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A transition towards plant-based diets on its way? Consumers' substitutions of meat in their diets in Finland

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ABSTRACT

In recent years, the position of meat has been challenged in Western food cultures due to its ecological, health and animal welfare impacts. This study examined consumers' reported changes in their meat and plant protein consumption in a new situation after the prominent market entrance of novel plant-based products in Finland. The study is based on an online survey (N = 1,000) among 18–79-year-old consumers living in Finland. Using latent class analysis, four consumer clusters were identified based on self-reported past changes in meat and plant protein consumption. The largest cluster was 'No change' (43.3 % of the respondents), followed by 'Less red meat, more plant proteins' (30.4 %), 'Less red meat, more poultry' (17.9 %) and 'No/very little meat, more plant proteins' (8.4 %). The clusters differed in their sociodemographic characteristics: gender, age, level of education and area of residence. One-way ANOVA showed differences between the clusters in food neophobia, natural concerns, health and pleasure motives. In addition, the clusters held varying attitudes towards meat, beans, and plant-based protein products. The results suggest an increasing interest among consumers in less-meat diets, indicating support for the needed societal transition towards more sustainable patterns of eating.

1. Introduction

During the last two decades, it has been increasingly recognized in scientific, political and popular discourses that animal-based food production and consumption have significant, detrimental environmental impacts (Notarnicola et al., 2017; Rijsberman, 2017; van Dooren et al., 2014). The production and consumption of animal-based foods, particularly beef, generate high amounts of greenhouse gas emissions, use substantial areas of land and aggravate acidification, eutrophication and water scarcity (Clark et al., 2019; Nijdam et al., 2012; Scarborough et al., 2014).

At the same time, contemporary dietary guidelines in many European countries recommend reducing red and processed meat intake (Meltzer et al., 2019; Reynolds et al., 2014). High red and processed meat consumption is associated with nutrient-poor dietary habits, overweight, smoking and less physical activity (Fogelholm et al., 2015; Grosso et al., 2017) as well as an increased risk of several chronic disease (de Smet & Vossen, 2016), such as cancer (Bouvard et al., 2015) and type 2 diabetes (International Agency for Research on Cancer, 2015). The environmental and health-related problems of meat production and consumption have made it evident that a transition towards more plant-based diets is urgently needed (Godfray et al., 2018; Rose et al., 2019; Willett et al., 2019).

Such a change is not easy, since meat is an essential part of Western food cultures and plays an important role in everyday food practices and routines. For many people, meat is a self-evident part of everyday eating (Smil, 2013), and especially unprocessed meat is regarded as nutritious (Michel et al., 2021a; Verbeke et al., 2010), tasty and fulfilling (Jallinoja et al., 2019). Meat products are widely available, convenient and socially appropriate (Korzen & Lassen, 2010). In Western countries, meat is typically rationalized as natural, normal, necessary and nice (Piazza et al., 2015). Due to the 'cultural stickiness' of meat, it is challenging for consumers to replace meat with plant protein products. Consumers also have doubts concerning the healthiness and naturalness of processed plant protein products (Varela et al., 2022).

However, some signs of change can be seen: During the last decade, diets with less meat and more plant-based foods as well as 'flexitarianism', i.e., following a mainly plant-based diet but also occasionally eating meat, have become more popular in Western countries (Dagevos, 2021; Rosenfeld et al., 2020). This parallels the significant media

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attention to, and consumer interest in, veganism and other forms of plant-based diets in recent years (Jallinoja et al., 2019). In addition, there has been an increase in research focusing on consumer perspectives on plant-based eating (e.g., de Boer et al., 2014; Niva & Vainio, 2021; Niva et al., 2017; Schösler et al., 2012; Vanhonacker et al., 2013).

At the same time, the availability of plant proteins has widened considerably from beans, tofu, and textured soy protein to easy and quick-to-use plant protein products, which are also marketed to omnivores wishing to reduce their meat-eating (Michel et al., 2021a). The increasing market supply of plant protein products over the last decade is an international phenomenon, and the market is still developing (Clément et al., 2018; Curtain & Grafenauer, 2019). A variety of novel products made of oats, peas and fava beans as well as new soya-based foods have increasingly entered shops, and the new foods imitate meat in appearance and mouthfeel.

There is also wide policy interest in the transition towards sustainable diets: The Farm to Fork Strategy and the ambitious climate targets of the European Union (European Commission, 2020) call for more sustainable food consumption. In Finland – the context of our study – the government started in 2020 a climate-friendly food programme that aims at increasing the consumption of plant and fish and diminishing the role of meat and milk in Finnish diets (Ministry of Agriculture and Forestry, 2021).

Against this background, the present study examines recent changes in meat and plant protein consumption in Finland. First, we aim to identify specific consumer clusters based on self-reported past changes in the consumption of meat (beef, pork, poultry) and two types of plant proteins: beans and plant protein products. Second, we examine the characteristics of the clusters in terms of sociodemographic factors, eating motives, and attitudes towards meat, bean and plant protein products. The aim is to examine possible challenges and drivers of meat and plant-based protein consumption among Finnish consumers.

2. Meat and plant protein consumption in Western countries

2.1. Meat and plant protein consumption

In Western countries, global total meat consumption has increased since the early 1960s, but red meat, mostly beef, consumption per capita has been stable, and the consumption of white meat (poultry) has increased (Bonnet et al., 2020). According to FAOStat (2021), in 2019, average meat consumption per capita was 76 kg in Europe and 125 kilos in North America. Compared to the global average meat consumption of 43 kg per capita per year, European and North American consumption is thus very high and reflects the position of meat as an everyday staple food in these areas. In Finland, yearly meat consumption is today at around 80 kg per person, and consumption levels have not increased in recent years. Finnish red meat (beef, pork) consumption has been quite stable, while the consumption of poultry has almost tripled during the last 30 years (Natural Resources Institute Finland (Luke), 2022). These changes reflect international trends.

In European countries, plant protein consumption has recently increased rapidly: between 2018 and 2020 it grew by 49 % (Smart Protein Project, 2021), and the number of product launches of plant protein products has grown during the last decade (Aschemann-Witzel et al., 2020). In Finland, although sales of plant protein products were predicted to increase by as much as 67 % in volume between 2017 and 2021 (Makery, 2019), their consumption remains low compared to that of meat (Aalto, 2018). Most Finns use plant proteins very infrequently or not at all (Jallinoja et al., 2016). Previous studies indicate that the willingness of many Western consumers to replace meat with meat substitutes is quite low (Hartmann & Siegrist, 2017). For instance, in an Australian study 46 % (Malek et al., 2019) and in a Finnish study 48 % of respondents (Latvala et al., 2012) reported consuming beef regularly, with no intended future changes. In another Finnish study (Vainio et al. 2016), 25 % of respondents had an established diet with beef and no plant proteins, whereas 46 % had an established diet with either beef and beans or beef, beans, and soy products. Some 20 % did not eat beef or were transitioning towards plant-based diets. The results by Latvala et al. (2012) some ten years ago showed that many consumers were reducing meat-eating or shifting to different meat types, typically from red to white meat (see also Jallinoja et al., 2016).

Various sociodemographic, attitudinal and motivational, social, and practical factors have been identified as playing a role in eating meat and alternative proteins. These factors are often interlinked. For instance, sociodemographic differences may result from a complex mixture of biological (e.g., age), sociocultural (e.g., perceptions of masculinity and femininity) and contextual (e.g., availability) factors.

2.2. Sociodemographic factors

Previous studies have indicated sociodemographic variation in the consumption of meat and plant proteins. In terms of *gender*, women are more likely to reduce their meat consumption. Women are more likely to have already reduced their meat consumption or to be planning to do so (Latvala et al., 2012; Vainio et al., 2016; Malek et al., 2019) and also are more likely to adopt meat-reducing strategies, e.g., meatless meals (de Boer et al., 2014), and women also are more likely to be frequent eaters of pulses and plant proteins than men (Jallinoja et al., 2016; Siegrist & Hartmann, 2019).

In terms of *age*, some studies have found that older consumers are less likely to decrease their meat consumption (e.g., Hielkema & Lund, 2021), and older consumers tend to have more positive beliefs about red meat than younger consumers and are more likely to be established beef lovers (Vainio et al., 2018). However, Neff et al. (2018) found that older consumers were more likely to have decreased or to consider decreasing the consumption of some meat types, such as red meat. Younger consumers were more likely to adopt a vegetarian diet or to increase their plant protein consumption than middle-aged or older consumers (de Gavelle et al., 2019).

Level of education has been found to be associated with a higher willingness to reduce meat consumption or to replace meat with plant proteins. Consumers with higher education consume less meat, their bean consumption is more frequent, they are more likely to be vegetarians than consumers with lower education and they are more likely to choose plant protein alternatives to reduce their meat consumption (Jallinoja et al., 2016; Lacroix & Gifford, 2019; Latvala et al., 2012; Lehto et al., 2021; Slade, 2018).

Living in urban rather than rural areas is also associated with less frequent meat consumption. Shaw and Iomaire (2019) found that Irish consumers living in rural areas consumed meat more frequently than consumers living in urban areas. In a Finnish study, consumers living in the capital area were more frequent bean consumers (Jallinoja et al., 2016).

A potential explanation for sociodemographic differences is that young, educated and urban consumers may be more exposed than others to novelties and varieties of food (Mascarello et al., 2020; Meiselman et al., 2010). Although the evidence on the role of sociodemographic factors is not quite consistent, we expected to find that consumer clusters tending to reduce or avoid eating meat and to prefer plant proteins would be younger, female and living in an urban area (*Hypothesis 1*).

2.3. Food attitudes and eating motives

Food neophobia has been found to be one of the most important person-related factors associated with meat substitute acceptance (Hoek et al., 2011) as well as with acceptance of novel foods more generally (Tuorila & Hartmann, 2020). Food neophobia refers to a tendency to avoid new foods, and it is associated with reduced consumption of protein-rich foods, fruit and vegetables (Jaeger et al., 2017; Knaapila et al., 2011). Moreover, consumers with a high level of food neophobia have been found to be less concerned about health or the environment

than consumers with a low level of food neophobia (Jaeger et al., 2021; Michel et al., 2021b). Therefore, we expected to find that food neophobia would be more prevalent in consumer clusters tending to avoid changes in diet or to avoid meat substitutes as compared to other clusters (*Hypothesis 2*).

Attitudes towards meat and plant-based alternatives are associated with dietary changes related to these foods. For instance, positive attitudes towards meat are associated with a reduced willingness to decrease meat consumption (de Boer et al., 2014; Graça et al., 2015), and semi-vegetarians have been found to express a more positive attitude towards meat than strict vegetarians (Rothgerber, 2014). Based on these earlier results, our hypothesis was that positive attitudes towards meat would be more prevalent in clusters that avoid changes in meat consumption or that replace red meat with other types of meat rather than with plant proteins (*Hypothesis 3a*), and that positive attitudes towards beans and plant protein products would be more prevalent in clusters that avoid meat and use plant-based alternatives (*Hypothesis 3b*).

Recent research indicates that reducing meat is associated with *eating motives related to health* (Haverstock & Forgays, 2012; Vinnari & Tapio, 2009) and *sustainability* (here referring to the environment and to animal welfare) (Rosenfeld et al., 2020; Vainio, 2019). Health consciousness and perceptions of the environmental impact of meat substitutes are predictors of meat substitute consumption (Siegrist & Hartmann, 2019). Clark and Bogdan (2019) found that, among Canadians, both health and animal or environmental ethics were significant in personal decisions to eat plant proteins. In Finland, Vainio et al. (2016) showed that an ongoing transition to plant proteins was positively associated with natural concerns and health and weight-loss motives. Graça et al.'s (2019) recent findings indicated that consumers with food consumption orientations towards health and naturalness were more willing than others to reduce their meat consumption and to adopt a plant-based diet. Based on these findings, we expected that health, natural concerns and sustainability-related motives would be more prevalent in clusters that reduce or have low consumption of meat and that increase the consumption of plant-based alternatives as compared to other groups (*Hypothesis 4a*).

According to Vainio et al.'s (2016) study in Finland, price motive is less important to consumers with established diets, including beans and soy products, compared to other groups. Graça et al. (2019) showed that pleasure orientation was less important to consumers following a plant-based diet or reducing meat intake than to other groups. Based on these previous findings, we expected that price and pleasure motives would be more prevalent in clusters that avoid changes in meat consumption as compared to those who reduce or have low consumption of meat (*Hypothesis 4b*).

3. Materials and methods

3.1. Study sample

An online questionnaire was sent to a sample of members of a consumer panel of the commercial marketing research company Taloustutkimus in January 2018. The invitation to the survey explained that the study focused on food consumption and food choices. The sample was created in two stages. The first sample was a randomized sample, and the second sample was a quota sample (with sociodemographic quota variables age, gender, region and education) representing the 18–79-year-old population living in mainland Finland. In 2018, almost 100 % of 15–44-year-old, over 90 % of 45–74-year-old, and 40 % of 75–89-year-old Finns had Internet access at their home (Official Statistics of Finland (OSF), 2019). Of the contacted consumers, 16 % completed the questionnaire, and the final size of the dataset was 1,000 respondents. The same data has been used in an article focusing on both earlier and planned changes in the consumption of beef and plant- and insect-based proteins (Niva & Vainio, 2021).

The gender and geographical distributions of the data were close to those of the Finnish population (Table 1). However, 50–64-year-old respondents were overrepresented, whereas 18–34-year-olds and over 65-year-olds were underrepresented in the data compared to population statistics. Respondents with a secondary-level education were somewhat underrepresented, while those with a tertiary-level education were overrepresented in the data. All in all, apart from the 50–64-year-old age group, the differences between the data and the population statistics were between 0.3 and 8.3 percentage points, and we conclude that the data were thus reasonably representative of the Finnish population.

Table 1
Age, gender and highest education level in the Finnish 18–79-year-old population in 2017 (Statistics Finland, 2018) and in the data sample (N = 1,000)0.[1]

	Finnish population (%)	Data sample (%)
Gender[2]		
women	50.2	50.5
men	49.8	49.5
Age group (years)		
18–34	27.8	20.9
35–49	24.4	22.4
50–64	26.5	40.6
65–79	21.3	16.1
Highest education[3]		
basic level	23.9	18.5
secondary level	43.0	41.4
tertiary level	33.1	41.4
Region		
Helsinki metropolitan area	20.9	22.4
Southern Finland	21.9	23.3
Western Finland	35.1	32.6
Northern and Eastern Finland	22.3	21.7

[1] The participants were requested to indicate their gender (man, woman, other/do not want to respond), age (recoded into 1 = 18–34 years, 2 = 35–49 years, 3 = 50–64 years and 4 = at least 65 years), highest level of education (recoded into 1 = basic degree, 2 = secondary degree, 3 = tertiary degree) and size of place of residence (1 = capital city area, 2 = other city with more than 100,000 inhabitants, 3 = city with 50,000–100,000 inhabitants, 4 = a city/municipality with<50,000 inhabitants). Fourteen respondents reported their gender as 'other/do not want to respond', and they were excluded from the dataset because of the small size of the category.

[2] For gender, those who responded 'other' or 'I do not want to answer' (n = 14) were excluded.

[3] In the population, the percentages show education level among 20–74-year-olds.

3.2. Questionnaire

The questionnaire consisted of five sections. In addition to meat- and plant protein-related questions, there were sections on other timely food phenomena of interest in the larger project 'Changing structures and competition issues in the Finnish food markets', of which the survey formed a part. The first section included questions on food attitudes and eating motives; the second was about private label products; the third concerned meat and plant proteins; the fourth dealt with edible insects; and the final section included sociodemographic and diet-related background questions.

3.3. Measures

One set of questions used in this study dealt with past changes in the consumption of 1) beef, 2) pork, 3) poultry, 4) canned and dried beans and 5) plant protein products with tofu, pulled oats, 'härkis' (a fava bean-based product) and vegetable patties given as examples. Using a 4-point scale, the respondents indicated whether 1) they had not consumed these foods at all or whether their consumption had 2) decreased, 3) remained stable or 4) increased in the previous 2–3 years.

Five sets of questions measured eating motives (Table 2). The questions were derived from earlier research using established Finnish translations (Urala et al., 2005) and presented with 7-point Likert scale

Table 2
Items (7-point Likert scale) measuring eating motives, meat and bean attitudes and plant protein product attitudes, Cronbach's alphas and interpretations.

	Cronbach's alpha	Interpretation
Eating motives		
Neophobia	0.849	The higher the score, the higher is the level of neophobia.
I am constantly sampling new and different foods (reversed).		
If I don't know what is in a food, I won't try it.		
I like foods from different countries (reversed).		
At dinner parties, I will try a new food (reversed).		
I am afraid to eat things I have never had before.		
I like to try new ethnic restaurants (reversed).		
General health interest (GHI)	0.864	The higher the score, the higher is health consciousness.
I am very particular about the healthiness of food I eat.		
I always follow a healthy and balanced diet.		
It is important for me that my diet is low in fat.		
I eat what I like and I do not worry much about the healthiness of food (reversed).		
It is important for me that my daily diet contains a lot of vitamins and minerals.		
I take a notice of how much food contains protein.*		
I avoid sugar.*		
Natural product interest (NPI)	0.830	The higher the score, the more important is naturalness of food.
I do not eat processed foods because I do not know what they contain.		
I do not care about additives in my daily diet (reversed).		
I try to eat foods that do not contain additives.		
I would like to eat only organically grown vegetables.		
In my opinion, artificially flavoured foods are not harmful for my health (reversed).		
Price	0.623	The higher the score, the more important is quality over price.
I will grocery shop at more than one store to take advantage of low prices (reversed).		
I buy groceries at the cheapest possible price (reversed).*		
When grocery shopping, I compare the prices of different brands to be sure I get the best value for money (reversed).		
I buy expensive groceries, because they have better quality.*		
Generally speaking, the higher the price of a product, the higher the quality.		
Pleasure	0.772	The higher the score, the more important is pleasure related to food.
Eating is very important for me.		
I often treat myself to something really delicious.		
For me, delicious food is an essential part of weekends.		
Eating is a highlight of the day.		
Taste is the most important aspect of food.*		
I show my loved ones and myself care by cooking healthy and tasty meals.*		
Meat, bean and plant protein product attitudes		
Meat in diet	0.849	The higher the score, the more important is meat as part of diet, cooking and sociability.
Meat is an important part of a balanced diet.		
Meat is an essential source of proteins.		
Meat can well be replaced with plant proteins (reversed).		
Meat in cooking	0.791	
I can cook tastier meals from meat than from other ingredients.		
I am used to cooking meat dishes.		
It's easier for me to find recipes for meat dishes than for vegetable dishes.		
Meat as sociability	0.814	
In a restaurant, I prefer to eat meat.		
I prefer to serve meat to my guests.		
My family eats meat and does do not want to reduce meat-eating.		
Sustainability	0.855	The higher the score, the more critical is the stance on the sustainability of meat production and consumption.
If people in the world ate less meat, there would be enough food for every-one.		
To slow down climate change, meat consumption should be considerably reduced.		
Meat production is unethical.		
Bean attitudes	0.799	The higher the score, the more favourable is the attitude towards beans.
Beans are inexpensive.		
Beans have an unpleasant taste (reversed).		
Beans are a versatile ingredient.		
Beans are easy to use.		
Plant protein product attitudes	0.921	The higher the score, the more favourable is the attitude towards plant protein products.
Healthy – Unhealthy (reversed)		
Natural – Processed (reversed)		
Attractive – Disgusting (reversed)		
Familiar – Unfamiliar (reversed)		
Affordable – Expensive (reversed)		
Tasteful – Distasteful (reversed)		
Domestic – Foreign (reversed)		
Environmentally friendly – Environmentally unfriendly (reversed)		
Ethical – Unethical (reversed)		
Socially acceptable – Socially unacceptable (reversed)		
Easy to prepare – Effortful to prepare (reversed)		
Easily available – Not easily available (reversed)		
Interesting – Uninteresting (reversed)		

*The item was added to the original measure by the authors.

Table 3
Results of fitting alternative latent class models (latent class analysis).

Model description	LL	BIC(LL)	AIC(LL)	Npar	L^2	df	p-value	Class.Err.
1-Cluster	−5573.41	11250.44	11176.82	15	2141.169	985	1.60E-87	0
2-Cluster	−5114.31	10442.76	10290.62	31	1222.968	969	4.50E-08	0.0522
3-Cluster	−4882.7	10090.06	9859.399	47	759.7467	953	1	0.06
4-Cluster	**−4808.75**	**10052.69**	**9743.497**	**63**	**611.8442**	**937**	**1**	**0.124**
5-Cluster	−4775.64	10,097	9709.283	79	545.6306	921	1	0.1773
6-Cluster	−4750.28	10156.81	9690.569	95	494.9165	905	1	0.1867
7-Cluster	−4724.95	10216.66	9671.904	111	444.2512	889	1	0.1404

response options (1 = totally disagree, 2 = somewhat disagree, 3 = disagree a little, 4 = neither disagree nor agree, 5 = agree a little, 6 = somewhat agree, 7 = totally agree). Five mean variables were formed based on the items (Table 2): *Neophobia* (respondent's willingness to try new foods, ingredients and dishes) (Pliner & Hobden, 1992), *Health* (General health interest GHI; Roininen et al., 1999), *Natural concerns* (Natural product interest NPI; five variables included from Roininen, 2001), *Price* (Lichtenstein et al., 1993) and *Pleasure* (Bäckström et al., 2004). We added items to the measures in order to take into account recent food-related discussions.

Meat- and bean-related attitudes were measured with sets of statements concerning the role of meat as part of the diet and sociability of eating, meat as part of cooking, sustainability issues relating to meat production and consumption, and attitudes to beans. Again, the respondents were asked to take a stand on the statements by using a 7-point Likert scale (see above). Five mean variables were formed: *Meat in diet, Meat in cooking, Meat as sociability*, *Sustainability attitudes* and *Bean attitudes* (Table 2).

In the questionnaire, it was explained to the respondents that "plant protein products mean pulled oats, härkis, tofu or other soy-based products, quorn, tempeh, seitan or other similar plant-based product rich in protein", and attitudes towards such products were measured with 13 items using a 7-point semantic differential scale in which the response options were given as opposite adjectives at each end. The respondents were asked to indicate the point of the scale that best matched their image of plant protein products. The semantic differential scale items included healthiness (with the ends healthy – unhealthy), naturalness (natural – processed), attractiveness (attractive – disgusting), familiarity (familiar – unfamiliar), affordability (affordable – expensive), tastefulness (tasteful – distasteful), origin (domestic – foreign), environmental friendliness (environmentally friendly – environmentally unfriendly), ethicality (ethical – unethical), social acceptability (socially acceptable – socially unacceptable), ease of preparing (easy to prepare – effortful to prepare), availability (easily available – not easily available) and appeal of plant protein products (interesting – uninteresting). The original scale was reversed. A mean variable titled *Plant protein product attitudes* was formed based on the items (Table 2).

The frequency of replacing meat with beans or plant protein products was measured with a 6-point scale with a separate option for 'vegetarian, no meat consumption' (Table 5).

3.4. Statistical analysis

Consumer clusters with different patterns of consuming various types of meat and plant proteins were identified by latent class analysis (LCA) using Latent Gold version 5.1 (Vermunt & Magdison, 2016). Latent classes are unobserved clusters, which are based on cross-classification of observed variables, in this case self-reported past changes in the consumption of beef, pork, poultry, beans and plant protein products. LCA aims to find latent clusters in which individuals share similar

Table 4
Variables used in forming the clusters (latent class analysis).

	C1. No change (N = 433)	C2. Less red meat, more plant proteins (N = 304)	C3. Less red meat, more poultry (N = 179)	C4. No/very little meat, more plant proteins (N = 84)	Total (N = 1000)
Cluster size (%)	43.3	30.4	17.9	8.4	100.0
Indicators					
Beef					
No consumption	0.02	0.02	0.04	0.95	0.10
Consumption has decreased	0.06	0.84	0.48	0.02	0.38
Consumption has remained stable	0.92	0.11	0.37	0.03	0.50
Consumption has increased	0.00	0.02	0.11	0.00	0.03
Pork					
No consumption	0.01	0.04	0.08	0.98	0.11
Consumption has decreased	0.06	0.83	0.40	0.02	0.35
Consumption has remained stable	0.93	0.13	0.38	0.00	0.51
Consumption has increased	0.00	0.00	0.14	0.00	0.03
Poultry					
No consumption	0.02	0.02	0.04	0.73	0.08
Consumption has decreased	0.04	0.26	0.10	0.19	0.13
Consumption has remained stable	0.80	0.45	0.45	0.08	0.56
Consumption has increased	0.14	0.28	0.41	0.00	0.22
Beans					
No consumption	0.28	0.08	0.46	0.06	0.24
Consumption has decreased	0.10	0.04	0.24	0.05	0.11
Consumption has remained stable	0.55	0.57	0.29	0.47	0.50
Consumption has increased	0.07	0.31	0.00	0.42	0.16
Plant proteins products					
No consumption	0.70	0.24	0.95	0.01	0.56
Consumption has decreased	0.06	0.04	0.05	0.06	0.05
Consumption has remained stable	0.18	0.33	0.00	0.28	0.20
Consumption has increased	0.06	0.40	0.00	0.64	0.20

Table 5
Sociodemographic characteristics and frequency of replacing meat with beans or plant protein products in the four clusters (N = 1,000, %, Pearson chi-square test of differences between the clusters).

		Established diet				Pairwise comparisons						
		C1. No change in meat consumption (N = 433)	C2. Less red meat, more plant proteins (N = 304)	C3. Less red meat, more poultry (N = 179)	C4. No/very little meat, more plant proteins (N = 84)	Total (N = 1000)	Contrast C1 vs C2	Contrast C2 vs C3	Contrast C3 vs C4	Contrast C1 vs C4	Contrast C1 vs C3	Contrast C2 vs C4
Cluster size (%)		43.3 %	30.4 %	17.9 %	8.4 %	100.0 %						
Gender							***	ns	***	***	***	***
	Man	61.3	42.7	44.4	22.1	49.5						
	Woman	38.7	57.3	55.6	77.9	50.5						
Age group							ns	*	***	***	ns	***
	18–34 years	15.5	23.0	14.5	54.8	20.9						
	35–49 years	23.8	23.4	19.0	19.0	22.4						
	50–64 years	43.0	37.5	48.6	22.6	40.6						
	65 years or over	17.8	16.1	17.9	3.6	16.1						
Education							***	***	*	ns	*	ns
	Basic level	20.6	13.5	24.0	14.3	18.5						
	Secondary level	41.8	34.5	50.3	45.2	41.4						
	Tertiary level	37.6	52.0	25.7	40.5	40.1						
	Place of residence						ns	**	**	**	ns	*
	Capital city area	20.6	26.3	15.1	33.3	22.4						
	Other, greater than100,000 inh.	21.0	23.7	17.9	21.4	21.3						
	Other, 50,000–100,000 inh.	13.2	10.9	18.4	19.0	13.9						
	Other, <50,000 inh.	45.3	39.1	48.6	26.2	42.4						
Replacing meat with beans or plant protein products							***	***	***	***	ns	***
	Vegetarian (no meat)	0.0	0.7	0.6	70.2	6.2						
	Several times a week	2.8	21.1	0.6	21.5	9.5						
	Once a week	2.3	18.1	3.4	2.4	7.3						
	At least once a month	10.6	30.0	6.1	3.6	15.1						
	Less than once a month	25.2	18.8	24.6	2.4	21.2						
	Never	59.1	11.5	64.8	0.0	40.7						

*p < 0.05 **p < 0.01 ***p < 0.001.

Table 6
General eating motives and attitudes to meat, beans and plant protein products in the four clusters with pairwise comparisons (N = 1,000, one-way ANOVA, Tukey's HSD).

	Established diet								Pairwise comparisons					
	C1. No change in meat consumption		C2. Less red meat, more plant proteins		C3. Less red meat, more poultry		C4. No/very little meat, more plant proteins		Contrast C1 vs C2	Contrast C2 vs C3	Contrast C3 vs C4	Contrast C1 vs C4	Contrast C1 vs C3	Contrast C2 vs C4
Group size (%)	43.3		30.4		17.9		8.4							
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean difference					
General eating motives														
Neophobia***	3.38	1.29	2.86	1.08	3.75	1.41	3.04	1.41	0.53*** (C1 > C2)	−0.89** (C2 < C3)	0.71*** (C3 > C4)	0.35	−0.36** (C1 < C3)	−0.18
Health***	3.74	1.24	4.52	1.17	4.02	1.38	4.72	1.14	−0.79*** (C1 < C2)	0.50*** (C2 > C3)	−0.70*** (C3 < C4)	−0.98*** (C1 < C4)	−0.28	−0.20
Natural concerns***	3.88	1.24	4.63	1.22	4.23	1.26	4.78	1.48	−0.75*** (C1 < C2)	0.40* (C2 > C3)	−0.55** (C3 < C4)	−0.89*** (C1 < C4)	−0.34* (C1 < C3)	−0.15
Pleasure	4.87	1.04	4.99	0.97	4.72	1.11	4.86	1.11	−0.11	0.26* (C2 > C3)	−0.13	0.17	0.15	0.13
Price	3.52	1.07	3.65	1.08	3.56	1.18	3.46	1.06	−0.13	0.08	0.10	0.05	−0.05	0.19
Meat, beans and plant protein product attitudes														
Diet***	5.22	1.11	3.88	1.52	5.13	1.22	1.47	0.89	1.34*** (C1 > C2)	−1.26*** (C2 < C3)	3.67*** (C3 > C4)	3.75*** (C1 > C4)	0.08	2.41*** (C2 > C4)
Sociability***	5.49	1.09	4.22	1.26	5.15	1.36	1.79	0.96	1.28*** (C1 > C2)	−0.93*** (C2 < C3)	3.37*** (C3 > C4)	3.71*** (C1 > C4)	0.34** (C1 > C3)	2.43*** (C2 > C4)
Sustainability***	3.59	1.40	4.93	1.41	3.68	1.58	6.50	0.84	−1.34*** (C1 < C2)	1.25*** (C2 > C3)	−2.82*** (C3 < C4)	−2.91*** (C1 < C4)	−0.09	−1.57*** (C2 < C4)
Cooking***	5.22	1.18	4.67	1.33	5.19	1.20	2.04	1.09	0.55*** (C1 > C2)	−0.52*** (C2 < C3)	3.15*** (C3>C4)	3.18*** (C1 > C4)	0.03	2.62*** (C2 > C4)
Beans***	4.49	1.21	5.23	1.07	4.15	1.26	6.32	0.84	−0.74*** (C1 < C2)	1.08*** (C2 > C3)	−2.18*** (C3 < C4)	−1.84*** (C1 < C4)	0.34** (C1 > C3)	−1.09
Plant protein products***	3.96	0.93	4.75	0.88	3.77	1.01	5.72	0.95	−0.79*** (C1 < C2)	0.98*** (C2 > C3)	−1.95*** (C3 < C4)	−1.76*** (C1 < C4)	0.19	−0.97*** (C2 < C4)

*p < 0.05 **p < 0.01 ***p < 0.001.

patterns of observed variables (Berlin et al., 2014), and the method has been applied in recent studies on changes in meat and plant-based protein consumption in Finland (Latvala et al., 2012; Vainio et al., 2016; Niva & Vainio, 2021). LCA provides a number of solutions, and the selection of an adequate solution is based on the values of evaluative indicators, such as the Bayesian information Criterion (BIC) and Akaike information Criterion (AIC). The lowest BIC value, the lowest AIC value, and a non-significant p-value are the criteria for examining the fittest model (Magidson & Vermunt, 2004). If the values suggest different models, the model with the best interpretation should be chosen. In our case, the solutions between one and seven clusters were compared. The BIC suggested the 4-cluster solution, whereas AIC suggested the 7-cluster solution (Table 3). The BIC is the most often used criterion for model selection, and it is recommended to accept the model with the lowest BIC (Nylund et al., 2007). Therefore, we chose the 4-cluster solution that had the lowest BIC value. Table 4 shows variables used in forming the clusters.

Differences between the clusters in terms of their sociodemographic background were first examined by Pearson chi-square test (Table 5). Thereafter, differences between the four clusters in eating motives and attitudes to meat, beans and plant protein products were tested with analysis of variance (ANOVA) with a set of pairwise comparisons (Tukey's HSD (honestly significant difference) test) (Table 6 and Appendix Table 2).

4. Results

4.1. Four clusters

Four clusters were identified based on the reported past changes in beef, pork, poultry, beans and plant protein product consumption. In the following, the clusters are referred to as 'No change' (C1), 'Less red meat, more plant proteins' (C2), 'Less red meat, more poultry' (C3) and 'No/very little meat, more plant proteins' (C4), respectively.

The first, largest cluster (C1, 43.3 % of the respondents) consisted of consumers who had not changed their consumption of the measured meat types or plant proteins during the past 2–3 years. This cluster reported no consumption of plant protein products. This cluster was a few percentage points smaller than similar clusters found in some previous studies (Latvala et al., 2012; Malek et al., 2019).

The second, i.e., next-largest cluster (C2, 30.4 %) included consumers who had decreased their red meat consumption and whose consumption of plant protein products had remained stable or increased. In this cluster, the consumption of poultry had mostly remained stable, but there were also reducers and increasers.

The third cluster (C3, 17.9 %) had decreased their red meat consumption and increased their poultry consumption. The majority in this cluster had not used plant protein products, and the consumption of beans was rare or had decreased.

Consumers in the fourth and smallest cluster (C4, 8.4 %) did not consume beef and pork at all and either did not consume poultry or had reduced its consumption. They had increased their consumption of plant protein products, and their consumption of beans was stable or increased. In all, 38.8 % (the second and fourth cluster together) of the

respondents were increasing their use of plant proteins.

4.2. Sociodemographic characteristics

Table 5 shows the sociodemographic backgrounds as well as the replacement of meat with beans or plant protein products in the four clusters.

The 'No change' cluster was dominated by men, and the difference between the 'No change' cluster and the other clusters was statistically significant. The cluster very rarely replaced meat with plant protein products. Of the four clusters, this was the one with the most established consumption patterns.

The respondents in the 'Less red meat, more plant proteins' cluster were more often women than men. They were more likely to have a tertiary-level education and to live in a larger city compared to the whole sample. In terms of age, this cluster did not differ significantly from the 'No change' cluster.

Respondents of the 'Less red meat, more poultry' cluster were more often older than 50 years of age, with a basic or secondary-level education and living in middle-sized or small cities or municipalities. In terms of age and place of residence, the cluster did differ significantly from the 'Less red meat, more plant proteins' and 'No/very little meat, more plant proteins' clusters, and in terms of education the cluster did differ from the other clusters. The respondents in the cluster very rarely replaced meat with beans or plant protein products compared to the 'Less red meat, more plant proteins' and 'No/very little meat, more plant proteins' clusters.

The 'No/very little meat, more plant proteins' cluster was strongly dominated by women. They were mostly 34 years or age or younger, and many of them lived in the capital area. In terms of age and place of residence, the cluster did differ significantly from the other clusters. Many were vegetarians, and those who were not often replaced meat with plant protein products with significant differences compared to the other clusters.

These findings indicated that consumer clusters tending to reduce or avoid eating meat and prefer plant proteins were younger ('No/very little meat, more plant proteins' cluster), more often women than men ('Less red meat, more plant proteins' and 'No/very little meat, more plant proteins' clusters) and living in an urban area ('Less red meat, more plant proteins' and 'No/very little meat, more plant proteins' clusters). Thus, we found support for Hypothesis 1.

4.3. Eating motives and meat and bean attitudes

Eating motives varied between the clusters (Table 6). We expected to find that food neophobia would be more prevalent in those consumer clusters that tend to avoid changes in diet or avoid meat substitutes (Hypothesis 2). The 'No change' and 'Less red meat, more poultry' clusters were more neophobic compared to the 'Less red meat, more plant proteins' cluster. However, the difference between the 'No change' and 'No/very little meat, more plant proteins' clusters was not statistically significant. Therefore, Hypothesis 2 was only partially confirmed.

We also expected to find that positive attitudes towards meat would be more prevalent in clusters that avoid changes in meat consumption or that replace red meat with other types of meat rather than with plant proteins (Hypothesis 3a), and that positive attitudes towards beans and plant protein products would be more prevalent in clusters that avoid meat and use plant-based alternatives (Hypothesis 3b). As expected, for the 'No change' and 'Less red meat, more poultry' clusters, associations of meat with diet, sociability and cooking were more important than for the other clusters (Table 6). In contrast, for the 'No/very little meat, more plant proteins' cluster, meat was less important as part of diet, sociability and cooking than for the other clusters. The 'No/very little meat, more plant proteins' cluster also held the most positive attitudes towards plant protein products. The attitudes of the 'Less red meat, more plant proteins' cluster were between the attitudes of the 'No/very little meat, more plant proteins' cluster and the other two clusters. The 'No change' and 'Less red meat, more poultry' clusters did not significantly differ from each other in terms of attitudes to plant protein products. These two clusters held the most negative attitudes towards plant protein products and regarded plant proteins as less familiar and tasty than the other two clusters (for details, see Appendix Table 2). Therefore, Hypotheses 3a and 3b were confirmed.

Moreover, we tested the hypothesis that health, natural concerns, and sustainability-related motives would be more prevalent in clusters that reduce or have low consumption of meat and increase the consumption of plant-based alternatives compared to other groups (Hypothesis 4a). This hypothesis was confirmed: The 'No/very little meat, more plant proteins' cluster held the most critical attitudes towards the sustainability of meat production and consumption and the most favourable attitudes to beans (Table 6). Natural concerns were less important to the 'No change' cluster than to the other clusters, and the health motive was more important to the 'Less red meat, more plant proteins' and 'No/very little meat, more plant proteins' clusters than to the other two clusters. We also tested the hypothesis that price and pleasure motives would be more prevalent in clusters that avoid changes in meat consumption compared to those who reduce or have low consumption of meat (Hypothesis 4b). This hypothesis was rejected: no differences in the pleasure and price motives were found between the clusters.

For the 'Less red meat, more plant proteins' cluster (Table 6), health and natural concerns were more important and meat was less important in terms of dietary necessity and sociability compared to the 'No change' and 'Less red meat, more poultry' clusters. The 'No/very little meat, more plant proteins' cluster differentiated from the other clusters in terms of meat, beans and plant protein product attitudes. To this cluster, health and natural concerns were more important than to the other clusters. The respondents in this cluster considered meat less important in terms of dietary necessity and sociability, and they had more positive attitudes towards beans and plant protein products than the other clusters. (Comparisons presented in Appendix Table 2 show that their attitudes towards plant protein products were more positive in almost all attitudinal dimensions that were measured.) Sustainability was also more important to this cluster than to the other clusters.

5. Discussion

5.1. General discussion

In this study, our aim was to identify consumer clusters based on self-reported past changes in meat and plant protein consumption among a relatively representative sample of Finnish consumers to identify potential signs of change. Furthermore, we analysed the differences between these clusters in sociodemographic backgrounds, eating motives and attitudes towards meat, beans, and plant protein products.

In the analysis, we found four clusters of consumers: one with established patterns and no change ('No change', 43.3 % of the respondents); one which had reduced the consumption of red meat and increased the use of plant protein products ('Less red meat, more plant proteins', 30.4 % of the respondents); one which had reduced the consumption of red meat and increased the consumption of poultry ('Less red meat, more poultry', 17.9 % of respondents); and one which had reduced the consumption of all meat or consumed no meat at all, and had increased consuming plant protein products ('No/very little meat, more plant proteins', 8.4 % of the respondents). Although the 'No change' cluster with established meat-eating patterns was the largest cluster, the proportion of those who were replacing meat with plant proteins was larger in our study, in total 38.8 % of the respondents, than in two earlier Finnish studies, in which the proportions were 8 % of the respondents (see Latvala et al., 2012) and 20 % of the respondents (Vainio et al., 2016). The increase in the number of consumers who report having reduced or stopped meat-eating has taken place in a

period during which plant-based options have become more available and received increasing consumer interest and media publicity (Jallinoja et al., 2019). Finnish consumption statistics, however, do not support a strong decline in meat consumption levels. Recent statistics show only a small, 2.7 % decline in total meat consumption from 2018 (81.3 kg per person) to 2021 (79.1 kg per person) (Natural Resources Institute Finland (Luke), 2022) (see the Limitations section below).

The results show some sociodemographic differences between the clusters. In the 'No change' cluster, there were more men than women, whereas the 'No/very little meat, more plant proteins' cluster was dominated by women and the young. In the 'Less red meat, more plant proteins' cluster, the respondents were more highly educated than those in the other clusters, and there were also more women than men in this cluster. The results concerning sociodemographic differences between the clusters are largely in line with findings from earlier studies regarding differences in gender (de Boer et al., 2014; Latvala et al., 2012; Vainio et al., 2016; Malek et al., 2019), age (de Gavelle et al., 2019; Neff et al., 2018) and educational background (Vanhonacker et al., 2013). Our results thus show that these sociodemographic factors still play a role in the transition to plant-based diets. There are several reasons for this. First, it has been shown that women, young people and people with higher education are less neophobic (Jaeger et al., 2021; Meiselman et al., 2010). Second, meat consumption has been considered an aspect of masculinity (Adams, 1990; Modlinska et al., 2020; Nath, 2010). However, 'meat attachment' among men is not a monolith, as many other factors, such as age and education, are also associated with meat consumption (Carroll et al., 2019; de Backer et al., 2019). For instance, young age and high educational level are associated with health consciousness and awareness of the environmental impacts of food production (Siegrist & Hartmann, 2019).

Some specific eating motives were related to changes in meat and plant protein consumption. The respondents in the 'Less red meat, more plant proteins' and 'No/very little meat, more plant proteins' clusters were more concerned about the naturalness and healthiness of food than those in the 'No change' cluster. In healthiness, a similar difference was also found between the 'Less red meat, more poultry' and the 'No change' clusters. These findings suggest that health and natural concerns are important for those consumers who are changing their consumption patterns towards less or no meat (see also Cliceri et al., 2018; Latvala et al., 2012; Vainio et al., 2016). Our results also suggest that people who eat very little meat and are increasing their use of plant proteins do not see novel types of processed plant protein products as unnatural.

The results also support earlier findings about the association between food neophobia and willingness to make changes in food consumption patterns. Food neophobia decreases the willingness to try novel foods (Raudenbush & Frank, 1999) and to try out or use plant proteins (Hoek et al., 2011; Clark & Bogdan, 2019). In our study, the 'No change' and 'Less red meat, more poultry' clusters were more food neophobic compared to the 'Less red meat, more plant proteins' and 'No very little meat, more plant proteins' clusters. However, neophobia is not necessarily a permanent characteristic; exposure to novel foods reduces food neophobia (Pliner & Hobden, 1992). Now that plant protein products are more readily available in grocery stores, cafes and restaurants than previously, their acceptance may increase, and the products more easily become normalized in everyday life.

Pleasure and price were the only eating motives which did not differentiate the four clusters. Pleasure from food was highly appreciated in all clusters. In this respect, our findings are in line with other recent studies indicating that pleasure or taste preferences are not segregating factors between consumer clusters with different meat-eating patterns (Cliceri et al., 2018; Latvala et al., 2012; Vainio et al., 2016). This is interesting because it suggests that people who turn from meat to alternative proteins seemingly do not feel that they need to compromise on taste. Previous results on the importance of price in the choice of plant proteins have varied somewhat (e.g., Graça et al., 2019; Neff et al., 2018; Vainio et al., 2016). Our results suggest that price orientation in food choices is neither a barrier nor a motivating factor in the change of diet from meat-based to plant-based foods.

Attitudes towards meat, being accustomed to using meat in cooking and perceiving meat as nutritionally necessary and as part of the sociability of eating also played a role in the changes made. The respondents in the 'No/very little meat, more plant proteins' cluster regarded meat as less important in terms of nutrition, sociability, and as a familiar ingredient in cooking. They held very positive attitudes towards beans and used plant-based protein products to replace meat in cooking. This finding implies that the 'cultural stickiness' of meat is probably lower among these respondents, and as the results show, they also eat plant proteins as part of their diet. For the other clusters, meat was more important. The 'Less red meat, more plant proteins' cluster consumed plant proteins quite frequently, but compared to the 'No/very little meat, more plant proteins' cluster, their attitudes to meat were more positive. These results support the findings of earlier studies (Rothgerber, 2014). The two other clusters, 'No change' and 'Less red meat, more poultry', consumed plant proteins very rarely, and their attitudes to meat were very positive, also supporting earlier studies (de Boer et al., 2014; Graça et al., 2015).

The clustering resulted in three clusters of people who had already reduced their consumption of beef and pork, and nearly-six out of ten respondents were clustered into these clusters. This suggests both polarization and diversification in eating habits: some consumers have established, non-changing patterns including meat, while others are reducing meat-eating but diverging in what they eat instead: for some, poultry may replace red meat; for others, plant proteins are a viable option.

As noted by Aiking and de Boer (2018), a dietary transition from animal-based to plant-based foods is urgently needed, for both food security and sustainability reasons. Schösler et al. (2012) remarked that the substitution of animal proteins with plant proteins may require "a profound societal transition". They also suggested four policy pathways for such a transition: incremental change towards vegetarian meals, focus on convenience, reduced portion size of meat at meals, and a practice-oriented and cultural change towards vegetarian meals. Our results suggest that such a societal and cultural transition is on its way: we found indications of change towards plant-based eating, probably partly because novel and convenient plant-based options are more readily available than previously. In addition, consumers who are frequently using plant proteins are already carrying out a practice-oriented and cultural change towards plant-based meals.

Despite these developments, it is evident that various kinds of policy measures are needed to support the change and that there are multiple factors in society that may contribute to decreasing or increasing meat or plant protein consumption (Vinnari, 2008). According to Meltzer et al. (2019), sustainable dietary changes should be addressed simultaneously in national public policies, in communities and organizations, and at the individual level. Similarly to Willett et al. (2019), they also stressed that health and sustainability are closely connected. Health-motivated changes towards more plant-based diets may motivate a transition towards sustainable plant-based diets and thus be beneficial also from the perspective of ecological sustainability (de Boer et al., 2017). Our own results support this by showing that for consumers who are already

increasing their use of plant proteins, both health and sustainability aspects are important. In our study, healthiness, naturalness and sustainability were found to be important factors differentiating the clusters which had already transitioned towards more plant-based diets from those clusters which had not. To make plant-based diets more socially desirable, the links between health, naturalness, sustainability and plant-based diets should be promoted in food policies.

Our results also indicate the differentiation of attitudes and motives in different consumer groups and thus point to the need for tailored messages and promotion. To support people of various backgrounds to reduce the consumption of red and processed meat and to increase the use of plant proteins, not only education about the health and ecological impacts of animal- and plant-based foods is needed but also support and measures to familiarize consumers with plant proteins. A recent Finnish study suggests that dietary changes towards diets with less meat are feasible for healthy Finnish adults, and that smaller changes (in which 50 % of total protein intake is plant-based) are much easier to carry out than more extensive changes (70 % of total protein intake being plant-based). At the moment, 30 % of total protein intake among Finnish consumers is plant-based. Dietary transition at the population level takes time, and more knowledge is required in the planning of population-level measures towards more plant-based diets (Päivärinta et al., 2020). National dietary guidelines with more emphasis on plant-based eating, plant-based public catering at schools, worksite canteens and other public facilities as well as more favourable tax treatment for plant proteins are potential policy measures that can advance plant-based eating among consumers (de Boer & Aiking, 2021; Jallinoja et al., 2016; Vinnari, 2008).

In the future, more information is needed about how the transition towards plant-based diets may be supported in all population groups, paying particular attention to consumers who are currently not – for various individual, economic, social and cultural reasons – changing their diets. Research is needed on the role of social norms and social influence in changing diets (see, e.g., Cheah et al., 2020; Ruby & Heine, 2012), but also on the public acceptability, potential and effectiveness of policy measures in steering food production and consumption towards plant-based eating, including measures that aim at influencing dietary patterns and choices (e.g., dietary guidelines, education, campaigns and 'nudging' or 'practice' interventions) as well as the market environment (e.g., taxation, agricultural subsidies and regulation, steering public catering).

5.2. Limitations

Some limitations of the study should be noted. The response rate of our survey was quite low, which can be partly explained by facts that the sampling period was limited (14 days) and the questionnaire itself was quite extensive. Survey response rates have been declining and have led to low response rates in many countries (Stedman et al., 2019). There is also evidence that non-responses do not distribute equally in all groups (Tolonen et al., 2006). Indeed, in our study, highly educated and middle-aged individuals were to some extent overrepresented compared to the Finnish population.

It should also be noted that our study was based on cross-sectional self-reported data about changes in meat and plant-based protein consumption during the past few years. Only the direction (increase or decrease), not the volume, of potential changes was enquired, and thus, the respondents probably reported even very small perceived changes. In addition, when asked about food-related habits, people tend to be optimistic and partly reply according to what they think they should do or hope to have done. Social desirability bias can be a potential limitation of using self-reported measures (Cerri et al., 2019). These factors may explain why the changes identified by the respondents were not in all respects in line with food balance data based on national statistics, which show, for instance, a relatively stable consumption of beef (Natural Resources Institute Finland, 2022). However, we can say that, similar to other studies about food-related behaviours based on self-reporting, the results reveal how people themselves experience changes in their food consumption patterns and what kind of aspirations they have in terms of eating meat and plant-based proteins.

6. Conclusion

The results suggest that a relatively large share of Finnish consumers have self-reportedly changed their patterns of eating towards less red meat and more poultry or plant proteins. First, we found a group of consumers comprising a little less than one-fifth of the respondents who had reduced the consumption of red meat and increased the consumption of poultry. Second, and from a sustainability point of view, more importantly, the two groups of consumers that had reduced or given up red meat intake and increased the use of plant protein products no longer represented a small minority, as the groups comprised almost four out of ten respondents. Being young, female, highly educated and living in an urban area predicted a transition towards less red meat and more plant-based diets. However, elderly consumers living in less urban areas also reduced their consumption of red meat. Our results thus suggest that a cultural turn in which meat-eating is challenged and other options are searched for is strengthening, but that this turn is by no means shared by all consumers.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Author contributions

The questionnaire was designed by a research group led by Mari Niva. Elina Nevalainen was a member of the group. Elina Nevalainen and Annukka Vainio conducted the statistical analyses for this study. All authors have contributed to writing all parts of the paper and have approved the submitted version of the manuscript.

Appendix A

See Tables A1–A2.

Table A1
Profiles of the four clusters based on stated past changes of meat, beans and plant proteins (N = 1,000, %).

	C1. No change (N = 433)	C2. Less red meat, more plant proteins (N = 304)	C3. Less red meat, more poultry (N = 179)	C4. No/very little meat, more plant proteins (N = 84)	Total (N = 1000)
Cluster size (%)	43.3	30.4	17.9	8.4	100.0
Beef					
No consumption	1.8	2.3	3.4	95.2	10.1
Consumption has decreased	3.7	85.5	54.7	1.2	37.5
Consumption has remained stable	94.5	10.2	29.1	3.6	49.5
Consumption has increased	0.0	2.0	12.8	0.0	2.9
Pork					
No consumption	0.9	3.0	10.1	98.8	11.4
Consumption has decreased	2.1	85.2	46.9	1.2	35.3
Consumption has remained stable	97.0	11.8	27.4	0.0	50.5
Consumption has increased	0.0	0.0	15.6	0.0	2.8
Poultry					
No consumption	2.1	16	3.9	73.8	8.3
Consumption has decreased	4.6	25.0	9.5	19.0	12.9
Consumption has remained stable	78.5	46.1	43.6	7.1	56.4
Consumption has increased	14.8	27.3	43.0	0.0	22.4
Beans					
No consumption	28.9	5.6	52.0	6.0	24.0
Consumption has decreased	10.6	2.6	26.3	4.8	10.5
Consumption has remained stable	54.0	60.5	21.8	46.4	49.6
Consumption has increased	6.5	31.3	0.0	42.9	15.9
Plant protein products					
No consumption	72.5	23.4	95.0	1.2	55.6
Consumption has decreased	5.8	3.3	5.0	6.0	4.9
Consumption has remained stable	15.5	34.2	0.0	28.6	19.5
Consumption has increased	6.2	39.1	0.0	64.3	20.0

Table A2
Items of plant protein product attitudes mean variable in the four clusters with pairwise comparisons (N = 1,000, one-way ANOVA, Tukey's HSD).

	C1. No change in meat consumption (N = 433)		C2. Less red meat, more plant proteins (N = 304)		C3. Less red meat, more poultry (N = 179)		C4. No/very little meat, more plant proteins (N = 84)		Pairwise comparisons					
Cluster size (%)	43.3 %		30.4 %		17.9 %		8.4 %		C1 vs C2	C2 vs C3	C3 vs C4	C1 vs C4	C1 vs C3	C2 vs C4
	Mean	SD	Mean	SD	mean	SD	mean	SD	Mean difference					
Attitudes towards plant protein products														
Healthy - Unhealthy***	3.20	1.34	2.43	1.24	3.26	1.46	1.74	1.18	0.77*** (C1 > C2)	−0.83*** (C2 < C3)	1.52*** (C3 > C4)	1.47*** (C1 > C4)	−0.06	−0.77*** (C2 > C4)
Natural - Processed***	4.00	1.58	3.38	1.56	4.26	1.74	2.94	1.74	0.63*** (C1 > C2)	−0.89*** (C2 < C3)	1.32*** (C3 > C4)	1.06*** (C1 > C4)	−0.26	0.44*** (C2 < C4)
Attractive - Disgusting***	4.45	1.30	3.41	1.38	4.79	1.39	2.01	1.32	1.04*** (C1 > C2)	−1.38*** (C2 < C3)	2.78*** (C3 > C4)	2.44*** (C1 > C4)	−0.34* (C1 > C3)	1.40*** (C2 < C4)
Familiar - Unfamiliar***	4.75	1.40	4.04	1.39	4.91	1.43	2.58	1.54	0.71*** (C1 > C2)	−0.86*** (C2 < C3)	2.32*** (C3 > C4)	2.17*** (C1 > C4)	−0.16	1.46*** (C2 < C4)
Affordable - Expensive***	4.75	1.39	4.51	1.47	4.92	1.36	3.75	1.76	0.24	−0.40* (C2 < C3)	1.17*** (C3 > C4)	1.00*** (C1 > C4)	−0.17	0.76*** (C2 < C4)
Tasteful - Distasteful***	4.34	1.36	3.47	1.37	4.74	1.40	2.04	1.31	0.87*** (C1 > C2)	−0.48*** (C2 < C3)	2.71*** (C3 > C4)	2.30*** (C1 > C4)	−0.40** (C1 > C3)	1.44*** (C2 < C4)
Domestic - Foreign***	4.20	1.35	3.82	1.37	4.30	1.42	3.48	1.43	0.38** (C1 > C2)	−0.47** (C2 < C3)	0.83*** (C3 > C4)	0.73*** (C1 > C4)	0.01	0.34
Environmentally friendly - Environmentally unfriendly***	3.47	1.31	2.73	1.32	3.67	1.50	1.87	1.17	0.74*** (C1 > C2)	−0.94*** (C2 < C3)	1.80*** (C3 > C4)	1.60*** (C1 > C4)	−0.20	0.93*** (C2 < C4)
Ethical - Unethical***	3.44	1.36	2.62	1.27	3.51	1.43	1.69	1.09	0.83*** (C1 > C2)	−0.89*** (C2 < C3)	1.82*** (C3 > C4)	1.75*** (C1 > C4)	−0.07	0.93*** (C2 < C4)
Socially acceptable - Socially unacceptable***	3.30	1.35	2.38	1.26	3.36	1.52	1.57	1.03	0.93*** (C1 > C2)	−0.99*** (C2 < C3)	1.79*** (C3 > C4)	1.73*** (C1 > C4)	−0.06	0.81*** (C2 < C4)
Easy to prepare - Effortful to prepare***	4.12	1.31	3.38	1.40	4.40	1.44	2.08	1.31	0.75*** (C1 > C2)	−1.03*** (C2 < C3)	2.32*** (C3 > C4)	2.04*** (C1 > C4)	−0.28	1.29*** (C2 < C4)
Easy to purchase - Effortful to purchase***	3.85	1.34	3.09	1.36	3.99	1.34	2.25	1.24	0.76*** (C1 > C2)	−0.90*** (C2 < C3)	1.74*** (C3 > C4)	1.60*** (C1 > C4)	−0.14	0.84*** (C2 < C4)
Interesting - Uninteresting***	4.59	1.66	2.98	1.60	4.87	1.70	1.63	1.21	1.61*** (C1 > C2)	−1.90*** (C2 < C3)	1.35*** (C3 > C4)	2.96*** (C1 > C4)	−0.28	1.30*** (C2 < C4)

*p < 0.05 **p < 0.01 ***p < 0.001.

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