	Mean
Burger	1
Pot roast	2.9
Meatballs	1.7
Quiche	2.7
Dumplings	5.3

II: Questionnaire experiment

[Intro] Dear participant, This survey is about the consumption of insects. It will take about 5 minutes to complete the survey. The questions are processed anonymously. Thank you in advance for your time and your participation! Kind regards, Leontien Rutenfrans

Q1 This research is about the intention of students to eat insects. When you are a student, please continue with the questionnaire. When you answer the questions about the products, you do not have to consider price or quality. For the convenience, price and quality are equal for all the products and are comparable to other meat products. Thank you for your time!

Q2

Q3 The image shows a burger where the meat is partially replaced by cricket flour. The next questions are about your intention to eat the burger.

	Definitely not (1)	(2)	(3)	(4)	(5)	(6)	Definitely (7)
I intend to eat the burger over the next week (1)	❍	❍	❍	❍	❍	❍	❍
I plan to eat the burger over the next week (2)	❍	❍	❍	❍	❍	❍	❍
I want to eat the burger over the next week (3)	❍	❍	❍	❍	❍	❍	❍

Q4 Please answer the next question

	Strongly Disagree (1)	(2)	(3)	(4)	(5)	(6)	Strongly agree (7)
I would be prepared to eat insects as a substitute for meat (1)	❍	❍	❍	❍	❍	❍	❍

Q5

Q6 The image shows a burger where the meat is partially replaced by crickets. The next questions are about your intention to eat the burger.

	Definitely not (1)	(2)	(3)	(4)	(5)	(6)	Definitely (7)
I intend to eat the burger over the next week (1)	❍	❍	❍	❍	❍	❍	❍
I plan to eat the burger over the next week (2)	❍	❍	❍	❍	❍	❍	❍
I want to eat the burger over the next week (3)	❍	❍	❍	❍	❍	❍	❍

Q7 Please answer the next question

	Strongly Disagree (1)	(2)	(3)	(4)	(5)	(6)	Strongly agree (7)
I would be prepared to eat insects as a substitute for meat (1)	❍	❍	❍	❍	❍	❍	❍

Q8

Q9 The image shows dumplings where the meat is partially replaced by cricket flour. The next questions are about your intention to eat the dumplings.

	Definitely not (1)	(2)	(3)	(4)	(5)	(6)	Definitely (7)
I intend to eat the burger over the next week (1)	❍	❍	❍	❍	❍	❍	❍
I plan to eat the burger over the next week (2)	❍	❍	❍	❍	❍	❍	❍
I want to eat the burger over the next week (3)	❍	❍	❍	❍	❍	❍	❍

Q10 Please answer the next question.

	Totally disagree (1)	(2)	(3)	(4)	(5)	(6)	Totally agree (7)
I would be prepared to eat insects as a substitute for meat (1)	❍	❍	❍	❍	❍	❍	❍

Q11

Q12 The image shows dumplings where the meat is partially replaced by crickets. The next questions are about your intention to eat the dumplings.

	Definitely not (1)	(2)	(3)	(4)	(5)	(6)	Definitely (7)
I intend to eat the dumplings over the next week (1)	○	○	○	○	○	○	○
I plan to eat the dumplings over the next week (2)	○	○	○	○	○	○	○
I want to eat the dumplings over the next week (3)	○	○	○	○	○	○	○

Q13 Please answer the next question

	Strongly Disagree (1)	(2)	(3)	(4)	(5)	(6)	Strongly agree (7)
I would be prepared to eat insects as a substitute for meat (1)	○	○	○	○	○	○	○

Q14 The last question contains twelve statements about eating meat. Eating meat is something...

	Totally Disagree (1)	(2)	(3)	(4)	(5)	(6)	Totally agree (7)
I do frequently (1)	❍	❍	❍	❍	❍	❍	❍
I do automatically (2)	❍	❍	❍	❍	❍	❍	❍
I do without having to consciously remember (3)	❍	❍	❍	❍	❍	❍	❍
that makes me feel weird if I do not do it (4)	❍	❍	❍	❍	❍	❍	❍
I do without thinking (5)	❍	❍	❍	❍	❍	❍	❍
that would require effort not to do it (6)	❍	❍	❍	❍	❍	❍	❍
that belongs to my daily routine (7)	❍	❍	❍	❍	❍	❍	❍
I start doing before I realize I'm doing it (8)	❍	❍	❍	❍	❍	❍	❍
I would find hard not do to (9)	❍	❍	❍	❍	❍	❍	❍
I have no need to think about doing (10)	❍	❍	❍	❍	❍	❍	❍
that's typically 'me' (11)	❍	❍	❍	❍	❍	❍	❍
I have been doing for a long time (12)	❍	❍	❍	❍	❍	❍	❍

Q15 Have you eaten insect products before?

- ❍ No (1)
- ❍ Yes, one or two times (2)
- ❍ Yes, several times (3)

Q16 What is your gender?

- ❍ Male (1)
- ❍ Female (2)

Q17 What is your age?

This the end of the questionnaire. Thank you very much for your time!

III: SPSS Output

SPSS output Age and Gender on Intention

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5,706	1,520		3,754	,000
	HABITOVERALL	-,020	,097	-,018	-,207	,837
	VISIBLE	-,861	,285	-,259	-3,019	,003
	BEKEND_EFFECT	,132	,142	,079	,926	,357
	HABITGMC_BEKENDEFF	,170	,098	,151	1,734	,085
	What is your age?	-,096	,070	-,119	-1,378	,171

a. Dependent Variable: intentionoverall

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3,390	,789		4,297	,000
	HABITOVERALL	-,005	,101	-,004	-,048	,962
	VISIBLE	-,889	,287	-,267	-3,101	,002
	BEKEND_EFFECT	,146	,144	,088	1,016	,312
	HABITGMC_BEKENDEFF	,148	,097	,132	1,526	,130
	What is your gender?	,158	,315	,045	,501	,618

a. Dependent Variable: intentionoverall

SPSS output Age and Gender on Preparedness

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2,729	1,790		1,525	,130
	HABITOVERALL	-,259	,114	-,197	-2,278	,024
	VISIBLE	-,703	,336	-,181	-2,095	,038
	BEKEND_EFFECT	,075	,167	,039	,450	,653
	HABITGMC_BEKENDEFF	,040	,115	,030	,344	,732
	What is your age?	,147	,082	,157	1,791	,076

a. Dependent Variable: PREPAREDOVERALL

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6,445	,932		6,917	,000
	HABITOVERALL	-,290	,120	-,221	-2,424	,017
	VISIBLE	-,659	,338	-,170	-1,949	,054
	BEKEND_EFFECT	,048	,170	,025	,281	,780
	HABITGMC_BEKENDEFF	,072	,115	,055	,626	,532
	What is your gender?	-,327	,372	-,080	-,879	,381

a. Dependent Variable: PREPAREDOVERALL