

**Erasmus
School of
Economics**

Bachelor Thesis

International Business Economics

Can insect protein products fly-off the shelves in the Netherlands?

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Final Version Date: 26/07/2022

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1. Executive Summary

The population is increasing, the access and availability of food become increasingly uncertain, potentially leading to malnutrition. Protein is an essential component of a complete diet. Current protein sources are not sustainable for the long run; thus, the consumption of insect protein is proposed a potential part of the solution. Yet, western cultures are not open to the idea of insects as food, making it a risky investment for a firm. This paper analyses how Dutch consumers choose their snacks and matches the findings with insect products, who are also suggested in a ready-to-eat/snack form. This process can give insights as to whether the adoption of insect-based snacks seems feasible and where their promotion should focus on. From the results, the promotion of insect products is suggested to focus on their natural ingredients, health and sustainability but also highlights other potentially relevant factors. Marketers are then suggested to influence all places where a consumer may come in contact with the product. A lack of knowledge is found as a significant concern of the respondents, hindering their willingness to consume insect snacks. Through educational promotions, marketers can help alleviate the (potential) concerns of consumers regarding the consumption of insect products and aid in their decision-making process. The acceptance of insects looks more of a cultural rather than an individual level problem. Concludingly, this paper shows which criteria are essential to the adoption of insects as snacks, whether the criteria are currently met and proposes where further research should focus on.

2. Introduction

According to projections , by 2050 there will be over nine billion people on this planet. To satisfy the world's food needs, our current food production needs to increase by 50% (World Resources Institute, 2018). Food security is a two-dimensional problem where quality and quantity are both essential components of the solution. Adequate protein consumption is a requirement for a fully nutritious diet, as it is necessary for both human and animal growth. Since the population is growing, one of the most pressing matters is whether our current food production is enough to sustain this increasing demand.

As a solution, the Food and Agriculture Organization (FAO, 2013) proposed tapping into unutilized food sources. Among the food sources listed were insects, as they have a rich protein profile, high scalability, and a circular economy. They can help alleviate difficulties in the conventional food supply chain, such as global water, land, and energy shortages, by serving as a source of protein in the human food cycle or as a primary feed source in animal feed production. Both approaches aim to lessen dependency on current protein sources. For humans, insects are a key source of protein in many Asian, Oceanian, African, and Latin American countries. This solution of consuming edible insects is feasible and executable on a large scale. European countries are either legalizing or have already legalized their sale and production, including the Netherlands. The International Platform of Insects for Food and Feed (IPIFF) states that the next few years will be a critical turning point for entomophagy as nine million Europeans have already tried insects in 2019 and forecasts expect sharp increases by 2030 (Hancock, 2020). According to Global Market Insights, the edible insect industry is expected to rise to \$1.5bn by 2026 from 112m in 2019 (Hancock, 2020), while the value of soya is estimated at 6.49 bn by 2025 (*Global Textured Soy Protein Market Size Report 2019–2025*, 2019).

Nevertheless, western cultures are hesitant to engage in entomophagy (the consumption of insects) (Huis et al., 2013; Schösler et al., 2012; Vanhonacker et al., 2013). The main barriers in the adoption of insects are psychological and cultural. For most, insects are not even considered a food choice. It is not uncommon for western consumers to react with disgust towards insects. Their concerns extend to potential allergies to the types of edible insects and their lack of regulatory clarity in terms of hygiene.

Despite the adoption barriers, if westernized cultures were to overcome their fear of insects on their plates, it would mean a versatile and competitive food product, a long-term solution for the food-chain and a sustainable solution for the environment. But for a startup this is a risky investment, as the outcome of the adoption of insect products is uncertain. For established firms, there is a risk of receiving criticism, harming their image. Removing the psychological barriers of consumers' regarding entomophagy is a challenge for marketers. Even though consumer acceptance of insects has been studied from an abundance of perspectives, marketing stands as an exception. In general, the adoption of new products is a complex task, especially when talking about the introduction of a new food, let alone of one that causes disgust to a lot of western consumers.

2.1 Research Question

For most products, especially food ones, the adoption process usually depends on the product's unique circumstances (Salmen, 2021; Mukherjee, 2011; Kleynveld, 1974). If marketers want to aid with the adoption of insects, they must first understand what drives their consumption. The adoption process for new products is complicated, as it requires selecting the right customer segment, analyzing the product itself, understanding the needs of the consumer and integrating all that into the consumer decision journey. When consumers choose food products, they look to satisfy certain needs and desires which are all different for each consumer. Therefore, it is necessary to evaluate the reasons/motives behind consumers' food choices to comprehend the factors that influence and/or stand as barriers to the adoption of insect-based products in Western countries. The study will focus on snacks as they are a commonly proposed form for insect products, as it will be explained later. Thus, by knowing the unique needs which consumers address through food consumption and quantifying their importance, they can be linked to the case of insect products. The results will help analyze whether the adoption of insect products is feasible, and which potential marketing strategies can be used to that extend. The research question of this study is:

“What is the relationship between the needs behind the food choices of Dutch consumers and the adoption of insect-based snacks?”

First, the relevance of the study will be discussed from a societal, academic and management perspective. Next, the existing literature on the adoption of new products will be described, followed by the literature available on the acceptance of insects in terms of the consumer and the product itself. Afterwards, the model used to quantify the importance of the unique needs of consumers regarding their food choices will be explained. Lastly, the results of the study will be presented. On that basis, conclusions will be made regarding the feasibility of the adoption of insects and the potential strategies a marketer can follow to aid with adoption. The paper serves as an overview of the current state of insect acceptance and discusses its implications from a marketing standpoint.

3. Research Relevance

In this section, the relevance of the adoption of insects will be discussed from a societal, academic, and managerial perspective.

3.1 Social Relevance

As mentioned, adequate protein is a requirement of a complete diet. Current protein sources are mainly plant or animal based. It is estimated that 70% of agricultural land is occupied for livestock production. But the meat industry has been characterized as unsustainable and harmful to most aspects of environmental well-being (Stoll-Kleemann & O’Riordan, 2015). A 50% reduction in meat consumption is necessary to achieve a “planet-friendly” diet, based on current consumption figures (Cheung, 2021). By Q4 of 2023, as per Article 13 of the European Legislation, animals will be considered and treated as sentient beings. In the Netherlands, a 30% decrease in livestock numbers is in the works, which is one of the largest plans of its kind (Guardian, 2021). Even consumption trends are changing with a strong emphasis on the wellbeing of animals such as the farm to fork, cage-free and cruelty-free trends. Both legislations and trends will impose restrictions on the capacity of food that can be produced and will add stress to other food resources. Even though plant-based protein sources have negligible emissions, they still create a significant strain on our natural resources and land, making them a major contributor to deforestation, water depletion and pollution (Cheung, 2021).

Therefore, how can an increasing population be fed, avoid malnutrition, and find a sustainable long-term solution all together? If alternatives are not found the consumption of insects begins to look like a “when” not an “if” question. For example, artificial meat has been a recent solution towards that end, but its scalability and acceptance from the consumers have not been fully addressed yet. It would be naïve to ignore that the relevance of insects partly originates from necessity. If innovations such as artificial meat become scalable, sustainable, and affordable, insects will have a new indirect competitor. A common conception is that the world must go through some hardships before insects are consumed, but by investigating the consumption of insect-based products, it may help to slowly introduce them as a novel food to the west and not as a “yuck” last resort, as protein inadequacy appears unavoidable.

3.2 Academic Relevance

At its core, the goal of marketing analysis is to obtain a deep understanding of the market by understanding the customers, their drives and their product or brand perceptions. Insect products are a new addition to the market for most consumers. When introducing a product in the market it is hard to tell how customers would respond and literature results are mixed, as they are too case-specific. For example, the successful adoption of sushi in the west, can be attributed to many factors. The economic boom of the Japanese economy in nineties and the globalization of the Japanese cuisine and culture in the 20th century are two of them. Hsin-I Feng (2012) explains how the success of sushi is no mystery as it is “healthy but not bland, has exotic flavors and unique textures with a beautiful presentation”. But for a new product this information is not necessarily helpful in its adoption process. Cunha et al. (2015) points out that cultures who showed a higher acceptance of sushi were also more accepting of insects (Cunha et al, 2015). This hints that some cultures may be more ready for new foods than others. Yet, it must be said that sushi did not bear the labels insects do, such as annoyances or pests. Even though the two cases sound similar, insects remain a unique case and learning from the success of sushi or other products is of limited use.

Mukherjee (2011) discusses the limitations of the existing models with which researchers forecast and analyze new product adoption. The main drawbacks of the models relate to the assumption that “customer satisfaction translates into demand” and that conventional models of rational choice and consumer behavior, do not always explain purchasing intentions. In situations of risk and uncertainty for the consumer, Mukherjee (2011) shows that “trust” is a

factor which explains purchasing intentions more successfully. For new products, especially ones which cause a feeling disgust, trust is a crucial piece of their adoption puzzle. Predicting the success of new products depends on a lot of factors but as more research is performed more common patterns can be observed. The topic of marketing “impossible” products like insects has remained understudied and this gap will be addressed to a certain extent through this research.

3.3 Managerial Relevance

Historically Dutch supermarkets Albert Heijn and Jumbo have placed insect products in their shelves (2014), which were later discontinued. An Albert Heijn representative stated that the reason for their removal was the lack of demand (de Jong, 2020). On the other hand, Jumbo’s products were processed to make consumption easier on the consumers. This resulted in enthusiasm at first, but demand still dropped in the long term (de Jong, 2020). Although it is not fully clear, people treat insect-based products as an adventurous or exotic one-time choice instead of a regular item to introduce into their diets.

Insect based products are to a certain extent, already being sold either online or in specific stores, but there is a significant lack of information as to how they should ideally be marketed to consumers.

4. Theoretical Framework

In this section the difficulties of studying new product adoption will be explained. Next, a choice framework will be presented. Then the factors affecting the acceptance of insects will be listed, both on a product and an individual level. Lastly, the process of analyzing the needs of consumers and their relation to the case of insect products as snacks, will be described.

4.1 Adoption

Introducing new products into the market can be tricky. Products have a specific lifecycle, and according to the Product Lifecycle Model (PLC) there are four distinct stages can be identified in the product’s lifecycle (Levitt, 2014). The model is often mapped against the consumer adoption curve as shown by Tekic et al. (2013).

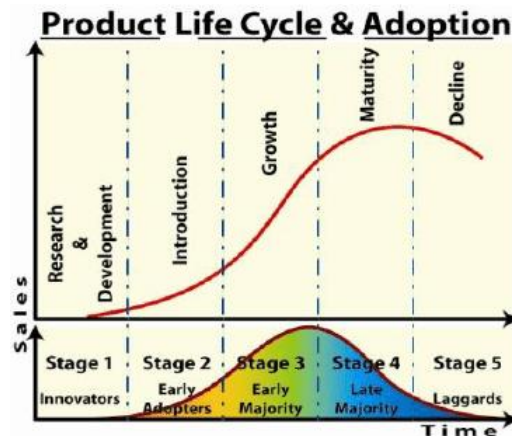


Figure 1: Product life cycle against the consumer adoption curve. Obtained by Tekic et al. (2013)

According to the model, by identifying the stage that the product is going through it is possible to pick the ideal customer segment to target. Although it is hard to pinpoint exactly in which phase a product is in, both Stages 1 and 2 could be argued for insect products. In both cases, the customer segments of innovators and early adopters will be the first to try the product and evaluate it, determining whether it will proceed to the next stage.

Kotler (2019) provides a framework for the consumer adoption process with six distinct stages: **awareness-, interest-, evaluation-, trial-, adoption- and post adoption** stage. Within the framework of Kotler (2019) insect products would fall between the interest and evaluation phases. In the interest phase consumers collect as much information about the product/innovation. In the evaluation stage consumers consider all the factors which are significant in judging the new product/innovation and whether to try it or not (Kotler, 2019). Therefore, knowing which factors consumers look for when evaluating a product and making sure that consumers have the relevant information and knowledge is a crucial step for a new product/innovation to be considered in the evaluation stage. The adoption process applies to all types of consumers but varies in the time required for each stage to take place for each consumer.

The models of Kotler (2019) and Tekic et al. (2013) are both useful in formulating a marketing strategy for a product. A crucial component between both models is the evaluation phase needed to advance to the next stages of adoption. For the evaluation phase, knowledge is necessary by the consumers, so that they have all information needed when judging the various aspects of the product. From the two adoption models and the stage of insect products (snacks), the following hypothesis can be made.

H1. Knowledge is a significant determinant for the evaluation and adoption of insect products by the consumers

The term knowledge refers to whether the consumer has adequate information to evaluate the product, in this case insect-based snacks. If consumers lack information they will not be able to evaluate the relevant aspects of a product. For example, if they are concerned with food safety they would need to be able to gather enough information to address that concern and make a choice based on their judgement.

The previous models focus on the market and the consumers to help create a marketing strategy, but they are not tailored to any product. The product itself should have some characteristics which will determine whether it will be successfully adopted or not. A commonly accepted framework for the attributes that drive adoption of an innovative or new product is Roger's Five Factors framework (Stacks et al., 2019). The framework includes five factors that drive the adoption of a product:

1. Relative Advantage
2. Compatibility
3. Complexity
4. Trialability
5. Observability

Hereby, each factor of Roger's framework will be explained and related to insect products. **Relative advantage** refers to the extent to which the new product is better than its competitors or alternative choices. Insect products are advantageous in terms of sustainability and potentially nutritional benefits. But as a food choice they are not necessarily better than the alternatives. For example, they do not satisfy a hungry consumer more than any other snack or food in general. Thus, the relative advantage depends on the consumer and their needs when making a choice. **Compatibility** refers to the degree of consistency between the product and the customer's values and experiences. In that factor, insects are at a disadvantage. They are not a novel food and culturally they are far away from most western consumers (van Huis, 2013), thus slowing the adoption speed. **Complexity** refers to the difficulty in using and understanding the new product. The preparation of insects as food is not common knowledge, however as it will be seen later, they are proposed in ready-to-eat/snack forms which deals with that issue. Thus, complexity in snack forms should not be a problem. **Trialability** refers to how

easily or often the new product can be tried or experimented with. In snack forms this should be quite easy given that consumers are open to trying the product. **Observability** refers to the extent to which customers can imagine others using the product. This may be a disadvantage for insects due to their unfamiliarity, and lack of knowledge around the product. However, it is possible that a snack form is easier to imagine being used since the insects themselves will not be distinguished in the products.

Insect products satisfy the Relative Advantage criterion, but it depends on the consumers being aware of the advantages. It is also important that consumers find the advantages significant when choosing a product, which depends on their needs. Thus, knowing which product dimensions are valued by different consumers, is required for insect products to realize their potential relative advantage. The rest of the factors of Roger's framework could be argued to improve as more consumers are convinced to at least try insect products once.

4.2 Choice

But how do consumers choose a product in the first place? Decision making assumes that consumers have a specific need or goal which they can fulfill through consumption. For example, if a consumer is hungry and wants to address that, they will refer to their consideration set. The term consideration set refers to all the brands/products the consumer might consider purchasing to address their needs (Szmigin & Piacentini, 2018). Insects are not a familiar choice and thus they fall out of the consideration set for most western consumers, making it very unlikely for them to be chosen as they are not considered in the first place. This is an assumption that conventional choice models follow. Choices can be either lower or higher involvement (Szmigin & Piacentini, 2018). Lower involvement decisions mean that the consumer does not go through extensive research or information seeking before making a choice. For this reason, the barrier of not being included in the consumers' initial consideration set is easier to overcome for products whose purchase is typically low in involvement (Shine, 2020). In general, most literature considers food products to be a low-involvement choice (Kamrath et al., 2019). Yet, Kamrath et al. (2019) show that food choices can also become higher in involvement. This is usually the case with dietary/health supplements, but also whenever the consumption of a food product is motivated by health (Kamrath et al., 2019). In terms of insect products, Shine (2020) adds that since they are an unfamiliar ingredient, the level of involvement in the decision-making process can be expected to increase. Yet, it must be said that it is still unclear whether a consumer would actually go through an extensive

evaluation phase despite the expected higher level of involvement. For example, if a consumer is hungry and just wants to satisfy their hunger, it is unlikely for them to spend a long-time examining different options before choosing. On the other hand, if a consumer just cares about being sustainable with their food-choice, the higher level of involvement is expected to take place. Thus, in practice, depending on what consumers value or their needs, different levels of involvement can be expected. This can be bridged with the Relative Advantage mentioned earlier, wherein knowing which consumers value specific attributes, can help realize that advantage, but also give insights into the level of involvement in the decision-making process. The process of categorizing consumers based on their needs and preferences is known as consumer segmentation (Szmigin & Piacentini, 2018).

Shine (2020) uses the *consumer decision journey* model of Court et al., (2009) to illustrate the process of navigation when purchasing (insect) products. In traditional models, it is assumed that consumers begin with their consideration set which they narrow down to make their final choice. Yet, such models failed to count for the existence of more recent “marketing-touchpoints” such as digital channels, the variety of choices and the increasing engagement of consumers when evaluating a product (Shine, 2020). Court et al. (2009) describes this as the “push” strategy wherein marketers try to influence all touchpoints through advertisement and promotion to make a sale. Newer models become more customer-centric acknowledging that customers also “pull” information that is useful to them. This information can be “Internet reviews, word-of-mouth recommendations and past experiences” but also non-cognitive factors where marketers can interfere (Court et al., 2009; Shine, 2020). The *consumer decision journey* is visualized below:

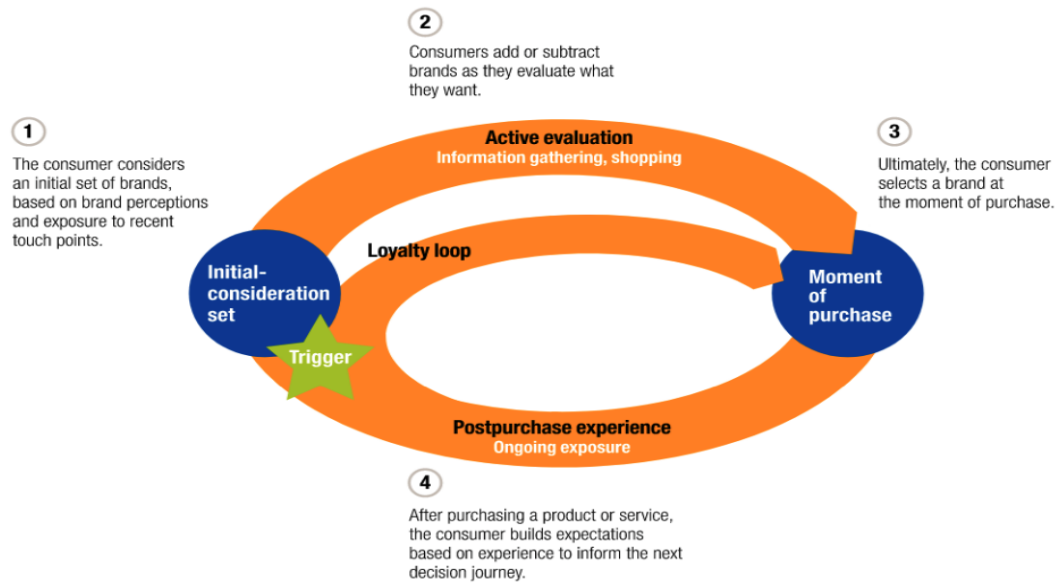


Figure 2: The consumer decision process by Court et al. 2009, obtained from Shine 2020

In the model marketers can influence all four touchpoints shown. It shows that consumers start with a consideration set already in mind. Then, depending on the level of involvement, active evaluation takes place where consumers gather all information useful to make a product choice. In contrast with traditional models the ability to add and remove products from the consideration set is recognized instead of it just shrinking until a choice is made. Finally, even after the consumer has decided, the post purchase experience affects how future evaluations will take place which ideally for marketers translates to customer loyalty.

Shine (2020) highlights that this framework can be used to provide various marketing insights. Marketers can identify the reasons and motives behind the consumption of insects for each consumer. Some example motives, include insects an alternative protein source, meat-alternative, environment-friendly/ sustainable food choice, fitness nutrition supplement. This opens for a “communication” with the consumers wherein marketers can address their concerns. Influencing all product touchpoints ensures that consumers are constantly informed about insect products, as they “pull” the information that is useful for them, making it easier to make a choice.

4.3 Acceptance

Brunner and Nuttavuthisit (2019) identify the different consumer segments (shown in the model of Tekic et al. (2013)) along with their characteristics based on the openness to

consuming insect products. The segment of the “early adopters” (9.3% of population) and the “early majority” (32.5%) are the most educated in terms nutritional knowledge and are either fully or partly open to entomophagy. The last segments are the “late majority” (27%) and highly neophobic consumers (31.2%), of which neither group is open to insects. This makes the first two segments the most likely customers of insect products which strengthens the findings that higher educated consumers are more open to insects. The first two groups are also the keenest on consuming foods such as raw fish and sushi which also faced ambiguity before becoming novel and popular. Being uninformed about insects regarding their safety, nutrition, sustainability would naturally result to consumers being hesitant to choose them. Conversely, if consumers are educated it would translate into a less uncertain choice, which could explain the findings of Brunner and Nuttavuthisit (2019). The correlation between sushi and insects may simply be a result of the level of food-neophobia in each segment, wherein less food-neophobic consumers are more open to “exotic” food choices. In each case the importance of the positive evaluation from the early adopters for the adoption of a product is apparent.

Naranjo-Guevara et al. (2020) in a study of Dutch and German students estimate that 48% would be open to consuming insects as human food, while Reed et al. (2021) shows that approximately one-third of Americans are open to entomophagy. Research from Menozzi et al. (2017) shows that the intention to consume products with insect flour is notably higher in the Netherlands compared to other western cultures. These are promising numbers for the adoption of entomophagy and if they hold in practice, it is possible for the early adopters of insect products to create trust in the industry and help break down some considerable cultural and social barriers to adoption.

A systematic literature review on consumer acceptance of insects in western society by Kröger et al. (2022) concludes that in total there are around 115 factors affecting consumer acceptance of insects. A fundamental problem in entomophagy research is the lack of comparability between findings. Despite the numerous studies, results tend to be mixed on the importance of each factor in consumer acceptance. Furthermore, the definition of the factors themselves tends to vary. Kröger et al. (2022) use the example of education wherein some studies define education as the knowledge of the term entomophagy while others refer to the knowledge of the benefits of entomophagy. If definitions between the same factors differ then it is hard to generalize and conclude literature findings. Despite that limitation, some universal trends can still be spotted among certain factors. Below, the significant factors known to affect insect

acceptance are split into the categories of product factors and socio-demographic factors. Product factors refer to the distinct characteristics of the insect products which affect its appeal. Socio-demographic factors refers to the differences in acceptance based on personal characteristics such as gender, age, education etc.

4.3.1 Product Factors

Starting with the product factors, willingness to try insect products increases when insects cannot be distinguished in the product (Tucker, 2014; Capparos Medigo et al., 2016), which suggests that a snack or processed form is generally more preferred. This is a unique case where the main ingredient of a product instead of being showcased is rather being “hidden” to aid with general attractiveness. Given the associations western cultures have with insects it can be expected that the less visible they are for the better.

Price poses mixed results in consumer acceptance of insects. Yet, Kröger et al. (2022) summarizes a total of eight studies on the importance of price wherein the majority prove that a higher price results in lower acceptance. Given the potential disgust coming from the consumption of insects it is reasonable that consumers would expect a lower price for insect products, hence the negative relationship with their acceptance. On top of that, since they are proposed to become products such as protein bars which already exist in the market, a higher price will simply put them at a disadvantage compared to the alternative options. For a firm this is something important to consider since Bashi et al. (2020) show that insect protein needs to cut down 50% on production costs for the products to become competitively priced. On the other hand, due to the regulations and social trends currently, it can also be expected that animal and plant protein sources will become more expensive in the long term, while the insect sector can achieve economies of scale as investments occur.

Clarkson et al. (2018) point out that when food security is not an immediate problem (most western countries), willingness to try insect products increases given that they are considered advantageous to alternative choices. Making consumers see insects as advantageous or premium is challenging as they are commonly a source of disgust. This may come down to educating consumers about the benefits of entomophagy. In such a way, consumers will see how and where insects can be advantageous to alternative choices, such as in terms of sustainability and nutrition, bringing the focus on the importance education and knowledge as seen with Kotler’s (2019) and Tekic’s (2013) models earlier.

In research from Capparos Medigo et al. (2016) Belgian consumers are only open to ready-to-eat insect-based products (snacks). This could be attributed to the fact that the preparation of insects is something that most western consumers are not familiar with. Herbert and Beacom (2021) explain that the focus around snack products is based on the common finding across research (Tucker, 2014; Clarkson et al., 2018; Hoek et al., 2011) that western consumers are reluctant to accept insect products as meat alternatives. Thus, Herbert and Beacom (2021) infer that snacks may be more likely to be accepted by Western consumers.

Packaging has also started receiving attention in studies although there is still disagreement regarding research's findings. But a consensus is that visible insect products through transparent packaging leads to higher consumer aversion (Capparos Medigo et al., 2014; 2016). As shown in research of Morales et al. (2007), the easier it is for consumers to see the origin of disgust or "contamination" in a product the more easily their evaluation of a product can change for the worst in most cases. Since insects are potentially a cause of disgust to consumers, it means that a transparent packaging would influence how consumers see the product more easily than a non-transparent one. On a further note, packaging must adapt to the customer target. For example, when targeting active users packaging should focus on the nutritional contents of the product, while for food-adventurers it may be better to display the type of insect included in the product.

Barton et al. (2020) shows that even though consumers may initially report disgust around insects, after trying a product (i.e., protein powder) they are more likely to buy it and recommend them to their social circle. The finding hints that initial preferences can change for the better. For this reason, a commonly proposed strategy for adoption is to get more consumers to at least try insect-based products. For marketers, this means that they need to maximize the number of consumers who try insect products even once, something that was also inferred through Roger's five factor model earlier.

4.3.2 Socio-Demographic and Personal factors

Kröger et al. (2022) shows that researchers disagree on the importance of some economic and demographic data on the attitude around entomophagy. Yet some common trends can be spotted among literature. A summary of the research of Kröger et al. (2022), on the topic of socio-demographic and personal factors shows the following:

Gender influences consumption of insect products wherein most studies show that males are more accepting of insects than females. No studies have found females to have a

higher acceptance of insects, but it must be said that some studies have also found that gender has no influence at all.

In terms of age most studies show that it has no effect. However, all studies which show a link between age and consumer acceptance show that younger age groups are more open to consuming insects. No direct theory supporting this finding is reported. One study of Dupont and Fiebelkorn (2020), finds a positive relationship in age and acceptance. The finding is backed up, from the theorem that when entering adult life and obtaining autonomy, individuals are more likely to expand their food-spectrum. The topic of age remains inconclusive, with most studies pointing to no significant effect.

Income and occupation were shown to not have a significant effect either. Factors such as religion, place of residence and nationality effect openness to entomophagy, but their results are too case specific to be generalized. An interesting note was that Dutch and Finnish consumers are more open to entomophagy compared to countries like Spain and the UK.

Being more involved and knowledgeable with sustainability and environmental issues provides mixed results in openness to consume insects. In some cases, it was shown to have a positive effect, while others showed no effect. Sustainability is a truly relevant matter and as more attention is being put into it, the more it could influence consumers 'choices.

One of the most common factors affecting openness to entomophagy is food neophobia which is defined as the reluctance to try new food products. Most studies (89.2%) conclude that there is a negative connection between being food-neophobic and being open to entomophagy. Food neophobia is usually measured through the Food Neophobia Scale. Every individual scores differently in the scale. In research from Schickenberg et al. (2007), food neophobia is higher when the level of education of an individual is lower. It is also shown, that neophobia is negatively related to the willingness to try healthy food alternatives.

From this section it can be inferred that the two variables who are more likely to influence the acceptance of insects are education and food-neophobia which lead to the following hypotheses:

H2: Being a male and/or having a higher level of education is positively related to the willingness to consume insect-based products

H3: Age and Employment status do not affect the level of willingness to consume insect products

H4: A higher level of food-neophobia is negatively related to the willingness to consume insect-based products

Bringing all models together; the model Tekic et al. (2013) shows that at the current life cycle of the product, it is suggested that the main customer targets are the innovators and early adopters. Kotler's (2019) model helps show that regardless of the target segment, consumers of insect products are still within the interest and evaluation phases. From these two models the importance of knowledge from the consumer side becomes apparent for insect products to be positively evaluated and to move on to the next adoption stages within both models. It was also shown that it is necessary to convince consumers to at least try the products once, which also addresses the problem of insect products not being included in the consideration set of consumers. This is important for Roger's model, so that the factors within the framework, excluding relative advantage, can improve as explained earlier. In the acceptance section, all product and socio-demographic factors affecting the acceptance of insect products are listed. The product sub-section explains the reasoning behind the focus on snack/ready-to-eat insect products. The socio-demographic sub-section shows that education and food neophobia are significant determinants of insect acceptance. These two variables may help identify different consumer segments such as the early adopters whose openness to insect would naturally be higher. Lastly, as it was explained consumers are inherently different and their needs and motives behind the choice of a product differ. Knowing the needs and consumption motives of consumers can help in each framework; align the marketing strategy with the needs of the early adopters who are the target in Tekic's (2013) model, aid the evaluation and interest phase within Kotler's (2019) model, and by analyzing the different levels of involvement and addressing the consumer's needs through the touchpoints in the choice model of Court et al. (2019).

Pincus (2004) suggests that marketing and consumer behavior research can lead to more insights and actionable strategies by adding a quantifiable measure for the unmet needs of

consumers within the choice motives research framework. In the next section, the procedure with which consumers choose food products based on their needs, will be explained.

5. Research Methodology

5.1 Underlying Theory

To quantify the needs behind the choice of foods products, Steptoe et al. (1995) developed the Food Choice Questionnaire (FCQ). The FCQ has been used extensively in research from various disciplines. The original FCQ by Steptoe et al. (1995) is a multi-item questionnaire. Onwezen et al. (2019), propose that, even though the FCQ is the standard in measuring different motivations behind food-choices, a shorter version was needed with the main criticism being around its length. Lengthy surveys tend to receive diminishing attention from responders, lead to fatigue and high-dropout rates especially on an era characterized by short-attention span and information overload (Onwezen et al., 2019). To that extend, Onwezen et al. (2019) develop the Single-Item FCQ (SIFCQ), which they assess and deem as a robust (for most products) short substitute for the original FCQ, as it maintains and performs well in predictive and convergent validity. For this reason, the SIFCQ will be used in this research instead of the original FCQ.

All versions of the questionnaire are based on measuring several factors. The SIFCQ uses eight factors from Steptoe et al. (1995) and three more ethical-based dimensions from Lindeman and Väänänen (2000). The detailed version of the SIFCQ and the respective dimensions can be found in the Appendix (Section I). The proposed questionnaire:

Table 1. Proposed SIFCQ by Onwezen et al. (2019)

Is healthy
Is a way of monitoring my mood (e.g., feeling-good, helps with stress)
Is convenient in buying
Provides me with pleasurable sensations (e.g., texture, appearance, smell, taste)
Is natural
Is affordable
Helps me control my weight
Is familiar
Is environmentally friendly and sustainable
Is animal friendly
Is fairly traded

Note: The answers to these statements will be measured in a scale of 1-7 from not at all important (1) to very important (7).

Yet, this is a framework suitable to most food products, but the consumption of insects may have more dimensions behind its choice process. Some notable reasons to be chosen may include high protein content, non-GMO, and sustainability (Kauppi et al., 2019). Notable reasons to not be chosen may include food-neophobia and the subjective norm. To count for these factors, the following statements will be added to the SIFCQ.

Table 2. Additional questions based on insect-specific dimensions	
Has a high-protein content	<i>Measure of protein preference</i>
Is non-GMO	<i>Measure of non-GMO preference</i>
Is what my peers also eat	<i>Measure of subjective norm influence</i>

Note: The answers to these statements will be measured in a scale of 1-7 from not at all important (1) to very important (7).

Food-neophobia has been characterized as one of the most important barriers to adoption for insects. The level of food neophobia of the responders will be evaluated by the following statements which were also used in research from Naranjo-Guevara et al. (2020). Responders choose which statement describes them the best.

Table 3. Food Neophobia Questions and Levels	
I am curious and often try new foods/products	= <i>Low</i>
I am open to new foods if they are close to what I already know	= <i>Medium</i>
I rarely try new foods, especially if they have unfamiliar ingredients	= <i>High</i>

Lastly, participants will be asked to state their preferences regarding the consumption of insects. This will also happen via a series of statements which they will need to evaluate. The statements were chosen in light of van der Pas (2017), who explains their selection based on the theory of planned behavior by (Ajzen, 1991; Mark et al., 2014), but they are not identical. Van der Pas (2017) explains how the theory of planned behavior is an important and immediate predictor of the behavior of an individual. The statements chosen, are shown in the table below:

Table 4. Insect Acceptance Questions	
I would be open to consuming products containing insect flour/protein	
I would purchase insect-based products if I had the choice	
I would be open to introducing insect-based products to my diet regularly	
I would try insect products once	

Note: The answers to these statements will be measured in a scale of 1-7 from strongly disagree (1) to strongly agree (7).

Naturally choosing a food product requires context. For example, a consumer chooses differently when looking for a snack compared to looking for a full meal. Thus, in this study the participants will be asked to answer the SIFCQ in the context of “when choosing a ready-to-eat snack.” This framework suits insect products as their proposed versions are mostly snacks, as mentioned above. The answers will give insights to the importance of the various needs of consumers when choosing a snack, which can then be linked specifically to insect-based snacks.

Since certain socio-demographic variables have been found to influence the acceptance of insects. Therefore, responders are asked to provide their socio-demographic data before proceeding with the questionnaire described above. The last step of the survey will be to ask the respondents for which reasons they would not consume insect products. The total overview of the theoretical framework (the focus of this research is highlighted):

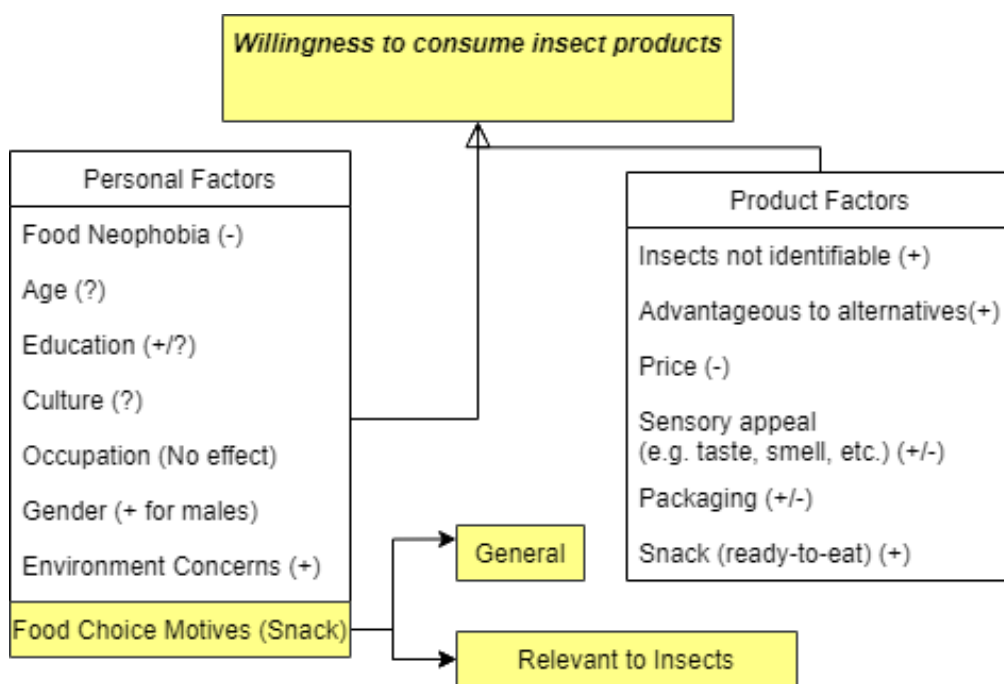


Figure 3: Theoretical framework of study. Signs represent expected effect according to existing literature/studies.

In short, the motives/needs of the participating sample, regarding their food choices, will be measured. The consumption of insects may also be determined by some of their unique characteristics; thus, these factors will also be included in the SIFCQ. Certain socio-demographic variables have been shown to affect the acceptance of insects. Both socio-

demographic and insect acceptance are measured in the research, thus their relationship can be evaluated along with the needs/motives which will be quantified by the SIFCQ. Lastly, the research will help test the hypothesis made earlier.

5.4 Survey

To conduct this research a survey will be created and distributed. To avoid selection bias, the survey will be distributed without informing the participants of its research topic. The topic of entomophagy will not be mentioned to the participants until the last block of the survey to avoid biasing their answers in the case of a disgust reaction to the idea of insects. The survey will be distributed via the internet at multiple social media platforms. The target audience would ideally be a representative sample of the Dutch population.

6. Results

In this section, the results of the survey will be summarized and analyzed in a variety of methods. After each result is presented, its implications from a marketing perspective will be discussed individually. The next section of conclusions will be a complete summary which considers all results mentioned within this section.

The distribution of the survey lasted from July 6th up to and including July 20th. During the period 163 complete responses were collected. Incomplete responses were dropped along with responses of consumers who did not report living within the Netherlands. The restricted sample is 146 responses. All tables and analyses will focus only on the restricted sample.

Table 5: Socio-Demographic descriptive statistics

Question	Answer	Percentage
What is your age?	19-25	50%
	26-35	24%
	35+	26%
What is your gender?	Male	46%
	Female	54%
What is your employment status?	Student	42%
	Employed/Working	47%
	Unemployed	11%
What is your education level?	High-School	23%
	Bachelor	33%
	Master	10%
	College	34%
How important are environmental concerns to you?	Very important	55%
	Moderately important	40%
	Not important	5%
Do you complement your diet with protein supplements?	Yes	73%
	No	27%

6.1 Representativeness

Based on the sample a few things can be expected to affect results according to literature. Compared to the 2021 report of the CBS (Statistics Bureau Netherlands) (2022a) the age groups of 19-25 and 26-35 are overrepresented in this study, as the age group of 20-40 makes up for only 22% of the actual total Dutch population. As mentioned earlier, age has been an inconclusive matter in insect literature, making it unclear whether it will influence results. In terms of gender, the CBS (2022b) reports an almost equal distribution with ninety-nine males for one hundred females. The sample is also close to an equal distribution with a higher female population (53 %), unlikely to influence results. According to the CBS (2022) approximately 40% of the Dutch population has obtained a secondary level of education as of 2018. Thus, the collected sample has a higher level of education, likely related to the overrepresented age groups. One of the hypotheses made earlier is that a higher level of education increases the acceptance of insects. In terms of environmental concerns, it is hard to make a direct comparison to the Dutch population. A similar measure by Statistics Netherlands (2021) shows that 53.5% have a positive attitude towards transitioning to sustainable energy. If this is used as a proxy, then it can be inferred that the collected sample is like the general population in terms of environmental concerns. Regardless, sustainability concerns have shown mixed results and their influence on entomophagy is inconclusive.

To measure the level of food-neophobia the scale of Naranjo-Guevara et al. (2020) was utilized, where responders were asked to best identify themselves among three statements regarding trying new food products. It is found that 53%, 13%, and 34% of the respondents report a medium, high, and low level of neophobia, respectively. Naranjo-Guevara et al. (2020) report 49%, 41%, and 10% for medium, high, low food neophobia levels. Therefore, the responding sample of this research is less food-neophobic than the sample of Naranjo-Guevara et al. (2020). The level of food neophobia does not provide significant insights, but its relationship and variation with the rest of the variables in the survey potentially does.

6.2 The SIFCQ

Table 6: Descriptive statistics for the SIFCQ Answers (sorted by mean)

	Mean	Std. Dev.
Is affordable	5.02	1.47
Provides me with pleasurable sensations	4.86	1.35
Is healthy	4.85	1.40
Helps me control my weight	4.76	1.51
Is natural	4.76	1.49
Is environmentally friendly and sustainable	4.71	1.68
Is convenient in buying	4.70	1.42
Is animal friendly	4.66	1.9
Is fairly traded	4.58	1.65
Has a high protein content	4.55	1.68
Is familiar	4.49	1.63
Is a way of monitoring my mood	4.20	1.50
Is non-GMO	3.84	1.75
Is what my peers also eat	3.84	1.72

Note: The answers to these statements are measured in a scale of 1-7 from not at all important (1) to very important (7).

From the table it is shown that the three most important variables are affordability, health, and sensory appeal. The rest of the factors until familiarity can argued to be of similar medium(-high) importance. The three least relevant factors affecting the choice of a snack for consumers are mood-regulation, non-GMO, and peer influence. These results are helpful for a marketer for general snack choices, but not necessarily insect products specifically. For a marketer, a balance between the relevant and the “insect-specific” factors must be stricken, to maximize the reach of insect-based snacks.

6.3 Willingness to consume insect-based snacks

To measure the willingness to consume insect-based snacks, four different statements were evaluated by the respondents, whose choice was explained in the previous section.

Table 7: Descriptive statistics of willingness to consume insect-based snacks

	Mean	Std. Dev.
I would be open to consuming products made with insect protein/flour	2.79	1.16
I would purchase insect-based snacks if I had the choice	2.71	1.22
I would be open to introducing insect-based snacks to my diet regularly	2.76	1.27
I would try insect-based snacks once	3.17	1.37

The table shows that most statements rank similarly on average apart from trying insect-based snacks once. This is a good indicator for marketing purposes as throughout the paper, the importance of convincing consumers to try insect snacks even once was iterated. A frequent practice to assess the reliability and consistency of a measurement is Cronbach's Alpha. It checks the internal consistency between a set of data/answers if they were grouped (Cronbach, 1951). Research suggests that Cronbach's alpha should be ranging between 0.7 and 0.9 in a reliable set (Tavakol & Dennick, 2011; Goforth, 2015; van Nierop 2021). If the set of answers prove to be consistent then it is possible to combine all of them in a single variable. In this case, the Cronbach's alpha for the four questions of willingness to consume gives a score of 0.848, which would commonly classify as very reliable (Appendix 2). Furthermore, by observing the alpha column, removing any of the four statements measuring TWTC does not increase the Cronbach's alpha, reaffirming that all four statements can be combined in one factor. Thus, the average score of all four statements will be combined in one variable for each survey response. The combined variable will hereby be referred to as Total willingness to consume (TWTC). All four separate statements were measured in a scale of 0 to 5, meaning that TWTC also ranges from 0 to 5. The mean is 2.88 with a standard deviation of 1.02. Again, these statistics are of little use on their own, and are abstract. Therefore, it is important to see how TWTC varies within the sample instead of its absolute value.

6.3.1 TWTC and socio-demographics

A bivariate correlation between TWTC and the Socio-Demographic characteristics of the sample is utilized. The complete correlation matrix table is available in the Appendix (3). From the output it is shown that the only socio-demographic variables influencing TWTC insect-based products are Environmental Concerns and Protein Supplementation. The variable of Environmental concern is positively correlated with TWTC with a coefficient of 0.275, which is significant at a 5% level. Frequent protein supplementation has a positive correlation

coefficient of 0.3 and is significant at a 1% level. No other socio-demographic variable was found to be statistically significant towards the TWTC insect-based products.

6.3.2 Food Neophobia

Food neophobia is characterized as one of the most significant obstacles to the adoption of insects. The correlation coefficient between TWTC is -0.263 and is statistically significant at a 1% level. This verifies the findings of most literature which also reports a negative relationship between food neophobia and the acceptance of insects.

6.3.3 Regression

To explore insect acceptance based on different food choice motives, a regression is performed. The output can be found on the table below:

Table 8: Regression of Acceptance on food choice motives:

Total Acceptance	Coefficient	P-Value
Is healthy	-0.097	0.247
Is a way of monitoring my mood	0.008	0.905
Is convenient in buying	-0.037	0.605
Provides me with pleasurable sensations	-0.106	0.124
Is natural	0.197*	0.009
Is affordable	0.125	0.138
Helps me control my weight	-0.054	0.500
Is familiar	-0.080	0.236
Is environmentally friendly and sustainable	0.131	0.072
Is animal friendly	-0.144	0.407
Is fairly traded	0.117	0.096
Has a high protein content	0.028	0.662
Is non-GMO	0.065	0.247
Is what my peers also eat	0.061	0.303
Constant	1.504	0.001

*: Coefficient is statistically significant at 5% level.

From the regression only one statistically significant result emerges. Consumers who look for natural ingredients in snacks are more likely to be more willing to consume insect-based snacks. The coefficient is 0.197 which means that on average, consumers who value natural contents, score 0.197 points higher in TWTC insect-based snacks. The coefficient of environmentally friendly and sustainable is almost significant at a 5% level and given its

relevance to the case of entomophagy it is recommended to be considered despite not being fully statistically significant.

6.3.4 Reasons not to Consume

In the end of the survey, respondents filled in which of the reason(s) they would not consume insects for. The distribution of the results is available on the figure below:

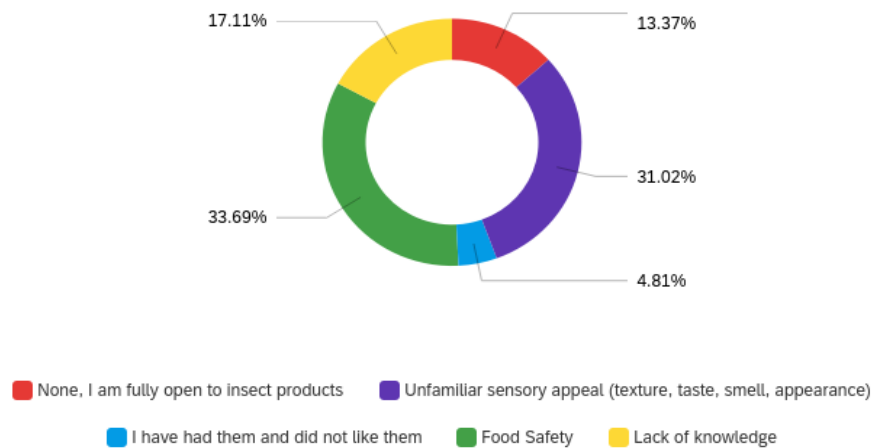


Figure 4. Reasons not to consume insect products answers distribution

The most popular reasons for not consuming insect products are food safety and an unfamiliar sensory appeal. Around 17% of responders report having no concerns or in other words being fully open to insect products. A lack of knowledge follows as the next reason to not consume insect products. The least popular reason happens to be negative past experiences, although the number of consumers who tried insects in general was not measured. It could be argued that the factor of food safety is also a matter of a lack of information on the consumer's side. To further investigate the relationship between reasons not to consume and insect acceptance a regression is performed.

Table 9: Regression of Acceptance on reasons to not consume:

Total Acceptance	Coefficient	P-Value
None, fully open to insects	0.742*	0.002*
Unfamiliar sensory appeal	-0.135	0.519
Had them and did not like them	0.091	0.812
Food Safety	-0.037	0.867
Lack of knowledge	-0.555*	0.03*
Constant	2.927	0.000

*: Coefficient is statistically significant at 5% level.

From the output it is shown that only Lack of Knowledge is a statistically significant reason at a 5% level, with a coefficient amounts to -0.947. Meaning that, respondents who report a lack of knowledge as a reason to not consume insect snacks on average score -0.555 points less in TWTC insect snacks in a scale out of five. The second statistically significant result is being fully open to insects. The coefficient is statistically significant at 1% level and is 0742. This means that on average being fully open to insects increases the TWTC insect snacks by 0.742 points. The result is self-explanatory.

7. Conclusions

In this section, the conclusions with their marketing implications presented. The order in which the conclusions are presented is according to the order of the hypotheses made throughout the paper. The conclusions build up on answering the research question of the paper.

Hereby is a list of all hypotheses made across the length of this paper and whether they were proven or disproven after the analysis of the research results.

Table 10. Hypotheses and their respective outcomes

Hypothesis	Accepted/Rejected
H1: Knowledge is a significant determinant for the evaluation and adoption of insect products by the consumers	+
H2: Being a male and/or having a higher level of education is positively related to the willingness to consume insect-based products	-
H3: Age and Employment status do not affect the level of willingness to consume insect products	+
H4: A higher level of food-neophobia is negatively related to the willingness to consume insect-based products	+

Note: a + sign indicates that the hypothesis was accepted and vice versa.

(H1.) The first hypothesis was proven to be the case within this paper. A lack of knowledge was the only reason as to which respondents would not consume insect-based snacks that was also found to be statistically significant. Despite not being the most popular reason reported to inhibit the consumption of insect-based snacks, it could be argued that the factor of food safety, who ranked the highest, is also a matter originating from a lack of knowledge. The hypothesis was made based on the adoption models and frameworks mentioned earlier. The first hypothesis can be concluded to be accepted.

(H2.) The second hypothesis was rejected based on the findings of the paper. Throughout the analysis of the results neither the variable of education nor age was found to significantly effect willingness to consume insect-based snacks. On a further note, a bachelor's level of education was found to be statistically significant and positive when correlated with Food Neophobia. As food neophobia is an established barrier to adoption, the result could even suggest a negative relationship between willingness to try insects and the level of education. Naturally, the result cannot be interpreted independently, as it was not actually found significant directly to insects.

(H3.) The third hypothesis was proven. Excluding environmental concerns and protein supplementation, none of the other socio-demographic (which include age and education) variables measured were shown to influence the willingness to consume insect products. Age and employment were inconclusive in literature, with most studies suggesting that no relationship exists between them and insects. This hypothesis is thus accepted and proven within the study.

(H4.) The fourth hypothesis was successfully proven within this paper. Food neophobia is the most established barrier to the adoption of insect products, found by most studies on the topic. A negative relationship between the level of food-neophobia and the willingness to consume insect products was thus hypothesized. The correlation coefficient between food neophobia and TWTC insect snacks was found to be statistically significant with a negative sign. Therefore, the hypothesis is accepted.

Based on the rest of the results and the outcomes of the hypotheses the main research question is addressed. Throughout the paper the theme of convincing consumers to try insects at least once was often mentioned. Doing so would help within Roger's Product adoption model to aid with the potential problems with the factors Compatibility, Complexity, Trialability, Observability. It would also address the problem of not being included in the consideration set of consumers during the customer's decision journey. Barton et al. (2020) shows that after trying an insect product (i.e., flour) consumers were much more likely to suggest it to their

peers and purchase it. For marketers, this means that a potential strategy would be to try to maximize the reach of the product to consumers. A positive result is that the factor with highest score in willingness to consume insect-based snacks is “trying them once.”

According to the Product lifecycle framework in combination with the consumer adoption curve, the ideal consumer target is estimated to be the early adopters and innovators. Brunner and Nuttavuthisit (2019) find that early adopters are characterized by a higher level of education and lower food neophobia. Within the paper only the latter is proven. The findings of this paper further suggest that consumers with a higher willingness to consume insect snacks, are mostly ones who often complement their diet with protein supplements and/or are environmentally concerned. The factors of environmentally friendly and high protein content ranked well in the results of the SIFCQ. Therefore, marketers are suggested to promote insect-based snacks with an emphasis on their environmental benefits and higher protein content, as these factors were positively related both with insects and snack products in general.

Kotler’s (2019) model of consumer adoption suggests that consumers of insect products are either in the interest and/or evaluation phase. For consumers to judge and decide whether to choose a product, a level of knowledge about the product is required. This is a crucial step, required to proceed to the next adoption stages. The communication with the consumers was conceptualized within the choice framework suggested by Shine (2020). In the framework, marketers can increase and influence, the touchpoints of the consumers with the product, thus they can address the consumers ‘concerns and needs. The hypothesis of the lack of knowledge being a barrier in the willingness to consume insect products was proved within the paper. By understanding what drives the consumption of (insect) snacks, marketers can obtain useful insights towards identifying different consumer segments and understanding the level of involvement during the decision-making process. To that extend, the SIFCQ was utilized. The results, show that most choice factors are of similar importance in the choice of snacks, with affordability, sensory appeal and health standing out by ranking the highest. Yet, as mentioned earlier, this does not mean that these factors are necessarily relative to the choice of insect products. Even if a factor does not score the highest, for a marketer, it does not mean that they should exclude it in their strategy or ignore its importance in choice. For example, affordability did not have a direct effect on the TWTC insect snacks, but it was the highest-ranking factor in the general choice of snacks. Thus, a balance is required between addressing the factors which are important in the choice of both general snacks and for insect snack in specific. The

only SIFCQ factor directly and positively related to the willingness to consume insect products was containing natural ingredients, but a case around sustainability and environmental benefits increasing TWTC insect products, could also be made.

In short, analyzing the current stage in the adoption of insects and the choice process of the consumers, marketers are suggested to do the following. Within the paper, the consumers with the highest willingness to consume insect snacks are supplementing their diet with protein and are environmentally concerned, potentially making them early adopters. Marketers should focus on educational based promotions of insect snacks. The content of the promotions should revolve around the following factors: food safety, health, protein content, natural contents, sensory appeal, and environmental benefits of insect-based snacks. By doing so marketers maximize the reach of the product and they can address the barrier of the lack of knowledge, aiding with the adoption process in turn. To summarize:

- Educational promotions to address the barriers related to the lack of knowledge by the consumers
 - o Only statistically significant relation to willingness to consume insect snacks
 - o Food safety also a problem of knowledge
- Get consumers to try the snacks at least once as it is important for:
 - o The adoption & evaluation process
 - o Research shows a higher liking towards the product after trying
 - o Ranks the highest in the statements around the willingness to consume insect snacks
- Market the product based on:
 - o Regular consumers of protein supplements and/or consumers who are environmentally concerned are the most willing to consume insect products
 - o Natural contents are a consumption need directly and positively related to the willingness to consume insect products
 - o Keep in mind general snack needs, such as affordability, sensory appeal weight control, etc. (still require research individually)
 - Explain what consumers can expect in terms of sensory appeal as it was a high-ranking need when choosing snacks. For example, “nutty flavor.”

Before concluding whether the adoption of insects is feasible in the Netherlands, there are some things to be considered. Several factors which are relevant to snacks in general, such as

affordability and controlling weight, need to be considered even if they were not directly related to insect products. Marketing also consists of more dimensions such as branding, packaging, distribution, etc., which would require further research individually. The sample at hand was less food neophobic and younger than the Dutch population. Yet, age was insignificant towards the results. The scale used to measure food is relatively difficult to compare, and no studies are available on the neophobia of Dutch consumers. If innovations are made which also tackle the future lack of protein or malnutrition in general, then insects will have more competition. One example mentioned earlier, was artificial meat. Thus, this paper cannot provide a direct answer to whether the adoption of insects is feasible. However, it stands as a guiding point for the potential marketing strategies one could use to maximize the likelihood of the adoption of insect snacks. Finally, it helps guide future research, which is required to address some of the potential concerns one would have before proceeding with the marketing of insect-based snacks.

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Appendix

Appendix I. The proposed SIFCQ's factors and dimensions. Obtained by Owenzen et al. (2019)

Proposed SIFCQ	Dimensions of Steptoe et al. (1995)	Dimensions of Linderman and Vaananen (2000)
It is important to me that the food I eat on a typical day is:		
Healthy	Health	
A way of monitoring my mood	Mood	
Is convenient (in buying and preparing)	Convenience	
Provides me with pleasurable sensations	Sensory appeal	
Is natural	Natural Content	
Is affordable	Price	
Helps me control my weight	Weight control	
Is familiar	Familiarity	
Is environmentally friendly	Ethical Concern	Environmental Protection
Is animal friendly		Animal welfare
Is fairly-traded		Political values religion

Appendix 2. Cronbach's Alpha Total Statistics

Test scale = mean(standardized items)

Item	Obs	Sign	Item-test correlation	Item-rest correlation	Average interitem correlation	alpha
WTC1	146	+	0.8320	0.6928	0.5807	0.8060
WTC2	145	+	0.8683	0.7537	0.5419	0.7801
WTC3	144	+	0.8299	0.6852	0.5847	0.8086
WTC4	145	+	0.7976	0.6331	0.6201	0.8304
Test scale					0.5818	0.8477

Appendix 3. Correlation Matrix Total Willingness to consume insect-based snacks with demographic variables.

	twtc	Age	Gender	aEnv	stud	unempl~d	employed						
twtc	1.0000												
Age	0.0109 0.8973	1.0000											
Gender	-0.0729 0.3871	0.0111 0.8942	1.0000										
aEnv	0.2753* 0.0009	-0.0047 0.9551	-0.1200 0.1476	1.0000									
stud	-0.1202 0.1526	-0.7637* 0.0000	-0.0555 0.5043	-0.0544 0.5125	1.0000								
unemployed	0.1305 0.1202	0.1479 0.0737	0.2109* 0.0103	-0.1035 0.2124	-0.2985* 0.0002	1.0000							
employed	0.0387 0.6461	0.6633* 0.0000	-0.0767 0.3559	0.1184 0.1531	-0.8033* 0.0000	-0.3287* 0.0000	1.0000						
Highsch	0.0657 0.4356	-0.0071 0.9318	0.0248 0.7657	0.1044 0.2081	0.0357 0.6676	0.1784* 0.0306	-0.1467 0.0763	1.0000					
Bachelor	-0.0109 0.8970	-0.2343* 0.0043	-0.1075 0.1949	-0.0723 0.3843	0.2143* 0.0092	-0.0154 0.8527	-0.2024* 0.0139	-0.3804* 0.0000	1.0000				
Master	-0.0260 0.7575	0.2261* 0.0059	-0.0948 0.2532	-0.0505 0.5432	-0.2424* 0.0031	-0.1178 0.1553	0.3134* 0.0001	-0.1814* 0.0279	-0.2384* 0.0036	1.0000			
College	-0.0309 0.7145	0.0949 0.2527	0.1457 0.0782	0.0122 0.8831	-0.0898 0.2794	-0.0665 0.4236	0.1304 0.1156	-0.3863* 0.0000	-0.5077* 0.0000	-0.2420* 0.0031	1.0000		
Supplement	0.3002* 0.0003	0.0862 0.2990	0.1720* 0.0372	0.1682* 0.0417	-0.1278 0.1229	0.0664 0.4240	0.0850 0.3060	0.1092 0.1882	-0.0865 0.2977	-0.0969 0.2431	0.0518 0.5332	1.0000	

Appendix 4. Correlation between food neophobia and education

	FN	Highsch	Bachelor	Master	College
FN	1.0000				
Highsch	-0.0867 0.2963	1.0000			
Bachelor	0.1686* 0.0412	-0.3804* 0.0000	1.0000		
Master	-0.0014 0.9866	-0.1814* 0.0279	-0.2384* 0.0036	1.0000	
College	-0.0905 0.2756	-0.3863* 0.0000	-0.5077* 0.0000	-0.2420* 0.0031	1.0000

Appendix 5. Survey Report

Q26 - What is your age?

#	Answer	%	Count
1	19-25	50.00%	73
2	26-35	23.97%	35
3	35+	26.03%	38
	Total	100%	146

Q28 - What is your gender?

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What is your gender? :	1.00	4.00	1.55	0.54	0.29	146

#	Answer	%	Count
1	Male	45.89%	67
2	Female	53.42%	78
4	Other	0.68%	1
	Total	100%	146

Q29 - What is your employment status?

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What is your employment status? :	1.00	3.00	1.68	0.66	0.43	146

#	Answer	%	Count
1	Student	42.47%	62
2	Employed	46.58%	68
3	Unemployed	10.96%	16

	Total	100%	146
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Q32 - How important are Environmental Concerns to you?

#	Answer	%	Count
11	Very important	54.79%	80
12	Moderately important	39.73%	58
14	Not important	5.48%	8
	Total	100%	146

Q41 - What is your education level?

#	Answer	%	Count
21	College	34.25%	50
15	Bachelor	33.56%	49
14	High School	22.60%	33
16	Master	9.59%	14
	Total	100%	146

Q48 - Do you live within the Netherlands?

#	Answer	%	Count
1	Yes	100.00%	146
	Total	100%	146

Q30 - Do you complement your diet with protein supplements (e.g., protein bars/powder)?

#	Answer	%	Count
1	No	26.71%	39
2	Yes	73.29%	107
	Total	100%	146

Q44 - When having a ready to eat snack it is important to me that: (higher means more important)

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
6	Is affordable	1.00	7.00	5.02	1.47	2.17	146
4	Provides pleasurable sensations (e.g., taste, aroma, texture, appearance)	1.00	7.00	4.86	1.35	1.83	145
1	Is healthy	1.00	7.00	4.85	1.40	1.96	146
7	Helps me control my weight	0.00	7.00	4.76	1.51	2.28	142
5	Is natural	1.00	7.00	4.76	1.49	2.22	145
9	Is environmentally friendly and sustainable	0.00	7.00	4.71	1.68	2.81	145
3	Is convenient in buying	0.00	7.00	4.70	1.42	2.02	145
10	Is animal friendly	0.00	7.00	4.66	1.90	3.60	145
11	Is fairly traded	0.00	7.00	4.58	1.65	2.72	146
12	Has a high protein content	0.00	7.00	4.55	1.68	2.82	143
8	Is familiar	0.00	7.00	4.49	1.63	2.65	146
2	Helps me monitor my mood (e.g., feel good, reduce stress)	0.00	7.00	4.20	1.50	2.26	146
14	Is what my peers also eat	0.00	7.00	3.84	1.72	2.97	143
13	Is non-GMO	0.00	7.00	3.84	1.75	3.05	144

Q43 - Which of the following statements best describes you?

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Which of the following statements best describes you?	1.00	3.00	1.79	0.65	0.42	146

#	Answer	%	Count
1	I am curious and often try new food products	33.56%	49
2	I am open to new food products if they are close to what I already know	53.42%	78
3	I rarely try new food products, especially if they have unfamiliar ingredients	13.01%	19
	Total	100%	146

Q45 - Evaluate the following statements:

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	I would be open to consuming products made with insect flour/protein	0.00	5.00	2.79	1.16	1.35	145
2	I would purchase insect-based snacks if I had the choice	0.00	5.00	2.71	1.22	1.50	144
3	I would be open to introducing insect-based snacks to my diet regularly	0.00	5.00	2.76	1.27	1.61	143
4	I would try insect-based snacks once	0.00	5.00	3.17	1.37	1.89	144

Q46 - What are some of the reasons you would not consume products with insect flour/protein?

#	Answer	%	Count
1	None, I am fully open to insect products	13.37%	25
2	Unfamiliar sensory appeal (texture, taste, smell, appearance)	31.02%	58
3	I have had them and did not like them	4.81%	9
4	Food Safety	33.69%	63
5	Lack of knowledge	17.11%	32
	Total	100%	187