

# Perceptions of three diets varying in animal- and plant-based protein contents: Analysis of participant experience diaries

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## ABSTRACT

The market for new plant protein-based meat substitutes is expanding, although their consumption remains limited compared to animal-based protein sources. Further research is necessary to comprehend the perceptions of diets in which animal-based protein sources are partially replaced with plant proteins. This qualitative study is part of an intervention trial, during which participants adhered to one of the three intervention diets for 12 weeks: the ANIMAL diet (70% animal-based protein/30% plant-based protein), the 50/50 diet (50% animal/50% plant) or the PLANT diet (30% animal/70% plant).

The dataset comprises 79 experience diaries from healthy participants aged 23 to 69. The study investigated perceptions of intervention diets, the meat protein (MPPs) and the plant protein products (PPPs) included in the intervention and self-reported changes in perceptions during the intervention period. These perceptions were categorized into eight themes: body-related experiences, practicalities and everyday life, sensory properties, social situations and special occasions, familiarity and novelty, health, ethical aspects, and non-specific liking. Across the diets, body-related experiences were the most frequently mentioned theme. The ANIMAL diet received more negative than positive comments. In contrast, comments on the 50/50 diet were relatively balanced between positive and negative, and the PLANT diet received more positive comments than negative ones. The PPPs were commented on in a positive way more often than the MPPs were. With consistent exposure, participants reported more positive than negative changes in perceptions. However, there is still room for improvement in enhancing the sensory quality and ease of food preparation of PPPs.

## 1. Introduction

There is a widely acknowledged need to transition to plant-based diets to enhance human health and reduce the environmental impacts of animal-sourced foods (Godfray et al., 2018; Willett et al., 2019). The diets with reduced meat and dairy consumption offer a feasible opportunity to mitigate climate change (Seves et al., 2017; Willett et al., 2019). Early signs of an increased interest in more sustainable plant-based diets have emerged. In Finland, a majority acknowledges the need to decrease the consumption of red and processed meat and increase the consumption of pulses (Erkkola et al., 2021). According to a recent online survey of 1000 adult consumers, 39% reported replacing a part of the red meat with plant proteins (Nevalainen et al., 2023). Moreover, the public image of plant-based eating in Europe has become more positive (Jallinoja et al., 2019).

However, despite a slight increase in vegetarianism, its prevalence has remained relatively low (Lehto et al., 2022; Niva & Vainio, 2021). Earlier studies have revealed several barriers to adopting more sustainable and plant-based diets. To start with, many consumers feel that they are personally entitled to eat meat (Graça et al., 2015; Lacroix & Gifford, 2019; Niva & Vainio, 2021) and that humans are meant to consume considerable amounts of animal-based meat (Perez-Cueto et al., 2022).

Moreover, meat substitutes are perceived as less appealing than real meat. Many consumers consider that the sensory aspects of plant protein products or milk substitutes do not compare to those of traditional meat or milk products (Cardello et al., 2022; Collier et al., 2021; Haas et al., 2019; Hoek et al., 2011; Michel et al., 2021; Rööös et al., 2022). Meat is also seen as easier to prepare than legumes or meat substitutes (Rööös et al., 2022). Many consumers find cooking plant-based meat alternatives challenging or unfamiliar, posing a reason not to eat them (Collier

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### Abbreviations

50/50	a diet containing equal amounts of animal and plant proteins
ANIMAL	a diet containing 70% animal and 30% plant protein
MPP	meat protein product
PLANT	a diet containing 30% animal and 70% plant protein
PPP	plant protein product

et al., 2021; Elzerman et al., 2013; Figueira et al., 2019; Jallinoja et al., 2016; Knaapila et al., 2022; Varela et al., 2022).

Furthermore, difficulties in eating plant-based meat or dairy alternatives in social or formal situations may act as a barrier to replacing meat or dairy with them (Cardello et al., 2022; Elzerman et al., 2021; Michel et al., 2021; Reipurth et al., 2019). Finding a restaurant serving plant-based meals can be challenging (Reipurth et al., 2019). In a restaurant, many perceive meat alternatives as being of lower value than meat (Michel et al., 2021). A lack of social support (Lacroix & Gifford, 2019) and family members' opposing preferences (Figueira et al., 2019; Knaapila et al., 2022) can hinder efforts to reduce eating meat.

Some consumers are concerned about the nutritional content of plant-based foods, such as insufficient intake of essential vitamins and other micronutrients (Weinrich, 2018) or protein (Reipurth et al., 2019). Others expressed worry about the unhealthiness of the plant-based meat and cow-milk substitutes (Haas et al., 2019; Hartmann et al., 2022; Kerslake et al., 2022; Varela et al., 2022). Some consumers perceive that plant protein products cause digestive problems, such as flatulence (Figueira et al., 2019; Jallinoja et al., 2016), and are not easily digestible (Elzerman et al., 2013). Due to these negative perceptions of plant-based foods and craving for meat and dairy, various diets where meat and dairy consumption is significantly reduced but not totally prohibited might be more feasible options than aiming for large-scale vegetarianism or veganism.

However, studies have also reported positive perceptions of plant-based foods. Regular consumption of plant-based meat substitutes can be justified by a preference for trying new foods (Knaapila et al., 2022) or familiarity with the product (Hoek et al., 2011). The perceived healthiness of plant-based foods was among the most frequently mentioned reasons to use plant protein products or plant-based milk substitutes (Elzerman et al., 2013; Kerslake et al., 2022; McCarthy et al., 2017). Moreover, certain nutrient content of meat or dairy substitutes is seen as a positive aspect of these foods (Elzerman et al., 2013; McCarthy et al., 2017). Lightly processed plant-based foods were seen as healthier than meat (Röös et al., 2022). Frequent bean consumption was shown to be associated with perceptions that beans are good for the environment (Jallinoja et al., 2016).

Finally, intervention studies have shown that perceptions of plant-based diets and plant-based foods can change. During a 3-week vegan intervention, there was a reduction in reporting unfamiliarity with preparing plant-based foods and concerns about insufficient energy or strength from a vegan diet (Crimarco et al., 2020). An increase in positive eating experiences was shown in a 10-week intervention study including flexitarian and vegetarian diets (Gillies et al., 2023). Another 10-week intervention included groups consuming one of two plant protein products or a reference meat product in their selected meals. Some participants of the intervention reported boredom, some increased liking of the product, whereas others reported no change in liking of the product (Hoek et al., 2013).

The present study aimed to compare experiences and perceptions of three diets differing in their meat- and dairy content. The data were collected during a dietary intervention trial, where the participants followed the three diets for 12 weeks. To the best of our knowledge, only three earlier intervention studies have explored diet-related perceptions

and experiences (Crimarco et al., 2020; Gillies et al., 2023; Okpara et al., 2022), and two studies have explored product-related perceptions and experiences - one among participants of intervention with different plant-based diets (Gillies et al., 2023), and the other with different plant- or meat-based products (Hoek et al., 2013). Additionally, Gillies et al. (2023) analysed experiences of red meat or plant-based meat alternatives in the diets of young vegetarians.

These earlier intervention studies did not include diets that resemble typical local diets. The present study aims to fill this knowledge gap. The trial involved an average Finnish animal protein-based diet as a reference diet and two diets in which animal protein sources were replaced with plant protein sources with different proportions. Neither of these two diets was purely vegetarian or vegan but represented diets that have been termed "flexitarian", "plant-based" or "semi-vegetarian". Additionally, we contribute to the thus far limited number of qualitative studies in intervention setting by utilising a free-form experience diary data collected over a 12-week randomised controlled trial.

Our research questions were: 1) How did the study participants perceive the intervention diets and what experiences did they report? 2) How did the study participants perceive the animal and plant-protein products and what experiences they reported? 3) What were the reported changes in these perceptions during the intervention? The results shed light on why people accept or reject plant-based diets and foods.

## 2. Methods

### 2.1. Participants and recruitment

This qualitative study is based on 79 electronic experience diaries written during the 12-week randomised controlled trial, the ScenoProt study, conducted at the University of Helsinki. It included healthy adult (20–69 years) participants with body mass index (BMI) between 18.5 and 35.0 kg/m<sup>2</sup> and with willingness to follow any of the three diets throughout the trial in a parallel design. The exclusion criteria for the intervention were as follows: fasting plasma glucose >6.9 mmol/l and total cholesterol >6.5 mmol/l, use of medication for diabetes or hypercholesterolemia, presence of disorders in intestinal or endocrine systems or lipid metabolism, renal or liver diseases, eating disorder, any malignant illness within the past five years, presence of food allergies, recent use of antibiotics (during the last three months), extreme sports, smoking and pregnancy or lactation. A detailed intervention description has been provided elsewhere (Päivärinta et al., 2020).

We used the newspaper Helsingin Sanomat (widest circulation in Finland), Facebook (on the project's pages and further distributed by the project researchers), and the university's mailing lists in recruitment. The recruitment period took place from December 2016 to March 2017, with intervention periods commencing between January and March 2017. The participants were stratified by gender and age and then randomly allocated to three dietary groups. An animal protein-based diet containing 70% animal and 30% plant protein was designed to represent an average Finnish diet (from here on the ANIMAL diet). Two diets that include a bigger proportion of plant-based proteins were designed to represent plant-based and flexitarian diets; the diet with equal amounts of animal and plant proteins (the 50/50 diet); and a diet with 30% animal and 70% plant protein (the PLANT diet). Most participants adhered to these diets as demonstrated by the food diaries recorded at the end of the intervention, the proportions of plant protein were 74% for the PLANT diet, 52% for the 50/50 diet and 32% for the ANIMAL diet (Päivärinta et al., 2020). At the first study visit we collected urine, stool and blood samples and conducted anthropometric measurements. Each participant was then introduced to their diet group using a colour code (blue, yellow, and green diets), used throughout the study. The participants were not informed of the protein contents of their diets, although some reported that they had concluded from the foods they received what diet group they belonged to.

In total, 136 (107 women, 29 men) of 145 participants completed the

intervention study. All participants were asked to fill in an online experience diary, and 79 participants (58%) wrote in the diary at least once during the intervention period. Two participants dropped out of the study during the intervention period. We did not analyse their writings.

Characteristics of all intervention participants and those who wrote the experience diaries are described in Table 1. Because women were more active diary writers than men, our data shows an even larger proportion of women than was observed in the intervention. The participants who wrote in the diaries were, on average, five years older than those who did not write experience diaries. No significant differences in writing activity were observed based on education level or employment status. The participants in the PLANT group were the most active in writing diaries, whereas the 50/50 group was the least active. In addition, we analysed the consumption of certain foods before the intervention. The food records showed that those who wrote diaries ate less white (33 g/day vs 50 g/day,  $p = 0.031$ ) and processed meat (12 g/day vs 27 g/day,  $p = 0.004$ ), and their total meat consumption was lower (88 g/day vs 130 g/day,  $p = 0.002$ ) compared to those who did not write diaries. Moreover, a somewhat larger proportion of their protein consumption was of plant proteins (36% vs 32%,  $p = 0.023$ ).

## 2.2. Intervention diets and products

In short, all intervention diets were planned with a whole diet approach, and the designed average protein intake was 17 E%. On average, 80% of the daily energy intake was controlled in all groups (Päivärinta et al., 2020). Participants were allowed to consume fruits, berries, dietary fats and oils, confectionery, and beverages as usual. The amount of red meat, poultry, and dairy products was lowest in the PLANT diet and highest in the ANIMAL diet. We categorized the plant-based proteins replacing animal protein into two groups: Firstly, the traditional plant protein sources in Finnish food culture such as bread, porridge, cereals, and potatoes, and secondly, plant protein sources that are new in the context of Finnish food culture such as nuts, almonds, seeds, and plant-based milk substitutes. In the 50/50 and PLANT diets, the new plant protein sources were the most significant replacements of meat protein sources. The amounts of eggs and fish were the same in each diet group (Suppl Table 1). Participants in the PLANT diet followed the 50/50 diet during the first week of the intervention to

**Table 1**  
Characteristics of all intervention participants and those who wrote the experience diaries.

	All intervention participants n = 136	Participants who wrote the experience diaries n = 79
Age (mean)	47.8 years	50.1 years
Gender (n, %)		
Female	107 (79)	69 (87)
Male	29 (21)	10 (13)
Education (n, %) <sup>a</sup>		
Upper secondary or less	30 (24)	18 (23)
Bachelor's degree or higher	94 (76)	59 (77)
Employment status (n, %) <sup>a</sup>		
Full or part time employed	90 (73)	59 (74)
Off from work	5 (4)	3 (4)
Student	8 (6)	3 (4)
Retired	21 (17)	14 (18)
Diet group (n, %)		
ANIMAL (70% animal, 30% plant proteins)	46 (34)	27 (34)
50/50 (50% animal, 50% plant proteins)	46 (34)	22 (28)
PLANT (30% animal, 70% plant proteins)	44 (32)	30 (38)

<sup>a</sup> Missing information for the education and employment status 12/136 (9%).

ease the possible gastrointestinal discomfort caused by plant protein products. Then, they started the PLANT diet. Participants were advised to discontinue using dietary supplements and herbal or other natural remedies two weeks before and during the intervention.

The participants visited the research unit weekly to receive most of their protein sources. They obtained raw meat, ready-made meat meals, ready-made plant-protein products, fresh, dried, or ground pulse products, breads, nuts, plant-based dairy substitutes (only milk substitutes), and fish (ready-made and frozen). Some of the products were frozen ready-made meals or patties. Liquid plant-based milk substitutes were not fortified. Participants also received recipes for cooking the products they got during the intervention.

## 2.3. The study methods

At the beginning of the intervention, all participants were given an individual identification number, password, and instructions to fill in web-based experience diaries. The participants had unlimited access to the diaries during the whole intervention period and two weeks after the intervention ended. One diary entry consisted of two parts: "date" and a question: "What kind of experiences, sensations, joys, or worries you have had by now?" Participants were instructed to freely write anything they had in mind in the experience diary. There were some examples of the topics to write, such as "favourite or unpleasant food products", "easiness or difficulties in cooking", "possible changes in vigour or sleep", "possible symptoms caused by food supplies", and "Does following the diet effect, for example, food selection situations or social situations". Altogether, diary texts included 356 entries and 71 pages of writing in Word (PLANT 33 pages, 50/50 22 pages, ANIMAL 16 pages). The PLANT diet participants reported on average 1.1 pages, the 50/50 participants 1 page and the ANIMAL diet participants 0.6 page. Some participants wrote many entries during the intervention, and some assembled their experiences only at the end of the intervention. The number of entries varied between one and 34, and 20 (25%) participants wrote only one entry. By entry, we refer to the entire diary entry a participant wrote, upon logging in.

## 2.4. Data analysis

The content analysis of the data was done by applying inductive and deductive thematic analysis. We investigated participants' perceptions and experiences of the intervention diets, the meat protein products (the MPPs) and the plant protein products (the PPPs) included in the diets and the reported changes in the perceptions during the intervention. In addition, we compared perceptions and self-reported changes in perceptions between the intervention groups and between the MPPs and the PPPs.

During phase 1, we familiarised ourselves with the data and determined the scope of the study. The first writer read through the experience diaries and made notes. In each diary entry, sections where diets and their foods were commented on were identified and marked. These sections are termed mentions.

At first, we aimed to detect and analyse sections of the diaries where the participants evaluated the intervention diets. While reading the data, we noticed that, additionally, there were many comments on the meat and plant protein products included in the diets. There were also comments on the changes in diet- and food-related perceptions, such as getting used to some aspects of the diets or their foods. We concluded that these parts of the diaries, too, were necessary for the full understanding of the participants' perceptions and experiences and decided to include them in the analysis.

Regarding the food products, we limited our data to foods included in different diets in different amounts, the meat protein products (the MPP) and the plant protein products (the PPPs). The PPPs included new plant protein sources: peas, beans, lentils, chickpeas, tofu, crushed soya beans or fava beans, vegetable patties, pizza, mushroom dishes, nuts,

almonds and seeds, and plant-based dairy-like products (other than cheese) (Suppl Table 1). This meant the exclusion of the mentions of fish, eggs, and traditional plant protein products. As an exception to this, we excluded cow's milk products. Although they were instructed to be used in different amounts in each diet, they were not provided to participants by the project. Finally, mentions where we could not identify the protein source were left out of the analysis. In addition, we excluded all the comments related to general diet instructions or features of the diets that were the same for all diet groups.

In phase 2, we formulated the preliminary and final codes. The first author outlined the initial codes, which were discussed with fellow writers several times. Through this iterative process, a total of 26 codes emerged. Each code could refer to positive, negative, or neutral evaluations of the diets and foods, or their tone was ambivalent and contained both positive and negative assessments. For example, the code "taste of product" refers to descriptions of food's good or bad taste. In neutral evaluations, there was no clear indication of either a positive or negative tone. In the tables, we grouped neutral and ambivalent evaluations. Related to self-reported changes, we found changes to both positive and negative directions and mentions of no change during the intervention. In total eight codes related to self-reported change were located.

We defined the themes during phase 3. The codes related to diets and foods were grouped into eight themes, and the codes related to self-reported change were grouped into five themes (Table 2). Again, each theme contained positive, negative, or neutral/ambivalent evaluations.

During phase 4, to answer the last research question about the differences between dietary groups and between meat protein products and plant protein products, we calculated how often each code and theme was mentioned by participants either in a positive, negative, or neutral/ambivalent tone – in each dietary group and in relation to either meat protein products or plant protein products. We also compared the negative and positive self-reported changes, or writings of "no change".

In phase 5, we selected the extracts of the diaries to present each theme. When presenting quotes from the diaries, we use participant ID numbers generated by the Atlas.ti programme.

The first author made suggestions in every phase and they were discussed and modified by all authors, returning to earlier phases when necessary. The data were coded using Atlas.ti 9 (23), a qualitative data

management software programme.

### 3. Results

In general, the diaries showed an abundance of perceptions related to the three diets and the food products. In the following sections, we will highlight the main findings. First, we present the findings related to each diet. Then, we present the findings regarding perceptions and experiences of food products, and changes in perceptions. Each section begins with an overall view of the perceptions, followed by a more detailed description of the themes. We also provide a more detailed presentation of the frequently mentioned codes.

#### 3.1. Perceptions of the diets

##### 3.1.1. The ANIMAL diet

Overall, over half of the mentions related to the ANIMAL diet were negative (52%), almost one-third (28%) were positive, and 20% were neutral or ambivalent (Fig. 1). The most typical comments in this group were various bodily experiences in a negative tone, including, for example, fusty or tired feelings (13 mentions) and gastrointestinal symptoms (11 mentions). P28 described the following gastrointestinal symptoms:

*"I defecate/empty my bowels a little less often than earlier, excrement is quite different in its colour. The excrement is soft, however I always got a feeling that the bowel would not empty properly. The feeling is blocked overall. I have had flatus also much more than earlier."*

Positive body-related experiences were reported less often, and these comments were mostly related to better energy levels ( $n = 4$ ). For example, P12 described: *"I have been able to exercise more than before [the intervention]"*.

Mentions of practicalities and everyday life were most often about diet restrictions in a negative tone. For example, participants reported missing plant-based foods and nuts (4 mentions), fish (4 mentions), or dairy products (4 mentions). However, a few commented on restrictions in a neutral manner: participants described how they used to eat and the changes they had to make to their diets. On the other hand, the diet was positively perceived as easy to follow (8 mentions).

A few were concerned about the unhealthiness of the ANIMAL diet. P72 feared the causes of the diet: *"I am quite scared/concerned what this kind of unhealthy diet causes overall in the long run."*

In the theme of non-specified liking, there were more positive mentions than negative ones. For example, P51 described the experience *"Of course, I am pleased that I can eat so to speak normal food."* Then again P72 commented that being on the ANIMAL diet was a disappointment for her:

*"My immediate reaction was a disappointment. The dice have 'favoured' me by appointing me to the blue group [ANIMAL]. I have reduced the intake of meat and pasta/macaroni/potato quite a lot, and now adding them again in my diet felt really bad"*.

##### 3.1.2. The 50/50 diet

In general, participants in the 50/50 group reported slightly more positive (44% of all mentions) than negative (38%) experiences and perceptions of the diet (Fig. 1). Body-related experiences were the most frequently mentioned theme and the positive and negative mentions were given evenly. The most often mentioned positive body-related experiences were better energy level compared to the pre-intervention situation (16 mentions) and feeling fullness (11 mentions).

Some mentioned experiencing energetic, light, or strong feeling during the diet, some were feeling better than before the intervention and three participants had an increase in energy for their exercise hobby. Conversely, some reported negative body-related experiences that were primarily related to decreased energy levels (15 mentions) or

**Table 2**  
Codes and themes of perceptions of diets and foods.

Code	Theme
Abdominal activity	Body-related experiences
Energy level	
Sleep quality	
Feeling of fullness and hunger	
Other symptoms	
Experiences of cooking	Practicalities and everyday life
Restrictions caused by the diet	
Easiness	
Price	
Amount of food too big	
Social situations	Social situations and special occasions
Special occasions (e.g. trips, restaurants)	
Taste	Sensory properties
Texture	
Condiments	
Ingredients right/not right	
Unethical production methods in farms	Ethical aspects
Animal treatment	
Environmental impact	
Other ethical issues	
Healthiness, unhealthiness	Health
Nutrients, ingredients not right, nutrient adequacy	
Unfamiliarity	Familiarity and novelty
Familiarity	
Novelty	
Non-specific comments of the diets	Non-specific liking/disliking

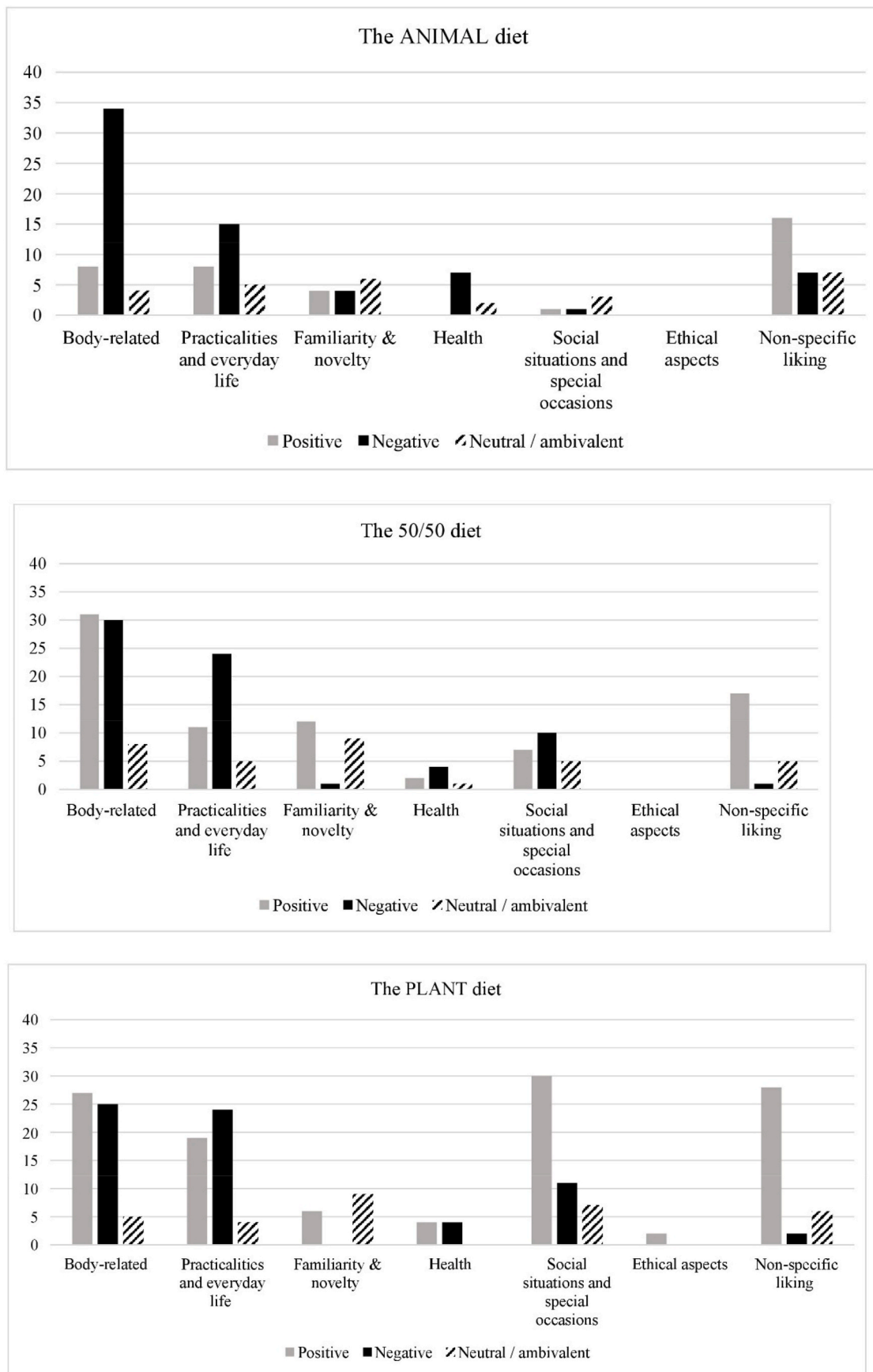


Fig. 1. Positive, negative, and neutral/ambivalent perceptions or experiences of the ANIMAL, 50/50, and PLANT diets, frequencies of mentions.

diverse gastrointestinal symptoms (9 mentions).

Experiences related to practicalities and everyday life were more frequently mentioned in negative than positive or neutral/ambivalent tones. Here, the negative mentions were most often associated with diet restrictions, particularly concerning dairy products (9 mentions). In addition, participants were longing for dietary supplements (4 mentions), plant-based foods or nuts (4 mentions). A positive aspect of the practicalities and everyday life was the easiness of the diet (9 mentions).

In the theme of social situations and environments, negative mentions ( $n = 9$ ) were mostly related to special occasions, such as having lunch in canteens, restaurants, and during trips. Some said that they did not even go to lunch canteens, and some experienced that eating outside the home demanded extra work or thinking, as demonstrated by P65; *“sport hobby and eating outside home demanded extra attention and caused changes in plans”*. Positive experiences (5 mentions) on special occasions were related to successfully adhering to the diet while travelling abroad, on restaurant visits, and at Easter and the May Day Celebration Dinner. Other adverse experiences in social situations (5 mentions) were related to visits where the food served deviated from the trial diet and caused difficulties in eating with family and workmates.

Familiarity or novelty of the diet was quite frequently perceived either positively or neutrally. Positive new things were mostly related to new products, such as *“In general, I am glad that I took part in this study where I got new plant-based options”* [P65]. Some combined the easiness and familiarity: *“The diet has been fairly easy to implement so far, and it has not required big changes because I am omnivore anyway.”* [P54]. The positive non-specified liking was related, for example, to overall positive experiences, feelings, good motivation, and likability of the foods. Non-specified comments were most often positive, too.

### 3.1.3. The PLANT diet

In total, over half of the mentions related to the PLANT diet were positive (54%), about a third of them negative (31%), and 15% neutral or ambivalent (Fig. 1). As the most frequently mentioned theme, body-related experiences were mentioned quite evenly in both positive and negative tones. The most often mentioned positive experience was improved energy level during the diet. Some even said they were coping better in their daily life than before the intervention. A few participants wondered whether the reason for feeling better was the diet or something else. For example, P26 thought better feeling resulted from regular eating:

*“My energy level is better than before the intervention. This is certainly caused by “half-compulsory” eating proper food regularly”*.

As a negative body-related experience, gastrointestinal symptoms were the most mentioned (13 mentions).

Experiences in social situations and environments were primarily reported positively. These include experiences in restaurants, lunch canteens, working trips, holiday trips, and summer cottage. On the other hand, participants also had difficulties (8 mentions) in parties, restaurants, trips, visiting others, and lunch canteens. At restaurants, participants had challenges with offerings or amounts of dairy products in plant-based meals. Participants also wrote about positive (17 mentions) and negative (3 mentions) experiences with family members, workmates and guests, and how other people think about the diet or plant-based products. P25 described the social aspect as follows:

*“Now I can say that this is not only my project but this is my whole family’s project. Also, our acquaintances have come into this with their interest and questions.”*

Practicalities and everyday life theme was the only theme experienced mostly negatively, mostly related to the restrictions posed by the intervention setting. Participants were longing for some restricted foods, mainly dairy products (16 mentions), as P48 wrote:

*“The biggest headache has been caused by the small amount of dairy products. As a heavy user of yogurt and quark I have had to think about how I will compensate for their loss. I do not think there is any good substitute in this diet.”*

Participants also longed for more fish (3 mentions) or meat (2 mentions) products. Despite the restrictions, some experienced the PLANT diet as easy to follow (14 mentions).

Regarding the non-specified liking of the diet, many reported being pleased to be in the PLANT diet group, had overall positive experiences or feelings about the diet and its foods, and were motivated and doing well. P13 wrote, *“I am happy to be in this [diet] group”*.

Summing up the findings from these three diets, participants in the ANIMAL diet mostly longed for plant-based foods, while in the 50/50 and the PLANT diets, there was a more frequent longing for dairy products. Positive and negative aspects of following the diet in different social situations and special occasions raised comments mostly in the PLANT and 50/50 diets. When looking at the body-related experiences, energetic and good feelings were more frequently reported in the 50/50 and PLANT diets and fusty and tiredness more in the 50/50 and ANIMAL groups. Particularly, the 50/50 and PLANT diets were perceived as “new” diets, as P70 following the PLANT diet wrote: *“This new kind of diet is inspirational”*. The ANIMAL diet was perceived more frequently as unhealthy than other diets.

## 3.2. Perceptions of the food products

### 3.2.1. The meat protein products

In total, there were more negative mentions (56% of all) than positive (38%) or neutral/ambivalent (6%) on experiences and perceptions related to the MPPs (Fig. 2).

The sensory properties of the MPPs were the most frequently mentioned experiences, with more mentions related to positive experiences predominantly related to taste (66 mentions); the poultry products were said most often as tasty, as P56 (ANIMAL diet) wrote: *“From last week’s foods chicken-lemon risotto was good”*. Adverse experiences were related to taste (22 mentions), texture (17 mentions) and condiments (12 mentions) of the MPPs.

The experiences of practicalities and everyday life were primarily positive and related to cooking (36 mentions). There were only two mentions of negative cooking experiences related to the MPPs. Positive experiences were related to the ease and simplicity of cooking and successfully adding vegetables, plant proteins, and condiments when cooking. P39 (PLANT diet) wrote: *“I fried pork filet, boiled black pasta, and bean vegetables, a little salt and other condiments, and quite tasty it became”*. As to the negative practicalities and everyday life experiences, the most frequently mentioned was a too much meat products overall (8 mentions).

Non-specific liking was the third most frequent theme here, and the tone was often negative. Participants did not like some of the products or found them disgusting; some ate them despite the difficulties, whereas some said they would never use the products again after intervention, and some even left them uneaten. The mentions mainly were related to the ready-made MPPs. P42 (ANIMAL diet) wrote, *“Part of the ready-made foods are terrible: ready-made hamburger, Finnish potato hash, meatballs and Potato mash and sausage-potato casserole. I have left some uneaten”*.

Other themes were brought up only by a few participants.

### 3.2.2. The plant protein products

The reported experiences and perceptions of the PPPs mainly were positive (64% of all), one-fourth (27%) were negative and 9% were neutral or ambivalent (Fig. 2). This trend was visible in almost all themes. Sensory properties of the PPPs were the most frequently mentioned theme. For example, the participants reported good taste (120 mentions), texture (10 mentions) or condiments (5 mentions) of many kinds of PPPs. For example, P27 (50/50 diet) wrote,

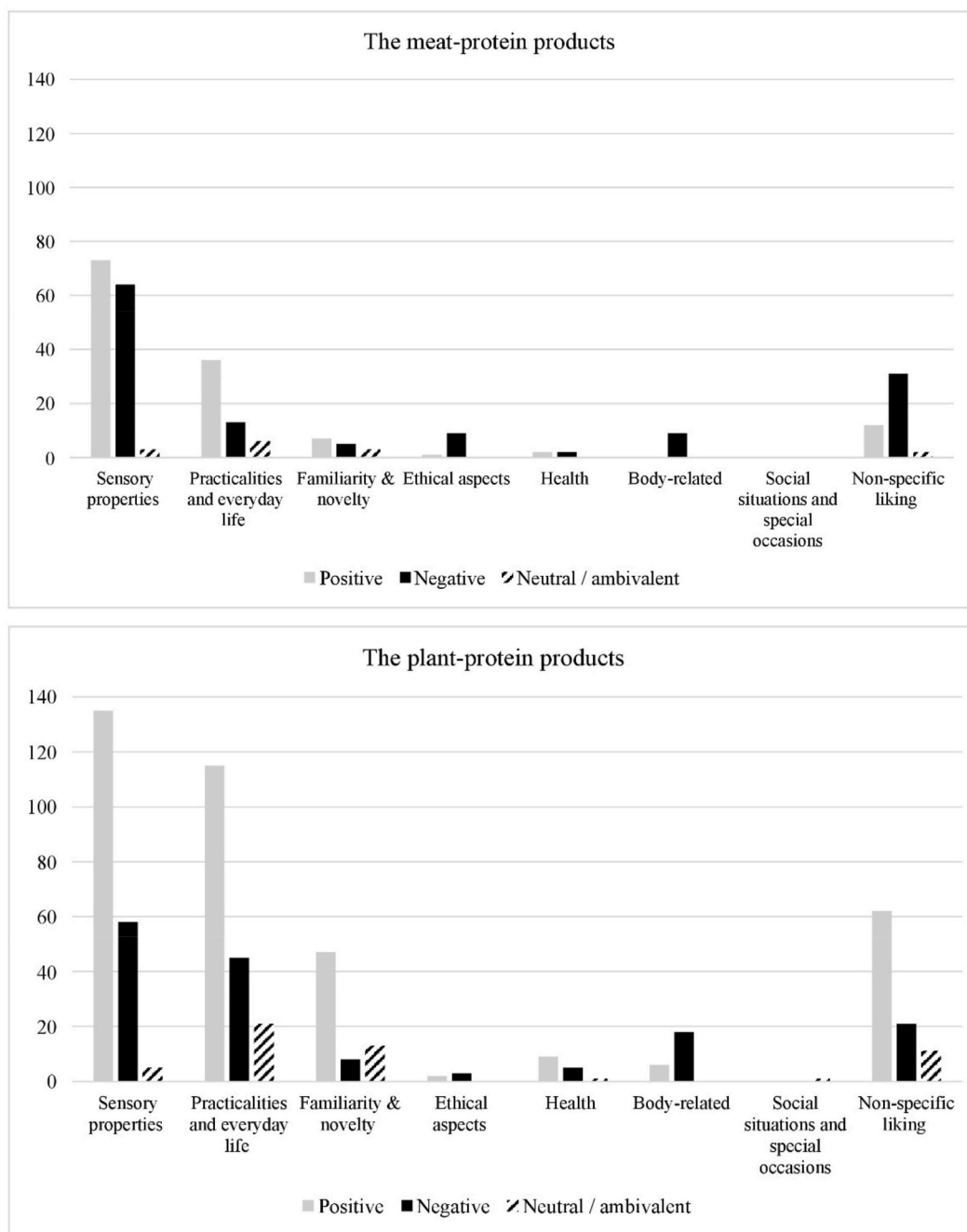


Fig. 2. Positive, negative, and neutral/ambivalent perceptions or experiences of meat protein products and plant protein products, frequencies of mentions.

*“Taste of vegetable patties was the best. The tofu was good. Patties that I made from pea groats were good. Likewise, the puree that I made from fava beans.”*

As a negative sensory aspect, participants reported mostly that they did not like the taste (40 mentions), texture (13 mentions), or condiments (5 mentions) of the products. Some said meat substitutes were tasteless, industrial, dry, or weird. P34 (50/50 diet), for example, commented on tempeh in the following manner:

*“Tempeh was also a new acquaintance. I marinated and fried it. The taste was disappointment and texture oddly floury.”*

Regarding the practicalities and everyday life, cooking-related experiences were more frequently positive (115 mentions) than negative (36 mentions). For example, participants wrote about successful recipes

they had used, and some also mentioned the easiness and speed of cooking as positive things. Some felt that given recipes helped them in cooking, like P18 following the PLANT diet,

*“Faba beans and yellow peas have been a nice surprise, especially ‘hummus’ made from yellow peas. They have activated me to cook plant protein dishes myself, however, the recipes are essential, I would not be able to use them otherwise.”*

As to the negative notes on cooking, participants often had difficulties in making the product or the prepared food tasty, and cooking times were difficult with dried bean products. Some participants saw the unfamiliarity of the plant-based dishes as the cause of their difficulties in cooking, as P52, following the 50/50 diet described, *“Eating/cooking plant-based dishes have been challenging because I have not eaten them very much/at all earlier.”*

Regarding the familiarity and novelty theme, some PPPs, such as plant-based milk substitutes, new plant-based meat substitutes, frozen bean mixtures, and dried beans, were mentioned by some as familiar or by some as new. The novelty was related to products the participants had not tried before, as P78 (50/50 diet) wrote, “*Tempeh was delicious tasting and funny novelty that I would probably not have tried without the opportunity this study brought.*”.

Bodily experiences were reported relatively infrequently, and these were mostly negative comments on gastrointestinal symptoms (14 mentions) caused by pea or other bean products. P11 in the PLANT group associated the excessive amount of plant proteins with gastrointestinal symptoms:

*“The large amounts of bean/pea and rye bread have been challenging for my gut and actually also seeds and nuts. I have been like a balloon sometimes and stomach pains have been unbearable.”*

Comparing the comments on the PPPs and the MPPs shows that the PPPs sparked more mentions than the MPPs. Moreover, the PPPs were more often commented on positively than negatively, particularly regarding sensory properties, practicalities, everyday life and non-specific liking. Body-related experiences and symptoms differed: the MPPs caused heartburn or burping, and the PPPs caused flatulence and swelling. The PPPs were more frequently perceived as novel products compared to the MPPs.

### 3.3. Self-reported changes in experiences and perceptions during the intervention

A positive change was reported most often in the PLANT group (17 mentions) and least often in the ANIMAL group (7 mentions) (Table 3). In the ANIMAL group, this positive change was most typically expressed non-specified, whereas in the other two groups, there was more variation.

As an example of adjustment, P46 in the ANIMAL group wrote:

*“I got used to the intervention diet surprisingly well, even though it felt really different and unhealthier than my diet, for example, for salt and saturated fats. At the end of the intervention, it felt normal and familiar!”*

The positive bodily changes mainly were related to gastrointestinal symptoms. There were altogether seven mentions about first having gastrointestinal symptoms. However, the symptoms eased at some point during the intervention.

The participants also reported adapting to restrictions (8 mentions) and cooking (2 mentions); both reported relatively evenly in the 50/50 and PLANT diets. Interestingly, in the PLANT group there were several mentions of “no change” – in abdominal activity, sleep quality or energy level during the diet.

Regarding the changes in perceptions of the products, the MPPs were reported only in relation to an adverse change whereas the PPPs were reported more often in a positive tone (Table 4). P43 following the PLANT diet described adjustment to cooking the PPPs as follows: “*The most challenging thing was to prepare härkis [faba bean product], nyhtökaura [‘pulled oats’ product] and tofu as tasty dishes, not until the end*

**Table 3**  
Self-reported changes of perceptions of the intervention diets, frequencies of mentions.

Theme	The ANIMAL diet n = 27			The 50/50 diet n = 22			The PLANT diet n = 30		
	Positive change	Negative change	No change	Positive change	Negative change	No change	Positive change	Negative change	No change
Body-related experiences	1	0	1	3	0	3	4	0	15
Practicalities and everyday life	0	0	0	5	0	0	7	0	0
Social situations and special occasions	0	0	0	0	0	1	0	0	1
Non-specific liking	6	3	0	5	3	0	4	5	0
Total	7	3	1	13	3	4	15	5	16

**Table 4**  
Self-reported changes of perceptions of the meat-protein and plant-protein products, frequencies of mentions.

Theme	Meat protein products n = 79		Plant-protein products n = 79	
	Positive change	Negative change	Positive change	Negative change
Practicalities and everyday life	0	0	9	0
Sensory properties	0	0	2	0
Non-specific liking	0	6	9	6
Total	0	6	20	6

*of the intervention these become better experiences by adding spices (such as chilli).”*

All reported changes in perceptions of the MPPs under the theme of non-specific liking. There were three mentions about getting bored with some MPPs. P3 in the 50/50 group wrote: “*I have got bored with almost all animal-based food products, except for unseasoned raw animal protein from which one can prepare a meal oneself.*” No one reported getting used to the MPPs.

## 4. Discussion

We explored perceptions of and experiences of three intervention diets and their food products as well as reported changes in these perceptions. We found a rich variety of perceptions and experiences that we grouped into eight themes: body-related experiences, practicalities and everyday life, sensory properties, social situations and special occasions, familiarity and novelty, health and ethical aspects, and finally, a theme where liking or disliking was not specified. We found that participants commented on the PLANT and the 50/50 diets and plant protein products more often in a positive tone than the ANIMAL diet and meat-protein products. In all diets, changes in perceptions were mostly positive.

Body-related experiences were the most often mentioned theme related to all three diets. Participants described both negative and positive experiences, mostly related to their energy level or gastrointestinal symptoms. It was anticipated that gastrointestinal symptoms would be reported in all diet groups due to the differences between intervention diets and participants’ pre-intervention diets. On a product level, reported symptoms were expectedly related to the bean products. Earlier studies have shown that one barrier to plant protein product consumption could be that they are known to cause digestive problems (Figueira et al., 2019; Jallinoja et al., 2016). However, some see legumes benefiting the gut or digestion (Figueira et al., 2019). There were few mentions in every diet group that the bowel movement was adjusted during the intervention. This observation aligns with the results of Winham and Hutchins (2011), who found that after a few weeks of daily bean consumption, many participants perceived their flatulence returning to normal levels. In a qualitative study by Collier et al. (2021), some participants reported that reducing meat consumption helped to

ease their digestive and stomach problems (Collier et al., 2021). We also found mentions of the absence of gastrointestinal symptoms among the followers of the PLANT diet.

The improved energy level was a commonly mentioned positive experience, particularly in the 50/50 and PLANT groups. This finding is noteworthy in the context of an earlier study showing that the perception that a plant-based diet or foods may not offer an adequate amount of energy or strength served as a significant barrier to the consumption of plant-based foods (Perez-Cueto et al., 2022). It is possible that also some of our participants held similar perceptions when they started the intervention diets. If that is the case, the PLANT and the 50/50 diets might have provided some of them with new and positive experiences of the effects of these kinds of diets. Interestingly, fusty and tired feelings were described mostly in the ANIMAL and 50/50 diets.

Regarding the food products, sensory properties were the most frequently mentioned theme. The meat protein products were commented relatively equally as positive and as negative, whereas the plant-protein products were significantly more frequently commented positively. Especially taste as an important driver or barrier to using plant-based products has been highlighted also in previous studies (Figueira et al., 2019; Gillies et al., 2023; Hoek et al., 2011; Jallinoja et al., 2016; Kerslake et al., 2022; Knaapila et al., 2022; McCarthy et al., 2017; Reipurth et al., 2019; Varela et al., 2022; Weinrich, 2018). However, there were a lot of negative comments, too, related to texture condiments or ingredients.

It's noteworthy that participants demonstrated a higher frequency of liking the PPPs compared to disliking them. Earlier studies have shown that meat or dairy products are often more positively perceived than their plant-based substitutes (Cardello et al., 2022; Collier et al., 2021; Gillies et al., 2023; Haas et al., 2019; Michel et al., 2021; Rööös et al., 2022). Reasons for the relatively frequent liking of the PPPs might be that the intervention included a variety of PPPs: many could find at least one product to like. Moreover, individuals already interested in plant-based foods at the baseline participated more eagerly in the study. This explanation is supported by Gillies et al. (2023), who found that the strongest motivation to attend an intervention study involving plant-based diets was a strong interest in trying plant-based diets.

The theme covering various practicalities and everyday life situations was the second most frequently mentioned theme related to diets and products. Within this theme, negative experiences were, for a good part, related to the restrictions of diets. A similar barrier to following a plant-based diet was reported in earlier studies (Kerslake et al., 2022; Okpara et al., 2022).

The restrictions of dairy products were perceived as challenging in all diet groups, but particularly in the 50/50 and PLANT diets. This is not surprising considering the characteristics of the pre-intervention diets of the study participants: they had higher than the Finnish average consumption of milk products combined with less than the average meat consumption (Valsta, 2019). A previous study indicated that Finns with low consumption of red and processed meat tend to consume more liquid dairy and cheese (Lehto et al., 2022). Additionally, dairy products are important in Finnish food culture (Kylli, 2018). Plant-based dairy substitutes do not seem as well-liked due to their sensory properties or not as suitable on all occasions as dairy products (Cardello et al., 2022).

For these reasons, replacing meat was not as challenging as replacing dairy products among these study participants. Additionally, in our intervention, participants received only plant-based milk substitutes but no other plant-based dairy substitutes. That might have caused some difficulties in finding replacement products on their own. However, despite the challenges, during the 12-week intervention, many participants reported getting used to restricting the use of dairy products.

With the products, the practicalities and everyday life-related experiences were mostly related to cooking. Similar factors have been found to be an important contributor related to the use of plant-based products in many earlier studies, too (Figueira et al., 2019; Kerslake et al., 2022; Reipurth et al., 2019; Varela et al., 2022). In this study, the

participants brought up a lack of cooking skills, especially concerning the PPPs. On the other hand, it seems that trying the provided or own recipes during the intervention may have positively influenced participants' cooking experience and fostered their cooking skills through practice and trying.

Participants of the 50/50 and PLANT diet groups reported rather similarly positive and negative experiences related to special occasions, such as restaurants, holidays, or journeys. Negative and positive aspects of eating plant-based foods in restaurants have been brought up in previous studies (for example, Biermann & Rau, 2020; Elzerman et al., 2021; Kerslake et al., 2022; Knaapila et al., 2022; Michel et al., 2021; Reipurth et al., 2019). Among our intervention participants, positive experiences related to the social environment were particularly reported by the followers of the PLANT diet. These comments were mostly related to positive comments from family members or relatives. In a study by Okpara et al. (2022), it was found that social support was an important driver for following vegan or meat-restricted diets in intervention settings.

While interpreting the results of our study, it is important to bear in mind the intervention context in which the research group designed the diets. The study participants incorporated the instructions and foods into their daily meals, demonstrating adaptation and compliance. The intervention may also have caused some resistance or rebellion against the preplanned diet or foods, such as boredom or negative experiences or perceptions (Botti et al., 2008; Lombardini & Lankoski, 2013). A promising finding was that participants' experiences and perceptions of diets and products changed mostly positively, even though some started with negative experiences and perceptions. An earlier 3-week vegan intervention reported similar findings: many perceived barriers diminished and reporting of benefits and acceptability increased (Crimarco et al., 2020). In this study, some participants reported liking routines and tight instructions that were easy to follow. On the other hand, some got bored and were longing for variation.

#### 4.1. Strengths and limitations

Notable strengths of our study are a highly controlled (about 80% of energy intake) trial with a relatively long duration and excellent compliance from the study participants. Also, the data contained a relatively large number of participants for qualitative research, which enables the comparison between diet groups and product categories. We were also able to analyse both the contents of the themes qualitatively and make quantitative comparisons between the diets and between the food groups. The intervention design provides a new perspective for studying perceptions of diets, with one diet representing an average Finnish diet and two representing "flexitarian" or "semi-vegetarian" alternatives. The intervention diets that closely resemble usual food choices increase the external validity of the results. In addition, an open-form diary enabled the study participants to express freely their experiences and perceptions.

As a limitation, the participants were a selected group of Finns. The participants had similar characteristics to those who have, in previous studies, been shown to be followers of plant-based diets or those interested in plant-based products or diets. They were mainly women and had a higher education level than the general population in Finland. However, their pre-intervention diets (64% animal-based/36% plant-based protein of total protein intake) were still closer to the traditional Finnish diet (70/30) (Valsta, 2019) than to the intervention diets where animal-sourced proteins are limited. Moreover, we could not compare the results by gender due to a larger proportion of women.

In addition, 42% of the intervention participants did not fill in experience diaries, and the proportion of those varied between the diet groups. We know that women wrote more actively than men. Those who wrote diaries ate less meat before the intervention compared to those who did not write diaries. Finally, diary entries by the PLANT diet participants and the 50/50 diet participants were almost twice as long as

the entries by the ANIMAL group participants (1.1 pages, 1 page, 0.6 page, respectively), so it seems that plant protein-based diets and new plant protein products raised most thoughts in the participants.

#### 4.2. Conclusion

Adverse sensory and cooking experiences and gastrointestinal symptoms related to plant protein products could pose a challenge and limit the use of certain products. However, this study showed that not everyone experiences these challenges and perceptions may evolve over time through experiences, especially the ones related to self-perceived energetic feelings or gastrointestinal symptoms. Our results call for increased attention to perceptions associated with various flexitarian diets, where only a portion of animal-based protein sources is replaced by plant-based alternatives. These diets are the first and most probable population steps towards a more plant-based diet. However, there is still room for improvement in enhancing the sensory quality and ease of food preparation of plant protein products.

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#### CRedit authorship contribution statement

**Tiina Pellinen:** Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Piia Jallinoja:** Writing – review & editing, Visualization, Validation, Supervision, Methodology, Investigation, Formal analysis. **Maijaliisa Erkkola:** Writing – review & editing, Supervision, Investigation, Data curation, Conceptualization. **Anne-Maria Pajari:** Writing – review & editing, Supervision, Resources, Project administration, Investigation, Funding acquisition, Data curation, Conceptualization.

#### Declaration of competing interest

The authors report no conflict of interest.

#### Data availability

Data will be made available on request.

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.appet.2024.107538>.

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