# Acceptance of hybrid meat among consumers living in the Netherlands

*MSc Thesis, FQD Consumer group*

Student: Claudia Castellanelli

Reg. number: 1027955

Chair group: Food Quality and Design

Course code: FQD80436

Supervisor: Pieter Groen

Examiner: Bea Steenbekkers

## Abstract

The current need to decrease meat consumption has led to the development of alternatives to meat products. Considering the major sensory and sociological barriers towards the shift to fully plant-based diets, hybrid meat, consisting of a combination of meat and plant-based proteins, can be a viable option for consumers to decrease meat consumption on a larger scale. The current study aimed to gain insight into hybrid products' acceptance and perception of consumers living in the Netherlands, and how their judgment is affected by their meat attachment and food neophobia. In particular, the attractiveness evaluation of two hybrid patties, containing either mushroom or bell pepper as main ingredients, was investigated. To do this, an online questionnaire was distributed to Dutch or international consumers living in the Netherlands (n=106). Results showed that hybrid meat has a good chance of being accepted by consumers. When rating hybrid meat's intrinsic attributes, healthiness and sustainability scored the highest, with an evaluation of 3.7 and 3.5 out of 5, respectively. After the participants became more familiar with the topic their perception of its naturalness improved, with its rating rising from 2.9 to 3.3. The main motives that induced participants to consume it were environmental reasons, price, and health reasons. Taste and texture remain difficult attributes to equalise to regular meat in terms of liking and acceptance, a problem that is observed with most alternative meat options. Between food neophobia and meat attachment, the latter had the most influence on the willingness to consume hybrid meat products and the evaluation of hybrid patties' attractiveness with mushrooms as the main replacing ingredient. The level of food neophobia only had a negative influence on the mushroom patty's evaluation. From the results, it appears that hybrid meat can be a valid option for most consumers to reduce their meat intake. Good communication about the health and sustainability benefits, and the sensory similarities to meat, is pivotal for the acceptance of these products. This is particularly important considering the challenges in getting approval of their sensory characteristics, especially among highly meat-attached consumers.

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# 1. Introduction

The consumption of meat has become a controversial subject of debate. Health, environmental, and ethical-related issues are increasingly prominent in such discussions. On the one hand, moderate amounts of meat can efficiently provide essential nutrients such as zinc, heme-iron, and vitamin B12, which are often harder to absorb if consumed through non-animal sources (Xie et al., 2022). On the other hand, high intakes of meat, especially processed meat products, are linked with cardiovascular disease incidence and mortality (van den Brandt, 2019; Lichtenstein et al., 2021). The cause is related to high amounts of fats and cholesterol in meat, and the type of preservatives used in processed meat products (Al-Shaar et al., 2020).
Besides health-related reasons, one of the main concerns with meat production and consumption is its environmental implications. Meat has a larger climate and environmental footprint than plant-based ingredients and products. Its production is estimated to account for up to 16% of total global greenhouse gas emissions (Barthelmie, 2022). The livestock industry also has a major impact on water footprint, water pollution, and water scarcity (Gómez-Zavaglia et al., 2020). Furthermore, the current meat production rates entail intensive farming practices, which often lead to poor animal welfare and animal suffering (Hernández et al., 2022).

These downsides linked to meat consumption are among the main reasons why more and more consumers opt to eat less meat, or even eliminate it from their diet (Cheah et al., 2020). The production and consumption of meat should be strongly reduced in high-income countries, where by now it is in surplus, and a large range of plant-based products are available, unlike low-income countries where suitable plant-based options might not be available all year round (Parlasca & Qaim, 2022). However, despite the increasing awareness about the issues related to meat, its production and consumption have seen a substantial rise over the last century. This is traceable to a combination of factors such as urbanization, economic growth, and advancements in meat production technologies (Di Novi & Marenzi, 2022). In many European countries, this translates into meat consumption rates per capita that exceed recommended quantities, despite the plateauing that is occurring in more recent times (Dagevos, 2023). To comply with the EAT-Lancet Commission guidelines for a healthy and sustainable diet, Italy should for example decrease its red and processed meat consumption by 75% and 90%, respectively (Vitale et al., 2021). In the Netherlands, the current amount of meat eaten exceeds the dietary guidelines in the Dutch Wheel of Five (Richtlijnen Schijf van Fijf) by 1.5 times per person per year (Dagevos & Verbeke, 2022).

The current situation shows the need for alternatives to traditional meat products, that allow the transition to a more balanced dietary pattern with a decreased meat portion in it, possibly reaching a fully plant-based approach, while still satisfying consumers. Limiting meat consumption, however, is not a straightforward process, and numerous barriers are often encountered.

### 1.2 Reducing meat consumption: possible alternatives and barriers

Increasingly common alternatives to meat fall under the category of meat analogues, namely products made with plant or fungi proteins mimicking meat in its appearance and sensory characteristics (Bohrer, 2019; Lee et al., 2020). The term meat analogue is often used interchangeably with other definitions like meat alternatives, and meat

substitutes (Hoek et al., 2011). The same will be done in this paper to refer to products that serve as an alternative to full meat products while mimicking their sensory properties. One of the first widespread uses of meat analogues sees its origins around the 14th century in China, where recipes for mock lung sausage and eel using wheat gluten have been mentioned in a recipe collection encyclopedia (Aoyagi, & Shurtleff, 2014; Lee et al., 2020). Since then, meat analogues have greatly evolved, having sensory properties that increasingly imitate the eating experience of real meat. Even though they are growingly spreading on the market and being bought by consumers, there are still some barriers that might hold some consumers back from purchasing such products (Ortiz-Luis, 2011).

*Sensory properties*

The sensory characteristics of meat analogues are often not accepted as equally satisfying as consuming a real meat product (Kerslake, 2022). Product-related factors such as appearance, taste, flavour, texture, and general closeness to meat have been identified as aspects negatively influencing consumer acceptance of plant-based meat alternatives (Giacalone et al., 2022; Michel et al., 2021). The sensory quality of plant-based products is often perceived as inferior to the traditional meat-based version for several products (Michel et al., 2021). The importance of meat analogues' sensory properties for their acceptance can partly be explained by the fact that consumers have a clear reference when consuming such products, namely real meat (Elzerman et al., 2021). Mimicking the structure and taste of meat can be seen as a double-edged sword when it comes to consumer acceptance. While on one hand, it could facilitate the transition to such products, on the other it could exacerbate consumers' dissatisfaction. If a meat analogue closely resembles real meat in appearance but falls short in taste and texture, it can lead to disappointment as the product is perceived as too far from the real meat counterpart (Cordelle et al., 2022). Furthermore, the sensory enjoyment of animal products and the concerns related to taste have been identified as one of the main barriers to adopting vegan diets (Bryant, 2019).

*Meat attachment*

What withholds consumers from reducing meat consumption, however, does not only depend on the apparent lack of valid alternatives. Many reasons directly relate to individuals and their socio-cultural environment. Some influential factors in meat consumption are gender, age, and socioeconomic status (Stoll-Kleeman & Schmidt, 2016). The degree of meat attachment, namely "a positive bond towards the consumption of meat", of consumers also plays an important role in the acceptance of these products (Kim et al., 2024). Meat attachment is a relevant parameter when studying meat consumption and meat substitution, as it adds explanatory capacity when observing consumer willingness to reduce meat and consume more plant-based products (Graça et al., 2015). Consumers with low meat attachment (LMA) tend to perceive more positively sensory characteristics such as the aroma and taste of plant-based meat products compared to consumers with high meat attachment (HMA). Even

though HMA consumers are more willing to consume meat analogues than LMA consumers, both groups express preferences for products that closely resemble meat (Kim et al., 2024). The influence of meat attachment on the individuum does not only concern the sensorial experience of meat alternatives. Consumers with higher meat attachment are usually more reluctant to reduce meat consumption, to follow a more plant-based diet, and more in general to change their eating habits (Graça et al., 2015; Szczebyło et al., 2022). In the case of HMA consumers, common interventions such as exposing consumers to information about the impact of meat production and consumption might even be detrimental, as it could trigger meat-eating justifications and defence mechanisms (Graça et al., 2015). It is therefore important to not only focus on what consumers experience and prefer when consuming an alternative to meat products but also on the type of relationship that they have with meat itself, to ensure optimal product development and correct communication about novel products.

*Food neophobia*

The reluctance to adopt new food habits, such as consuming products that help reduce meat intake, can arise from reasons that extend beyond consumers' relationship with meat and the enjoyment deriving from it. Food neophobia is a characteristic that can influence individuals throughout their lifespan, starting from childhood (Karaağaç & Bellikci-Koyu, 2022). It can be defined as "a trait with genetic and environmental determinants that characterises the reluctance to eat unfamiliar foods" (Jaeger et al., 2021). Neophobia can touch upon different areas of food acceptance and consumption. It can lead to the avoidance of unfamiliar products, foods from unknown origins, novel options, and even healthy versions of already known foods, among others (Siddiqui et al., 2022). It can be influenced by many variables, like exposure to varied diets, socioeconomic characteristics such as income and education level, and partly from genetic factors (Rigal et al., 2006; Rabadán & Bernabéu, 2021). The consumption of alternatives to meat such as meat analogues can be negatively influenced by high levels of food neophobia (van Dijk et al., 2023; Hoek et al., 2011). Neophobic consumers are less willing to consume novel foods, even after tasting them. The willingness to buy meat substitutes is also negatively influenced by food neophobia (van Dijk, 2023). The presence of similarities with familiar foods can help overcome the effects of food neophobia on novel products' approval (Mattavelli & Rizzoli., 2022). Food products with familiar traits such as known ingredients, similar flavours, or appearance are helpful tools to increase the acceptance of new food products among neophobic consumers (Mattavelli & Rizzoli., 2022; Hwang & Ling, 2010).

The aforementioned barriers to a smooth transition towards plant-based meat products show the need for alternatives that allow this change by considering the sensorial experience of consumption, but also sociological aspects such as attachment to meat and previous experience with certain products and ingredients.

### 1.3 Hybrid meat: a possible bridge between meat and plant-based options

To bridge the need between reducing meat consumption and the craving for traditional meat products, a combination of animal and plant-based proteins could be a viable path to undertake. Hybrid meat could represent a valid option to fill this gap, as it combines a portion of meat with a plant-based protein source, therefore constituting a more sustainable product while maintaining comparable sensory characteristics to regular meat (Grasso & Goksen, 2023; Boukid et al. 2024).

The term hybrid meat defines products in which the meat portion is partly substituted by proteins from more sustainable sources which are usually legumes, vegetables, and oilseeds (van Dijk et al., 2023; Neville et al., 2017). The protein substitution can range from 25% to 50%, and the ingredients are chosen for their positive connotations such as healthiness, lower environmental impact, and for being an aid for meat reduction purposes, and not as simple extenders for either economical or technological reasons (Grasso & Jaworska, 2020; Grasso & Gökşen, 2022; Grasso, 2020). The positive connotation of the ingredients is of great relevance, as it constitutes one of the main distinctions between hybrid meat and other processed meat products present on the market. The latter ones, in fact, also do not consist of meat only. According to UK food regulations, products such as sausage or burgers need to contain a minimum amount of 42% and 67% of meat, respectively, to be called as such (King's Printer of Acts of Parliament, 2014). The other ingredients that are added often act as extenders, fillers, or binders, which allows producers to reduce costs and achieve desirable product properties through water-binding ability and emulsification properties (Grasso, 2020). In the case of hybrid meat, the choice of ingredients mainly depends on their attractiveness, health perception, as well as their role in improving the flavour and juiciness of the product (Grasso, 2020). Some commonly used ingredients include peas, lentils, chickpeas, beans, and hempseed. Other terms used to describe hybrid meat are blended meat products, flexitarian meat, mixed meat or hybrid vegetable-meat products (Sogari et al., 2021; Alam et al., 2024; Sogari et al. 2022). Research is also being conducted on animal protein sources that, in Western countries, are considered more innovative, such as insects (Grasso & Gökşen, 2022). Over the last decade, a number of products have been launched and marketed highlighting their hybrid trait and the benefits deriving from it. Over the years, however, the products that are still available have reduced (Grasso, 2020). Some products that are still available in Europe are Tesco's Meat and Vegetable beef or chicken meatballs, and the Meat & Vegetables Beef Mince (Tesco, 2024). In the Netherlands, some items that do not use the word hybrid but could be associated with this concept are Stegeman's Chorizo, a blend of chorizo's meat and up to 20% vegetables like red pepper or Iglo's fish sticks combined with spinach (Albert Heijn, 2024).

## 1.4 Literature review

The concept of hybrid meat has aroused increasing interest over the past few years. At the moment, it is possible to find studies that focus on the technological aspects of such products, as well as possible acceptance by consumers, considering different factors such as sensory, health, and sustainability perception.

### *1.4.1 Sensory characteristics: experiences, and expectations*

From studies where hybrid meat products were made and served to participants, it emerges that hybrid meat is not the preferred option by default, also when compared to fully plant-based products. Factors extrinsic to the product can also impact liking. Providing information about the product can be influential, as found by Caputo et al. (2023), who performed a combined sensory and discrete choice experiment and noted that the hybrid option was preferred in the blind condition, while, when informed, consumers would prefer the vegan burger using animal-like proteins instead. However, according to Neville et al. (2017), who served hybrid burgers and sausages to consumers between 18 and 60 years old, hybrid meat is generally well-liked and preferred over meat-free products. The format of the product, like patty or sausage, was seen to have an impact on acceptability (Neville et al., 2017).

Some online surveys have been conducted, inquiring about the acceptance of hybrid products. According to Lang (2020), who reached 602 US consumers through an online survey, the main reasons for consumers to eat hybrid meat would be related to health, price, and taste benefits. Sensory characteristics of hybrid meat play a considerable role in its acceptance, as it was also confirmed by Banovic et al. (2022). Through an online survey with almost 3000 respondents, they concluded that hybrid meat can be a useful means to a plant-based transition. Regular meat eaters do have a positive sensory perception of hybrid meat products, along with high attitudes and intentions to buy. The sensory characteristics were found to be a mediator of the effects of different beliefs about plant-based products and ingredients on the attitude and intention to buy hybrid meat (Banovic et al., 2022).

Numerous studies focussed on the ideal composition of hybrid products according to consumers. Often, this was done via co-creation groups. As found by Verduzco Ibarra (2023), products that closely resembled the taste, texture, and appearance of meat were the preferred option for most participants. When creating a hybrid burger from scratch in a co-creation study conducted by Gerlag (2023), beef and pork were the most popular choices among the participants. Other ingredients, such as mushrooms and onion, were the ones chosen the most because of the familiarity of participants with the foods, and the fact that they already associated those ingredients with meat substitutes. Pea and cauliflower were chosen because they were perceived as good protein sources, while spinach because of the presence of vitamins and minerals (Gerlag, 2023). Some ingredients, however, determined an interesting distinction between consumers who preferred to have a visible addition of vegetables in the product or not. Carrots, for example, were mostly chosen by the participants who liked

to have a reminder that they were adding vegetables and thus the product did not contain only meat (Gerlag, 2023). Grasso et al. (2022), in a study that included a co-creation stage and reached more than 2000 participants in the UK, Spain, and Denmark, confirmed the preference for beef, while the second most chosen meat was chicken. The other ingredients that were the most preferred were onion, herbs, spices, and mushrooms, along with pulses. A minimum of 50% of meat in the product was desirable to most participants (Grasso et al., 2022).

### *1.4.2 Attitudes and perceptions of hybrid meat*

The acceptance of the idea of blending meat with plant-based ingredients has been further investigated focusing on the thoughts of consumers about this concept, and how some individual characteristics could influence them.

When investigating the factors influencing college students on their intention to buy hybrid burgers, Sogari et al. (2021) found that attitude toward innovation plays a crucial role. Furthermore, an inclination to try new food products when grocery shopping or eating at restaurants, as well as a positive perception of sustainable diets were seen as factors with a positive impact on the willingness to purchase the blended burgers served at the canteen (Sogari et al., 2021). Banovic et al. (2022) confirm the importance of environmental self-identity as a positive influence on attitudes towards hybrid meat, along with health consciousness. According to Smart and Pontes (2023), the sustainability perception of hybrid meat depends on the indulgence or restraint of consumers. While consumers with a restrained mindset would perceive the hybrid product as more environmentally sustainable with increasing plant-based protein ratios, the same was not observed with an indulgent mindset, which leads to increased attention to the hedonic attributes of the product instead (Smart & Pontes, 2023).

Grasso and Jaworska (2020) explored consumers' attitudes toward hybrid meat by performing language analysis on 201 online reviews. Sensory quality was once again one of the main aspects considered. In positive reviews, taste dimensions were prominent, praising its deliciousness, spiciness, and tastiness. Other positive remarks mentioned hybrid meat's healthiness and easiness to prepare. In negative reviews, taste and texture were mentioned and defined as poor, sloppy texture, and bland taste.

### *1.4.3 Food neophobia and meat attachment effects on hybrid meat's acceptance*

Some research has also been specifically conducted on the role of food neophobia and meat attachment on the acceptance of hybrid meat, often investigating both dimensions within the same study. Van Dijk et al. (2023) investigated their effect on willingness to buy hybrid meat, along with meat substitutes and cultured meat. The effects of food neophobia and meat attachment on the willingness to buy hybrid meat were rather neutral, which could make it a good candidate for the adoption of products with reduced meat content (van Dijk et al., 2023). Similar results were observed by Salgankoar & Nolden (2024), who focused on the drivers for the selection of beef, hybrid, or plant-based hotdogs. Person-related characteristics, including food neophobia and meat attachment, did not significantly influence the selection of hybrid hotdogs. Understanding the underlying mechanisms of food neophobia and its

influence on hybrid meat acceptance is however still important, as it is not always neutral or positive. According to Asioli et al. (2022), who investigated the information provided about hybrid meat and its effect on willingness to buy among European consumers, food neophobia can negatively affect hybrid meat's acceptance, also depending on consumers' familiarity with the world of meat alternatives. The same negative effect was observed for meat attachment, as participants having lower attachment would be the ones preferring hybrid products (Asioli et al., 2022). Profeta et al. (2021), who reached 500 German consumers through an online survey to gain insight into their attitudes towards hybrid meat, observed that both food neophobia and meat attachment negatively impact the preference for hybrid products.

## 1.5 Knowledge gap and problem statement

Current research on hybrid meat has widely covered its sensory acceptance, focusing on tangible aspects such as preferred product format and ideal sensory features. Aspects affecting consumers' perception of hybrid meat such as their sustainability knowledge, attitudes toward innovation, and health consciousness have also been investigated. Furthermore, some research has been conducted on the impact that food neophobia and meat attachment have on the general acceptance of hybrid products. However, more in-depth research on consumers' attitudes towards the concept of hybrid meat is needed to understand the drivers of its consumption. One of the limitations of current research is that the investigations on the acceptance of hybrid meat often do not specifically consider the perception of intrinsic characteristics of these products, such as their healthiness, sustainability, and appearance. The same can be said for the role of food neophobia and meat attachment, which are often related to the preference between regular meat and hybrid products, or the willingness to buy hybrid meat. The research on the influence of these two factors on specific product attributes such as the attractiveness perception of hybrid meat is limited.

More insights on these topics would help further understand the factors influencing hybrid meat's acceptability, which is not fully understood yet (Grasso, 2020). This study's objective is to gain insight into the perception of hybrid meat among consumers living in the Netherlands. Besides general perception, special focus will be placed on the evaluation of two hybrid patties containing mushrooms or bell pepper as main plant-based ingredients, in particular their attractiveness and appearance. Furthermore, the influence of food neophobia and meat attachment on the liking and evaluation of these two hybrid prototypes will be investigated. A better understanding of the factors influencing hybrid products' acceptance could help provide tailored information to consumers, highlighting their benefits and the aspects that would be most appealing to them. This would ease the transition to a reduction of meat consumption and the shift to more plant-based diets.

### *1.5.1 Research questions*

To reach the aims of this study, the following research questions were developed:

***Main question***

How do consumers living in the Netherlands perceive the concept of hybrid meat products and their appearance?

***Sub questions***

How does their perception relate to factors such as food neophobia and meat attachment?

What are the differences in acceptance between hybrid patties containing either mushrooms or bell peppers?

## 2. Materials and Methods

To address the research questions and pursue the aim of this study, an online survey was developed and distributed to consumers throughout the Netherlands. This research method was chosen because of the possibility reach a large number of participants, and the convenience that online surveys offer to researchers and participants. This research method allows data gathering without the need of contact between the researcher and the participants, and respondents can complete them at their own time and when it is convenient to them (Nwakaego, 2021). Furthermore, surveys can be quickly created and distributed (Andrade, 2020). These benefits were considered as ideal for the purpose of this study, as it could provide a large of respondents and a rather extensive set of questions. The questions were formulated after extensive literature research, to have a good overview of the topics that should be covered and of the best question format to use in order to achieve clear and exhaustive results.

### 2.1 Survey procedure

#### *2.1.1 Sampling criteria and survey distribution*

For this study, the participants had to follow two criteria: they had to consume meat at least occasionally, meaning that they did not avoid it completely and did not identify as vegan or vegetarian, and currently live in the Netherlands. If the options ‘vegan’ or ‘vegetarian’ were selected as dietary restrictions, the questionnaire would automatically close, while the participants who filled in the questionnaire but did not live in the Netherlands were manually removed from the sample. Furthermore, only the questionnaires which were fully answered were considered. These exclusion criteria led to a dataset of 106 respondents out of 153 people reached.

The survey was distributed through a combination of different procedures. First, convenience and snowball sampling were used. Through the researchers’ personal network, the first participants were recruited, and they were asked to spread the questionnaire. Subsequently, to reach a higher number of participants, a QR code to access the questionnaire was generated and printed on flyers made using the online graphic design tool Canva. The flyers were then hung in four libraries located in Wageningen, Utrecht, and Arnhem. Additionally, flyers were handed out personally to travelers transiting in the Amersfoort, Arnhem, and Utrecht central train stations. Besides reaching a bigger sample, the objective of this distribution format was to diversify the provenance of the participants, and not focus on the Wageningen area.

#### *2.1.2 Survey development and structure*

The survey for this study was made using Qualtrics, an online experience management platform offering an online survey tool service.

The questions were first developed in English, and subsequently translated to Dutch with the aid of two online translation services, namely Google Translate and DeepL, to increase wording accuracy. The Dutch versions of the Meat Attachment Questionnaire, Meat Reduction questions, and the Food Neophobia Questionnaire

were directly used from a study by van Dijk et al. (2023). In their work, the questions were translated into Dutch by the researchers and checked during a pilot study. For this questionnaire, two pilot studies were conducted, both in English and in Dutch, to ensure that the questions were clear and understandable.

The questionnaire (see Appendix I for the full questionnaire) started with a brief introduction explaining the aim of the study, mentioning an approximate duration of 15 minutes and that the target group would be omnivores or flexitarians, and vegetarian or vegan participants would be excluded. A consent form (see Appendix II) with more detailed information about the treatment of data was provided, and participants were asked to agree to it to continue with the survey. In terms of content, the questionnaire started by investigating the consumption frequency, meat attachment, willingness to reduce meat consumption, and food neophobia levels of the participants. The participant's meat attachment was measured through a Meat Attachment Questionnaire (MAQ), created by Graça et al. (2015). The MAQ consists of 16 statements touching upon four dimensions of meat consumption, namely hedonism, affinity, entitlement, and dependence (Graça et al., 2015). The 16 items are measured on a 5-point Likert scale ranging from "Strongly disagree" to "Strongly agree". The willingness to reduce meat consumption of the participants was investigated through a set of four statements referring to the inclination to make changes in their meat intake during the coming weeks, such as reducing it drastically or avoiding it altogether to consume plant-based products instead. The statements were taken from the previously mentioned study by van Dijk et al. (2023), who based their formulation on items in a study by Malek et al. (2019) who specifically investigated the willingness to change protein consumption of Australian consumers. Following van Dijk's method, the statements were rated on a five-point Likert scale from "Not willing at all" to "Extremely willing". Finally, the participants' degree of food neophobia was measured through the Food Neophobia Scale (FNS), developed by Pliner and Hobden (1992). The FNS contains 10 items about respondents' reluctance to try new or unfamiliar foods, which are rated on a Likert scale going from 1 ("Strongly disagree") to 7 ("Strongly agree"). Afterwards, a definition of hybrid meat was given. The definition was formulated based on the information available in literature about hybrid products, mainly focusing on the research by Grasso & Jaworska (2020), Grasso & Goksen (2022), and Grasso (2020). Hybrid meat was defined as follows:

"Hybrid meat refers to products containing plant-based proteins which replace 25% to 50% of the original animal protein content, reducing meat usage. Possible ingredients that can be used and have been objects of research include peas, lentils, chickpeas, beans, and hempseed. The ingredients can be added as fresh vegetables and legumes, or as protein isolates. Some product examples that are currently available on the market are hybrid burgers meatballs, sausages, and chorizo".

Participants were then asked whether they were familiar with this product concept. If the answer was yes, an additional question about the consumption frequency was asked. All participants had to evaluate on a 5-point Likert scale the perceived naturalness, healthiness, and sustainability of hybrid meat. This question was asked at the beginning and at the end of the questionnaire, to account for eventual changes

due to increased acquaintance with the topic. The four items were chosen based on available literature about the perception of hybrid meat among consumers and about the importance of these product characteristics for consumers, to have some comparison terms although in different settings (Profeta et al., 2021; Grasso et al., 2022; Román et al., 2017). A similar approach was applied when selecting the items for the subsequent questions, which focused on the participants' reasons for or against consuming hybrid meat. Price, taste, texture, preparation convenience, health, and environmental effects are among the main motivators and barriers related to the decrease in meat consumption, and the consumption of hybrid products (Lang, 2020; Grasso & Jaworska, 2020; Elzerman et al., 2013). Participants were then asked to compare the healthiness, sustainability, naturalness, tastiness, and attractiveness of hybrid meat, regular meat, and meat substitutes.
The third section of the questionnaire consisted of the evaluation of the attractiveness and attributes of two hybrid meat patties. The patties were made by combining 50% plant-based ingredients and 50% beef and pork mixture. To make a realistic product, which followed the purposes of hybrid meat by achieving a reduced meat content while still offering a nutritious item, the ingredients were calibrated also based on the protein content that a 100% beef and pork patty would offer. The only ingredients which differed between the two patties options were the mushroom and the bell pepper. These ingredients were chosen because of their different sensory profile, to make a clear distinction between a familiar combination, such as meat and mushroom, and a less common one with bell peppers, which would also be more visible in the picture. The two ingredients were chosen based on previous published research and previous theses by Wageningen University's students. While the use of mushrooms in hybrid meat products is quite common in research, the use of bell pepper is less widespread and usually adopted for technological reasons rather than for studies about consumer acceptance (Grasso et al., 2024; Cocan et al., 2022; Sogari et al., 2022; Grasso & Goksen, 2022). Both ingredients were mentioned by the participants of a thesis research by Gerlag (2023). In his co-creation study, mushrooms were the most selected ingredients, while bell peppers were mentioned by four out of the 29 participants. However, no particular explanation for the choice of this ingredient was given (Gerlag, 2023).

For both patties, a picture of the whole product and their cross sections were provided (See Figure 1). The list of ingredients was also given. The exact quantities and ratios were however omitted to set the focus on the appearance of the products and avoid any biases related to the recipes and ingredient use. Participants had to evaluate their attractiveness on a scale from 1 ("Extremely unattractive") to 5 ("Extremely attractive"). The participants then had to evaluate a series of attributes that could be seen, like vegetable visibility, or deduced, like the expected vegetable flavour intensity, by looking at the pictures on a 7-point Likert scale, from "Strongly like" to "Strongly dislike". The attributes were chosen based on the outcomes of a consumer-generated lexicon while describing hybrid meat samples in a study by Neville et al. (2017), which focuses on the co-creation of hybrid burgers and sausage analogues. Finally,

consumers were asked to choose which burger they were most willing to try and to provide a short explanation in an open-ended question.
The last section of the questionnaire focused on the sociodemographic traits of the participants.

*Figure 1 Pictures of the hybrid patties provided to participants in the survey. The left one depicts the bell pepper patty and the right one the mushroom patty.*

## 2.2 Data analysis

### *2.2.1 General perception and familiarity with hybrid meat*

The chapter about the acceptance of hybrid meat and its perception was mostly qualitative. The Likert scales and bipolar scales were converted to numerical values from 1 to 5 or 1 to 7, depending on the scale, and used to calculate means or kept as qualitative data to calculate the percentage of participants choosing one of the options. Two-tailed paired t-tests were used to compare mean scores when two means were analysed.

### *2.2.2 Meat attachment and food neophobia's effects on the acceptance of hybrid meat*

The statistical analyses to test for the influence that food neophobia and meat attachment level had on the evaluation and acceptance of hybrid products were performed using the program Rstudio (4.4.0).
For the MAQ and FNS, Cronbach's alpha was calculated to test for internal reliability. Before calculating the scores of the MAQ and FNS, the negatively worded statements were reversed, following Pliner and Hobden (1992) and Graça et al (2015). The MAQ and FNS scores were used as independent variables in all statistical tests. Depending

on the type of dependent variables, multiple statistical analyses were used. Similarly to Verbeke (2015), logistic regression was used to test how MAQ and FNS scores influenced the willingness to consume hybrid meat. The dependent variable (no/yes) was converted to numerical values (0/1).
Linear regression was used to test the influence of these two dimensions on the liking of the mushroom and bell pepper patty, which were rated in terms of attractiveness from 1 to 5, following van Dijk et al. (2023), who linked FNS and MAQ scores to the willingness to buy hybrid meat (rated on a 1 to 5 Likert scale). The participants were then divided into low, medium, and high MA and FN groups. To create such categories, the scores of the participants were broken down in tertiles, as previously done by Jaeger et al. (2017). Finally, one-way ANOVA was used to see how the mean evaluation scores of the two patties differed among the groups, as there was only one independent variable with multiple groups (FNS and MAQ groups) and one dependent variable (liking of the patties).

# 3. Results and Discussion

## 3.1 Sample description

Table 1 depicts an overview of the sociodemographic characteristics of the respondents (n=106). The majority were female (64.2%, n=68), and the age ranged from 18 to 68 years old, with a mean of 30.1 years. Most participants were between 18 and 24 (52.8%) and 25 and 34 (21.7%).

When asked about their diet, 57.7% (n=61) identified as omnivores and 42.5% as flexitarian. Most participants consumed meat at least twice a week (59.8%), while 15.1% consumed it two to three times a month or less. The majority of the respondents were slightly to not at all familiar with the concept of hybrid meat (64.2%), around 27% were moderately familiar, and 8.5% were at least very familiar with it.

*Table 1 Sociodemographic of the participants.*

| Attribute | Characteristic | n | % |
|---|---|---|---|
| Gender | Male | 38 | 35.8 |
| | Female | 68 | 64.2 |
| Age | 18-24 | 56 | 52.8 |
| | 25-34 | 23 | 21.7 |
| | 35-44 | 9 | 8.5 |
| | 45-54 | 7 | 6.6 |
| | 55-64 | 9 | 8.5 |
| | >65 | 2 | 1.9 |
| Diet | Omnivore | 61 | 57.5 |
| | Flexitarian | 45 | 42.5 |
| Working situation | Student | 51 | 48.1 |
| | Unemployed | 1 | 0.9 |
| | Working part-time | 11 | 10.4 |
| | Working full-time | 37 | 34.9 |
| | Self-employed/freelancer | 3 | 2.8 |
| | Retired | 1 | 0.9 |
| | Other | 2 | 1.9 |
| Meat consumption frequency | Less than once a month | 6 | 5.7 |
| | 2-3 times a month | 10 | 9.4 |
| | Once per week | 16 | 15.1 |
| | 2-3 times per week | 32 | 30.2 |
| | 4-5 times per week | 14 | 13.2 |
| | 6-7 times per week | 19 | 17.9 |

| | | | |
|---|---|---|---|
| | More than 7 times per week | 9 | 8.5 |
| Familiarity with hybrid meat | Not familiar at all | 41 | 38.7 |
| | Slightly familiar | 27 | 25.5 |
| | Moderately familiar | 29 | 27.4 |
| | Very familiar | 6 | 5.7 |
| | Extremely familiar | 3 | 2.8 |

### 3.2 Perception of hybrid meat

The following section gives an overview of the participants' general perception of hybrid meat and its main attributes, including the comparison with other products, and how it is perceived in relation to some daily-life situations.

*3.2.1 Perception of hybrid meat's healthiness, naturalness, and sustainability*
The participants were asked rate some attributes of hybrid meat, namely healthiness, naturalness, and sustainability, while solely focusing on hybrid meat. The same question was asked twice, once right after providing the definition of hybrid meat, and the second time at the end of the survey. The purpose was to gain insight before and after the participants were introduced to specific aspects of hybrid meat, and some concrete examples accompanied by pictures, looking for possible differences. Figure 2 summarizes the results from both times the question was asked.

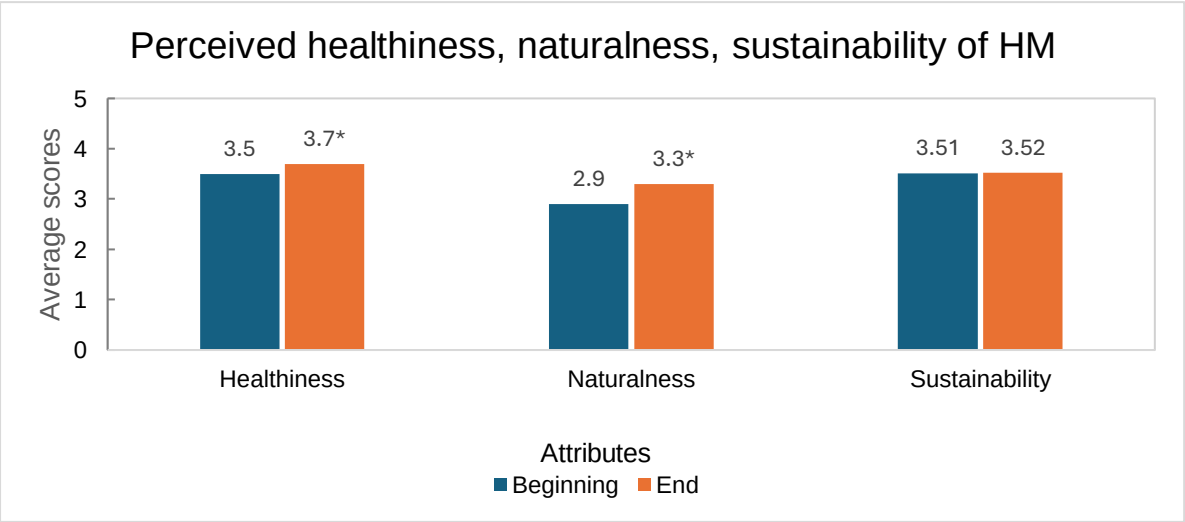


*Figure 2 Participants' (n=106) perception of hybrid meat's (HM) healthiness, naturalness, and sustainability. For each attribute the mean scores obtained from a 1-5 Likert ('Very unhealthy'-'Very healthy') scale are given. The evaluation was asked at the beginning of the questionnaire ('Beginning') and at the end ('End'). The means which significantly increased are marked with an asteric (*).*

For all parameters, there was an increase in the rating of the attributes the second time the question was asked. For sustainability, there was no increase in rating scores ($p=0.78$). For healthiness, the increase was significant ($p<0.01$) and for naturalness strongly significant ($p<0.001$). The percentage of participants rating hybrid meat as

‘healthy’ and ‘sustainable’ went from 50% to 65.1% and from 52.8% to 60.4%, respectively. Interestingly, a remarkable difference occurred when rating the naturalness of hybrid meat. While at first the attributes being chosen the most were ‘artificial’ (30.2%) and ‘neither artificial nor natural’ (31.1%), after diving deeper into the survey, and therefore the topic, hybrid meat was rated as ‘natural’ by 45.3% of the participants.

What particularly stands out is the little influence that perceived naturalness had on healthiness evaluation. In the present study, even though at the beginning of the questionnaire hybrid products were mostly considered ‘artificial’ and ‘neither artificial nor natural’, the opinions about healthiness and sustainability were positive. This is often not the case, as consumers tend to positively associate the naturalness of food products with their healthiness, even though from a scientific perspective this is not necessarily the case (Plasek et al., 2020). This outcome could be explained by the personal characteristics of the participants, such as their knowledge about nutrition and the food industry. However, this aspect was not investigated enough to make clear assumptions. Something that could have improved the healthiness perception despite the low naturalness scores is the presence of vegetables in the product, which was mentioned in the definition provided to the participants. Besides the general awareness about the healthiness of vegetables, their addition to hybrid products can improve their healthiness perception (Aviles et al., 2024). The presence of vegetables in hybrid chicken patties in a study by Aviles et al., 2024, directly led to the categorization of such products as healthy in a group of participants. Furthermore, in a co-creation study by Barone et al. (2021), vegetables were amongst the most important ingredients mentioned to improve the healthiness of meat products.

These results also show the importance of information for the evaluation of food products. For every attribute, their evaluations improved at the end of the survey, when the topic was further introduced, and the participants became more familiar with the product. This highlights the importance of information and familiarity for the evaluation of food products. The type of information provided about foods has indeed a strong influence on their evaluation and plays an important role in their acceptance (Asioli et al., 2022; de Boer & Aiking, 2017). In this study, while proceeding with the survey, consumers were faced with more specific questions about hybrid meat, and at some point pictures and two recipes were given, which might have clarified some doubts about these products and how they are made.

### *3.2.2 Comparison of hybrid, regular meat, and meat substitutes*

In Figure 3, the results of the comparison of some intrinsic attributes of hybrid meat, regular meat, and meat substitutes are shown.

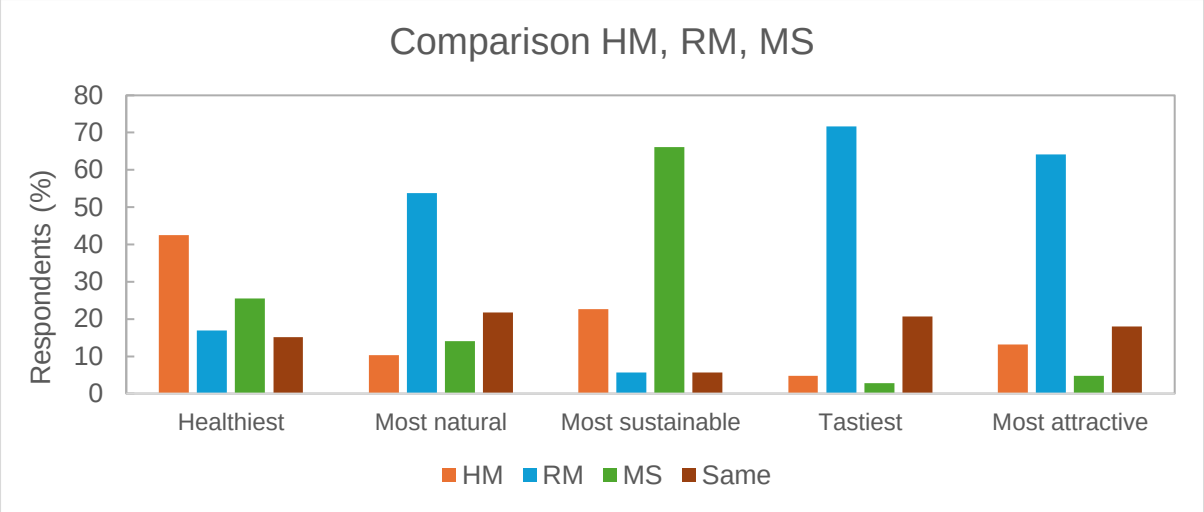


*Figure 3 Participants' (n=106) perceptions of the healthiness, naturalness, sustainability, tastiness, and attractiveness of hybrid meat (HM), regular meat (RM), and meat substitutes (MS). Participants were asked to compare these products and select the one they believed best represented each characteristic. "Same" indicates when all products were perceived as equally representative of the characteristic.*

Regular meat was the product that was considered the most natural, the most attractive, and the tastiest compared to the other options. In terms of sustainability, meat substitutes were seen as the best alternative out of the three. Hybrid meat was considered the healthiest option.

When comparing the healthiness of hybrid meat with other products, the outcomes available in the literature generally do not fully support the results of this study. According to Profeta et al. (2021), regular meat is considered the healthiest product, chosen by 45.3% of the participants (n=501), while 40.3% preferred hybrid meat and 14.4% chose neither. A study conducted by Salgaonkar and Nolden (2024) investigated, among others, the health perception of hybrid, plant-based, and beef hotdogs. In this comparison, 34.5% of participants considered plant-based hotdogs the healthiest, 31.9% chose conventional meat, and 33.6% preferred the hybrid product. In the present study, there was a considerable preference for hybrid meat (42.5%) compared to meat substitutes (25.5%) and regular meat (17%), while 15% of the participants perceived all products as equally healthy. This outcome could be explained by several factors concerning the perception of these products. Firstly, consumers are becoming more aware of the health implications of their food intake, and more specifically the health risks associated with meat consumption (Strijbos et al., 2016; Teixeira & Rodrigues, 2021). However, most consumers perceive plant-based meat as less healthy than regular meat products, as they view it as less natural and do not always trust these novel solutions (Hartmann et al., 2022). This may explain why hybrid meat was preferred the most, even more than meat substitutes that don't contain any meat at all. This is reinforced by the fact that consumers generally consider hybrid meat a healthy product (Grasso et al., 2022). The perception could have also been partly influenced by some factors relating to the information about hybrid meat provided in the questionnaire. Some expressions such as 'reducing meat usage' and 'ingredients can be added as *fresh* vegetables and legumes', and the layout of the

questionnaire flyer and poster which depicted a burger with fresh vegetables in the background (See Appendix III) could have let transpire a positive connotation of hybrid meat, possibly influencing the health perception of the product. Indeed, as previously mentioned, these two characteristics can positively affect the health perception of food products (Texeira & Rodrigues, 2021; Aviles et al., 2024).

This shift of preference from regular meat to other products was however not observed for taste, attractiveness, and naturalness. In terms of taste, the difference is notable, with 71.7% choosing regular meat, 4.7% preferring hybrid meat, and 2.8% opting for meat substitutes, while 20.8% found all three options to be equally tasty. The evaluation based on attractiveness showed similar results, with a slightly less striking difference between choices. Regular meat was considered the most attractive by 64.2% of the participants, hybrid meat by 13.2%, and meat substitutes by 4.7%, while 17.9% of the sample thought these products were equally attractive. The previously mentioned study by Profeta et al. (2021) confirms that regular meat is perceived as tastier than hybrid meat. In that case, too, the difference was quite significant, as 62.4% chose regular meat and only 16.8% saw hybrid meat as the tastiest option. The taste and attractiveness of animal products are known to be some of the major barriers when it comes to decreasing meat consumption (Giacalone et al., 2022; Bryant, 2019). This is especially true for plant-based meat alternatives. The reduced sensory quality of such products is one of the main barriers to their adoption (Bryant, 2019). The widespread negative view on meat substitutes' sensory attributes could explain the low results in terms of taste and attractiveness in this survey.

The perceived naturalness gave an interesting insight into participants' opinion on hybrid meat, as it was chosen as the most natural by 10.4% of the participants, versus regular meat and meat substitutes which were chosen by 53.8% and 14.2%, respectively. When compared to real meat, meat substitutes are usually seen as less natural, also due to the presence of several, complex ingredients, including additives (Weinrich, 2018). When comparing meat substitutes to hybrid and regular meat in a study by van Dijk et al. (2023), meat substitutes scored the second lowest in terms of naturalness, followed only by cultured meat. Unlike the current study, however, hybrid meat was still considered more natural than meat substitutes. A possible reason could be the definition provided by the authors, which does not mention protein isolates, in contrast to the one provided to the participants of this study. This term could have evoked food handling and processing, or maybe chemical changes, which are known to impact the perception of the naturalness of food products (Hartmann et al., 2022; Román et al, 2017).

In terms of sustainability, the participants were well aware of the environmental implications of meat, as it was chosen as the most sustainable option by only 5.7% of them. Hybrid meat was seen as notably more sustainable and was picked by 22.6% of the participants. However, meat substitutes scored higher and were considered the most sustainable option by 66% of the participants. Hybrid meat seems to be well accepted as a more sustainable option than regular meat, as confirmed by Profeta et al. (2021), where the hybrid option was considered as better for the environment by 53.3% of the participants, while only 22.6% chose regular meat and 24.2% neither. Similarly, the participants of the previously mentioned study by van Dijk et al. (2023)

recognized regular meat as the least environmentally friendly option, and hybrid meat, as well as meat substitutes, as more sustainable products. This outcome coincides with the growing interest and concern of consumers towards the environmental impact of food products (Petrescu et al., 2019).

### *3.2.3 Reasons to consume hybrid meat or not*

As shown in Table 2, when asked whether participants consume or would be willing to consume hybrid meat, most participants (n=65) did not consume it.

*Table 2 Previous experience with hybrid meat (HM) of the participants (n=106), and the willingness to consume hybrid meat by the ones who had never consumed it. For each answer (Yes/No) the percentage and total number of consumers selecting it is given.*

| Characteristic | Answer | n | % |
|---|---|---|---|
| Previous experience with HM | Yes | 41 | 38.7 |
| | No | 65 | 61.3 |
| No experience (n=65) – Willingness to consume | Yes | 52 | 78.5 |
| | No | 14 | 21.5 |

Among the participants who did not consume hybrid meat, most of them (n=52) were open to this possibility. Figures 4 and 5 show the most commonly selected reasons for doing it or not, based on the options presented in the survey.

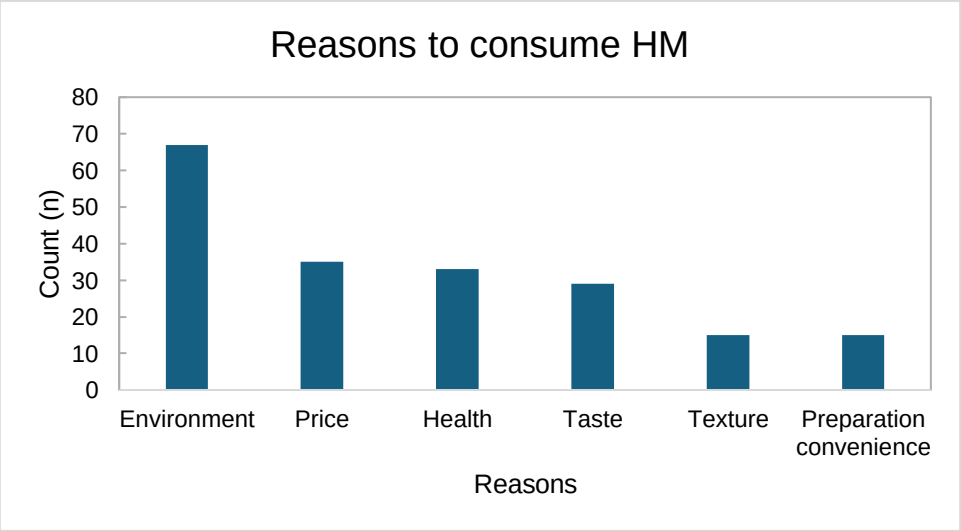


*Figure 4 Participants' (n=92) motivations to consume hybrid meat (HM). All participants who consumed or would be willing to consume hybrid meat are included. The items have been displayed in order of choice frequency.*

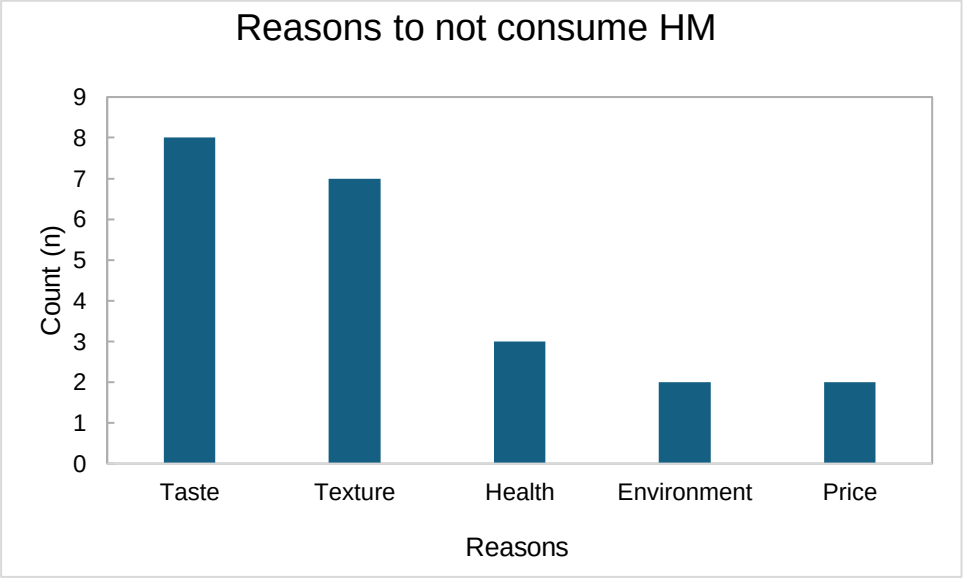


*Figure 5 Participants' (n=14) motivations to not consume hybrid meat (HM). All participants who did not consume and would not be willing to consume hybrid meat are included. The items have been displayed in order of choice frequency.*

The attributes that acted as motivators to eat hybrid meat were among the main barriers to not consuming them. Environment, health, and price were the most convincing reasons for participants who would include hybrid meat in their diet. Taste, texture, and preparation convenience were the least mentioned ones. Taste and texture, followed by health, were the most relevant problems encountered by the participants who were not interested in consuming hybrid products at all.

Most results are in line with what is often found in literature. Environmental reasons are often strong motivators across different countries to reduce meat consumption, as observed by Ford et al., (2024). In an online survey (n=1777), they investigated the motivations and barriers to reducing meat consumption and adopting alternatives among Australian, British, and Chinese consumers. Environmental benefits were among the top three motives to reduce meat consumption in every country. The health implications of excessive meat consumption are an issue that is increasingly well known among consumers (Teixeira & Rodrigues, 2021). When talking about hybrid meat, consumers were shown to be aware of the health benefits it can have, especially compared to meat, as mentioned in Chapter 3.2.1. Price is an important feature when selecting food products (Font-i-Furnols & Guerrero, 2014). In the context of hybrid meat this can be of even higher relevance, considering that ethical concerns often lead to meat avoidance, while personal concerns such as health and price are common drivers of meat reduction (Malek & Umberger, 2021). This coincides with the key feature of hybrid meat, namely a reduction in meat consumption rather than full elimination.

The main barriers to its consumption reflect the results of the comparison between hybrid meat and other products in Chapter 3.2.2, where hybrid meat, along with meat

substitutes, was considered far less tasty and attractive than regular meat. While on one hand this is understandable because of the high relevance and appreciation of meat sensory attributes, on the other hand, these results do not strengthen the theory that hybrid meat can be a valid alternative to meat as it can still satisfy consumers with its very similar sensory properties to meat (Grasso, Rondoni et al., 2022). Health being the third most mentioned barrier also raises some doubts on the perception of the role of hybrid meat. This outcome also lies in contrast with what emerged in Chapters 3.2.1 and 3.2.2, where hybrid meat seemed to be perceived as healthy on its own and when compared to other products. This contrast, however, is explained by the fact that while the positive health perception outcomes emerged when testing the whole sample (n=106), the question 'why would you *not* consume hybrid meat?' was only asked to the participants who did not consume it yet (n=65) and at the same time would also not be willing to consume it (n=14). This led to a dataset including a higher concentration of participants that do not share the same ideas as the others. Once contextualised, it is reasonable to think that hybrid meat is not always perceived as healthy, which was also observed by other authors, such as Profeta et al. (2020) who, as mentioned in Chapter 3.2.2, observed that hybrid meat was considered less healthy than regular meat. These results underline the need for proper communication and education about hybrid meat products, to make sure they are acknowledged by consumers as a valid and tasty alternative to meat because of their composition.

### *3.2.4 Willingness to consume hybrid meat over regular meat*

When asked if and how often participants would be willing to consume hybrid instead of regular meat products, most participants were open to the possibility of consuming hybrid products instead of regular meat. Both questions were asked to all participants, and the results showed that a small number of participants was not willing to consume hybrid meat at all. When asked whether they would be willing to consume it, 14 participants replied that they would not, while only 6 of them confirmed this by selecting 'Never' when asked at which rate they would substitute regular meat with hybrid options. The different framing of the second question might have led to reconsidering the answer of some of the respondents, which is understandable as, unlike the first question, it was asked after the participants read the recipes and saw the pictures of the two hybrid patties options. Increased familiarity and the provision of examples could have been a positive influence on their initial scepticism about these products. In Figure 6, the meat substitution rates of regular meat with hybrid meat are shown.

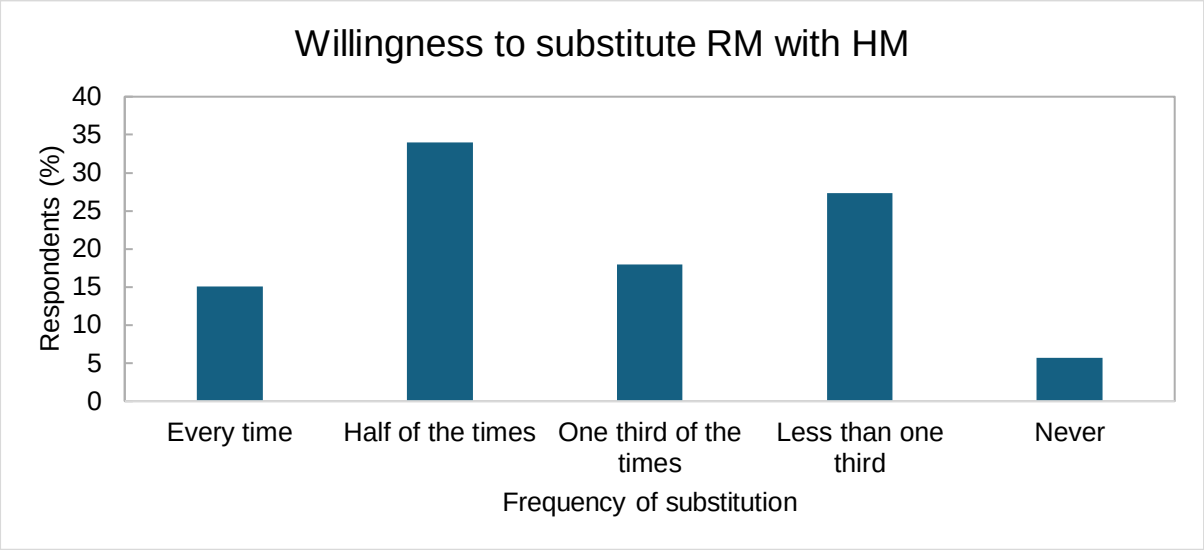


*Figure 6 Willingness of participants (n=106) to substitute regular meat with hybrid meat. The frequency at which they would substitute regular meat with hybrid meat is displayed.*

While 5% of the respondents (n=6) would never substitute regular meat, the rest of them were willing to do it to different extents. The most chosen option (34%) was to eat hybrid meat half of the times they usually consume meat. This was followed by less than one-third (27.4%), and one-third (17.9%) of the time. Lastly, 15.1% would be willing to fully substitute meat with hybrid options. These results show a positive attitude toward the adoption of different meat-eating habits, and the openness of consumers to change their meat consumption patterns. Hybrid meat seems to be a good product for this, as confirmed by Grasso et al. (2022), who found out that 57% of consumers were willing to try it, and 46% to buy it. Furthermore, there is a general openness to substitute meat among consumers, as seen by Profeta et al. (2020), who reached 500 German participants through an online survey. More than fifty percent of consumers were already substituting meat. When discussing the possibility of consuming meat hybrids, health perception turned out to be a decisive attribute for choosing hybrid options (Profeta et al., 2020). In the current study, as discussed in Chapter 3.2.3, health was also a significant motivation to start consuming hybrid meat, however the most prominent reasons were environmental and price related. This highlights the need for proper communication and focus on the beneficial aspects of hybrid meat, which touch upon multiple fields, to encourage a higher substitution rate of regular meat products.

### *3.2.5 Hybrid meat in real-life situations*

At the end of the survey, the participants had to rate some statements that touched upon different aspects of hybrid meat acceptance and consumption. They were asked to indicate how much they agreed with each statement. Table 3 summarizes the thoughts of the participants about the similarities in terms of preparation between regular and hybrid meat, and whether it would be easy for them to prepare such a product from scratch at home.

*Table 3 Participants' (n=106) agreement with the statements that hybrid meat's preparation is similar to the one of regular meat ('Preparation similarity') and that making hybrid meat from scratch at home is easy ('Easy to make from scratch').*

| Agreement | Preparation similarity (%) | Easy to make from scratch (%) |
|---|---|---|
| Completely disagree | 1.9 | 2.8 |
| Disagree | 0.9 | 6.6 |
| Somewhat disagree | 6.6 | 10.4 |
| Neither agree nor disagree | 12.3 | 10.4 |
| Somewhat agree | 16 | 29.2 |
| Agree | 51.9 | 34 |
| Completely agree | 10.4 | 6.6 |

Most participants agreed that the preparation techniques such as cooking methods of hybrid meat are similar to the ones of regular meat, with a total of 78.3% somewhat agreeing or higher. Even though the agreement is overall lower (69.8%), most participants also thought that making hybrid meat products from scratch would be easy. The latter result, however, should have been further contextualized by considering some individual factors such as cooking skills and experience in making more elaborate foods from scratch at home. Hence, to interpret the agreement with the statement that hybrid meat could be easy to make from scratch, some additional questions about how often the participants cook, or if they experiment new recipes when cooking at home should have been asked.

The perceived similarity with regular meat preparation and the fact that it can be easily made from scratch is a positive prerequisite for hybrid meat's acceptance and its adoption within the participants' eating habits. Generally, food products that are radically different from most products known by consumers, can be difficult to accept, as is for example observed for insect consumption (Nijssen et al., 2021; Tan et al., 2017). Knowledge and experience in food preparation methods, in particular, can be a determining factor for food product acceptance. When exploring consumers' experiences and expectations about meat substitutes, Elzerman et al. (2013) observed that easy preparation was a positive aspect of such products. The resemblance to meat of meat substitutes was mentioned as a preparation facilitator, as they would find it easier to prepare a dish with them (Elzerman et al., 2013). The lack of cooking skills is an important factor when trying to reduce meat consumption. According to a cross-sectional study by Mullee et al. (2017), which focused on the attitudes toward vegetarianism and meat consumption, the lack of cooking skills was among the main reasons why consumers would not be vegetarian. In a co-creation study by Grasso et al. (2023), it appeared that consumers were concerned with the ease of preparation of hybrid products and how to cook them. The fact that hybrid

meat's preparation resembles to more traditional product preparations and is perceived as a food that is easy to make at home can therefore act as a facilitator for its acceptance in the household.

The two statements shown in Table 4, touched upon some dietary implications that hybrid meat can have for the participants, namely the incorporation of more vegetables in their diet, and the satisfaction of their meat cravings when consuming hybrid products.

*Table 4 Participants' (n=106) agreement with the statements that hybrid meat can satisfy their meat cravings ('it satisfies my meat cravings') and that it help them introducing more vegetables in their diet with low effort ('it helps introducing more vegetables').*

| Agreement | It satisfies my meat cravings (%) | It helps introducing more vegetables (%) |
|---|---|---|
| Completely disagree | 5.7 | 4.7 |
| Disagree | 3.8 | 1.9 |
| Somewhat disagree | 14.2 | 11.3 |
| Neutral | 14.2 | 9.4 |
| Somewhat agree | 24.5 | 19.8 |
| Agree | 30.2 | 44.3 |
| Completely agree | 7.5 | 8.5 |

The agreement with these two statements was also high, especially for the role of hybrid meat when it comes to meat cravings. A total of 72.6% of the participants somewhat to completely agreed that hybrid meat could be helpful to introduce more vegetables in their diets, while 62.3% of them were positive about hybrid meat being a good substitute for regular meat when they craved it.

The majority of the participants agreed with the fact that hybrid meat can help them eat more vegetables. This is reasonable, also in light of the previous results, mentioning that hybrid meat is perceived as healthy, both independently, and when compared to regular meat. The presence of plant-based ingredients is the main difference between regular and hybrid meat products, and it is likely the reason why they are perceived as healthier than regular meat. Consumers therefore recognize the presence of vegetables as a positive addition, and not merely a way to reduce the meat portion in the product. This is in line with the definition of hybrid meat, in which the positive role of the ingredients in terms of health and sustainability is pivotal (Grasso & Jaworska, 2020). The addition of vegetables and plant-based proteins is often seen positively because it can help reduce meat consumption, however, the presence of vegetables can be seen as a positive addition on its own, focusing on fibers and vitamin content, for example. On a commercial level, this has been done for some products, like the 'Hidden Veggies' range, by Marks and Spencer, which

highlights that one portion of their hybrid products provides one out of the five servings of vegetables that are recommended per day, or the 'Love Meat and Veg' line by Sainsbury, which mentioned the chance to switch to a higher vegetable intake when describing their products (Grasso & Jaworska, 2020; Marks and Spencer, 2020). Good communication of these benefits can help provide consumers with more reasons to consume hybrid meat.

Most participants (62.3%) felt that hybrid meat could still satisfy their meat cravings, however out of all statements, this was the one with lowest agreement compared to the others. This once again confirms the importance of meat for consumers, and how this can be a barrier to the full acceptance of meat alternatives. The sensory pleasure derived from meat and the strong embeddedness in Western cultures make it difficult to introduce new alternatives to meat and decrease its consumption (Eckl et al., 2021; Kerslak et al., 2022). Furthermore, most participants (64.2%) were slightly to not at all familiar with the concept of hybrid meat, and low familiarity can negatively influence product acceptance (Salgaonkar & Nolden, 2022; van Dijk et al., 2023). In addition to this, this study only provided some pictures of the product, there was no tasting session involved. Participants therefore had no occasion to thoroughly assess the meat-related characteristics of hybrid products and more objectively evaluate whether they could still satisfy their meat cravings. The fact that the majority of the respondents agreed, however, still leads to the conclusion that hybrid meat could serve as a good means to decrease meat consumption while still satisfying consumers. This is widely confirmed in the literature, where hybrid meat is often described as a viable bridge between regular meat and plant-based options (Grasso & Göksen, 2022; Grasso et al., 2022).

Lastly, consumers were asked whether they would buy hybrid meat products if they encountered them in the supermarket. Table 5 summarizes the results.

*Table 5 Participants' (n=106) agreement with the statement that they would buy hybrid meat (HM) at the supermarket.*

| **Agreement** | **Would buy HM at the supermarket (%)** |
|---|---|
| Completely disagree | 6.6 |
| Disagree | 5.7 |
| Somewhat disagree | 4.7 |
| Neutral | 14.2 |
| Somewhat agree | 17.9 |
| Agree | 34 |
| Completely agree | 17 |

The outcome was positive, as 68.9% of the participants would be willing to buy hybrid meat if they encountered it in the supermarket. As previously mentioned, a study by Grasso et al. (2022) explored the willingness to buy hybrid products among consumers. On average, 46% of the participants were willing to buy hybrid meat. The most favourable consumer group was from Spain, and 63% of them were willing to buy such products. The high acceptance and willingness to purchase hybrid products can have positive implications for their introduction in the Dutch market, and possibly in consumers' eating habits.

### 3.3 Evaluation of mushroom and bell pepper patties

In this chapter, the preference and acceptance of specific hybrid products, namely the mushroom and bell pepper patties, is discussed.

#### *3.3.1 Preference and attractiveness rating of mushroom and bell pepper hybrid patties*

As shown in Table 6, the preference for one or the other hybrid options was not striking. Mushroom burgers were rated as more attractive; however the difference was not significant (*p=0.17*), and a slight majority (53.8%) would consume them over the bell pepper ones.

*Table 6 Attractiveness of the mushroom and bell pepper patties. Participants (n=106) were asked to rate both patties separately on a 1(Extremely unattractive) to 5 (Extremely attractive) Likert scale. For Attractiveness, mean scores are given. Participants were subsequently asked to choose their favourite patty. The percentage of participants choosing one or the other patty is given.*

| Attribute | Score mushroom | Score bell pepper |
|---|---|---|
| Attractiveness | 3.3 | 3.1 |
| Preference | 53.8% | 46.2% |

In Figure 7, an overview of the reasons why the participants preferred one of the patties over the other is given.

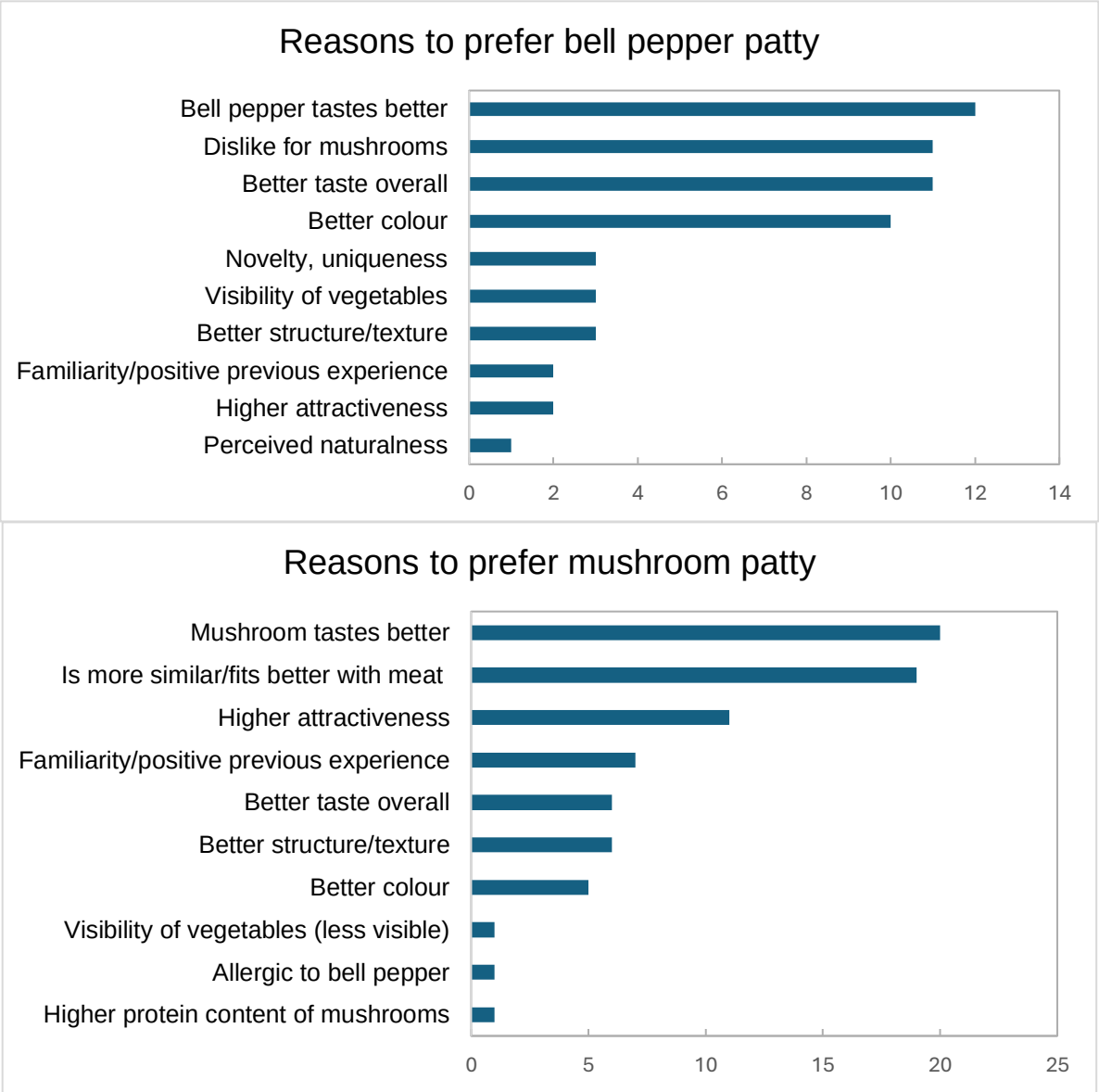


*Figure 7 Mentioned reasons why the bell pepper patty or the mushroom patty were chosen, and their mentioning frequency. The reasons were extrapolated from an open-ended question asking to explain their choice. Participants could therefore mention one or more reasons were extrapolated from an open-ended question asking to explain their choice.*

The most mentioned reasons why the participants chose the bell pepper hybrid patty relate to a general preference for bell pepper over mushroom, the expected taste of the patty, the fact that they specifically didn't like mushrooms, and that it had a better colour compared to the mushroom one. Similarly, the mushroom patty was often chosen because of a personal preference for mushrooms over bell peppers. The other most mentioned reasons, however, touch upon different aspects, that don't always relate to the sensory characteristics of the burgers. The fact that mushrooms are more similar or fit better with the taste and structure of meat has been mentioned 19 times, which, compared to other reasons, is quite remarkable. Along with a higher overall

attractiveness, mushrooms were also chosen because of a higher familiarity with the combination of mushroom and meat, or positive experiences with mushroom-based meat alternatives. Overall, the main reasons to choose the bell pepper option seem to relate to its expected taste and colour and a sense of curiosity for a more 'novel' product. The mushroom burger, instead, was a more familiar option, with more acceptable sensory outcomes because mushroom and meat are a well-known combination. Understandably, the main focus for both burgers was their sensory profile, especially their taste, which plays an important role for consumers when it comes to food products, including hybrid meat (Ryder et al., 2023). The motivations to choose one ingredient over the other were also in line with expectations. Mushrooms are indeed an ingredient that is often associated with meat and can even act as a substitute for it because of their flavour profile (Yuan et al., 2021; Wang & Zhao, 2023). A common flavour characteristic of meat and mushrooms that is increasingly looked at is umami (Phutela & Basin, 2021). Umami flavour is perceived as savoury and meaty, and it is due to the perception of certain compounds, such as monosodium glutamate (MSG), and derivatives of 5′-ribonucleotides (IMP or GMP) (Wang et al., 2020). This flavour was mentioned by two of the participants who preferred the mushroom patty. These rather technical notions that confirm that mushrooms and meat are a good combination were, however, not specifically mentioned by the participants. What probably led them to such an association was the common use of mushrooms and meat on a commercial level. There are plenty of products that use mushrooms instead of meat, for example, the 'vegetarian variant' of Unox ragout, or vegetarian mushroom burgers which are readily available in Dutch supermarkets (Albert Heijn, 2024). This is supported by the fact that 7 participants mentioned having tried this combination already and being positive about it. The link between bell pepper and meat is less straightforward. In literature, the combination of these two ingredients does not necessarily highlight particular taste similarities or complementarity. Some studies investigate the technical improvements that bell peppers can have on meat, such as oxidative stability and water-holding capacity in meat products (Elkah et al., 2022; Cocan et al., 2022). Furthermore, bell pepper is not really used as a main component of meat substitutes, even though it can be seen as an ingredient in commercially available products such as vegetarian bread toppings or real 'chicken sandwich sausages' (Albert Heijn, 2024).

*3.3.2 Evaluation of (expected) sensory properties of mushroom and bell pepper patties*

In Table 7, the mean evaluations of the sensory characteristics when looking at the mushroom and bell pepper patties' pictures are given.

*Table 7 Mean scores on a scale from 1 ('Strongly dislike') to 5 ('Strongly like') of the patties' characteristics evaluated from the picture provided to the participants (n=106). In this table, the attributes differing the most in mean scores (p<0.05) are shown. Standard deviation (SD) is provided, and the attributes with a significant evaluation difference between the two patties are marked with an asterisc (*).*

| Attribute | Score Mushroom (SD) | Score bell pepper (SD) |
|---|---|---|
| Colour * | 4.5 (1.6) | 4.2 (1.6) |
| Expected meat hardness * | 4.3 (1.5) | 4.1 (1.4) |
| Expected intensity of meat flavour * | 4.5 (1.5) | 4.2 (1.4) |
| Expected texture | 4 (1.7) | 3.8 (1.7) |
| Expected juiciness | 4.6 (1.6) | 4.6 (1.4) |
| Visibility of vegetables | 4.3 (1.6) | 4.5 (1.7) |
| Expected flavour | 4.6 (1.7) | 4.5 (1.6) |
| Expected intensity of vegetable flavour | 4.5 (1.5) | 4.5 (1.5) |
| Expected intensity of chickpea flavour | 3.9 (1.4) | 3.8 (1.4) |

Among the two patties' attributes, the colour, meat hardness, and intensity of meat flavour were the ones that significantly differed between the two products ($p<0.05$). The expected intensity of meat flavour scores is probably the least surprising outcome of the rating, especially in light of what was expressed by consumers when asked about their preference for one of the two burgers. As mentioned in Chapter 3.3.1, participants often associated the taste of mushrooms with the one of meat, considering it a good and commonly used combination. This was confirmed by the technical characteristics of meat and mushrooms, as the umami component plays an important role in both of them (Phutela & Basin, 2021). The expected meatier flavour of the mushroom patty was probably an important component of the preference for this option. The attribute "meaty flavour" was found to be the largest factor driving consumer acceptability of hybrid products among consumers in a study by Neville et al. (2017) comparing hybrid burgers and sausages. The preference for the mushroom patty's colour could be explained along the lines of the expected meat flavour preference motivations. Besides flavour, mushrooms also resembles meat in terms of colour when the product is cooked, which makes it a good replacement for beef products (Sogari et al., 2022; Patino et al., 2019). The contrast of the bell pepper with the meat was perceived as appealing by the participants who chose that option, while this feature was probably disliked by the participants choosing the mushroom patty. The expected meat hardness was preferred for the mushroom burger. The significant difference between the two scores was surprising, as bell pepper was expected to be liked because of its juiciness, possibly decreasing meat hardness, which is a feature that is usually not desirable in meat products. Besides the already mentioned acceptance of the mushroom-meat combination on multiple sensory levels, this result

could be explained by a preference for firmer patties. This reasoning was mentioned by one of the participants: “[The mushroom patty is] Firm yet juicy, nice colour, looks more robust”. Therefore, the mushroom patty was probably preferred in ‘hardness’ because it would be less likely to fall apart. These results were however not consistent with the evaluation of the expected texture of the burgers, as their mean scores did not significantly differ (p=0.09). This could be due to some characteristics that are not directly associated with meat hardness and are similar in both patties, such as the presence of visible vegetable chunks. This is confirmed by the fact that no significant preferences were expressed for the visibility of the vegetables in one or the other patty (p=0.18), meaning that both burgers were perceived similarly concerning this aspect. The expected flavour of the patty, and the chickpeas and vegetables expected taste intensity were also perceived similarly and no significant difference was detected (p=0.56, p=0.13, p=0.72, respectively). The lack of a tasting session might have influenced this outcome, as participants could not realistically evaluate such characteristics. The results are however in line with the ones of Chapter 3.3.1, where the mushroom and bell pepper patty scored similarly in terms of attractiveness, with a slight preference for the mushrooms-containing option.

## 3.4 Food neophobia, meat attachment, and their influence on hybrid meat preferences

In the next section, the role of meat attachment and food neophobia in the acceptance and evaluation of hybrid patties is discussed.

### *3.4.1 MA and FN scores of the participants*

The participants were divided into three categories, namely low, medium, and high, both for the food neophobia and meat attachment scales. To create such categories, the scores of the participants were broken down in tertiles, as previously done by Jaeger et al. (2017). The resulting categories are shown in Table 8. The complete distribution of the participants is shown in Appendix IV. The Cronbach’s alpha of the FNS was 0.819 and the one for MA 0.918, indicating acceptable reliability (Taber, 2018).

*Table 8 Food Neophobia and Meat Attachment group division based on tertiles. The percentage of participants (n=106) belonging to each of the FN and MA groups is given.*

| Category | Food Neophobia Score | % | Meat Attachment Score | % |
|---|---|---|---|---|
| Low | 10-23 | 36.8 | 20-45 | 34.9 |
| Medium | 24-30 | 33 | 46-54 | 34 |
| High | 31-61 | 30.2 | 55-79 | 31.1 |

Following the tertile distribution, the participants were evenly distributed among the low, medium, and high food neophobia and meat attachment groups.

*3.4.2 Willingness to consume hybrid products*

The participants' willingness to consume hybrid meat was only investigated among the participants who had not consumed hybrid meat yet (n=66). It was overall high, with 78.5% of them being open to eating it. Table 9 shows an overview of how the answers differed among low, medium, and high food neophobia and meat attachment groups.

*Table 7 Participants (n=106) willingness (Yes/No) to consume hybrid products among different food neophobia (FN) and meat attachment (MA) groups. The MA scores significantly influenced (p<0.05) the willingness to consume, whose scores are marked with an asterisk (*).*

| **Groups** | **Willingness to consume (%)** | |
|---|---|---|
| | Yes | No |
| Low FN | 77.3 | 22.7 |
| Medium FN | 82.6 | 17.4 |
| High FN | 76.2 | 23.8 |
| Low MA | 88 * | 12 * |
| Medium MA | 78.3 * | 21 * |
| High MA | 66.7 * | 33.3 * |

The food neophobia groups had homogeneous responses and no steady increase or decrease with increasing scores. As confirmed by the logistic regression performed using food neophobia scores as the independent variable and the participants' willingness to consume hybrid meat as the dependent variable, there were no significant differences with increasing food neophobia (p=0.53). Food neophobia usually negatively impacts the acceptance of new foods (Siddiqui et al., 2022). The influence of food neophobia on hybrid meat acceptance was confirmed by van Dijk et al. (2023), who observed a lower willingness to buy hybrid products with increasing food neophobia. However, the association of a newly developed product with familiar flavours, appearance, and preparation methods can help increase the acceptance of new foods (Hwang & Ling, 2010). The rather simple definition of hybrid meat, mentioning real meat and vegetables might have positively influenced consumers' perception of the product, despite increasing food neophobia scores. Furthermore, the influence of food neophobia on product acceptance is rather complex, and broader decision-making systems might also play an important role (van Dijk et al., 2023; Faccio & Fovino, 2019).

Unlike food neophobia, increasing meat attachment led to a significantly lower acceptance of hybrid products (p<0.05). This is understandable, as meat attachment can be a major barrier to the reduction of meat consumption and the acceptance of meat analogues (Salgaonkar & Nolden, 2024). The presence of meat in hybrid products could lead to the assumption that they would be relatively well accepted by more meat-attached consumers. This was remarked by van Dijk et al (2023), who observed that meat attachment only had a significant influence on the willingness to buy plant-based meat substitutes, the only option in their study which did not contain any real meat at all. The same was confirmed by Salgaonkar and Nolden (2024), who

saw that meat attachment had a negative association with plant-based hot dogs, and a positive one with the selection of beef hotdogs, while there was no significant correlation with hybrid hotdogs. However, this was not the case in the current study. This could be due to a multitude of factors, such as the sole focus on hybrid meat, without a consistent comparison with other products. Furthermore, the definition provided to participants mentioned the fact that hybrid products can help meat consumption reduction, which could have negatively influenced the perception of consumers with higher meat attachment.

### *3.4.3 Evaluation of bell pepper and mushroom patties*

Following the effects that food neophobia and meat attachment had on general acceptance, their influence on the evaluation of the two hybrid patties examples was further investigated. In Table 10, the differences in mean evaluation scores of low, medium, and high groups of the two burgers are shown.

*Table 10 Overall liking scores of bell pepper and mushroom patties among different food neophobia (FN) and meat attachment (MA) groups, including standard deviation (SD). High FN significantly differed from Low FN ($p<0.001$) and medium FN ($p<0.05$). High MA significantly differed from Low MA ($p<0.001$) and medium MA ($p<0.05$).*

| | **Mushroom patty scores (SD)** | **Bell pepper patty scores (SD)** |
|---|---|---|
| Low FN | 3.5 (1.1) | 3.3 (1.1) |
| Medium FN | 3.4 (1) | 3.1 (1.1) |
| High FN | 2.8 (1.2) | 2.9 (1.1) |
| Low MA | 3.8 (0.7) | 3.3 (0.9) |
| Medium MA | 3.2 (1.2) | 3.2 (1.2) |
| High MA | 2.7 (1.2) | 2.8 (1.2) |

According to the two one-way ANOVA performed on both patties' mean scores, the most significant differences in scoring among the food neophobia groups were observed in the mushroom ones. The most significant scoring decrease was between the High-Low ($p<0.001$) and High-Medium ($p<0.05$) groups. The differences for the bell pepper patties were less striking, as only the High-Low groups had significant differences ($p<0.05$). This was confirmed by linear regression, where a decrease in scores with increasing food neophobia was observed for both burgers, but statistical significance was only identified for mushroom burgers ($p<0.05$). Furthermore, with increasing food neophobia, participants were more likely to choose the bell pepper over the mushroom ($p<0.05$). The effects of food neophobia are therefore in line with expectations, as this trait can affect product acceptance and liking scores (Januszewska & Viaene, 2012). However, the lower influence of food neophobia on the bell pepper patties' evaluation was surprising, especially considering the motivations to choose one patty over the other seen in Chapter 3.2. While bell pepper

was often considered a good option due to curiosity and novelty reasons, along with its pleasant sensory properties, mushroom patties were preferred because of the familiar and, in some cases, already tested combination of this ingredient with meat. This would lead to the assumption that food neophobia would have a stronger negative influence on the liking of the bell pepper option, as it was often perceived as a new flavour combination.

Similar results were observed when investigating the effects that meat attachment had on the liking of the burgers. The one-way ANOVA results showed that the mean liking scores of the mushroom patty significantly differed between the High-Low ($p<0.001$) and the High-Medium ($p<0.05$) meat attachment groups, while no significant difference was detected between any of the groups when evaluating the bell pepper burger. However, even though no significant difference was detected between the groups, a linear regression analysis detected a significant decrease when treating meat attachment scores as continuous variables. The differences are therefore detectable, but not large enough to make a difference when categorizing the participants in groups. Similarly to what was already discussed, the lower liking due to increasing meat attachment confirms the fact that this personal trait can be a major barrier to meat consumption reduction. Interestingly, among the sample of this study hybrid meat's liking seems to be affected by meat attachment in a similar way to meat substitutes, rather than other conventional meat alternatives, like cultured meat. In the study by van Dijk et al. (2023), meat attachment was a significant predictor of the willingness to buy plant-based meat substitutes, while the hybrid and the cultured meat options' willingness to buy was not affected as much. Cultured meat has even been shown to be favorably perceived among individuals with higher meat attachment (Circus & Robinson, 2019). According to Banovic et al. (2022), consumers tend to categorize hybrid meat as part of the meat product group, and therefore regular meat consumers have positive attitudes toward them. Some factors that might have affected the results of this study are a rather low overall familiarity with hybrid meat, which could have led to an association of hybrid products with a meat-reduction tool, more like meat substitutes, therefore decreasing their liking with increasing meat attachment.

## 4. Conclusions

The outcomes of this study highlight a positive attitude of consumers living in the Netherlands towards the concept of hybrid meat and its appearance.
Most participants thought that hybrid meat is a healthy and sustainable product concept. By the end of the survey, after being exposed to examples and pictures of hybrid meat products, the participants also had positive perceptions regarding the naturalness of hybrid meat. At first instance, it was seen as a rather artificial product. However, this did not have a remarkable impact on its healthiness perception, unlike it is often seen in literature (Plasek et al., 2021). This highlights the importance of familiarity and providing information about food products for their acceptance. When comparing it to regular and plant-based meat, hybrid meat scored most positively in terms of health, while meat was still considered the tastiest and most attractive product. Overall the results of the comparison confirmed the current role of meat, which is often seen as a satisfying food, and is hardly replaceable by other products in terms of taste and attractiveness (Kerslake et al., 2022). Even if to a limited extent, hybrid meat opened up to the perspective of a meat alternative which is tastier and more attractive than regular meat substitutes. Taste and texture remain an important object of debate when considering alternatives to meat products, as these two attributes were mentioned the most when asking about barriers towards hybrid meat consumption. However, a small minority of the sample would not even consider including it in their diet. Environment, price, and health were the characteristics that motivated participants to consume or consider hybrid meat's consumption, showing high environmental and health awareness, and that hybrid meat can be considered an affordable product, possibly aiding its spread among consumers. Participants were generally positive when addressing aspects of hybrid meat that touch upon aspects that are encountered in daily life such as preparation, diet, or its purchase. A considerable majority thought that hybrid meat was a good way to introduce more vegetables in their diet, that it would be easy to make such products at home from scratch, and that their preparation is similar to the one of regular meat. These characteristics can have a positive influence on hybrid meat's acceptance, especially considering the growing interest of consumers on the healthiness of their diet and their need for products that are familiar and easy to prepare (Elzerman et al., 2013; Teixeira & Rodrigues, 2021). Most of the participants were also willing to buy hybrid products if they saw them at the supermarket, which suggests that hybrid meat has good chances to be accepted by consumers also on a commercial level.
The acceptance of hybrid meat, and more specifically hybrid patties containing either mushroom or bell pepper, was mostly influenced by the meat attachment degree of consumers. MA had both a negative influence on the willingness to consume hybrid products, and on the attractiveness rating of the mushroom burger in particular. Food neophobia had no significant influence on the participants' willingness to consume hybrid meat, however it also had a negative influence on the evaluation of hybrid bell pepper patties.

A common thread throughout this study was the importance of meat for consumers, which was visible when investigating on the general acceptance of hybrid products, and when the influence of meat attachment scores was further investigated.

## 5. Limitations and further research

The sample of the current study comprised participants that were mostly young, the majority being under 35 years old. While on one hand having a homogeneous sample can be beneficial to gain more realistic insights on a specific part of the population, including more age ranges could have been beneficial, especially because age often acts as discriminant when investigating on preferences and opennes to novelty. Focusing the distribution in locations where older participants could be found should be considered for future research.

When evaluating hybrid meat and the two examples provided in this study, participants received a brief definition and pictures of the products through an online questionnaire. While on one hand this was an efficient way to reach many consumers from different areas of the Netherlands, on the other hand having in-person sessions with real product tasting could have led to more precise and realistic insights. Tasting the mushroom and bell pepper patties and seeing them in real-life could have let to more detailed motivations for the participants' preference for one or the other. Furthermore, other factors beyond visual appearance could have been evaluated by the participants. Besides the possibility to give a more realistic product evaluation, this could have also helped having more concrete answers concerning the ability of hybrid meat to effectively satisfy participants' meat cravings and constitute a valid alternative to regular meat.

The results of this study highlighted the fact that meat is still an important product for consumers, that it is hard to find products that are as satisfactory on a sensory level, and that meat attachment plays an important role for the evaluation of hybrid meat products. A good communication about hybrid meat, highlighting the fact that it still contains a part of meat, and offers very similar properties to regular meat products could be helpful to increase acceptance among consumers, especially at higher meat attachment levels. Further research could therefore be performed to investigate on how to best communicate information about hybrid meat to consumers that have higher levels of meat attachment.

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# Appendices

## Appendix I Questionnaire (EN/NL)

# Hybrid Meat Survey

Dear Participant,

Thank you for taking part in this survey.

By answering the following questions, you are contributing to ongoing research on **hybrid meat**. Hybrid meat is currently object of research for both its technical aspects (i.e. composition) and its acceptability among consumers. It consists of a blend of traditional meat with proteins derived from vegetables and legumes.

Filling in this questionnaire will take about **15 minutes**. The first part of this questionnaire consists of some questions related to your **meat consumption habits**, while the second section will investigate the **thoughts and feelings** that the concept of hybrid meat evokes on you.

The information collected in this survey will be used for an MSc thesis project focused on the acceptance of hybrid meat by consumers. All data gathered will be used for research purposes only, and any participant's data will be treated confidentially. In the research report, it will be ensured that responses cannot be traced back to individual participants. Filling in this survey is **voluntary,** and you can exit it at any time.

Please note that this survey focuses on hybrid meat and meat consumption. If you are **vegan or vegetarian**, your dietary preferences may not align with the questions in this survey, and we kindly ask you to exit the survey at this time. Your participation is greatly appreciated, and we apologize for any inconvenience.

The following document fully explains the research purpose and how your personal data will be handled throughout the study.

Beste deelnemer,

Bedankt voor uw deelname aan deze enquête.

Door de volgende vragen te beantwoorden, draagt u bij aan lopend onderzoek naar hybride vlees. Hybride vlees wordt momenteel onderzocht vanwege zowel de technische aspecten (dat wil zeggen de samenstelling) als de aanvaardbaarheid ervan bij consumenten. Het bestaat uit een mix van vlees met eiwitten afkomstig uit groenten en peulvruchten.

Het invullen van deze vragenlijst zal ongeveer **15 minuten** duren. Het eerste deel van deze vragenlijst bestaat uit enkele vragen die verband houden met uw **vleesconsumptiegewoonten**, terwijl het tweede deel de **gedachten en gevoelens** onderzoekt die het concept van hybride vlees kan oproepen.

De informatie die in dit onderzoek wordt verzameld, zal worden gebruikt voor een MSc-

scriptieproject gericht op de acceptatie van hybride vlees door consumenten. Alle verzamelde gegevens worden uitsluitend voor onderzoeksdoeleinden gebruikt en de gegevens van alle deelnemers worden vertrouwelijk behandeld. In het onderzoeksrapport wordt ervoor gezorgd dat de reacties niet herleidbaar zijn tot individuele deelnemers. Het invullen van deze enquête is **vrijwillig** en u kunt deze op elk moment verlaten.

Let op: dit onderzoek richt zich op hybride vlees en vleesconsumptie. Als u **veganist of vegetariër** bent, komen uw voedingsvoorkeuren mogelijk **niet** overeen met de vragen in deze enquête. Wij verzoeken u dan ook vriendelijk de enquête op dit moment te verlaten. Wel willen we u hartelijk danken voor uw interesse.

In het volgende document wordt volledig uitgelegd wat het onderzoeksdoel is en hoe er tijdens het onderzoek met uw persoonlijke gegevens wordt omgegaan.

Choose the preferred language of the document

- English
- Dutch

Kies de voorkeurstaal van het document

- Engels
- Nederlands

Actieve geïnformeerde toestemming

Lees de Actieve Geïnformeerde Toestemming zorgvuldig voordat u verder gaat

Active informed consent

Lees de Actieve Geïnformeerde Toestemming zorgvuldig voordat u verder gaat

Consent Consent to the treatment of your data.
*By selecting the option 'I agree to participate in this survey' you are stating that you read and understood the previous form, agree with how your data will be used for research, and are willing to fill in the following questionnaire.*

- I agree to participate in this survey
- I don't want to participate in this survey

Consent Toestemming voor de behandeling van uw gegevens.
*Door de optie 'Ik ga akkoord met deelname aan dit onderzoek' te selecteren, verklaart u dat u het vorige formulier heeft gelezen en begrepen, dat u akkoord gaat met de manier waarop uw gegevens worden gebruikt voor onderzoek en dat u bereidt bent de volgende vragenlijst in te vullen.*

- Ik ga akkoord met deelname aan dit onderzoek
- Ik ga **niet** akkoord met deelname aan dit onderzoek

Q1 Please select the option that best describes your dietary habits

- Omnivore
- Flexitarian (limits meat intake but occasionally consumes it)
- Vegetarian
- Vegan
- Other (please explain)
  _____

Q1 Selecteer de optie die het beste uw voedingsgewoonten beschrijft

- Omnivoor
- Flexitarisch (beperkte inname van vlees, maar consumeert het af en toe)
- Vegetarisch
- Veganistisch
- Anders (leg uit a.u.b.) _____

Q2 MC How often do you consume meat?

- Never
- Less than once a month
- 2-3 times a month
- Once per week
- 2-3 times per week
- 4-5 times per week
- 6-7 times per week
- more than 7 times per week

Q2 MC Hoe vaak eet u vlees?

- Nooit
- minder dan één keer per maand
- 2-3 keer per maand
- Eens per week
- 2-3 keer per week
- 4-5 keer per week
- 6-7 keer per week
- meer dan 7 keer per week

Q3 MAQ Please indicate to what extent you agree with the following statements (Completely disagree/Disagree/Neither agree nor disagree/Agree/Strongly agree):

- A good steak is without comparison
- To eat meat is one of the good pleasures in life.
- I love meals with meat.
- I'm a big fan of meat.
- I feel bad when I think of eating meat.
- To eat meat is disrespectful towards life and the environment.
- Meat reminds me of diseases.
- By eating meat I'm reminded of the death and suffering of animals.
- According to our position in the food chain, we have a right to eat meat.
- To eat meat is an unquestionable right of every person.
- Eating meat is a natural and indisputable practice.
- Meat is irreplaceable in my diet.
- I would feel fine with a meatless diet.
- If I couldn't eat meat I would feel weak.
- If I was forced to stop eating meat I would feel sad.
- I don't picture myself not eating meat regularly.

Q3 MAQ Geef aan in hoeverre u het eens bent met de volgende stellingen (Helemaal mee oneens/ Oneens/ Niet eens, niet oneens/ Eens/ Helemaal mee eens)

- Een goede biefstuk is niet te vergelijken.
- Vlees eten is een van de genoegens in het leven.
- Ik houd van maaltijden met vlees.
- Ik ben een groot fan van vlees.
- Ik voel me slecht als ik denk aan vlees eten.
- Vlees eten is respectloos voor het leven en het milieu.
- Vlees doet me aan ziektes denken.
- Door vlees te eten word ik herinnerd aan de dood en het lijden van dieren.
- Volgens onze positie in de voedselketen hebben we het recht om vlees te eten.
- Vlees eten is een onbetwistbaar recht van iedereen.
- Vlees eten is een natuurlijke en onbetwistbare bezigheid.
- Vlees is onvervangbaar in mijn eetpatroon.
- Ik zou me prima voelen met een vleesloos eetpatroon.
- Als ik geen vlees zou kunnen eten, zou ik me zwak voelen.
- Als ik zou moeten stoppen met het eten van vlees, zou ik me verdrietig voelen.
- Ik kan me niet voorstellen dat ik niet regelmatig vlees zou eten.

Q4 MR How willing would you be to consider the following in the coming weeks?
(Not at all willing/Not willing/Neither unwilling nor willing/Willing/Very willing)

- Reduce your meat consumption.
- Follow a meat-free diet most of the time.
- Avoid eating meat altogether.
- Follow a strict plant-based diet.

Q4 MR Hoe bereidwillig zou u zijn om de komende weken het volgende te overwegen?
(Totaal niet bereidwillig/ Niet bereidwillig/ Noch onwillig, noch bereid/ Bereidwillig/ Totaal bereidwillig)

- Uw vleesconsumptie te verminderen.
- Voornamelijk een vleesvrij eetpatroon te volgen.
- Vlees volledig te vermijden.
- Een volledig plantaardig eetpatroon te volgen.

Q5 FNS Please indicate to what extent you agree with the following statements:
(Completely disagree/Disagree/Slightly disagree/Neither agree nor disagree/Slightly agree/Agree/Completely agree)

- I am constantly trying new and different foods.
- I don't trust new foods.
- If I don't know what is in a food, I won't try it.
- I like foods from different countries.
- Ethnic foods look weird to eat.
- At dinner parties, I will try a new food.
- I am afraid to eat things I have never had before.
- I am very particular about the foods I will eat.
- I will eat almost anything.
- I like to try new ethnic restaurants.

Q5 FNS Geef aan in hoeverre u het eens bent met de volgende stellingen:
(Helemaal mee oneens/Oneens/ Een beetje mee oneens/ Niet eens, niet oneens/ Een beetje eens/ Eens/ Helemaal eens)

- Ik probeer constant nieuw en verschillend voedsel.
- Ik wantrouw nieuwe voedingsmiddelen.
- Als ik niet weet wat er in een maaltijd zit, probeer ik het niet.
- Ik houd van voedsel uit verschillende landen.
- Buitenlands voedsel ziet er te vreemd uit om te eten.
- Tijdens etentjes probeer ik nieuw voedsel.
- Ik ben bang om voedsel te eten dat ik nog nooit eerder heb gehad.
- Ik ben erg kieskeurig over het voedsel dat ik eet.
- Ik eet bijna alles.
- Ik probeer graag nieuwe etnische restauranten uit.

*Introduction HM*

From now on, the questions will focus on the concept of **hybrid meat**.

Hybrid meat refers to products containing plant-based proteins which replace 25% to 50% of the original animal protein content, reducing meat usage. Possible ingredients that can be used and have been objects of research include peas, lentils, chickpeas, beans, and hempseed. The ingredients can be added as fresh vegetables and legumes, or as protein isolates. Some product examples that are currently available on the market are hybrid burgers meatballs, sausages, and chorizo.

*Introduction HM*

Vanaf nu zullen de vragen zich richten op het concept **hybride vlees**.

De term 'hybride vlees' omvat vleesproducten die een bron van plantaardige eiwitten bevatten die 25% tot 50% van het oorspronkelijke eiwitgehalte van het product uitmaken. Mogelijke ingrediënten die kunnen worden gebruikt en waarvoor onderzoek is gedaan, zijn onder meer erwten, linzen, kikkererwten, bonen en hennepzaad. Deze ingrediënten kunnen worden toegevoegd als verse groenten of als eiwitisolaten. Enkele productvoorbeelden die momenteel op de markt verkrijgbaar zijn, zijn hybride burgers, gehaktballetjes, worstjes en chorizo.

Q6 How familiar are you with the concept of hybrid meat?

| | Not familiar at all | Slightly familiar | Moderately familiar | Very familiar | Extremely familiar |
|---|---|---|---|---|---|
| Familiarity | ○ | ○ | ○ | ○ | ○ |

Q6 Hoe bekend bent u met het concept hybride vlees?

| | Helemaal niet bekend | Enigszins bekend | Redelijk bekend | Zeer bekend | Zeer vertrouwd |
|---|---|---|---|---|---|
| Bekendheid | ○ | ○ | ○ | ○ | ○ |

Q7 Based on the description provided about hybrid meat and your personal knowledge about the topic, how would you rate its healthiness, naturalness, and sustainability?

Q7 Hoe zou u, op basis van de beschrijving van hybride vlees en uw persoonlijke kennis over het onderwerp, de gezondheid, natuurlijkheid en duurzaamheid ervan beoordelen?

Q7a How do you perceive hybrid meat products' healthiness?

| | Very unhealthy | Unhealthy | Neither healthy nor unhealthy | Healthy | Very healthy |
|---|---|---|---|---|---|
| Healthiness | ○ | ○ | ○ | ○ | ○ |

Q7a Hoe ervaart u de gezondheid van hybride vleesproducten?

| | Heel ongezond | Ongezond | Noch gezond, noch ongezond | Gezond | Heel gezond |
|---|---|---|---|---|---|
| Gezondheid | ○ | ○ | ○ | ○ | ○ |

Q7b How do you perceive hybrid meat products' naturalness?

| | Very artificial | Artificial | Neither artificial nor natural | Natural | Very natural |
|---|---|---|---|---|---|
| Naturalness | ○ | ○ | ○ | ○ | ○ |

Q7b Hoe ervaart u de natuurlijkheid van hybride vleesproducten?

| | Heel kunstmatig | Kunstmatig | Noch kunstmatig, noch natuurlijk | Natuurlijk | Heel natuurlijk |
|---|---|---|---|---|---|
| Natuurlijkheid | ○ | ○ | ○ | ○ | ○ |

Q7c How do you perceive hybrid meat products' sustainability?

| | Very unsustainable | Unsustainable | Neither sustainable nor unsustainable | Sustainable | Very sustainable |
|---|---|---|---|---|---|
| Sustainability | ○ | ○ | ○ | ○ | ○ |

Q7c Hoe ervaart u de duurzaamheid van hybride vleesproducten?

| | Zeer onduurzaam | Onduurzaam | Noch duurzaam, noch onduurzaam | Duurzaam | Zeer duurzaam |
|---|---|---|---|---|---|
| Duurzaamheid | ○ | ○ | ○ | ○ | ○ |

Q8 Have you ever consumed a hybrid meat product?

- Yes
- No

Q8 Heeft u ooit een hybride vleesproduct geconsumeerd?

- Ja
- Nee

Q9 How often do you consume hybrid meat?

- I only consumed it once
- Less than once a month
- 2-3 times a month
- Once per week
- 2-3 times per week
- 4-5 times per week
- 6-7 times per week
- more than 7 times per week

Q9 Hoe vaak eet u hybride vlees?

- Ik heb het maar één keer gegeten
- Minder dan één keer per maand
- 2-3 keer per maand
- Eens per week
- 2-3 keer per week
- 4-5 keer per week
- 6-7 keer per week
- meer dan 7 keer per week

Q10 Why do you consume hybrid meat? Choose the attributes of these products that are **attractive** to you.
*Multiple options are possible*

- Price
- Taste
- Texture
- Preparation convenience
- Health effects
- Environmental effects
- Other (please explain)

Q10 Waarom consumeer je hybride vlees? Kies de kenmerken van deze producten die voor u **aantrekkelijk** zijn.
*Er zijn meerdere opties mogelijk*

- Prijs
- Smaak
- Textuur
- Bereideingsgemak
- Gehondheidseffecten
- Milieu-effecten
- Anders (leg uit)

Q11 Would you consider including hybrid meat in your diet in the future?

- Yes
- No

Q11 Zou u overwegen om in de toekomst hybride vlees in uw dieet op te nemen?

- Yes
- No

Q12 Why would you **be willing** to include hybrid meat in your diet?
*Multiple options are possible*

- Price
- Taste
- Texture
- Preparation convenience
- Health effects
- Environmental effects
- Other (please explain)

Q12 Waarom zou u **bereid zijn** hybride vlees in uw dieet op te nemen?
*Er zijn meerdere opties mogelijk*

- Prijs
- Smaak
- Textuur
- Bereideingsgemak
- Gehondheidseffecten
- Milieu-effecten
- Anders (leg uit)

Q13 Why would you **not include** hybrid meat in your diet?
*Multiple options are possible*

- Price
- Taste
- Texture
- Preparation convenience
- Health effects
- Environmental effects
- Other (please explain)

Q13 Waarom zou u hybride vlees **niet** in uw dieet opnemen?
*Er zijn meerdere opties mogelijk*

- Prijs
- Smaak
- Textuur
- Bereideingsgemak
- Gehondheidseffecten
- Milieu-effecten
- Anders (leg uit)

Q14 Which product between the following options (Hybrid burger/Regular burger/Meat substitute (burger)/They are the same) do you think is

- Healthiest
- Most natural
- Most sustainable
- Tastiest
- Most attractive

Q14 Welk product tussen de volgende opties (Hybride hambuerger/Gewone hamburger/Vleesvervanger (burger)/Ze zijn hetzelfde) is volgens jou

- Gezondst
- Meest natuurlijk
- Meest duurzaam
- Lekkerst
- Meest antrekkelijk

Picture 1 This picture shows a hybrid meat patty. The following questions will focus on this product and its characteristics. The meat and plant-based ingredient ratio is 1:1 (50% meat, 50% plant-based). The ingredients added are onion, chickpeas, and mushroom. For the sake of clarity, this patty will be referred as '**mushroom hybrid patty**'.

Picture 1 Deze foto toont een hybride vlees burger. De volgende vragen gaan over dit product en de kenmerken ervan. De verhouding vlees en plantaardige ingrediënten is 1:1 (50% vlees, 50% plantaardig). De toegevoegde ingrediënten zijn ui, kikkererwten en champignons. Voor de duidelijkheid zal deze burger '**champignon** hybride burger' worden genoemd.

--Picture of mushroom patty--

Q15 How attractive is the **mushroom** hybrid patty to you?

| | Extremely unattractive | Unattractive | Neither attractive nor unattractive | Attractive | Extremely attractive |
|---|---|---|---|---|---|
| Attractiveness | ○ | ○ | ○ | ○ | ○ |

Q15 Hoe aantrekkelijk is de **champignon** hybride burger voor jou?

| | Uiterst onaantrekkelijk | Onaantrekkelijk | Noch aantrekkelijk, noch onaantrekkelijk | Aantrekkelijk | Extreem aantrekkelijk |
|---|---|---|---|---|---|
| Aantrekkelijkheid | ○ | ○ | ○ | ○ | ○ |

Q16 Based on the **mushroom** hybrid patty picture provided, please express your liking of the following attributes
(Strongly dislike/Dislike/Slightly dislike/Neither like nor dislike/Slightly like/Like/Strongly like)

- Colour
- Visual Texture
- Visual juiciness
- Visibility of vegetables in the burger
- Expected flavour
- Expected meat hardness
- Expected intensity of meat flavour
- Expected intensity of vegetable flavour
- Expected intensity of chickpea flavour

Q16 Op basis van de verstrekte **champignon** hybride burger afbeelding kunt u uw voorkeur voor de volgende kenmerken kenbaar maken (Zeer onaantrekelijk/Onantrekelijk/ Lichtelijk onaantrekkelijk/Neutraal/Enigszins aantrekelijk/Aantrekelijk/Zeer aantrekelijk)

- Kleur
- Visuele textuur
- Visuele sappigheid
- Zichtbaarheid van groenten in de burger
- Verwachte smaak
- Verwachte hardheid van het vlees
- Verwachte intensiteit van de **vleessmaak**
- Verwachte intensiteit van de **groentesmaak**
- Verwachte intensiteit van de **kikkererwtensmaak**

Picture 2 This picture shows a hybrid meat patty. The following questions will focus on this product and its characteristics. The meat and plant-based ingredient ratio is 1:1 (50% meat, 50% plant-based). The ingredients added are onion, chickpeas, and red bell pepper. For the sake of clarity, this patty will be referred as '**bell pepper hybrid patty**'.

Picture 2 Deze foto toont een hybride vlees burger. De volgende vragen gaan over dit product en de kenmerken ervan. De verhouding vlees en plantaardige ingrediënten is 1:1 (50% vlees, 50% plantaardig). De toegevoegde ingrediënten zijn ui, kikkererwten en rode paprika. Voor de duidelijkheid zal deze burger '**paprika** hybride burger' worden genoemd.

-- Picture of bell pepper patty--

Q17 How attractive is the **bell pepper** hybrid patty to you?

| | Extremely unattractive | Unattractive | Neither attractive nor unattractive | Attractive | Extremely attractive |
|---|---|---|---|---|---|
| Attractiveness | ○ | ○ | ○ | ○ | ○ |

Q17 Hoe aantrekkelijk is de **paprika** hybride burger voor jou?

| | Uiterst onaantrekkelijk | Onaantrekkelijk | Noch aantrekkelijk, noch onaantrekkelijk | Aantrekkelijk | Extreem aantrekkelijk |
|---|---|---|---|---|---|
| Aantrekkelijkheid | ○ | ○ | ○ | ○ | ○ |

Q18 Based on the **bell pepper** hybrid patty picture provided, please express your liking of the following attributes (Strongly dislike/Dislike/Slightly dislike/Neither like nor dislike/Slightly like/Like/Strongly like)

- Colour
- Visual texture
- Visual juiciness
- Visibility of vegetables in the burger
- Expected flavour
- Expected meat hardness
- Expected intensity of meat flavour
- Expected intensity of vegetable flavour
- Expected intensity of chickpea flavour

Q18 Op basis van de verstrekte **paprika** hybride burger afbeelding kunt u uw voorkeur voor de volgende kenmerken kenbaar maken (Zeer onaantrekkelijk/Onaantrekkelijk/Lichtelijk onaantrekkelijk Neutraal/Enigszins aantrekkelijk/Aantrekkelijk/Zeer aantrekkelijk)

- Kleur
- Visuele textuur
- Visuele sappigheid
- Zichtbaarheid van groenten in de burger
- Verwachte smaak
- Verwachte vleeshardheid
- Verwachte intensiteit van de vleessmaak
- Verwachte intensiteit van de groentesmaak
- Verwachte intensiteit van de kikkererwtensmaak

Q19 Which patty would you be more willing to try?

- Mushroom hybrid patty
- Bell pepper hybrid patty

Q19 Welke burger zou jij het liefst willen proberen?

- Champignon hybride burger
- Paprika hybride burger

Q20a Please give a short explanation on why you would choose the **mushroom** hybrid patty over the other patty

_____

Q20a Geef een korte toelichting waarom u de **champignon** hybride burger zou verkiezen boven de andere burger

_____

Q20b Please give a short explanation on why you would choose the **bell pepper** hybrid patty over the other patty

_____

Q20b Geef een korte toelichting waarom u de **paprika** hybride burger zou verkiezen boven de andere burger

_____

Q21 To what extent would you be willing to substitute regular meat products with their hybrid alternative?

| | I would choose the hybrid option **every time** I consume meat products | I would choose the hybrid option **half of the times** | I would choose the hybrid option **one third of the times** | I would choose the hybrid option **less than one third of the times** | I would **never** choose the hybrid option |
|---|---|---|---|---|---|
| Degree of substitution | ○ | ○ | ○ | ○ | ○ |

Q21 In hoeverre zou u bereid zijn reguliere vleesproducten te vervangen door hun hybride alternatief?

| | **Elke keer** dat ik vleesproducten consumeer, zou ik voor de hybride optie kiezen | Ik zou de **helft van de tijd** voor de hybride optie kiezen | **Een derde** van de keren zou ik voor de hybride optie kiezen | **Minder dan een derde** van de keren zou ik voor de hybride optie kiezen | Ik zou **nooit** voor de hybride optie kiezen |
|---|---|---|---|---|---|
| Mate van vervanging | ○ | ○ | ○ | ○ | ○ |

Q22 After diving deeper into the characteristics and some examples of hybrid meat, did your perception of its healthiness, naturalness, and sustainability change? Please rate these attributed again

Q22 Is uw perceptie van de gezondheid, natuurlijkheid en duurzaamheid veranderd nadat u dieper in de kenmerken en enkele voorbeelden van hybride vlees bent gedoken? Gelieve deze opnieuw te beoordelen.

Q23a How do you perceive hybrid meat products' healthiness?

| | Very unhealthy | Unhealthy | Neither healthy nor unhealthy | Healthy | Very healthy |
|---|---|---|---|---|---|
| Healthiness | ○ | ○ | ○ | ○ | ○ |

Q23a Hoe ervaart u de gezondheid van hybride vleesproducten?

| | Heel ongezond | Ongezond | Noch gezond, noch ongezond | Gezond | Heel gezond |
|---|---|---|---|---|---|
| Gezondheid | ○ | ○ | ○ | ○ | ○ |

Q24b How do you perceive hybrid meat products' naturalness?

| | Very artificial | Artificial | Neither artificial nor natural | Natural | Very natural |
|---|---|---|---|---|---|
| Naturalness | ○ | ○ | ○ | ○ | ○ |

Q24b Hoe ervaart u de natuurlijkheid van hybride vleesproducten?

| | Heel kunstmatig | Kunstmatig | Noch kunstmatig, noch natuurlijk | Natuurlijk | Heel natuurlijk |
|---|---|---|---|---|---|
| Natuurlijkheid | ○ | ○ | ○ | ○ | ○ |

Q25c How do you perceive hybrid meat products' sustainability?

| | Very unsustainable | Unsustainable | Neither sustainable nor unsustainable | Sustainable | Very sustainable |
|---|---|---|---|---|---|
| Sustainability | ○ | ○ | ○ | ○ | ○ |

Q25c Hoe ervaart u de duurzaamheid van hybride vleesproducten?

| | Zeer onduurzaam | Onduurzaam | Noch duurzaam, noch onduurzaam | Duurzaam | Zeer duurzaam |
|---|---|---|---|---|---|
| Duurzaamheid | ○ | ○ | ○ | ○ | ○ |

Q26 Please indicate how much you agree with the following statements (Completely disagree/Disagree/Somewhat disagree/Neutral/Somewhat agree/Agree/Completely agree)

- I think it's easy to make hybrid meat products from scratch at home
- I think the preparation (e.g. cooking techniques) of hybrid meat products is similar to the one of regular meat
- Hybrid meat can help me introduce more vegetables in my diet with low effort
- Hybrid meat can satisfy my meat cravings
- I would buy hybrid meat at the supermarket

Q26 Geef aan in hoeverre u het eens bent met de volgende stellingen (Volledig mee oneens/Enigszins oneens/Oneens/Neutraal/Enigszins mee eens/Mee eens/Helemaal mee eens)

- Ik denk dat het gemakkelijk is om thuis hybride vleesproducten te maken
- Ik denk dat de bereiding (bijvoorbeeld kooktechnieken) van hybride vleesproducten vergelijkbaar is met die van regulier vlees
- Hybride vlees kan mij helpen om met weinig moeite meer groenten in mijn dieet te introduceren
- Hybride vlees kan mijn honger naar vlees stillen
- Ik zou hybride vlees in de supermarkt kopen

D1 What is your age in years?

_____

D1 Wat is uw leeftijd in jaren?

_____

D2 What gender do you identify with?

- Female
- Male
- Non-binary / third gender
- Prefer not to say

D2 Met welk geslacht identificeert u zich?

- Vrouw
- Man
- Niet-binair / derde geslacht
- Zeg ik liever niet

D3 What is your nationality?

_____

D3 Wat is uw nationaliteit?

_____

D4 Which city/town are you from?

_____

D4 Uit welke stad/gemeente komt u?

_____

D5 Which city/town do you live in **at the moment**?

_____

D5 In welke stad/gemeente woont u **momenteel**?

_____

D6 What is the highest level of education you **achieved**?

- No diploma
- Primary School
- Middle School
- High School Diploma (or equivalent)
- Higher Vocational Education (HBO)
- Bachelor's Degree
- Master's degree
- Doctoral Degree (e.g. PhD)
- Other (please specify)

  _____

D6 Wat is het hoogste opleidingsniveau dat u **heeft behaald**?

- Geen diploma
- Basisonderwijs
- VMBO, HAVO/VWO onderbouw, MB01
- HAVO, VWO, MBO2-4
- HBO
- Bachelor (WO)
- Master (WO)
- Doctoraat (e.g. PhD)
- Anders (leg uit a.u.b.) _____

D7 What is the highest level of education you are **currently achieving**?

- High School Diploma (or equivalent)
- Bachelor's Degree
- Higher Vocational Education (HBO)
- Master's degree
- Doctoral Degree (e.g. PhD)
- I am done with my studies
- Other (please specify)

  _____

D7 Wat is het hoogste opleidingsniveau dat u **momenteel** aan het verwezenlijken bent?

- VMBO, HAVO/WO onderbouw, MB01
- HAVO, VWO, MBO2-4
- HBO
- Bachelor (WO)
- Master (WO)
- Ik ben klaar met mijn studie
- Anders (leg uit a.u.b.) _____

D8 Please specify your latest study program/PhD field

_____

D8 Wat is uw meest recente studierichting/PhD richting?

_____

D9 Are you a Wageningen University **student** or **PhD**?

- Yes
- No

D9 Bent u student of PhD'er aan Wageningen Universiteit?

- Ja
- Nee

D10 What is your working situation

- Student
- Unemployed
- Working part-time
- Working full-time
- Self-employed/Freelancer
- Retired
- Other (please specify)
  _____

D10 Wat is uw werksituatie?

- Student
- Werkloos
- Part-time werknemer
- Fulltime werknemer
- Zelfstandige/Freelancer
- Gepensioneerd
- Anders (gelieve te specificeren)
  _____

Dear Participant,

Thank you for filling in this questionnaire, your input is highly valuable and will contribute to gaining new insights about consumers' acceptance of hybrid meat, possibly leading to a decrease in meat consumption in the future.

To submit your answer, please **click on the arrow at the bottom right** of the page.

Thank you once again for your participation and consideration!
Contact person for any further questions about the study: claudia.castellanelli@wur.nl

Beste deelnemer,

Bedankt voor het invullen van deze vragenlijst.

Uw inbreng is zeer waardevol en zal bijdragen aan het verkrijgen van nieuwe inzichten over de acceptatie door consumenten van hybride vlees, wat mogelijk zal leiden tot een daling van de vleesconsumptie in de toekomst. Nogmaals bedankt voor uw deelname en aandacht!

Om uw antwoord te verzenden **klikt uw op de pijl recthsonder** op de pagina.

Contactpersoon voor eventuele verdere vragen over het onderzoek: claudia.castellanelli@wur.nl

## Appendix II Active Informed Consent (EN/NL)

### Consent Form

Acceptance of hybrid meat products among consumers

This study is conducted by the Consumer Behaviour group of the Food Quality and Design department. The researchers are Claudia Castellanelli (MSc-student) and Pieter Groen (supervisor).

**Purpose of the study**
The purpose of the study is to investigate on the perception of hybrid meat products by consumers, including their general thoughts, opinions, and ideas about this topic. The study aims to contribute to the ongoing research about these products and investigate on the variations in acceptance depending on some core consumer characteristics.

**What the participation to this survey involves**
We ask participants who came across this survey to fill in an online questionnaire. This will take about **15 minutes.**

Your participation is voluntary. You can quit the questionnaire at any time.

**Use and storage of your data**

Some personal information will be asked (age, nationality, occupation, meat consumption frequency). This could give useful insight on how the demographics of a population might influence the perception of hybrid meat. Raw data will only be accessible to the abovementioned researchers. The report and any publications will not contain any identifiable information.

**Do you have any questions?**

For any questions please contact claudia.castellanelli@wur.nl.

For information about your data privacy rights, you can contact privacy@wur.nl

**Giving your consent**

In the online survey, you'll be given the opportunity to give consent.

This research activity has been approved by the WUR- Research Ethics Committee (rec@wur.nl).

**Toestemmingsformulier**

Acceptatie van hybride vleesproducten onder consumenten

Dit onderzoek wordt uitgevoerd door de groep Consumentengedrag van de afdeling Food Quality and Design. De onderzoekers zijn Claudia Castellanelli (MSc-student) en Pieter Groen (begeleider).

**Doel van de studie**
Het doel van het onderzoek is om de perceptie van hybride vleesproducten door consumenten te onderzoeken, inclusief hun algemene gedachten, meningen en ideeën over dit onderwerp. Het onderzoek heeft tot doel een bijdrage te leveren aan het lopende onderzoek naar deze producten en onderzoek te doen naar de variaties in acceptatie, afhankelijk van enkele kernkenmerken van de consument.

**Wat de deelname aan dit onderzoek inhoudt**
Deelnemers die deze enquête tegenkwamen, vragen wij om een online vragenlijst in te vullen. Dit zal ongeveer 15 minuten duren.

Uw deelname is vrijwillig. U kunt de vragenlijst op ieder moment verlaten.

**Gebruik en opslag van uw gegevens**
Er zullen enkele persoonlijke gegevens worden gevraagd (leeftijd, nationaliteit, beroep, frequentie van vleesconsumptie). Dit zou nuttig inzicht kunnen geven in de manier waarop de demografische kenmerken van een populatie de perceptie van hybride vlees kunnen beïnvloeden. Ruwe data zullen alleen toegankelijk zijn voor bovengenoemde onderzoekers. Het rapport en eventuele publicaties zullen geen identificeerbare informatie bevatten.

**Heb je nog vragen?**
Voor eventuele vragen kunt u contact opnemenclaudia.castellanelli@wur.nl.
Voor informatie over uw gegevens privacy rechten kunt u contact opnemen metprivacy@wur.nl

**Uw toestemming geven**
In de online-enquête krijgt u de mogelijkheid om toestemming te geven.

Deze onderzoeksactiviteit is goedgekeurd door de WUR-Research Ethics Committee (rec@wur.nl).

## Appendix III Flyer/Poster for questionnaire distribution


*Figure 8 Graphics to distribute the questionnaire. The same picture was used as poster and personally handed out flyers.*

# Appendix IV distribution of MAQ and FN scores among participants

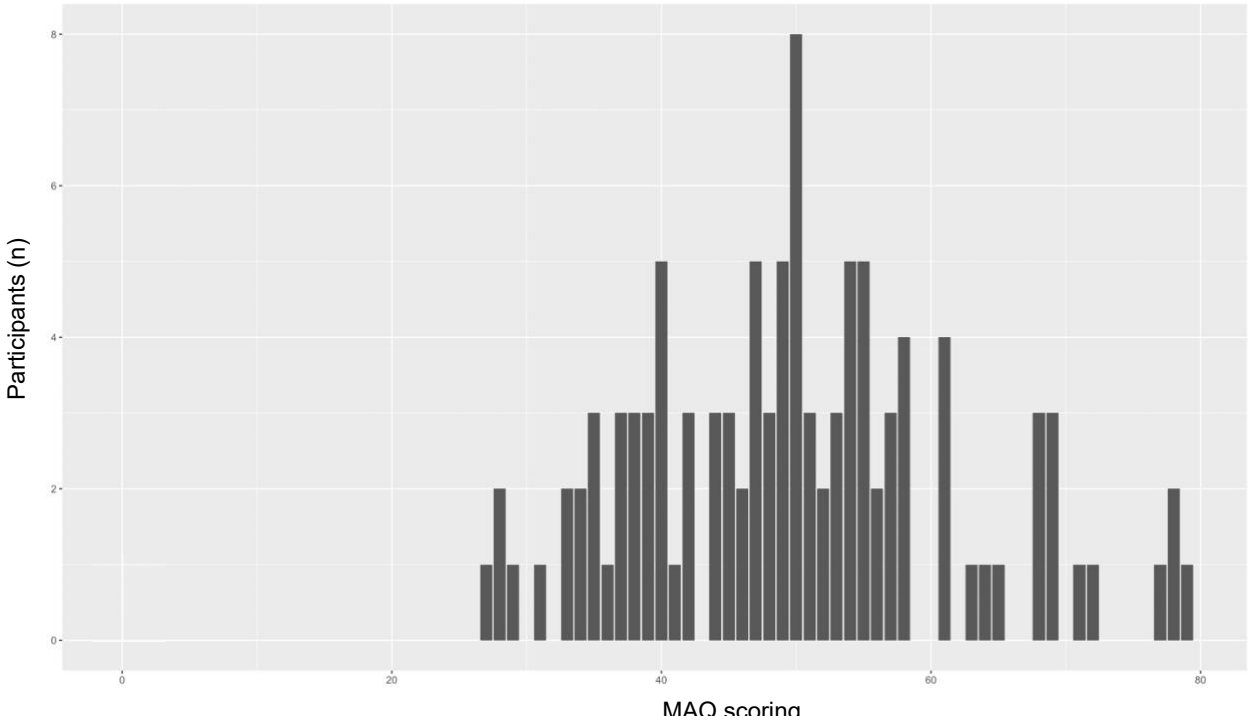


*Figure 9 Distribution of Meat Attachment (MAQ) scores among the participants.*

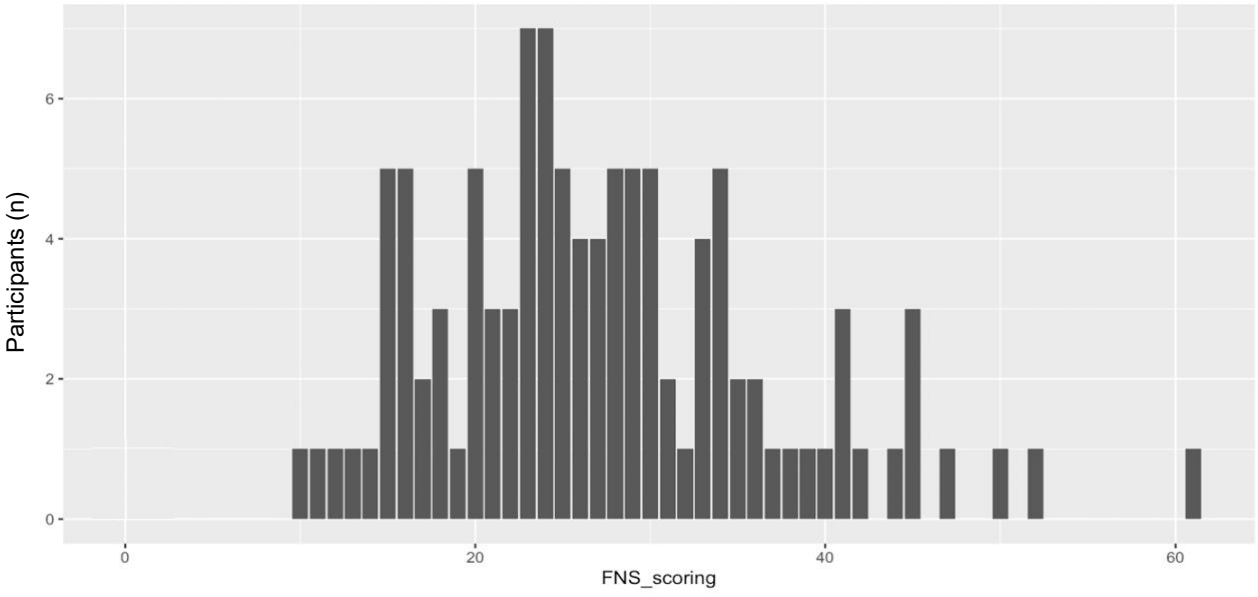


*Figure 8 Distribution of Food Neophobia Scale (FNS) scores among the participants.*