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Meat tastes good, legumes are healthy and meat substitutes are still strange - The practice of protein consumption among Swedish consumers

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A B S T R A C T

Replacing some meat with grain legumes would benefit human health, the environment and agriculture. This study analysed legume and meat consumption practices by investigating consumer perceptions and competences relating to lightly processed grain legumes (LPL), legume-based meat substitutes (LBMS) and meat in Sweden, and how these (and demographic variables) influenced stated intention to change consumption. Major differences in consumer perceptions of LPL and LBMS compared with meat related to product attractiveness and status, with meat seen as more fun, popular, suitable in diets and for festive occasions, and tastier. Most consumers knew of the environmental impact of meat and health benefits of LPL. Country of origin, *i.e.* Swedish origin, was important for many consumers (especially for meat and women). Preferences relating to health and environmental impact were important for intention to decrease meat consumption. Perceived environmental impact was important for intention to change consumption of LPL, but taste, healthiness, weight control, ease of preparation and suitability in the diet were equally or more important. Leveraging stated consumer willingness and intention to eat more LPL by making LPL more accessible to consumers could increase their consumption. For LBMS, there are still important barriers in terms of taste, familiarity and overall attractiveness of these products that need to be overcome to increase their consumption in Sweden.

1. Introduction

Global food systems have large negative environmental and health impacts (Willett et al. 2019). In terms of environmental pressures, meat and dairy have substantially higher impacts than plant-based foods (Machovina et al. 2015; Poore & Nemecek, 2018). In terms of health, consumption of whole grains, fruits and vegetables is below the recommended level in most countries, while intake of red meat, sugar and salt in Western countries is above the recommended level (GBD 2017 Diet Collaborators, 2019; WCRF, 2018). Therefore, for human and planet health, eating patterns need to change towards more plant-based foods. Grain legumes in combination with whole grain cereals can replace meat as a protein, zinc and iron source, while also increasing intake of fibre and folate above the commonly low levels in Western diets (Röös et al. 2019). Consumption of grain legumes is known to have several positive health effects (Clemente & Olias, 2017). Cultivation of grain legumes also brings benefits to cropping systems, since legumes can fix nitrogen and act as a break crop in cereal-based systems (Röös et al. 2019). However, consumption of grain legumes is generally low in Western countries (GBD 2017 Diet Collaborators, 2019). For example, the latest dietary survey in Sweden showed that only 44% of the population consumed legumes, but with large variation (Steib et al. 2020). To reduce meat consumption and increase legume consumption, especially in food cultures where meat is deeply entrenched and grain legume consumption is low, more knowledge is needed about the barriers to replacing meat with grain legumes (Niva et al. 2017, pp. 157–171).

Grain legumes can be eaten lightly processed (soaked and boiled) or processed into foods that resemble meat. For the latter, the protein is commonly extracted from the grain legumes (commonly soy, but lately also pea), extruded, mixed with vegetable fat and seasonings, and formed into mince, sausages, patties etc., to mimic meat in terms of sensory and functional aspects (Joshi & Kumar, 2015; Kumar, 2016; Wild et al. 2014). These two categories of grain legume products, *i.e.* lightly processed and 'meat substitutes', have different characteristics. Lightly processed legumes can be considered a vegetable rather than the protein component of a main meal in Western diets, while meat substitutes are true 'meat replacers' in how they function in meals (de Boer & Aiking, 2019; van der Weele 2019). While consumption of grain legumes and derived products is still limited in Western diets, increased awareness of the negative environmental impacts associated with food production and the health benefits of greener eating have sparked interest in such products in recent years (Niva et al. 2017, pp. 157–171).

However, acceptance of consuming less meat and replacing meat

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with alternative proteins is generally still low in Western societies (Hartmann & Siegrist, 2017; He et al. 2020; Onwezen et al. 2021). Barriers to reduced meat consumption include lack of skills in preparing meat-free meals, lack of knowledge of the nutritional value of meat and its alternatives, denial of the negative outcomes of livestock production, delegation of responsibility to others in order to handle cognitive dissonance, taste, habits and routines, social and cultural norms, political inaction, and limited availability of meat alternatives (Graça et al. 2019; Stoll-Kleemann & Schmidt, 2017). On reviewing 91 studies, Onwezen et al. (2021) identified the following drivers of acceptance of different kinds of alternative protein sources: motives of taste and health, familiarity, attitudes, food neophobia, disgust and social norms. However, there is large variation between individuals and between different types of alternative proteins, *e.g.* acceptance is generally higher for pulses and plant-based alternative proteins than for insects or cultured meat.

Food choice is known to be governed by many factors (Köster et al. 2009; Leng et al. 2017) and it is a prominent example of a routine behaviour (a practice). Consumers are seldom aware of the environmental impact associated with food and are reluctant to reduce their meat consumption, as meat is perceived as central to their food practices (Hoek et al. 2017; Macdiarmid et al. 2016; Onwezen et al. 2021). Insights into consumption practices relating to switching meat for plant-based foods are important to steer consumption patterns in a more sustainable direction. Although many studies on consumer acceptance of alternative proteins have been performed, most have investigated insects; only 19 out of 91 studies in the review by Onwezen et al. (2021) concerned pulses or plant-based meat alternatives and very few of those compared meat alternatives directly with meat.

The aim of this study was to increase understanding of the practice of consuming legumes in Sweden and to provide knowledge that can accelerate transition to more sustainable eating. This was done by studying consumer perceptions related to legumes and how intentions to eat more legumes relate to demographic variables and competences, perceptions and material aspects of legumes in Sweden. Separate analyses were performed for lightly processed grain legumes (LPL), *i.e.* peas, beans and lentils sold dry or cooked, and legume-based meat substitutes (LBMS), *e.g.* soy mince or sausages, and for meat in comparison.

2. Theory and hypotheses

2.1. Social practices theory

Various theories have been applied when investigating how to achieve sustainable food consumption (El Bilali, 2020; Liu et al. 2016). Liu et al. (2016) suggest use of the Social Practices Approach (SPA) for studying promotion of sustainable consumption, as it "*combines both human agency and social structures to understand sustainable consumption issues*". SPA describes a practice as a behaviour that has become routine and is governed by an interaction between personal attitudes, skills, positive images and material components in the surrounding infrastructure (El Bilali, 2020). SPA involves a move from a sole focus on individual attitudes and rational mental processes to combining human agency with social structures (Hargreaves, 2011). According to SPA, change is not only governed by consumer attitudes and motivations, but to a large degree by society's social practice of eating meat on a daily basis, which influences behaviour. However, practices are not fixed and behaviour can change following shifts in competences, perceptions and material aspects (Shove et al. 2012). In terms of food, competences include the skills to prepare certain foods and meals, while perceptions include aspects such as taste, healthiness and sustainability of the foods, and how well the practice fits in current food cultures and meal contexts. Material aspects deal with the materials and technologies needed to follow a food practice, including having access to certain foods. Jallinoja et al. (2016) applied the SPA lens to study consumption of legumes in Finland and concluded that, in order for legume eating to emerge in the current meat-dominated culture of Europe, several aspects have to be in place. These include positive meanings of legumes, appropriate materials, and skills and competences to prepare such foods. In this study, we applied the theory of SPA in a similar manner.

2.2. Hypotheses

The empirical analysis in this study was divided into two parts. In the first part, we investigated consumer perceptions, competences and material aspects separately for meat, LPL and LBMS, focusing specifically on the difference between male and female consumers. In the second part, we analysed factors explaining intention to increase consumption of LPL and LBMS and decrease consumption of meat. These factors included socio-demographic aspects, and perceptions, competences and material aspects of the products. In this section, we describe the rationale behind our hypotheses.

2.2.1. Perceptions of legumes versus meat

Meat is a food product that is highly valued by most individuals and is associated not only with nutrition and sensory pleasure, but also with status and identity (Graça et al. 2015; Macdiarmid et al. 2016), especially in terms of masculinity (Nakagawa & Hart, 2019). Legume-based foods are not valued as highly. Common barriers to legume consumption that have been identified in the literature are unpleasant taste, inconvenience and lack of familiarity and skills to prepare legumes (*e.g.* Hoek et al. 2011; Jallinoja et al. 2016; Niva et al. 2017, pp. 157–171; Schyver & Smith, 2005; Schösler et al. 2012; Wenrich & Cason, 2004; Weinrich, 2018; Melendrez-Ruiz et al. 2019; Collier et al. 2021). Further, pulses are seen as old-fashioned, "food for the poor" and a cause of flatulence (*e.g.* Weinrich, 2018). A study by Elzerman et al. (2021) on the appropriateness of meat products, meat substitutes and meat alternatives in different usage situations indicated that plant-based alternatives are seen as healthier, but that meat is seen as more fun, tastier and more festive.

A literature review by Sanchez-Sabate and Sabaté (2019) showed that only 23–35% of participants in studies were aware of the negative environmental impacts of meat, while a survey in Switzerland found that participants mistakenly perceived the environmental impact of LBMS and conventional meat as being similar (Siegrist & Hartmann, 2019). However, there is reason to believe that consumers in Sweden are better informed, as public debate on the environmental impacts of meat has been intense in recent years. Based on the above, we formulated the following hypothesis:

H1. On average, and more pronounced for men than for women, individuals consider LPL and LBMS to be less fun, less popular, less suitable in everyday and festive meals, less tasty, less readily available and more difficult to prepare than meat. In addition, LPL and LBMS are perceived by individuals as being healthier, better for weight control and more environmentally friendly than meat.

Consumer interest in the country of origin of food and the environmental impact associated with food production has increased lately, partly as a result of the Covid-19 pandemic (Borsellino et al. 2020). Balcombe et al. (2016) found that country of origin is valued most for fresh meat and less for processed products.

Consumer interest in country of origin for LPL and LBMS remains unknown, since to our knowledge no previous study has investigated this aspect. In addition, during the past 15 years there has been an increase in demand for organic food in Europe (EP, 2020). In Sweden, however, demand for organic foods has levelled off or even decreased recently (Agrovektor 2020). The reasons for this are unclear, but there are indications that environmentally conscious consumers who previously bought organic foods are increasingly buying plant-based foods, as a consequence of greater awareness of the climate impact of meat (Agrovektor 2020). In this switch, consumers seem to be less concerned with how the plant-based products are produced, *i.e.* they are becoming

less interested in organic products. We formulate the following hypothesis to explore these novel aspects:

H2. Individuals consider country of origin and organic certification to be more important for meat than for LPL and LBMS, and women do so more than men.

2.2.2. Factors influencing the intention to change consumption

Apart from the influence of perceptions, competences and material aspects on the intention to increase consumption of LPL and LBMS, demographic variables may also explain intention, but with mixed significance (Onwezen et al. 2021). Young, highly educated and urban-dwelling individuals are often more inclined to accept alternative protein sources (Graça et al. 2019; Hoek et al., 2004, 2011; Jallinoja et al. 2016; Slade, 2018). Women are generally more likely to adopt plant-based diets or to reduce their meat intake (Graça et al. 2019; Milfont et al. 2021; Rosenfeld & Tomiyama, 2021; Sanchez-Sabate & Sabaté, 2019; Stoll-Kleemann & Schmidt, 2017), and to eat more vegetarian foods (Eustachio Colombo et al. 2020) or legume-based foods (Lemken et al. 2019). Based on this, we formulated the following hypothesis:

H3. Young, female, urban and highly educated individuals who respond positively in terms of perceptions, competences and material aspect of LPL and LBMS (H1) have higher stated willingness to increase their consumption of such products and to decrease their consumption of meat.

3. Methods

3.1. Study design

The sample was selected from a Swedish online panel (Citizen Panel) with mostly self-recruited participants aged between 18 and 85 years. Prior to sampling, individuals in the panel meeting these criteria were divided into strata based on sex, education level, place of residence and age bracket, resulting in 26 strata. The total sample size was $n = 4500$. Data were collected between September 15 and October 26, 2020. Two email reminders were sent out to non-respondents. The response rate was 56%, with a complete response defined as answering more than 80% of all applicable questions. In total, 2527 individuals were complete respondents according to this definition (see also Table S1.2). As a precaution against low-quality data, for all analyses we excluded speeders, here defined as those who spent less than five minutes responding to all applicable questions. We identified and removed 30 speeders from the complete respondents, which gave us a final response set of $n = 2497$. "Don't know" answers and item non-responses were also omitted, which further reduced the response set for specific analyses. The distributions of the Swedish population and the final response set in different strata are presented in Figure S1.1. Women over 50 with low or middle education were slightly over-represented in the sample, whereas men over 50 with high education were under-represented. More details on the sample, including limitations and strengths, are provided in Supplementary Material (SM) S1.

3.2. Variables

The demographic variables available for all individuals in the Citizen Panel, and hence also for all our study participants, were sex, education, place of residence, age, marital status and income (Table S2.1). In the questionnaire, we added a question about children living at home.

The questionnaire asked about present and intended future consumption of the following foods: 1) meat, defined and presented to respondents as everything from steak and cutlets to ham, bacon and minced meat, including poultry meat like chicken and turkey, but not fish or seafood; 2) beans, peas and lentils, defined as raw, dried and precooked forms, including *e.g.* kidney beans, chickpeas, yellow and white peas, and black and brown beans; and 3) legume-based alternatives to meat, defined as products that replace meat in various dishes, including soy mince, soy burgers, tofu and tempeh, but not Quorn. Note that we described the third food type in the questionnaire by the term "alternatives to meat", rather than "meat substitutes", as we wanted to avoid the word substitute since it might have negative connotations (replacing something that might be perceived as a first-hand choice).

As in Jallinoja et al. (2016), the practice of eating meat/LPL/LBMS was captured by asking about the frequency of eating these products. As we were interested in legumes as a meat replacer in meals, we clarified that in the question: "How often do you eat the following in your meals (lunch/dinner)? Think of the last 12 months". The response alternatives were given on a seven-point scale from "Less than once per month" to "Always". We also asked whether the respondent planned to decrease, maintain or increase their consumption of meat, LPL and LBMS over the coming 2–3 years (the option of "Do not eat this" and "Don't know" were also provided).

In terms of perceptions (meanings and images), competences, and material and bodily aspects related to the three food types, following our hypothesis H1 we asked the set of questions listed in Table 1 using a five-point scale and containing a "Don't know" alternative (*e.g.* for the question on taste the scale was: Tastes very bad, Tastes rather bad, Neither bad nor good, Tastes rather good, Tastes very good). To investigate the extent to which country of origin and organic certification were important attributes of the different products (H2), we also asked the following questions: "Do you think it is important or unimportant that the following foods are produced in Sweden?" and "Do you think it is important or unimportant that the following foods are organically labelled?". For each question, we used a five-point response scale, together with a "Don't know" option.

Table 1
Questions about perceptions, competences, material and bodily aspects, and importance of country of origin and organic production methods for the different foods investigated (meat, lightly processed legumes and legume-based meat substitutes). Responses were given on a five-point scale and a "Don't know" option. (Phrases in brackets are the labels used when presenting results in figures.)

	Aspect	Question(s)
Perception	Taste	In your opinion, does the following food taste bad or good? (Tasty)
	Healthiness	In your opinion, is the following food healthy or unhealthy to eat? (Healthy)
	Environmental friendliness	Do you think that the following food has a large or small impact on the environment? (High env. impact)
	Boring or fun	In your opinion, is the following food boring or fun? (Fun)
	Cultural acceptability	How well do you think that the following food fits into your diet? (Fits in diet)
		Do you think that the following food is suitable or not to serve on a festive occasion? (Festive)
	Social acceptability	Among your friends, how popular is the following food? (Popular)
Competences	Ease of preparation	In your opinion, is the following food difficult or easy to prepare? (Easy to prepare)
Material and bodily aspects	Availability	Do the shops you visit have a large or small supply of the following food? (Available)
	Weight control	In your opinion, is the following food good or bad to eat if you are trying to keep or lose weight? (Good for weight)
Importance of …	Country of origin	Do you think it is important that the following foods are produced in Sweden? (Importance, origin)
	Organic production	Do you think it is important that the following foods are labelled organic? (Importance, organic)

When designing the questionnaire we tested the questions for clarity in iterations on a convenience sample of friends and colleagues of different ages, education levels, sex and ethnicities. We iteratively discussed the design of the questions with experts at the Laboratory of Opinion Research, Gothenburg University. We also tested the questionnaire on a random sample of 400 individuals from the Citizen Panel, of which 270 chose to respond to the questionnaire. Based on analyses of the pilot data, we adjusted the design of the questions (*e.g.* the reference period for some questions) and the questionnaire (*e.g.* its total length), in an attempt to prevent measurement errors and non-responses.

3.3. Analysis

To investigate differences in individual views regarding perceptions, competences and material aspects of meat, LPL and LBMS (H1) and the importance of country of origin (*i.e.* Swedish) and production method (*i.e.* organic) (H2), we analysed the responses to the questions in Table 1 using analysis of variance (ANOVA). We included a random factor for respondent since we measured the same subject (person) repeatedly. Each selected subject (person) was asked to rate, on a scale from 1 to 5, how boring or fun it is *e.g.* to eat a product (meat, LPL or LBMS). We used a two-factor model, since we studied the effects of sex (factor *A*) and food type (factor *B*) on the rating. We assumed random subject effects and fixed factor *A* and *B* effects. When we found significant sex-food type interaction effects, we conducted pairwise comparisons of means for different food types within sex, and pairwise comparisons of means for different sexes within food type. For two questions, sex-food type interaction effects were not significant, and the model and the analyses were simplified accordingly. For details of the analyses, see SM S5. The results of the analyses are reported in detail in Table S5.1a-b. The results only of the post hoc tests (the pairwise comparisons of means) are presented in Table 2.

To investigate aspects that influenced the likelihood of intention to alter consumption of meat, LPL and LBMS (H3), we used multinomial logistic (MNL) regressions. The explanatory variables were demographic factors, competence, perceptions and material aspects of the respective products as perceived by the respondents. One MNL model was estimated for each product group separately, *i.e.* for meat, LPL and LBMS. The dependent categorical variable was 'intention to change consumption' of each product with the same response categories as in the survey, *i.e.* decrease, maintain or increase. We simplified the scales of perception variables from 1 to 5 to only three categories, as we otherwise experienced problems with estimations due to non-convergence of models. Because MNL coefficients are difficult to interpret and compare across variables (see Cameron & Trivedi, 2005), we calculated the marginal effect on the likelihood of planned consumption change for each variable. This also enabled us to make comparisons across the product groups (*i.e.* meat, LPL and LBMS) and assess the influence of different variables on the intention to change legume consumption. Results are presented in Table 3 and Tables S6.1-6.3.

Some additional analyses are provided in SM, *e.g.* Table S3.1 presents various socio-demographic characteristics of the sample separately for light or non-eater and frequent consumers of LPL and LBMS, respectively. For each combination of socio-demographic characteristic and eating frequency, separately for LPL and LBMS, the result of a chi-squared test of independence is given. In Table S4.1, current consumption of meat, LPL and LBMS is presented as sample proportions and as estimated proportions of the Swedish population. In Tables S4.2 and S4.3, separately for LPL and LBMS, observed frequencies of current consumption and the intention to increase consumption are cross-tabulated. Results of ordinal chi-squared tests of the association between current consumption and the stated intention to increase consumption are also given.

4. Results

4.1. Perceptions of legumes versus meat

Based on our ANOVA results, both men and women considered LPL and LBMS to be less tasty, less fun, less festive, less popular, less easy to prepare and less available than meat (Table 2). Men considered meat to fit better in diets than LPL and LBMS. Women also thought that meat fits better in diets than LBMS, but women considered meat and LPL to be approximately the same in terms of suitability in diets. Both women and men considered LBMS and especially LPL to be considerably more environmentally friendly than meat. Women also considered LPL and LBMS to be healthier than meat, while men viewed LPL as healthier but did not view LBMS as healthier than meat. LBMS and especially LPL were regarded as being better for weight control than meat (here no difference in perception between the sexes was found).

Country of origin (Sweden) was an important attribute for all products, especially for women, and more so for meat than for LPL and LBMS, as hypothesised in H2 (Table 2). We also expected a similar pattern for organic certification (H2) and, although there was a significant difference between the products, it was small and we found no significant difference between the sexes for this attribute.

4.2. Intention to change consumption

As hypothesised in H3, several socio-demographic variables were significantly associated with intention to decrease meat consumption, with female, young, those in a relationship and highly educated consumers being more likely to state such an intention (Table 3, Table S6.1). Interestingly, however, consumers' view on the environmental impact of meat was the main determinant of intention to change consumption of meat in the model. Health and weight control were also important variables, but not to the same extent as environmental impact.

Fewer socio-demographic variables were significantly associated with intention to increase consumption of LPL and LBMS. For LPL, only sex, age and income were significantly associated and for LBMS only age and education (Table 3). Women, the young and those with lower income were more likely to state an intention to eat more LPL (Table S6.2). For LBMS, young and less educated respondents were more inclined to increase their consumption of LBMS (Table S6.3), the latter contradicting our hypothesis (H3). Perceived environmental impact of the product was an important variable for the intention to change consumption of LPL, but to a lesser extent than meat. Aspects such as taste, healthiness, weight control, ease of preparation and suitability in the diet were equally or more important (Table 3). These same attributes were also important for the stated intention to increase consumption of LBMS. Surprisingly, however, individuals who found LPL and LBMS more difficult to prepare were more likely to state that they intended to increase their consumption of these products (Tables S6.2-6.3).

Overall, the fit of the three MNL models (one each for meat, LPL and LBMS) was satisfactory, with pseudo R^2 values in the range 0.12–0.19 (Table 3). On the other hand, this highlights that planned consumption was not fully explained by the socio-demographic factors and preferences covered in the questionnaire, indicating that additional factors are related to stated intentions to increase LPL and LBMS consumption and decrease meat consumption.

5. Discussion

According to our study, 80% of the Swedish population consume meat in their meals more often than 2–3 times a week, while a majority (60%) never or seldom eat LBMS (Table S4.1). However, put differently, 40% of the Swedish population eat LBMS more than once a month and approximately 20% eat LBMS on a weekly basis. This can be considered quite rapid uptake of a new type of food practice, especially considering the small share of non-meat eaters in the population (Table S3.1). In our

Table 2
Partial results from ANOVA analyses: pairwise comparisons of group means. For questions with significant sex-food type interaction effects, means are compared pairwise within sex ("Diff product") and within food type ("Diff sex"). For the questions "Good for weight" and "Importance of organic production", sex-food type interaction effects were not significant, and means were therefore compared directly. For full results of the ANOVA analyses, see Table S5.1a-b in SM.

		Women				Men				
		Mean	SE	Diff. product		Mean	SE	Diff. product		Diff. sex
Tasty	Meat	4.24	0.0328	***	***	4.64	0.0326	***	***	***
	LPL	4.01	0.0328	***		3.78	0.0326	***		***
	LBMS	3.19	0.0328			2.98	0.0326			***
Healthy	Meat	3.20	0.0301	***	***	3.45	0.0296	***		***
	LPL	4.49	0.0301	***		4.34	0.0296	***		***
	LBMS	3.49	0.0301			3.48	0.0296			
High env. impact	Meat	4.28	0.0312	***	***	3.98	0.0299	***	***	***
	LPL	2.52	0.0312	***		2.51	0.0299	***		
	LBMS	3.17	0.0312			3.00	0.0299			***
Fun	Meat	3.57	0.0333	***	***	4.03	0.0325	***	***	***
	LPL	3.26	0.0333	***		3.03	0.0325	***		***
	LBMS	2.64	0.0333			2.30	0.0325			***
Fits in diet	Meat	3.71	0.0373		***	4.24	0.037	***	***	***
	LPL	3.80	0.0373	***		3.60	0.037	***		***
	LBMS	2.73	0.0373			2.42	0.037			***
Festive	Meat	4.17	0.036	***	***	4.53	0.0347	***	***	***
	LPL	3.46	0.036	***		3.22	0.0347	***		***
	LBMS	2.90	0.036			2.51	0.0347			***
Popular	Meat	3.98	0.0317	***	***	4.22	0.0315	***	***	***
	LPL	3.27	0.0317	***		3.15	0.0315	***		
	LBMS	2.82	0.0317			2.51	0.0315			***
Easy to prepare	Meat	4.09	0.036	***	***	4.17	0.0361	***	***	
	LPL	3.79	0.036	*		3.71	0.0361	***		
	LBMS	3.67	0.036			3.45	0.0361			***
Available	Meat	4.28	0.0316	***	***	4.23	0.0312	***	***	
	LPL	3.78	0.0316	***		3.69	0.0312	***		
	LBMS	3.48	0.0316			3.24	0.0312			***
Import. origin	Meat	4.75	0.0322	***	***	4.47	0.0309	***	***	***
	LPL	4.16	0.0322	***		3.87	0.0309	***		***
	LBMS	4.01	0.0322			3.54	0.0309			***
		All								
Good for weight	Meat	3.36	0.0227	***	*					
	LPL	4.12	0.0227	***						
	LBMS	3.46	0.0227							
Import. organic	Meat	4.08	0.0256	***	***					
	LPL	3.89	0.0256	***						
	LBMS	3.79	0.0256							

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

Table 3
Results from three multinomial logistic regression models (one for meat, one for lightly processed legumes and one for legume-based meat substitutes), with intention to change consumption of each product as the dependent variable and demographic factors, competences, perceptions and material aspects as independent variables.

	Meat			Lightly processed legumes			Legume-based meat substitutes		
	chi2	*df*		*chi2*	*df*		*chi2*	*df*	
Demographic variables:									
Sex	35.5	2	***	27.2	2	***	1.6	2	
Age	29.6	10	***	19.2	10	**	18.9	10	**
Marital status	7.2	2	**	3.5	2		0.7	2	
Children	2.1	2		4.1	2		2.3	2	
Education	14.4	6	**	4.9	6		15.5	6	**
Income	5.9	6		18.7	6	***	2.4	6	
Area of residence (urban/rural)	13.3	8		8.2	8		3.8	8	
Competences, preferences and material aspects:									
Tasty	5.4	4		9.3	4	*	14.4	4	***
Healthy	35.7	4	***	12.6	4	**	15.9	4	***
High env. impact	89.4	4	***	13.5	4	***	6.3	4	
Fun	1.9	4		3.6	4		6.7	4	
Fits in diets	3.9	4		20.7	4	***	12.7	4	**
Festive	3.3	4		2.9	4		6.9	4	
Popular	3.0	4		4.1	4		3.2	4	
Easy to prepare	1.7	4		38.7	4	***	14.9	4	***
Available	8.0	4	*	4.0	4		1.4	4	
Good for weight	15.3	4	***	13.9	4	***	11.1	4	**
Goodness of fit statistics:									
No. of obs:	1840			1714			955		
LR chi2:	505.42			295.92			242.12		
Prob > chi2:	0			0			0		
Pseudo R^2:	0.1862			0.1162			0.1488		
Log likelihood:	−1104.84			−1135.33			−692.73		

Notes: Chi^2 values show whether the model was significant and stated intentions were explained by the explanatory factors included in the model (variable significantly associated with the stated intention to change consumption at ***$p < 0.001$, **$p < 0.01$ and *$p < 0.05$ level). More detailed results, including coefficients and goodness-of-fit statistics, are provided in Supplementary Material (Tables S6.1-6.3).

survey, LPL were generally considered healthy and suitable in diets and many respondents stated an intention to increase their consumption of LPL (Table S4.2), but LPL were not part of routine eating behaviour to the same extent as meat, with only one third of the population consuming LPL more than once a week (Table S4.1).

We found that consumers considered LBMS to be substantially less tasty and suitable in diets compared with meat and even compared with LPL (Table 2). Of those who reported eating LBMS regularly (once a week to once a month), 40–50% intended to increase their consumption further, while very few of those who never or seldom eat LBMS plan to do so in the future (section S4). Hence, there is a large group of people in the population that are not interested in these products. Collier et al. (2021), who performed focus group interviews with Swedish consumers to determine their willingness to consume LBMS, found that participants were generally unwilling to buy LBMS without having tried them beforehand, as they felt uncertain and sceptical about these products for a range of reasons, including taste. Previous research has found that consumers prefer meat substitutes that are similar to meat in taste, texture, appearance and smell (Hoek et al. 2011), but replicating the taste and texture of meat is challenging (Samard & Ryu, 2019). Investment in further product development is important to overcome the current sensory limitations associated with LBMS.

Our results show that LPL are seen by consumers as more attractive than LBMS and that many individuals already have the intention to increase their consumption of LPL, even among those who currently consume these products at very low frequencies (Table S4.2). Investing more in enabling consumers to realise this intention could be an effective strategy to increase consumption of legumes and decrease meat consumption among those groups of consumers who are sceptical about LBMS. van der Weele et al. (2019), who investigated implications of a change to five meat alternatives, make a similar case for pulses. They concluded that pulses, which they identified as the most sustainable alternative but in need of some further technological development, are currently being neglected, while attention, money and scientific capacity are being devoted to other meat alternatives.

Perceptions of the healthiness and benefits for weight control were important variables explaining the stated intention to change consumption of both meat, LPL and LBMS (Table 3). LPL were perceived to be healthier than meat and LBMS, which confirms previous findings (Love & Sulikowski, 2018). Elzerman et al. (2021) also found healthiness to be a driver of meat substitution, as did Hoek et al. (2011). The actual healthiness of LBMS is an issue which is still under debate. While some literature highlights positive health outcomes of LBMS (*e.g.* Toribio-Mateas et al. 2021), there are also questions regarding the health implications of LBMS, as many of these products fall within the definition of ultra-processed foods (Bohrer, 2019). Consumer perceptions of LBMS include scepticism about seemingly unhealthy preservatives and additives, and potential negative consequences of processing (Collier et al. 2021). Investment and research in consumer communication strategies aimed at overcoming this barrier of perceived 'strangeness' of LBMS is needed to enable expansion of these products.

In terms of environmental impact, meat was perceived as having a higher environmental impact than LPL and LBMS (Table 2). Only 2% of respondents indicated that they did not know the environmental impact of meat, while 77% indicated that meat has a rather large or large negative impact on the environment. Hence, contrary to previous research showing that consumers in general are not aware of the environmental impact of meat (*e.g.* Tobler et al. 2011), Swedish consumers appear to be well-informed. For LBMS, respondents ranked the environmental impact as somewhere in between that of meat and LPL. The environmental impact of meat substitutes can vary greatly depending on the type of product, with LBMS generally showing less impact than *e.g.* lab-grown meat or insect-, dairy- or mycoprotein-based substitutes (Smetana et al. 2015). A study investigating the environmental impacts of LBMS on the Swedish market found that the climate impact varied between 1 and 3 kg CO_2e per kg of product (Karlsson Potter, Lundmark, & Röös, 2021). This can be compared to 0.1–0.7 kg CO_2e per kg for LPL (Tidåker et al. 2021) and 3.8, 7.0 and 29 kg CO_2e per kg bone-free chicken, pork and beef, respectively, on the Swedish market (Moberg et al. 2019).

For the environmental benefits of increased legume consumption to materialise, increased consumption of LPL and LBMS must be accompanied by a decrease in meat consumption, which is not always the case (Schösler et al. 2012). In particular, LPL are seen as more as a side dish to meat rather than a meat replacer (de Boer & Aiking, 2019; van der Weele 2019). Thus it is relevant to investigate the actual extent to which LPL replaces meat. Judging from our data, it seems that consumers intend to replace some of the meat in their diet with LPL and LBMS, as there was a significant positive correlation between intention to decrease meat consumption and intention to increase consumption of LPL ($r = 0.5142$; $p < 0.05$) and LBMS ($r = 0.4255$; $p < 0.05$) (calculated using Kendall's tau-*b* correlation coefficient; Agresti 2007).

Most individuals stated that origin of the product (Swedish) and organic certification were important attributes for all products. Women stated this preference significantly more often than men for origin, but the difference between men and women regarding organic certification was not significant, contradicting previous findings (*e.g.* Tobler et al. 2011). In terms of ease of preparation, we also found some conflicting findings; individuals who reported it difficult to prepare LPL and LBMS (especially LPL) were more inclined to state an intention to increase consumption of these products compared with those who found them easy to prepare. We observed that those who viewed preparation as difficult currently eat less LPL, so one tentative explanation for this result could be that these people have an ambition to eat more LPL for *e.g.* health reasons, but currently find them difficult to prepare.

6. Conclusions

Major differences in consumer perceptions of LPL and LBMS in comparison with meat related to the attractiveness and status of the products, with meat generally seen as more fun, more popular, more suitable for diets, more suitable for serving on festive occasions and tastier. However, LPL scored higher than LBMS on all these variables and were also seen as easier to prepare than LBMS, despite LBMS being designed to be convenient. Most consumers were aware of the high environmental impact of meat and the health benefits of LPL. Country of origin of the products, *i.e.* being of Swedish origin, was very important for a majority of respondents, especially in the case of meat, and this was more pronounced for women. Organic certification was also an important attribute for all products, but with only minor differences between products.

The 'usual' socio-demographic variables proved to be important for explaining intention to decrease meat consumption, *i.e.* female, young, highly educated and urban consumers were more inclined to state an intention to decrease their meat consumption. In addition, variables relating to health and environmental impact were important in explaining intention to decrease meat consumption, indicating potential to influence consumption through increased awareness of the environmental and health benefits of decreased meat consumption. Environmental impact was an important variable for intention to change consumption of LPL, but to a lower extent than meat, for which aspects such as taste, healthiness, weight control, ease of preparation and suitability in the diet were equally or more important. Leveraging the stated willingness and intention to increase LPL consumption and using strategies for making LPL more accessible to consumers can be important to increase consumption of LPL. For LBMS, there are still important barriers in terms of taste, familiarity and overall attractiveness of these products for a large part of the population. Such barriers need to be overcome if these products are to play a substantial role of the future practice of protein consumption in Sweden.

Author contributions

All authors jointly planned the study, developed the questionnaire and analysed the results. Röös wrote the main parts of the manuscript with input from Stephan and de Groote, who performed the statistical analyses. All authors have approved the final version of the manuscript.

Ethical statement

In this study we collected data using a Swedish online panel called the Citizen Panel. This well-established panel, founded in 2010, is run by the Laboratory of Opinion Research at the University of Gothenburg (https://www.gu.se/en/som-institute). The responses to our questionnaire was provided to us completely anonymized. We did not ask any personal questions of sensitive nature. Before conducting the survey we discussed ethical aspects of our questionnaire with the Laboratory that has extensive experience in this field and established praxis for handling ethical issues, and we were informed that we would not need ethical approval for our study.

Declaration of competing interest

The authors declare no conflicts of interest.

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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.2022.106002.

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