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## **Consumer associations and preferences surrounding insects as food**

- A descriptive study of South Africa and Sweden

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**Titel**

Konsumenters associationer och preferenser kring insekter som mat –En beskrivande studie om Sydafrika och Sverige

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Consumer associations and preferences surrounding insects as food –A descriptive study of South Africa and Sweden

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**Sammanfattning**

Insekter som mat är ett ämne som fått mycket uppmärksamhet på senare tid. För att insektsmat ska kunna slå igenom i västvärlden, där insekter i nuläget inte konsumeras, måste man ta reda på hur insektsmat uppfattas av konsumenter, och vilka konsumentgrupper som äter insekter i andra länder. Detta ger en bild av hur insekter kan och bör användas på den svenska marknaden. Syftet med denna uppsats är att undersöka associationer och preferenser rörande insektsmat i Sverige och Sydafrika. Studien undersöker vilka konsumentgrupper som äter insekter i de två länderna, vad konsumenterna har för associationer och preferenser för insektsätande, och hur insekter kan användas i mat i framtiden. En webbaserad enkät skickades ut till konsumenter i vardera land, och besvarades av totalt 73 deltagare. Frågorna handlade om associationer, preferenser och erfarenhet i förhållande till insektsätande. Tre insektsproducenter intervjuades i Sverige och Sydafrika för att ge en förståelse för produktionen samt deras tankar och erfarenheter av branschen och konsumenterna, nu och i framtiden. Oberoende av i vilket land undersökningen genomfördes var det inte möjligt att karaktärisera några konsumentgrupper där entomofagi var mer vanligt förekommande. När insekter används i mat föredrar konsumenter att dessa mals ned till ett pulver. Insekter associeras ofta med att vara näringsrikt, billigt och miljövänligt, samt med ovana och äckel.

**Ämnesord**

Entomofagi, associationer, mat, kultur, neofobi, konsumentpreferenser

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Consumer associations and preferences surrounding insects as food –A descriptive study of South Africa and Sweden

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**Abstract**

Insects as food is a subject that has gained a lot of attention in recent time. In order for insect-food to become popular in the west, where insects are currently not consumed, research has to be done on how consumers perceive insect-food, and which consumer groups that eat insects in other countries. This will give a picture of how insects can and should be used on the Swedish market. The purpose of the thesis is to research consumer associations and preferences of insect consumption in Sweden and South Africa. The study examines the question of which consumer groups that eat insects in either country, what associations and preferences consumers have of insect-eating, and how insects can be used in food in the future. An online questionnaire concerning associations, preferences and experiences of insect consumption was distributed in both countries, and was answered by 73 participants. Three producers of insects were interviewed in Sweden and South Africa to get an understanding of the production stage of insects and their experiences of the industry and the consumers, now and in the future. Entomophagy was not found to be more prevalent in any group in neither Sweden nor South Africa. When used in food, consumers prefer insects to be ground into a powder. The South African respondents who had previously eaten insects mainly as an everyday meal preferred the insects to be served whole while the others preferred the insects to be ground into a powder. Insects are often associated with being nutritious, cheap, and being environmentally friendly, as well as with unfamiliarity and disgust.

**Keywords**

Entomophagy, associations, food, culture, neophobia, consumer preferences

# Contents

Preface .....	4
Introduction.....	5
Purpose.....	5
Background.....	6
Benefits of entomophagy.....	6
Cultural differences in the perception of entomophagy in Sweden and South Africa	7
Material and method.....	9
Ethical considerations .....	11
Results.....	11
Questionnaires results.....	11
Interviews with insect producers .....	16
Discussion.....	18
Current and future consumers of insect food.....	18
Positive associations of entomophagy .....	19
Negative associations of entomophagy.....	19
How can insects be used in food and what do consumers prefer?.....	20
Countering negative impressions of insect food.....	20
Focusing on the positive aspects.....	21
The future of entomophagy .....	21
Discussion of materials and methods.....	22
Significance for Food and meal science .....	23
Further research .....	23
Conclusion .....	23
Bibliography .....	23
Appendices.....	28
Appendix 1 – Questionnaire Sweden.....	28
Appendix 2 – Questionnaire South Africa.....	29
Appendix 3 - Interview guide Swedish insect producer.....	30
Appendix 4 - Interview guide South African insect producers.....	31

## Preface

This study was initially intended as a “Minor field study” - a study conducted in South Africa paid for with a scholarship from Swedish SIDA but just before departing, travel restrictions set in place as a result of the Covid-19 pandemic prevented any international travels. South Africa went into lockdown as well, which meant that it would have been hard to reach people and places as planned. Instead, the study had to be adjusted so that it could be conducted from Sweden, mainly by doing interviews and questionnaires digitally.

South Africa was chosen as a fitting country to study as it is a country with a history of insect consumption. My personal interest in insect-food comes from the curiosity of the completely ignored food group. The concept of entomophagy (insect-eating - from entomos, insect and phagein, to eat) is often oversimplified and presented in a negative manner, which is why I find it interesting to see how others view the issue, and if this suspicion is justified.

The supervisor of this project is Viktoria Olsson, programme director of Food and Meal Science, and senior lecturer at Kristianstad University. The supervisor in the host-country is Nomusa Dlamini from CSIR Pretoria (Council for Scientific and Industrial Research). The organization works toward researching and developing technologies for socioeconomic progress in South Africa (CSIR, 2020). Nomusa Dlamini is a university lecturer at Johannesburg University with a PhD in food science and technology, BSc in biological sciences and MSc in food sciences. I would like to thank Viktoria Olsson and Nomusa Dlamini greatly for all their help in this project.

# Introduction

Recently insects for food and feed has gained much interest in western society and several European countries have already started to use insects in food products (Batat & Peter, 2020). Since the people of western countries like Sweden do not have a history of eating insects there is no widespread understanding of how they are used. This type of knowledge can, however, be found in South Africa, where insects have been consumed since around 100 000 BC (Van Huis, 2003), and 25-50 different species of insect are consumed today (FAO, 2013a; Van Huis, 2003). There have been numerous accounts of the prevalence of insect-eating in South Africa (Gahukar, 2011; Van Huis, 2003; Mutungi, 2019; Obopile & Seeletso, 2013; Mishyna, Chen & Benjamin, 2020) which makes it a fitting country to study the culture of entomophagy in, and get a view of the possibilities and opportunities that insects can offer.

Many westerners are hesitant towards the concept of eating insects and require some convincing before adapting to this practice (FAO, 2013a). In order to successfully bring insects on to the western food market, associations and preferences towards insects as food among consumers need to be probed. Insect producers are also important sources of information, given their own personal experience and views of consumer trends and the industry. This information is key in understanding how to use insects as food in the future. This study compares attitudes towards entomophagy (insect-eating - from *entomos*, insect and *phagein*, to eat) in Sweden and South Africa and finds ways of using insects in food in the future.

## Purpose

The aim of this study is to research associations and preferences of insect-containing food among consumers and insect producers in South Africa and Sweden.

Research questions:

- 1. Among which consumer groups is entomophagy prevalent in South Africa and Sweden?*
- 2. What associations do consumers have of entomophagy?*
- 3. How can insects be used as food in the future according to insect producers?*

# Background

## Benefits of entomophagy

Insects have the potential to become a new source of food in countries where entomophagy is not traditionally practiced. Insects are already consumed in many parts of the world where there is a long history and established traditions of insect-eating. But what are the benefits of insect consumption?

## Environment and sustainability

Recently insects for food have been brought to the attention of the masses as part of a solution in the fight against climate change. In this regard insects have many benefits as a food item. For instance, when it comes to greenhouse gas emission (GHGE), of which insects produce remarkably less than pigs, and an even greater difference can be found when compared to beef production (Oonincx et al., 2010). Production of ammonia, causing acidification in soil and water is lower among insects. Pigs for instance, produce 50 times the amount of ammonia produced by locusts (Oonincx et al., 2010). The water usage is also considerably lower in insect farming than with other types of meat production, as is the need for feed - cattle require 12 times the amount of feed to produce the same amount of protein than what is the case for crickets. Insects are highly efficient at converting feed into protein (FAO, 2013a). Some species can even live off of human waste material, which is a great advantage of insect rearing which in turn spares us the energy and resources of growing feed (Pali-Schöll, et al., 2018). An obvious benefit of rearing insects instead of cattle is the minimal need for space (Oonincx et al., 2010). The land areas currently used for keeping cattle could be used at a much greater efficiency if occupied by insect production instead. Insects have also become a more common ingredient in animal feed, competing with the traditional sources of protein; fishmeal and soybeans. Considering the ecological impact of overfishing and soy plantations – which is a cause of deforestation of rainforest, insects may prove a more sustainable option as animal feed (Stamer, 2015).

## Nutrition

On average the measured protein content of edible insects is 20% (fresh weight), sometimes reaching 48% (Xiaoming, et al., 2010) which is very high when compared to fish (20%) and beef (23%) (FAO, 2013a). One added value of using insects as a source of protein is that it serves as a natural alternative to synthetic ingredients commonly used in protein powders (Batat & Peter, 2020). Protein content is the most commonly referred aspect in regard to the nutritional value of insects, but there are other valuable components. Rumpold and Schlüter (2013) describe some of the micronutrients that can be found in insects:

“[insects are] rich in several micronutrients such as copper, iron, magnesium, manganese, phosphorous, selenium, and zinc as well as riboflavin, pantothenic acid, biotin, and in some cases folic acid.” (Rumpold & Schlüter, 2013)

The high level of amino acids found in some insects work as a complement to diets low in such nutrients. In several African nations maize is widely grown and is part of the staple

food. The proteins of cereals such as maize often lack in certain amino acids like tryptophan and threonine. Consumption of insects can be a help in reaching the needed levels of these amino acids among those that rely on maize for food (Sogbesan & Ugwumba, 2008; FAO, 2013a). Some insects also contain large amounts of lipids. The fat content of the African palm weevil reaches 54%, and edible grasshoppers 67% of dry matter (Womeni, et al., 2009). Some of the lipids in insects are essential fatty acids which are important in the developing stages of children, and has recently been deficient in some parts of the world (FAO, 2013a). This makes insects even more important in regard to possible uses.

## Cultural differences in the perception of entomophagy in Sweden and South Africa

### Western reluctance towards entomophagy

In traditional western food culture insects have not been categorized as a food item (Elorinne, Niva, Vartainen & Väisänen, 2019). In the FAO report “Edible Insects – future prospects for food and feed security” (2013a) the authors give an explanation of why eating insects initially did not gain the same popularity in the west as it did in other parts of the world. In the west, almost all of the domesticated animals could be found in nature, providing meat and milk to the civilizations that made use of those animals. As a result of this, insects simply could not compete in terms of food supply or other uses and were therefore not considered valuable enough as a food item. Further on, as urbanization started to take place the west relied more heavily on agriculture for food production and eating insects went on to be perceived as a primitive tradition only practiced in less advanced cultures. As insects were not consumed they became associated only with negative situations – flies and mosquitoes infecting people and cattle with disease, maggots appearing in rotting meat, termites destroying houses etc. These occurrences triggered the reaction of disgust which is still apparent in the western society of today when people come in contact with insects (FAO, 2013a).

Disgust is a natural mechanism aiming to keep the individual from consuming possibly harmful pathogens, working as a “behavioral immune system” (Jensen & Lieberoth, 2019). Jensen and Lieberoth (2019) comments the following: “*according to error management theory, disgust activation is biased towards emitting false alarms, thus making it oversensitive to potential threats*”. This explains why westerners have a negative (disgust) reaction towards the presence of insects even in a non-threatening situation (Jensen & Lieberoth, 2019). It should, however, be noted that this reaction is most common when the insect is presented as food or in combination with food – for instance when a beetle finds its way onto a dinner plate (Deroy, Reade, Spence, 2015). Apart from disgust there are three additional main causes of rejection of entomophagy: fear, risk, and aversion or negative perception of insect sensory (Batat & Peter, 2020).

### Methods of increasing acceptance of entomophagy

Evans et al. (2015) suggest avoiding the words “entomophagy” and “insects” when presenting westerners with foods containing insects in order to reduce the negative effect of common associations. Instead, naming the specific insect, method of preparation, or the name



used in the culture that the food came from would have a more positive impact on consumers. Crickets, mealworms and locusts have been described as “gateway bugs” that will ease consumers previously unfamiliar with eating insects into the habit of doing so. They are palatable and thereby decrease risk of scaring people away from insect foods (Wendin, Olsson, & Langton, 2019). Insects can also be made more acceptable as food by processing and presenting them in a familiar way (Barton, Richardson & McSweeney, 2020). Protein powder has been suggested as a good way of introducing westerners to insects, as protein powder is already popular in western countries, and the content can easily be modified without affecting the appearance (Barton, Richardson & McSweeney, 2020). Willingness to buy insect-based protein powder among Canadian consumers was increased after they had done a tasting of it (Barton, Richardson & McSweeney, 2020).

### Demographic differences in consumption of insects

While the research on which groups consume insects in South Africa is very limited, one study has covered this subject in the neighboring nation of Botswana. The findings showed that the source of income was not related to the consumption of insects. Some insects were popular in specific regions while not at all consumed in other regions. The authors speculate whether religious beliefs was a determining factor in some cases, as some of the local religions prohibit or discourage eating of insects. It is also mentioned that children preferred insects that are spineless, such as the caterpillar of the speckled emperor moth – also known as the mopane worm (*Gonimbrasia belina*) (Obopile & Seeletso, 2013). As previously mentioned, insect consumption is viewed by some as a primitive practice separating city dwellers from those living on the countryside (FAO, 2013b). This statement implies that insect consumption does not occur in the cities - only on the countryside, but when looking at Thailand one can see that insects are eaten all over the country (FAO, 2013b). In Thailand entomophagy is perceived by some to be a rural custom but is at the same time trendy (Olsson et al., 2019). A Belgian study (Megido et al., 2013) researched liking of insects and could not find any correlation between neither gender nor a specific age group and the prevalence of food neophobia (fear of new things) among its respondents. A Finnish study showed that vegetarians were the group with the most positive attitude towards eating insects, while vegans were least positive, following omnivores (Elorinne, et al., 2019). Finland is, however, a country without any traditional consumption of insects, resulting in a different demographic than one would encounter in a country that has a history of using insects in food.

### Insect consumption and culture

According to FAO (Food and Agriculture Organization) food consumption is defined by such factors as environment, history, community structure, human endeavor, mobility, and politico-economic systems (FAO, 2013a). FAO summarizes this by stating that occurrence of entomophagy is based on the culture of the subjects (FAO, 2013a). When presenting insects to people who have not consumed them traditionally culture is still important, but other factors need to be considered (Doberman, Swift & Field, 2017). According to Doberman, Swift and Field (2017) the factors affecting willingness to eat insects in western cultures are:

neophobia, familiarity, interest in the environment, convenience and attachment to meat. Socio-demographic data (e.g. age, sex, income) have not been shown to be suitable when attempting to find which groups consume insects (Doberman, Swift & Field, 2017).

## Legislature

In addition to the cultural barrier of eating insects in Sweden, there is a law prohibiting the sale of insects for food within the country. The EU law of Novel Foods aims to prevent new and untested foods to enter the market in favor of consumer safety. Before these foods can be sold they need to pass through standardized testing where the risks to human health and environment are assessed. The law covers all food items that have not been consumed to any large degree before 1997 within the EU. All nations of EU have to abide by this law, although some countries have interpreted it differently than others and allowed insects to be sold for human consumption. Sweden does not allow insects to be sold as food, but they may be sold as animal feed. Meanwhile, in the neighboring countries of Denmark and Finland sale of insects as food is permitted (National Food Agency, 2020).

## Material and method

### Research methods for case studies

A case study is a method of studying “*a person, a group or a unit (e.g. a community) where in-depth data relating to several variables is examined*” and is used to “*examine complex phenomena in the natural setting*” (Heale & Twycross, 2018, p. 1). Case studies are conducted by identifying and researching the chosen groups and then comparing the differences and similarities they have (Heale & Twycross, 2018). In this study one group consist of Swedish consumers and the other, South African consumers. The case study-methodology is applied when interviewing insect producers and comparing the two groups. By using this research method, we can study the intricate causes of reluctance and liking of entomophagy among different groups of people.

### Questionnaires

The study has been designed to describe various aspects of the phenomenon of human entomophagy in South Africa and Sweden. The primary method of data collection was questionnaires. A convenience sampling method was used with the questionnaires, where the Swedish questionnaire was distributed among friends and family of the author who then passed it on to colleagues and acquaintances, and the South African questionnaire was sent to employees of several South African universities who were asked to pass them on to their students or anyone they knew.

The questionnaires were available to the participants during two weeks, after which the data was collected. The two questionnaires contained slightly different questions and were intended to determine what separates those who have eaten insects from those who have not, based on their socio-demographic information (see appendix 1 and 2). The questionnaires were also used to get the experiences, views, preferences, and associations consumers have

regarding insect consumption. To get a sense of which situations they had experienced insect food, participants were asked which species of insects they had previously eaten and for what occasion they had mainly eaten insects. Some of the questions were open-ended to get answers of the participants serving preferences, hometown, native language, and their personal associations of insects in food. The answers to the open-ended questions of the questionnaires were thematized. The close-ended questions concerned age, gender, and if the participant had previously consumed insect food. A chi-squared test was used to determine if the share of South Africans that had previously eaten insects differed significantly from that of the share Swedes who had done so.

## Interviews

Parts of the project were designed as case studies to describe the phenomenon more at depth, where data was collected through interviews with insect producers in Sweden and South Africa. Several Swedish insect-producing companies were contacted, and Tebrito was chosen for an interview as it was the only company that agreed to do the interview. The South African supervisor of the thesis sent contact details of several South African insect-producing companies to the author who then contacted them. Two of them – Inseco and Ensekta agreed on doing an interview. The interviews concerned the production stage of edible insects and producers' views on the subject as well as their thoughts and experiences with consumers. Interview guides were used for the interviews (see appendices 3 and 4), with questions focusing on production methods, customer description and methods of using insects in food. Additional questions that were not part of the interview guide were also brought up as the conversation progressed. Because the companies of the interviewed CEOs were very different in terms of what they produce and the quantity produced, one interview guide was not sufficient. Instead, one interview guide per interview was used. The three 30 minute long interviews were conducted via computer with the videoconferencing program Zoom, where only audio was used. The interviews were transcribed and thematized according to the research questions; “who eats insects?”, “how is insect food perceived by consumers?”, and the use insects in food.

## Literature search

Summon has been used as the main search engine for finding scientific literature. Keywords used were “entomophagy”, “insects”, “culture”, “attitudes”, “South Africa”, “Africa” and “traditions”.

## Limitations and advantages

By using both methods of interviewing and questionnaires there is a risk of only getting limited results from the research. By spending less time on either method, there are not the same possibilities of delving deeper and getting the same in-depth information as one can expect when only using one of the methods (Bryman, 2018). On the other hand, the benefits of using both methods, are that you do not have to rely on one method entirely. You can get the statistical type of data that questionnaires provide, while also benefitting from the deep knowledge and experience that is available with individual interviews. Questionnaires

produce easily compiled data that is suitable when one aims to compare the groups of people participating (Bryman, 2018). One-on-one interviews allow the interviewer to ask questions that are not planned, which invites conversation rather than the simple questions featured in a questionnaire (Bryman, 2018).

## Ethical considerations

There are some aspects of the study that need to be taken into consideration when it comes to ethics. It is important to respect the privacy of subjects, and not insist on getting an answer when asking questions. The questionnaires have been designed with the help of South African scientist Nomusa Dlamini working at CSIR Pretoria and reviewed by the ethical committee of CSIR.

The topic of eating insects can be perceived by some as a strange practice, making respondents uneasy when asking them about the subject. Because of this it is important to let the respondent remain anonymous and not reveal their identity or answers to others. Detailed personal information such as names, addresses or other identity details will not be collected when communicating with private individuals that are not connected to an organization. The questionnaires were initially planned to touch on the subject of religious affiliation of participants as a way of showing if religious beliefs affected their views on insect consumption. This was, however, abandoned since it is legally questionable to ask of religious affiliation in a Swedish study. Those interviewed or handed a questionnaire will have to be informed of the purpose of gathering the information, and that the information gathered will be used in a scientific report. Regarding ethical considerations, the document of “Good Research Practice” from the Swedish Research Council (Svenska Vetenskapsrådet) has been consulted (Swedish Research Council, 2017).

## Results

### Questionnaires results

#### Participants demographic

The online questionnaire distributed among Swedes was answered by 38 people where 52% were male, and the largest age group was between 55 and 64 years old, followed by those of ages 25-34 years old. The online questionnaire distributed among South Africans was answered by 35 people of whom 80% were female. The largest age group was between 18 and 24 years old. Participants of the South African questionnaire were asked which city they grew up in. Answers varied widely and covered a large area of the country with a higher degree of people from Cape Town on the south-western coast, and least people from the central area of the country (Bloemfontein). A large portion of participants had grown up in the larger cities such as Cape Town, Port Elizabeth and Pretoria. A total of 7 people had grown up on the countryside (a city or village with less than 50 000 inhabitants located more than 50 km from a large city).

## Previous experience of insects in food

In order to identify a consumer group which eats insects the participants were asked if they had previously eaten insects. In Sweden there were 13 individuals who replied that they had previously eaten insects, of which 69% were male. The most commonly eaten insects were grasshoppers, ants, and “larvae” (species not specified). Other insects eaten were beetles and crickets. In South Africa, a total of 22 individuals replied that they had previously eaten insects. A chi-squared test showed that the number of South Africans who had previously eaten insects were significantly higher than the number of Swedes who had done so. Among those who had previously eaten insects 87% came from urban medium to large cities while the rest grew up on the countryside. The most commonly eaten insects (from most common to least common) were mopane worms (*Gonimbrasia belina*), black soldier fly larvae, meal worms, and termites. Other insects more rarely mentioned were grasshoppers, locusts, ants, *Cirina forda* (caterpillar), *Pardana pardalina* (caterpillar), crickets and *Gynanisa maja* (caterpillar).

By asking the participant in which context they mainly eat insects, we can separate those who have only eaten insects for the sake of trying it from those who have consumed insects on a regular basis. This information in combination with the demographic background data tells us which consumer groups eat insects regularly. In Sweden there were no participants who eat insects regularly. Among the Swedes who had eaten insects, 85% replied that they had mainly done so just to try it out, while the remaining portion said they had mainly eaten it as a snack. In South Africa, 68% of those who had eaten insects replied that they had mainly done so just to try it out, while 23% said they had eaten it as an everyday meal, and 9% as a snack.

## Native language

In order to find if the native language of the consumer can be used to separate insect eaters from those who don't eat insects, the participants were asked what their native language was. Out of the 7 people who had eaten insects either as a snack or part of an everyday meal only two had grown up on the countryside, and four had IsiZulu as their native language. The percentage of speakers of each native language among respondents is shown in table 1 below.

Table 1 Native languages of respondents, South Africa

Native language	Percentage of answers
Afrikaans	45
English	20
IsiZulu	17
Ndebele	4
IsiXhosa	2
Kalanga	2
German	2
TshiVhenda	2

There were people in all groups of native languages that had eaten insects except IsiXhosa (there was only one person in this group). The group of native language that had the highest percentage of people who had eaten insects was IsiZulu. Among those that had English or Afrikaans as their native language it was less common to have eaten mopane worms than it was in the other groups. Instead, the most commonly mentioned insects in these groups were grasshoppers, mealworms and crickets.

### Consumer preferences

In order to answer the question of how to use insect-containing food in the future we need to find out in what way consumers prefer them to be served. The respondents were given three alternatives of preferred serving option for insects (whole insects, powdered and used as ingredient, or insect protein extracted and used as an ingredient) and one additional option for personal suggestions. In figure 1 the preferred serving option among Swedes is shown. Answers “protein component used in food” and “powdered insects used in food” have been combined into “insect meal” as there may have been some confusion as to what the difference between these were. The 6% not shown in figure 1 are made up of those who answered with the “alternative option” and said either that the serving depended on the insect, that all of the options were viable, or that they had preferred insects be used in candy.

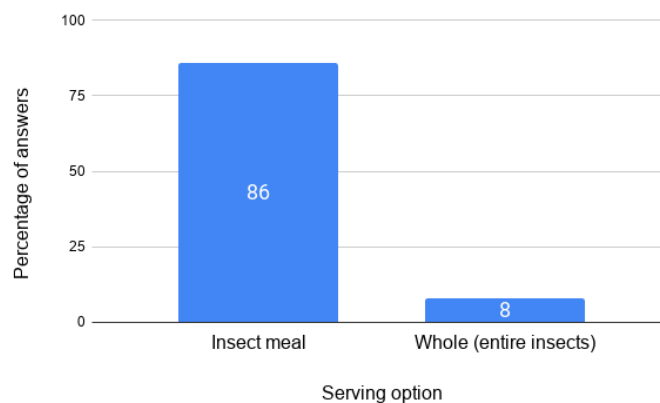


Figure 1 Preferred serving option, Sweden

The South African respondents were given the same three serving options for insects as in the Swedish questionnaire. Those that preferred insects to be served whole were the same people that had previously eaten insects as an everyday meal. In figure 2 the distribution of answers “insect meal” and “whole (entire insects)” is shown. Answers “protein component used in food” and “powdered insects used in food” have been combined into “insect meal” as there may have been some confusion as to what the difference between these were.

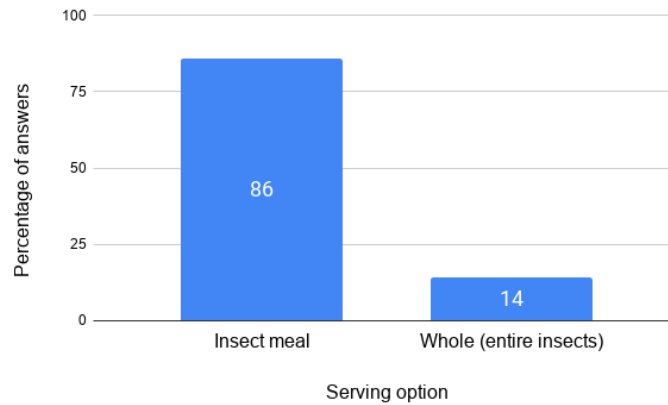


Figure 2 Preferred serving option, South Africa

### Positive and negative associations

Swedes' positive and negative associations of insects in food have been mapped in figures 3 and 4 respectively below. By looking at what type of associations consumers have we get an idea of how they think of insects in food. The positive associations were categorized and summed up in three groups: healthy and nutritious, environment and costs, and good taste. The first one - healthy and nutritious, is made up of the answers "rich in protein", and "healthy". The second one – environment, is made up by answers "environmentally friendly" and "improves food security". The third one is simply made up of answers where the good taste of insects was mentioned. The fourth – production factors is made up of answers "cheap", "easily farmed" and "no ethical considerations involved".

In figure 4, the negative associations of insect eating are shown. The first category - disgusting is made up of answers "disgusting", "vermin" and "disgusting consistency". The second category is made up of answers "unfamiliarity" and "no reason to eat". The third – bad taste is made up of the answer "tastes bad"

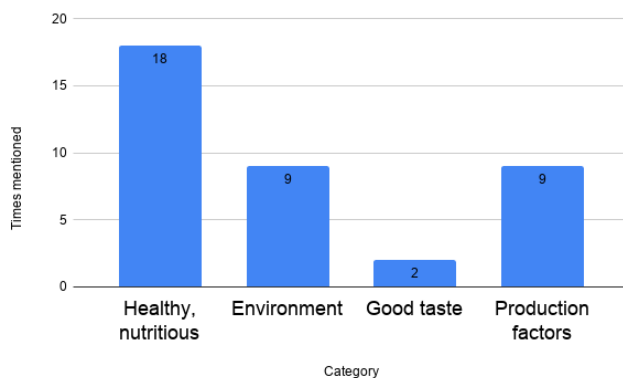


Figure 3 Positive associations insect eating, Sweden

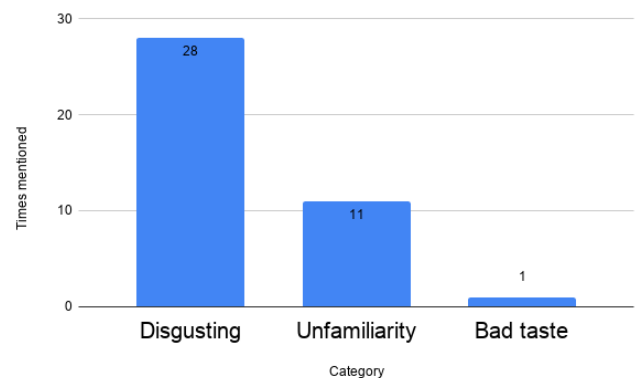


Figure 4 Negative associations insect eating, Sweden

In the Swedish questionnaire 38 mentions of positive associations and 40 mentions of negative associations were gathered.

The answers of participants in the South African questionnaire regarding associations of insects have been mapped figures 5 and 6 below. Answers were summed up in categories in the same way as in the Swedish questionnaire, although the categories have been modified according to answers in the South African questionnaire. The first category in the figure 5 - healthy, nutritious is made up of answers “rich in protein” and “nutritious”. The second category - environment is made up of answers concerning environmental benefits and improving food security. The third category – cultural factors is made up of answers “tastes good”, “traditional food”, and “new/trendy”. The fourth – production factors is made up of answers “cheap”, “easily farmed” and “no ethical considerations involved”. In figure 6, the first category – disgusting, vermin is made up of answers “disgusting” in terms of appearance and taste, and “vermin”. The second category is made up of answers pointing out the unfamiliarity with insect-eating. The third category – bad taste is made up of answers “tastes bad” and “sharp aftertaste”.

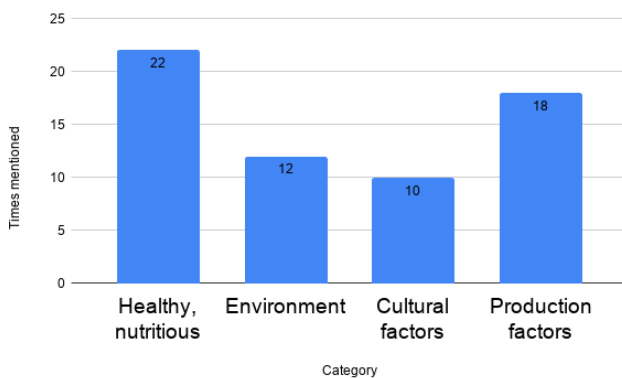


Figure 5 Positive associations insect eating, South Africa

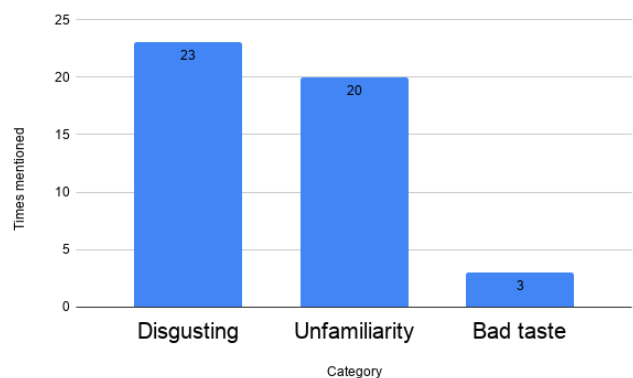


Figure 6 Negative associations insect eating, South Africa

In the South African questionnaire 62 mentions of positive associations and 46 mentions of negative associations were gathered.

### Summary of questionnaire results

In the Swedish questionnaire 35% had eaten insects of which 85% had primarily done so just to try it. Most people (86%) preferred insects to be used as a powder or meal and 8% preferred insects to be served whole. There were 38 positive and 40 negative mentions of associations related to insect food.

In the South African questionnaire 63% of participants had eaten insects of which 68% had primarily done so just to try it, and 23% had eaten insects as an everyday meal. Insect meal or powder was the most popular serving option with 86% of total answers. Those who preferred insects to be served whole (14%) were the same people who had primarily eaten insects as an everyday meal. The group of people with IsiZulu as their native language belonged to the language group with the highest percentage of people who had eaten insects, and the highest percentage of people who had eaten insects as an everyday meal. There were 62 positive and



46 negative mentions of associations related to insect food. A chi-squared test showed that the number of South Africans who had previously eaten insects were significantly more than the number of Swedes who had done so. In both countries insect food is mainly associated with being nutritious, environmentally friendly, and cheap, but also with unfamiliarity and disgust.

## Interviews with insect producers

### Interviewed companies

Tebrito is a Swedish company founded in 2016, producing various insect products. They focus on making food ingredients based on mealworms and aim to breed 1000 kg of mealworms per year. Tebrito chose to only use mealworms as they are endemic to the area and are easy to grow. The end products are insect protein powder containing 90% protein, and frass – a fertilizer made from the droppings of the insects.

Inseco is a South African company working with production of black soldier flies used as animal feed. A high lipid content meal is made from the black soldier flies and sold directly to farmers. A byproduct of the production is the frass (insect droppings), which is also sold.

Ensekta, a South African company, produces insect-containing food with focus on nutrition, sustainability and the insect food experience. CEO Joanne Techow worked with Endoki prior to founding Ensekta, which is a company that also produces insect-based food but market towards athletes and mothers who want protein-rich food for their children. Ensekta is more concerned with using insects in innovative ways to attract curious consumers who are open to trying something new and different.

### Who eats insects?

While insects are not yet allowed to be sold as food for human consumption in Sweden, Tebrito CEO Nils Österström says the group most interested in insects as a food item in Sweden is vegetarians. Vegans, on the other hand have not shown the same interest.

According to Joanne Techow at Ensekta there is a difference between the rural communities where people have consumed insects traditionally and the westernized city dwellers. The people who eat insects traditionally are more open to eating insects, but if presented with some edible insects that they are unfamiliar with such as crickets or silkworms there is still a reaction of neophobia. They will only respond positively to the familiar. In the cities people have a more western-based diet in which insects are not included, but there are those who are willing to eat insects. In the city it is the environmentally conscious ones who show the most interest for insect food. They are interested in conserving the environment and support green initiatives. Another group, that show less interest, are athletes and muscle builders who are looking for protein-rich food. The third group is the ones who are looking for an experience and are willing to try new things. During the interview with Ensekta it is also described how the city residents seems to be more open to eating insects as they have had positive

experiences with the rural cultures and eaten insects before. However, this is only a small percentage of the population.

### How are insects perceived?

Consumption of insects is often perceived as being a more environmentally friendly option than traditional sources of protein. During the interview with Tebrito, it is stated that when marketing insect food in Sweden one should therefore highlight the flavor of the actual insects to emphasize their presence, creating an added value for the consumer, with the sense of the food being environmentally friendly.

The environmentally conscious aspect of insect food can also be seen in the production at Inseco. Inseco is described as having a zero waste production process, where organic waste material from different industries such as the beer brewing industry, the dog food industry and different agricultural brands is purchased and used as feed for the insects. CEO Jack Chenells explains the ecological benefits of using insects instead of other alternatives: *“we are pulling fish from Norway and Peru and feeding it to our chickens which is a ridiculous value chain to me”*.

### How to use insects

Ensekta makes use of what Joanne Techow calls “gateway bugs” – insects that serve as a suitable option for those trying insects for the first time. This includes crickets, which are versatile and can be ground into a powder and used in foods without being noticed by consumers. Their shape is reminiscent of noodles, which makes them easier to eat when compared to other insects. During the interview it is pointed out that the sight of insects in food is seldom appreciated by consumers and so the insects should be “hidden” in one way or another so as not to deter people from eating them. By grinding insects into a meal, for instance, they can be made invisible to the consumer and the powder can be used in a number of different ways. Ensekta have previously made granola, which customers were positively surprised by, saying that they could not taste the insects. Tebrito successfully attempted to make pancakes in which 50% of the flour was replaced with mealworm-meal. Another method is covering the insect in chocolate, “hiding” them from the consumer, who will be less reluctant to eat it while also making the treat more recognizable in terms of taste. *“You can’t see the insect, and when you eat it, it just tastes like a biscuit”* (Joanne Techow). This way of presenting insects also attracts people and makes them curious while reducing the intimidating effect that insects can have on the unexperienced. The silkworm chocolates are sold in small packets, large enough for people to try them and be able to share them with whoever’s around them, but not be overwhelmed. Experimenting with the recipe, Ensekta has found that increasing the amount of chocolate in the silkworm chocolates makes them less intimidating to consumers who might otherwise be overwhelmed by the idea of eating insects.

# Discussion

## Current and future consumers of insect food

The intent of the study was to find the defining characteristics separating those who eat insects, or are willing to eat insects, from those who are not. The questionnaires failed to show any particular group of consumers who are more likely to eat insects than any other group. A discussion of this can be found under “discussion of method and material” below. There were, however, some indications that native language played a part in the prevalence of entomophagy. Judging from the species of insects previously consumed by participants, it appears as though those who had English or Afrikaans as their native language were not part of a culture in which insects are traditionally consumed since they had mainly eaten insects that are commonly used in modern insect farming (mealworms, grasshoppers, crickets). The people with other native languages than English or Afrikaans had mainly eaten insects that are collected in the wild (mopane worms, ants, termites).

According to the insect producers the most promising consumer groups to sell insects to in the future are vegetarians and environmentally conscious people. Elorinne et al. (2019) explains that the reason vegetarians eat insects might be related to environmental issues, while they also do not view insects in the same way as other animals. It is not obvious that insects are sentient beings and deserve the same treatment as other animals, which is why vegetarians are less strict when it comes to insects but at the same time more open to the concept of entomophagy as a result of environmental awareness (Elorinne et al., 2019). Vegetarianism, as well as flexitarianism is increasing in popularity in Sweden, more so among women than men. Vegetarianism is more common among the younger population, especially in major cities (Axfood, 2018). According to Axfood (2018) most vegetarians decide to eat vegetarian food because of environmental reasons, though men are more likely than women to choose a vegetarian diet because of health reasons.

Other potential consumer groups that are willing to eat insects, mentioned by the insect producers are athletes and muscle builders who are looking for protein supplements, and those who are curious and wanting to try something new. Insects are a good source of protein and with an increasing global population conventional sources of animal-protein may not be viable in the future (Churchward-Venne, et al., 2017). By using insects in protein powder supplements it's also possible to make a product completely free from the synthetic ingredients that are commonly used (Batat & Peter, 2020). The perception of insect food as new and exciting may be held by consumers who will later become early adopters of insect food. This view is different from the vegetarian or protein-focused views in that it is not based on ideology or nutrition, but rather on the experience of the food, and according to Deroy (2015) it is these consumers one should focus more on. Deroy (2015) argues that insect food should not be eaten out of “rational reasons” – environmental or nutrition-based, but rather because of its culinary appeal. *“Most of the insects eaten in the world are cooked as part of interesting preparations that make them a genuine competitor to other foods, and often a more attractive option. These insects are eaten by choice, not necessity”* (Deroy, p. 1,

2015). Insect products should focus less on their benefits and more on what makes it an interesting food.

## Positive associations of entomophagy

Based on the results of the questionnaires, consumers often associate insect food with being environmentally friendly and nutritious. This is probably founded on the way in which insect food is commonly presented as having the potential to replace meat. With the rise of vegetarian and vegan diets more consumers in Sweden are questioning the need for (conventional) meat (Axfood, 2018). A vegetarian or vegan diet can be chosen because of many reasons: personal health, animal welfare or environment and more (Cramer et al., 2017). Meat consumption is decreasing in Sweden as vegetarianism is becoming more widespread, and even among those who still eat meat it has become less favorable now that climate issues have turned more pressing (Axfood, 2018). Meat is often seen as having a negative impact on the environment (Axfood, 2018). With that in mind, insects represent a new type of protein that can be of great help in the fight against climate change, and does not have the same negative health effects and possibly not the same ethical issues as meat production (FAO, 2013a). The consumers' view of insects as something nutritious and eco-friendly is backed by scientific research (FAO, 2013a), and while these attributes may generally be positive they give a one-sided image of insects in food. What is often left out is the sensory aspect of insects – what do they taste like? Those who have no experience of insect food don't give as much remarks to the taste as they do to other aspects, like nutrition. This is, however, understandable since those who haven't eaten insects will probably not mention the taste firstly when describing them.

Many consumers – both Swedish and South African associate insect food with being easy and cheap to produce. The view of insect food as something cheap can affect the image of entomophagy both in a positive way and a negative way. The price of a product signals its quality to consumers – a higher price is seen as having a higher quality and vice versa (Akdeniz, Calantone & Voorhees, 2013). Consumers might link the low price of insect products with a low quality, making it less attractive but on the other hand a low price allows more people to purchase it. What makes insect production cheap is mainly that the farmer does not need to purchase expensive equipment or land since insects don't require any large areas of space (FAO, 2013a). Producing insects also doesn't require the same financial investment as with other livestock since the lifecycle is much shorter with insects.

## Negative associations of entomophagy

When asked what makes insects less of a popular food there were a larger number of answers from South Africans naming unfamiliarity with insects in food as a cause of dislike than there were from Swedes. This suggests that while South Africans are aware that some people find insects disgusting, they think the main reason for reluctance towards entomophagy is people not being used to it. Swedes, on the other hand, thought that the main reason was that people find insects disgusting. Out of the four main causes of rejection of entomophagy (disgust, fear, risk and aversion or negative perception of insect sensory) (Batat & Peter, 2020) disgust

and negative perception were the most apparent in this study. Risk of transmitting disease was not mentioned by any of the participants. A possible reason for this may be that the participants were aware that certain insects are edible and trust that adequate food safety is upheld. It should be pointed out that when participants answered the questions of why insects in food are popular/ not popular some may have focused more on their own views while others gave an answer that reflected society in general. South Africans also appeared to have a closer connection to insect food as they brought up the taste and traditions more than Swedes did, most likely because South Africans live closer to the cultures that practice entomophagy, and are therefore more familiar with the concept.

There are many consumers who have not had direct contact with insects in food, and therefore associate insect food with the bothersome and sometimes harmful insects one sees in daily life (FAO, 2013a). Whatever consumers think of insects it is something that producers and retailers have to adapt to. Consumer views and preferences of insect food can act as a guide for developing new food products in the future.

## How can insects be used in food and what do consumers prefer?

Interviewing the insect producers showed that they choose to focus on marketing towards the consumers who are environmentally conscious. This seems like a reasonable strategy as the environmentally conscious are the group most interested in insect food (Churchward-Venne, et al., 2017). To try and create new products for the groups that already eat insects seems less profitable as those people already have ways of acquiring and consuming insects, which leaves the option of marketing towards consumers who are new to the concept of entomophagy.

## Countering negative impressions of insect food

The results of the questionnaires confirm previous findings that show people prefer insects to be used as a ground powder rather than to be served whole (Elhassan, Wendin, Olsson, & Langton, 2019). This comes down to being unfamiliar with insects in food, and not wanting to acknowledge their presence in the food or rather, not wanting to see them as the appearance of food is closely related to liking of the food (Megido et al., 2013). At the same time – as shown in the interviews, the fact that insects has been used as an ingredient in a food item should be announced and can be used as an argument for the product being environmentally friendly. It is mostly the sight of insects, and not the smell or taste, which triggers the disgust reaction (FAO, 2013). The use of insects in food may very well be welcomed by Swedish and South African consumers as long as the insects are not visible. Negative associations caused by the sight of insects have to be countered by using methods that reduce its impact on consumers. Those who sell insect food have certain methods of serving insects that make the consumer less reluctant to eating it.

One method mentioned in several of the interviews is the idea of “hiding” insects when using them in food as a way of reducing consumers’ reluctance of eating insects. This finding is

consistent with previous research; the visual aspect should be taken into account in order to improve consumer acceptability (Wendin, Olsson, & Langton, 2019). This method is reminiscent of the way in which some new vegetarian food products have been designed to mimic popular and recognizable meat-based foods such as hamburgers, sausages and minced meat. The vegetarian variants of these foods are similar to their meat-based counterparts – both in taste, smell and looks, which is meant to persuade consumers who are not completely sold on the meat-free meal. In the same way, insects can be used in a discrete manner so as to introduce new consumers to the idea of eating insects.

## Focusing on the positive aspects

Interviewing the producers revealed that the taste of insects can be used in a positive context where the insects represent an eco-friendly choice. It is important to highlight the benefits of insects in food when interacting with consumers. The nutritional value and the positive effects on the environment are two aspects of insect food that should be held forward as reasons for eating insects, but the sensory aspects and overall experience of eating insects should also be pointed out. By emphasizing the positive aspects (healthy, eco-friendly, tasty) and counteracting the negative (disgust, unfamiliarity) one can persuade consumers more easily into accepting insects as food (McCoy, 2019).

The use of “gateway bugs” and preparation methods like covering insects in chocolate are attempts to familiarize customers with insects by presenting insect food in a recognizable way. An additional method is to avoid the words “entomophagy” and “insect” in conjunction with food (Evans et al., 2015). By doing these things consumers will become more familiar with insects in food. A previous study (Barton, Richardson & McSweeney, 2020) suggests introducing westerners with insect-based protein powder as a way of familiarizing consumers with insects.

## The future of entomophagy

Insects for food can be seen as an opportunity for food producers as well as for the insect farmers. As insects are to be introduced to the market in Sweden there are a great deal of questions that arise. The problem most often discussed is overcoming the disgust of eating insects, as people in the western world often regard insects as “non-food” (Ramos-Elorduy 1997; Rozin & Fallon, 1987), and there are substantial cultural barriers for integrating insects as part of the diet (Looy & Wood 2006; Ruby, Rozin & Chan 2015). This is however a problem that can rather quickly be resolved as insects become part of the everyday life. A comparison often made in this regard is that of sushi, which in the west went from the perception of just being “raw fish” to becoming one of the most popular takeout dishes in a very short time after being introduced into the market. The public’s views on lobster and shrimp has also made a significant shift in the same way, widely considered a lowly food for the poor not so long ago. The disgust factor is in other words one that can rapidly turn from strong to non-existent (FAO, 2013a). Other questions to consider are those concerning the usage and serving of insects as a novel ingredient, such as how to store and serve different insects as well as the practical processes of farming suitable species and processing them into

food. There are many things concerning insects for food that need to be looked upon before this novel ingredient can enter the food market. Once we have the proper knowledge of their uses, we can start to incorporate insects into the diets of peoples previously unfamiliar of the concept of eating insects.

## Discussion of materials and methods

As pointed out by FAO (2013a) the culture of the subject is the deciding factor for what they eat and do not eat. No specific culture was studied in this thesis other than the respective country as a whole, which is why no pattern could be distinguished. The people who eat insects belong to a culture in which entomophagy is part of the tradition. The issue here is how to define culture. The South African questionnaire attempts to do just that by using the criteria of hometown and native language, but as shown by the lack of obvious patterns in insect consumption of the different groups these criteria were not suitable – at least without additional information.

The validity of the questionnaires is debatable since the respondents in the small sample size could have belonged to the same group of people, and therefore were not representative of all people in either country. Unfortunately, the questionnaires were not answered by the same consumer groups in Sweden as in South Africa. A large portion of the Swedish participants were of a higher age than the South African participants. There was also an uneven distribution of sexes in the South African questionnaire, with the vast majority being women. Since there was such a small group of people participating in the questionnaires, it would have been better to only look at a certain group of people such as students or possibly the elderly. This would have made it easier to compare the results of the two questionnaires, but on the other hand it would have made it harder to reach a number of people large enough to show any meaningful results.

The goal of the South African questionnaire was to get the response of persons of varying social, ethnic and economic backgrounds where some were more familiar or open to the idea of entomophagy than others. With only 35 respondents it is hard to know which conclusions can be drawn, especially since research is scarce on the subject of South African culture and how its people generally perceive insects in food. Although the number of Swedish participants was almost the same as the number of South African participants, it is easier to confirm the results of the Swedish questionnaire since it correctly corresponds with previous papers – namely that Swedes are unwilling to eat insects and also prefer them to be ground into a powder and “concealed” when used in food.

By using the method of interviewing, a deeper understanding could be reached than what was possible with questionnaires. While the interviews with producers were satisfactory in getting in-depth information, more interviews would have improved the quality of the comparison between consumers in Sweden and South Africa. Additionally, interviewing consumers would also have had been helpful, although time-consuming and not providing the same type of broad information. The danger in using personal interviews in case studies is that all data

is collected from one source, and may be skewed without the interviewers' knowledge, which makes it even more important to reach out to a larger number of people. In the case of this study, the questions and answers in the interviews were relatively simple and therefore was not affected to any large extent by distorted personal views.

This study has given insight into the views and level of knowledge of entomophagy among Swedish consumers and compared it to that of South African consumers. This comparison highlights differences in cultures that are otherwise hard to describe. Consumer preferences are important to those who want to sell insects as food, and having an understanding of the reasons behind liking and disliking of foods is important when creating new products and dishes.

## Significance for Food and meal science

The study yielded an understanding of the difference and similarities of consumer views of entomophagy in Sweden and South Africa. The findings provide a simplified version of the way the average person in either country looks at insect consumption. Interviewing insect producers gave some insight of how you might successfully create and market insect-based food products. The business-side of insect food stands in contrast to the more commonly found scientific view of entomophagy. This information can be used in order to persuade more people into accepting insects as a food item, which is an important step to achieving a sustainable food chain in the future.

## Further research

The next step in integrating insect food into the western market is to find out more specifically which type of products consumers will accept. Which food category do consumers give most positive response to – snacks, bread, meat substitutes, etc? Even if consumers are aware of the benefits of eating insects they need to be convinced on a more basic level that they should eat insects, meaning we need to create interesting food creations that are appealing to the senses. Studies should focus on how to integrate insects into the everyday diet of the average consumer.

## Conclusion

Entomophagy was not found to be more prevalent in any group in neither Sweden nor South Africa. Among consumers insects in food are often associated with unfamiliarity and disgust, and with being nutritious, environmentally friendly and cheap. In order for entomophagy to grow and become popular the insects should be made invisible to the consumer – for instance by grinding into a meal and then used in products that the consumer can recognize.

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# Appendices

## Appendix 1 – Questionnaire Sweden

1. Hur gammal är du?

- 18-24
- 25-34
- 34-44
- 45-54
- 55-64
- 65-74
- 75+

2. Jag är...

- Man
- Kvinna

3. Har du någon gång ätit insekter?

- Ja
- Nej

4. Om du svarade ja, vilka insekter har du ätit?

5. Om du svarade ja, i vilket sammanhang äter du oftast insekter?

- Jag har bara smakat för att testa insekter
- Vid fest/firande
- Vid högtider
- Som ett tilltugg
- Som vardagsmat

6. Vilket tycker du är det bästa sättet att servera insekter på?

- Servera hela insekter
- Nermalda som ingrediens i mat
- Insektsprotein som ingrediens i mat
- Annat sätt (skriv nedan)

7. Andra sätt:

8. Vad gör insekter till en populär ingrediens?

9. Vad gör insekter till en mindre populär ingrediens?

## Appendix 2 – Questionnaire South Africa

1. What is your age?

- 18-24
- 25-34
- 34-44
- 45-54
- 55-64
- 65-74
- 75+

2. What is your gender?

- Man
- Woman

3. In which city did you grow up?

4. What is your native language?

5. Have you eaten insects before?

- Yes
- No

6. If you answered yes, which insects have you eaten?

7. If you answered yes, during which occasions have you most often eaten insects?

- I have only eaten insects to try it
- For parties/celebration
- For holidays
- As a snack
- As an everyday meal

8. What do you think is the best way to serve insects?

- Present Whole (entire insects)
- Powdered and used in food
- Protein component used in food
- Other suggestions (write below)

9. Other suggestions:

10. What makes insects a popular food?

11. What makes insects an unpopular food?

## Appendix 3 - Interview guide Swedish insect producer

Informera om inspelning av samtal.

1. Varför odlar ni just de arter av insekter som ni gör?

(Vilka produkter säljer ni idag?)

2. Är det stora skillnader mellan insektsproduktion för livsmedel jämfört med den för djurfoder?

3. Vilka olika metoder använder man (ni och andra företag) för att förpacka insekterna?

4. Vilka tror du är det som kommer att vara mest intresserade av insekter när insekter blir lagliga att sälja som livsmedel i Sverige?

(Vad är det som lockar till att äta insekter bland konsumenter?)

5. Hur använder era kunder produkterna?

(Säljer ni även för livsmedel utomlands?)

(Vad är genomsnittsåldern bland konsumenter?)

## Appendix 4 - Interview guide South African insect producers

Inform about the recording of the interview

### **Ensekta**

#### **Joanne Techow**

- When was your company founded?
- What inspired you to start this type of business?
- I understand you previously worked with Endoki. How would you say Ensekta differs from Endoki?

Which species of insects do you breed, and how much?

Why did you choose that specific species?

Which is your most popular insect product?

What does the production process look like?

What material do you use as feed for the insects?

Where does the material come from? (Recycled?)

Which methods of packaging do you use for your products?

Do you also sell cooked insects?

How would you describe your most common customer?

Age, city, native language, religion, social background (job)

### **Inseco**

#### **Jack Chenells**

1. Which is your most popular insect product?

How do you produce the insects?

What other products do you make?

2. Which methods of packaging do you use for your products?

Do you also sell cooked insects?

3. What material do you use as feed for the insects?

Where does the material come from? (Recycled?)

4. What are the advantages of using insects as opposed to other alternatives in terms of the products you are producing? (*Costs, environment, popularity*)

5. Do you sell mainly to farmers, or to retailers?

6. Are the products meant to be combined with other supplements before using?

What are the supplements?