



## Segmenting consumers of meat and dairy products from five European countries: Implications for promoting sustainable food choices

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### ABSTRACT

Accelerating the transition of agri-food systems towards higher sustainability requires greater understanding of consumers' decision-making related to sustainable food choices, together with competing drivers which may result in unsustainable food choice demand. Meat and dairy production systems negatively contribute to greenhouse gas targets, unless sustainable production methods are applied, and these are understood by consumers and used in food choices. The psychological factors determining consumers' attitudes towards sustainably produced meat and dairy products were assessed. Data were collected through an online survey across five European countries (Czechia, Spain, Sweden, Switzerland, and the United Kingdom) ( $n = 2490$ ) in November 2021. The results showed consumers perceived food sustainability to be less important than sensory and healthiness attributes. UK consumers showed the strongest intentions to increase consumption of sustainably produced meat and dairy products. In contrast, Swiss consumers demonstrated the weakest intentions. A two-stage cluster analysis based on consumers' perceived attribute importance identified four distinct segments: *low food involvement* (19.6 %), *high food involvement* (31.9 %), *price-sensitive* (23.2 %), and *health- and sustainability-involved* (25.3 %) consumer segments. Respondents in *low food involvement* and *price-sensitive* consumer segments tended to be younger and have lower environmental preservation attitudes and were more prevalent in Switzerland and Czechia. Those in *high food involvement* and *health- and sustainability-involved* consumer segments perceived higher importance of food sustainability and were more prevalent in Spain and Sweden. These respondents expressed greater intentions to increase consumption of sustainably produced meat and dairy products, at the same time being more likely to recognise the utility of sustainability labelling information. Animal welfare information was perceived to be most important for respondents in all the segments with the exception of those in the *price-sensitive* consumer segment. Building on the results, recommendations for promoting consumer sustainable food choices are proposed.

### 1. Introduction

Agri-food systems are widely acknowledged to represent significant drivers of climate change, biodiversity loss, and environmental pollution, all of which pose substantial threats to human well-being and the achievement of the Sustainable Development Goals (United Nations, 2015). From production to consumption, agri-food systems are

responsible for one-third of global anthropogenic greenhouse gas (GHG) emissions, and drive biodiversity loss through changes in agricultural land-use change (Crippa et al., 2021; Marques et al., 2019). Shifting societal norms towards more sustainable food choices can yield benefits for enhancing the sustainability of entire agri-food supply chains from the perspective of the demand side of the food system (Perignon et al., 2017; Steenson and Buttriss, 2021). Consequently, the promotion of

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sustainable food choices among consumers has emerged as a pivotal factor within both policy and research agendas over the past two decades (Geels et al., 2015).

One stream of research into sustainable food choices is centred around reducing environmental impacts of diets through reducing consumption of food categories known to have a high environmental burden, such as beef and dairy products (Meybeck and Gitz, 2017; Westhoek et al., 2014; Wolstenholme et al., 2020). This may be achieved by substituting these foods with food categories such as fruits and vegetables, or alternative foods such as ingredients derived from edible insects, which result in a lower environmental burden (see e.g., Graça et al., 2015; Orsi et al., 2019; Reipurth et al., 2019; Tilman and Clark, 2014; Verain et al., 2015). A second stream of research investigates consumer attitudes and behaviours associated with food produced through “processes and systems that are non-polluting, conserve non-renewable energy and natural resources, and are economically efficient, and safe for workers, communities and consumers, and do not compromise the needs of future generations” (Foresight, 2011, p. 204). Examples include organic food, locally produced food, food traced for “green production” attributes, and genetically modified and gene-edited food which has a reduced environmental impact (see e.g., Ditlevsen et al., 2020; Hughner et al., 2007; Jin et al., 2022, 2023; Muringai et al., 2020). Here, the term “sustainable food choices” primarily refers to the selection of food produced using sustainable processes and systems.

### 1.1. Food attributes and sustainable food choices

Consumers base their food-related decision-making on various attributes associated with specific foods, which often reflect their underlying motives for food choices, such as sensory appeal, healthiness, sustainability and price (Grunert, 1995; Markovina et al., 2015). While consumers can directly observe the price of a food product, they often evaluate other attributes using extrinsic indicators. For example, aspects such as colour, fat content, odour, and previous eating experience are commonly used by consumers to evaluate the sensory quality of meat (Kang et al., 2022). Healthiness and sustainability attributes may be communicated to consumers through food labels and certifications. Nutrient content, calories and gluten-free labels can serve as indicators of food healthiness, while carbon footprint, animal welfare or other combined sustainability labels and organic certification signify the sustainability levels of food products (Grunert et al., 2014).

The importance of different food attributes perceived by consumers could vary by individual, food category, region, and over time (Honkanen and Frewer, 2009; Markovina et al., 2015; Marty et al., 2021; Verain et al., 2021). For example, in the Netherlands, some consumers prioritised food taste, price and healthiness of food, while others considered the food’s origin, its environmental impacts during production, and animal welfare (de Boer and Aiking, 2022; Verain et al., 2016). Chinese consumers showed a higher demand for traceability information related to food safety, quality, and environmental impacts of food production compared to UK consumers (Jin et al., 2023). Temporal variation in consumer preferences can also be identified, implying the potential for change in consumers’ perceived importance of food attributes. For example, UK consumers’ demand for ethical and sustainable food has increased over the past ten years (Angelo et al., 2020), potentially as a consequence of increased scientific evidence regarding the negative environmental impacts of food production (Clark et al., 2022) and increased societal attention being paid to this issue (Bellotti and Panzone, 2016).

Previous research has established links between consumers’ perceived food attribute importance and their consumption decisions about sustainable food products (e.g., Allès et al., 2017; Dowd and Burke, 2013; Honkanen et al., 2006; Vanhonacker et al., 2013; Van Loo et al., 2017; Verain et al., 2015). Dowd and Burke (2013) observed that consumers who perceived the healthiness of consumed foods to be important were more likely to express intentions to buy locally produced

food. Consumers who were more concerned about the environmental impacts related to their food choices tended to exhibit more favourable attitudes towards organic food, at the same time exhibiting less concern about prices for these products (Allès et al., 2017; Honkanen et al., 2006). Consumers’ general food choice motives and the relative importance they attached to product attributes relate to their sensitivity and preferences regarding different food-related information (Bernués et al., 2003; Machín et al., 2016; Ufer and Ortega, 2023). For example, individuals reporting that they pay more attention to healthiness and convenience when making food choices place greater importance on nutritional information and details regarding the freshness of meat (e.g., use-by dates) compared to information concerning the associated production system, quality controls, or origin of the meat (Bernués et al., 2003).

### 1.2. Consumers’ interpretation of food sustainability

There is a lack of consistency and clarity in how consumers interpret the concept of food sustainability. Some research has reported that consumers’ perception of food sustainability is unidimensional, although different elements may contribute to this single dimension. For instance, Grunert et al. (2014) found that consumers primarily interpret sustainable food as that being produced with low environmental impacts. In addition, some consumers may link sustainability to environmental issues together with ethical concerns related to animals’ and workers’ welfare (Polzin et al., 2023; Verain et al., 2016), and local production (Verain et al., 2016). This may be also dependent on the research methodology and the questions asked. However, there is evidence that consumers may perceive sustainability as a multidimensional concept. For example, local production has been reported to be a separate dimension of sustainability, and as being distinct from environmental and ethical issues (Sautron et al., 2015; Verain et al., 2021). Van Loo et al. (2017) reported that, in addition to the environmental dimension, consumers’ perception of sustainability included social dimensions, considering workers’ welfare, food prices, and food healthiness, while animal welfare was related to both environmental and social dimensions.

### 1.3. Rationale and aims

Although both national and international policies have aimed to change agriculture production in line with the need to increase sustainability (United Nations, 2015), progress in reaching this goal has been mixed. European policy prioritises sustainable agriculture as part of its “Green Deal” (European Commission, 2019), but has faced various challenges in making significant progress towards achieving Sustainable Development Goals related to sustainable food consumption and production (Eurostat, 2023), in part because of the demand characteristics inherent in the food system. A deeper understanding of consumers’ food decision-making processes is needed, which can serve as a foundation for the development of effective strategies aimed at encouraging and empowering consumers to make more sustainable food choices in the future. Here, we aimed to gain insights into the sustainable food decision-making among European consumers through understanding perceived attribute importance of specific food products. Meat and dairy products were selected as their production often results in high GHG emissions (Clark et al., 2022). Optimising the extensification of animal farming in some production systems (e.g., permanent grasslands) can improve multifunctional ecosystem service delivery (Schils et al., 2022), although there is insufficient evidence regarding the consumer demand for foods which are produced by these systems (Tindale et al., 2023). The aims of the analysis were:

- 1) To investigate how European consumers perceive sustainability in relation to meat and dairy products;

- 2) To segment consumers on the basis of their perceived food attribute importance;
- 3) To understand consumers' responses to sustainably produced food and labelling information; and
- 4) To inform strategies aimed at facilitating consumers' adoption of sustainable food choices in relation to meat and dairy products.

Through achieving these research aims, this study makes novel empirical contributions to our understanding of consumers' food decision-making in the context of sustainable production and health considerations. Specifically, we investigate consumer heterogeneity regarding their perceived importance of food attributes in selecting meat and dairy products, as well as consumers' interpretation of the dimensionality of "food sustainability" in this context. Previous research (see e.g., Koksál, 2019; Kovács et al., 2022; Van Loo et al., 2017; Verain et al., 2016) has rarely segmented consumers based on multiple food attributes relevant to their decision-making while simultaneously considering the context of socio-cultural and biogeographic differences. This study notably includes countries representing diverse biogeographic zones with variant conservation status of habitats and species, as well as differing levels of meat and dairy consumption. These variations may reflect different societal demands across countries concerning the utilisation of natural resources in relation to food production. The results are of particular relevance to the development of interventions to promote health and sustainability within livestock production systems, and how this potentially varies across geographical and cultural contexts.

## 2. Method

This analysis draws on survey data collected as part of the European Horizon 2020 funded SUPER-G project (<https://www.super-g.eu/>). Ethical approval for the survey study was granted by Newcastle University on 21/08/2020 [Ref 20-TIN-029].

### 2.1. Questionnaire design

The questionnaire, designed to achieve the four research aims (see Section 1.3), was informed by the findings of the existing literature focusing on consumer food-related attitudes and behaviour (see e.g., Honkanen and Frewer, 2009; Johe and Bhullar, 2016; Markovina et al., 2015; Van Loo et al., 2017), and a priori qualitative research investigating public views on sustainably produced meat and dairy products from permanent grassland (Tindale et al., 2023). Research partners from the five selected countries co-developed the questionnaire, initially in English. The English version was first pre-tested as a pilot survey among UK consumers ( $n = 10$ ) to assess both the comprehension and wordings of the questions, as well as the approximate time taken to complete the survey. No changes were made to this version. To ensure consistency in the measurements of constructs in different languages, research partners translated and back-translated the English questionnaire into local languages of Czechia, Spain, Sweden, and Switzerland. A formal pilot study among consumers was subsequently conducted in all the five countries ( $n = 20$  in each country). Some minor changes were made to non-English questionnaires in relation to national languages where equivalent words were used.

In the final questionnaire, six types of food attributes associated with consumers' choice of meat and dairy products were included to measure perceived attribute importance indicated by respondents when buying those products (research aims 1 and 2) (Honkanen and Frewer, 2009; Markovina et al., 2015; Van Loo et al., 2017; Verain et al., 2016). Items measuring perceived importance of sustainability labelling and the specific sustainability information for sustainably produced meat and dairy products were included to capture respondents' responses to sustainability labelling (research aims 3) (Apostolidis and McLeay, 2019; Grunert et al., 2014). Items measuring the respondents' perceived behavioural control over their ability to make sustainable food choices

and their intentions regarding buying sustainably produced food were included to capture respondents' responses to sustainably produced food (research aim 3) (Aitken et al., 2020; Johe and Bhullar, 2016). Finally, to further understand factors affecting respondents' sustainable food choices and thus better inform strategy-making (research aim 4), items measuring respondents' general environmental attitudes<sup>2</sup> (Milfont and Duckitt, 2010) and socio-demographic information (gender, age, educational attainment, rural versus urban residency, and employment status) were included in the questionnaire. The respondents were asked to rate different statements on five-point scales (1 = "strongly disagree" to 5 = "strongly agree" or 1 = "not at all important" to 5 = "extremely important"). Detailed items are listed in Supplementary Information Table S1.

### 2.2. Sampling and procedure

An online survey was administered by a social research agency (Qualtrics LLC) in November 2021 to adults (over 18 years of age) from five European countries (Czechia, Spain, Sweden, Switzerland and the United Kingdom). After eliminating surveys where respondents did not report consuming meat and dairy products, a total of 2490 responses remained for further analysis. The original sample comprised respondents who were nationally representative of the population for each country based on age, gender, socio-economic class and rural versus urban residency. Sample characteristics of the respondents included in the analysis are summarised by country in Table 1.

The five countries were selected to obtain a spread across Western, Southern, Northern and Central Europe, covering five biogeographic zones in Europe (*Continental: Czechia, Boreal: Sweden, Mediterranean: Spain, Alpine: Switzerland, and Atlantic: UK*). The conservation status of habitats and species varies across the biogeographic zones. For example, the Atlantic and Continental regions have the most threatened conservation status of habitats and species. The Mediterranean region harbours the largest areas of degraded forests, grasslands, scrub, and heath, requiring substantial improvement (European Environment Agency, 2020). These conditions might contribute to heightened societal demands for sustainable food production and consumption within these regions. Conversely, the Alpine region boasts the most favourable conservation status for habitats, while the Boreal region demonstrates the best conservation status of species (European Environment Agency, 2020). Moreover, variations in meat and dairy consumption among the selected countries may be linked to societal demands concerning the utilisation of natural resources for relevant food production. For instance, of the five countries, Spanish consumers exhibit significantly higher meat consumption compared to those in other countries (Fig. 1, data available to 2020); and Switzerland has the highest milk consumption (Fig. 2, data available to 2020). These differences between countries, together with variations in national conservation status, represent potential perceptions of tensions and trade-offs between food production and environmental conservation, which can potentially influence societal attitudes towards sustainable food production and food choices.

### 2.3. Data analysis

The data analysis included descriptive statistics (reporting percentages of gender, education attainment, residency, and employment

<sup>2</sup> Environmental attitudes have two dimensions: "preservation" and "utilitarian". Preservation attitudes express the general belief that priority should be given to preserving nature and the diversity of natural species in their original natural states, and protecting nature and biodiversity from human use and alteration. Utilisation, in contrast, expresses the general belief that it is right, appropriate, and necessary for nature and all natural phenomena and species to be used and altered for human objectives (Milfont and Duckitt, 2010, p. 81).

**Table 1**  
Sample description for sample included in the analysis.

	Czechia (n = 515)	Spain (n = 507)	Sweden (n = 505)	Switzerland (n = 469)	UK (n = 494)	Total sample (N = 2490)
Gender						
Male	50.10 %	57.20 %	56.24 %	43.28 %	48.38 %	51.16 %
Female	49.90 %	42.80 %	42.97 %	56.08 %	51.62 %	48.55 %
Rather not to say	0.00 %	0.00 %	0.79 %	0.64 %	0.00 %	0.28 %
Age	47.32 (15.34)	44.07 (13.31)	48.54 (16.26)	47.25 (16.62)	47.56 (16.65)	46.94 (15.73)
Educational attainment						
Secondary education or less	8.93 %	33.13 %	22.18 %	6.82 %	21.05 %	18.55 %
Upper-secondary education	69.13 %	28.01 %	33.86 %	55.44 %	37.85 %	44.82 %
Undergraduate degree or diploma	19.61 %	29.98 %	31.88 %	15.35 %	32.59 %	25.98 %
Postgraduate degree or qualification	2.33 %	8.88 %	12.08 %	22.39 %	8.50 %	10.64 %
Residency						
Rural	51.26 %	45.96 %	51.09 %	49.25 %	48.99 %	49.32 %
Urban	48.74 %	54.04 %	48.91 %	50.75 %	51.01 %	50.68 %
Employment status						
Employed	62.14 %	61.93 %	59.01 %	65.03 %	60.12 %	61.61 %
Retired	21.36 %	8.68 %	25.74 %	22.17 %	18.02 %	19.16 %
Student	4.66 %	7.30 %	5.35 %	2.77 %	3.44 %	4.74 %
Unemployed	11.84 %	22.09 %	9.90 %	10.02 %	18.42 %	14.50 %
Environmental attitudes						
Preservation attitude	4.01 (0.626)	4.22 (0.627)	4.09 (0.607)	3.95 (0.580)	4.14 (0.631)	4.08 (0.622)
Utilisation attitude	2.57 (0.670)	2.84 (0.732)	2.62 (0.718)	2.65 (0.813)	2.84 (0.728)	2.70 (0.741)

Note: The mean value and standard deviation (in brackets) are used to show the age and environmental attitudes.

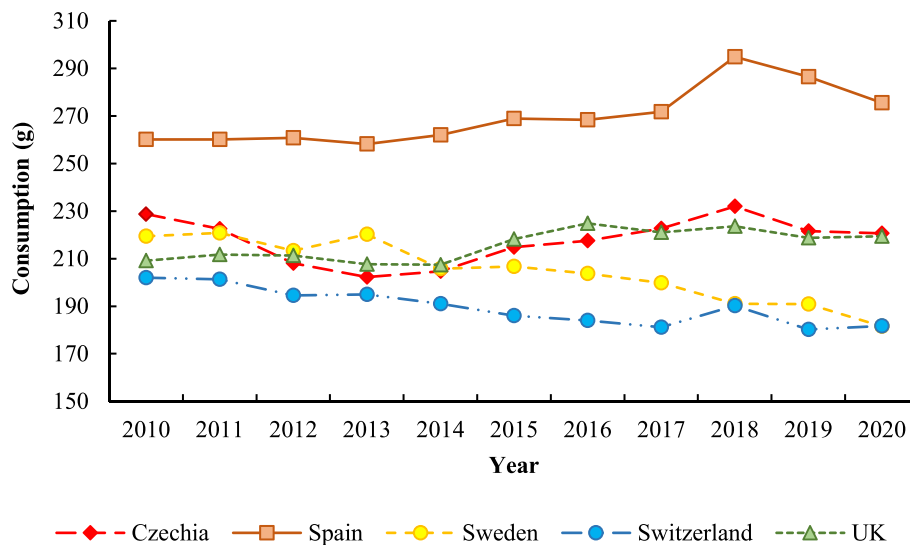


Fig. 1. Annual per capita meat consumption of five countries from 2010 to 2020. Data sourced from FAOSTAT, accessed 30 November 2023. <https://www.fao.org/faostat/en/#data>

status; means and standard deviations for age and environmental attitudes), and principal components analysis with varimax rotation to identify the underlying dimensions of 18 items that measured respondents’ perceived importance of food attributes in regard to meat and dairy products. Factor loadings of 0.50 and higher were considered practically significant (Hair et al., 2013). The internal reliability and consistency of the identified multi-item factors were evaluated using Cronbach’s alpha. These factors related to respondents’ perceived importance of food attributes were employed as segmentation variables in a two-step cluster analysis (hierarchical and K-means clustering). In addition, ANOVA and post hoc analysis were performed to compare the distributions of clusters across socio-demographic groups, as well as perceived behavioural control, purchase intentions and perceived importance of labelling information associated with sustainably produced food across the clusters. All data analysis was undertaken using

SPSS Statistical Package for the Social Sciences (Version 27).

### 3. Results

#### 3.1. Exploration of segmentation factors

Principal components analysis (PCA) with varimax rotation extracted five factors for both meat and dairy products based on 18 items measuring respondents’ perceived food attribute importance (Table 2) referring to perceived importance of sustainability (factor 1), healthiness (factor 2), sensory appeal (factor 3), familiarity and convenience (factor 4), and price (factor 5). The items related to sustainable packaging were deleted due to significant cross-loadings on factors 1 and 2 for both meat and dairy products (Hair et al., 2013). The PCA procedure was then repeated, resulting in five-factor solutions for meat and dairy



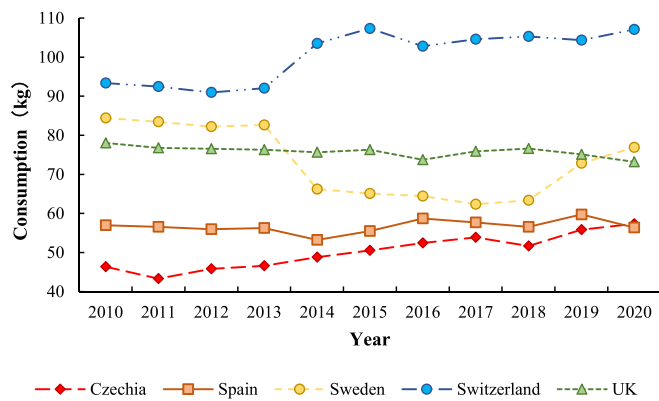


Fig. 2. Annual per capita milk consumption of five countries from 2010 to 2020. Data sourced from FAOSTAT, accessed 30 November 2023. <https://www.fao.org/faostat/en/#data>

products, which explained 69.4 % and 72.5 % of the total variance, respectively. Overall, the perceived importance of sensory appeal was ranked the highest, followed by healthiness (Table 3), both of which were associated with greater perceived importance compared to that associated with sustainability and price. Familiarity and convenience

were rated as the least important. The perceived importance levels of each food attribute item can be found in Supplementary Information Table S2.

### 3.2. Consumer segmentation and segment profiling

Based on the five extracted factors, a two-step cluster analysis was performed, including hierarchical clustering and K-means clustering, to identify consumer segments. Hierarchical clustering helped to determine that four clusters were optimal, after which a K-mean cluster analysis was performed using the optimal number of clusters. Finally, respondents whose data indicated relatively homogenous food attribute importance ratings were categorised into one segment, which enabled four distinct consumer segments to be identified: *low-involvement*, *high-involvement*, *price-sensitive*, and *health- and sustainability-involved* consumer segments (Table 3). Here, “involvement” refers to the individual importance or relevance of food attributes attached to an individual’s choice of meat and dairy products (Van Loo et al., 2017; Zaichkowsky, 1985). Respondents in the “low-involvement” consumer segment tended to associate relatively low importance to all the food attributes assessed (mean values no bigger than 3). The exception was the moderate level indicated for sensory appeal by respondents in this segment (mean values around 3.50), which was, however, still low in comparison to the

Table 2  
Factor loadings of perceived food attribute importance.

Attribute importance	Meat					Dairy products				
	1	2	3	4	5	1	2	3	4	5
Outdoor-reared/ free range	<b>0.831</b>	0.083	0.213	0.051	0.009	<b>0.840</b>	0.058	0.234	0.084	0.012
Pasture-fed	<b>0.804</b>	0.090	0.172	0.137	0.029	<b>0.820</b>	0.067	0.201	0.150	0.048
Food miles	<b>0.745</b>	0.209	0.030	0.151	0.023	<b>0.732</b>	0.234	0.018	0.217	0.049
Animal welfare	<b>0.721</b>	0.199	0.231	-0.033	0.029	<b>0.772</b>	0.176	0.240	-0.006	0.059
Carbon footprint	<b>0.657</b>	0.378	-0.151	0.238	0.047	<b>0.638</b>	0.403	-0.12	0.283	0.062
Fairtrade or producer/farmer paid	<b>0.656</b>	0.33	0.104	0.080	0.058	<b>0.681</b>	0.333	0.099	0.123	0.100
Locally produced	<b>0.637</b>	0.243	0.240	0.193	-0.027	<b>0.659</b>	0.221	0.226	0.243	-0.027
Organic	<b>0.626</b>	0.367	-0.122	0.268	-0.061	<b>0.626</b>	0.376	-0.109	0.291	-0.038
Nutrition	0.275	<b>0.696</b>	0.298	0.093	0.14	0.299	<b>0.652</b>	0.395	0.110	0.144
Healthy eating	0.384	<b>0.610</b>	0.226	0.099	0.098	0.436	<b>0.578</b>	0.239	0.149	0.100
Processing	0.35	<b>0.554</b>	0.203	0.105	0.077	0.414	<b>0.528</b>	0.254	0.166	0.115
Freshness	0.178	0.095	<b>0.761</b>	0.127	0.127	0.189	0.113	<b>0.763</b>	0.118	0.109
Quality/ taste	0.121	0.274	<b>0.709</b>	0.046	0.043	0.120	0.253	<b>0.761</b>	0.061	0.106
Familiarity or brand	0.248	0.091	0.084	<b>0.793</b>	0.106	0.242	0.141	0.068	<b>0.802</b>	0.133
Convenience of use/preparation	0.133	0.099	0.126	<b>0.742</b>	0.266	0.185	0.130	0.159	<b>0.718</b>	0.263
Special offers	-0.019	0.095	0.029	0.170	<b>0.825</b>	0.058	0.115	0.007	0.286	<b>0.792</b>
Price	0.015	0.079	0.165	0.050	<b>0.817</b>	0.025	0.048	0.161	0.141	<b>0.834</b>

Note: Factor loadings higher than 0.5 are in bold type. The Cronbach’s alpha values of factors 1–5 were 0.909, 0.742, 0.670, 0.723 and 0.722 for meat and 0.919, 0.789, 0.721, 0.742 and 0.758 for dairy products.

Table 3  
Consumer segments and factor scores.

Factors	S1 Low involvement consumers (n = 488; 19.60 %)	S2 High involvement consumers (n = 795; 31.93 %)	S3 Price-sensitive consumers (n = 578; 23.21 %)	S4 Health- and sustainability-involved consumers (n = 629; 25.26 %)	Total sample
<b>Meat</b>					
Sensory appeal	3.50 <sup>d</sup> (0.70)	4.56 <sup>a</sup> (0.47)	4.23 <sup>c</sup> (0.53)	4.40 <sup>b</sup> (0.52)	4.23 (0.67)
Healthiness	2.96 <sup>d</sup> (0.59)	4.39 <sup>a</sup> (0.51)	3.51 <sup>c</sup> (0.57)	4.02 <sup>b</sup> (0.53)	3.81 (0.76)
Price	3.05 <sup>b</sup> (0.68)	4.21 <sup>a</sup> (0.63)	4.12 <sup>a</sup> (0.54)	2.91 <sup>c</sup> (0.71)	3.63 (0.88)
Convenience & familiarity	2.65 <sup>d</sup> (0.75)	4.14 <sup>a</sup> (0.65)	3.12 <sup>b</sup> (0.77)	2.86 <sup>c</sup> (0.80)	3.29 (0.95)
Sustainability	2.86 <sup>d</sup> (0.63)	4.28 <sup>a</sup> (0.48)	2.97 <sup>c</sup> (0.66)	3.99 <sup>b</sup> (0.50)	3.63 (0.84)
<b>Dairy product</b>					
Sensory appeal	3.47 <sup>d</sup> (0.70)	4.60 <sup>a</sup> (0.46)	4.30 <sup>c</sup> (0.54)	4.42 <sup>b</sup> (0.52)	4.26 (0.68)
Healthiness	2.92 <sup>d</sup> (0.59)	4.48 <sup>a</sup> (0.48)	3.51 <sup>c</sup> (0.60)	4.04 <sup>b</sup> (0.53)	3.84 (0.79)
Price	2.92 <sup>c</sup> (0.68)	4.28 <sup>a</sup> (0.62)	4.02 <sup>b</sup> (0.58)	2.80 <sup>d</sup> (0.72)	3.58 (0.93)
Convenience & familiarity	2.60 <sup>d</sup> (0.76)	4.27 <sup>a</sup> (0.60)	3.17 <sup>b</sup> (0.78)	2.94 <sup>c</sup> (0.84)	3.35 (0.99)
Sustainability	2.80 <sup>d</sup> (0.63)	4.33 <sup>a</sup> (0.47)	2.97 <sup>c</sup> (0.72)	3.97 <sup>b</sup> (0.53)	3.62 (0.87)

Note: <sup>a-d</sup> Values with the same letter as superscript indicate not significantly different means, and different superscripts indicate significantly different means between the segments, following ANOVA post hoc Tukey tests at  $p < 0.05$ .

level of importance rated by respondents in the other three segments (mean values ranging from 4.23 to 4.60). In contrast, respondents in the “high-involvement” consumer segment attached high importance to all attributes assessed (mean values above 4). Those in the “price-sensitive” segment rated price as highly important (mean values at 4.12 and 4.05 for meat and dairy products, respectively), which was rated lower than sensory appeal, while the other three attributes assessed (healthiness, convenience and familiarity, and sustainability) were rated as being of relatively moderate importance. The “health- and sustainability-involved” consumer segment indicated relatively high perceived importance for both healthiness and sustainability, in addition to sensory appeal, while price and familiarity and convenience were perceived to be of relatively low importance.

Differences in socio-demographic attributes were also identified between respondents belonging to different segments. Respondents in the low-involvement consumer segment represented the smallest (19.60 %) of the four segments. Student and Swiss respondents accounted for a significantly larger proportion, and male and Spanish respondents accounted for a significantly lower proportion of respondents in this segment (Table 4; detailed statistical tests see Supplementary Information Table S3). Respondents in the low-involvement segment had significantly lower mean age than those in high-involvement and health- and sustainability-involved consumer segments and were the least positive towards environmental conservation across the four segments (Table 4). The high-involvement consumer segment represented the biggest segment and included 31.93 % of the respondents. Those who were educated only to secondary educational level and from Spain accounted for a significantly larger proportion, and student, Czech and Swedish respondents accounted for a significantly lower proportion in this segment. Czech respondents accounted for a significantly larger proportion in the price-sensitive consumer segment. The preservation attitude of those in the health- and sustainability-involved consumer segment was similar to those in the high-involvement consumer segment and significantly higher than low-involvement and price-sensitive consumer segment, while utilisation attitudes were significantly lower than for

respondents in low-involvement, high-involvement and price-sensitive consumer segments. Swedish and retired respondents accounted for a significantly larger proportion within the health- and sustainability-involved consumer segment, with Czech respondents accounting for a significantly lower proportion in the health- and sustainability-involved consumer segment.

### 3.3. Sustainable consumption intentions and labelling preferences

In terms of perceived behavioural control over making sustainable food choices, respondents perceived a moderate level regarding the extent that they perceived it easy to identify sustainably produced food (mean value 3.44) and a relatively low level regarding the extent to which they perceived it easy to buy sustainably produced food (mean value 2.95) (Table 5). Their intention to increase consumption of sustainably produced food was at a moderate level (mean value 3.16). In terms of the extent to which respondents perceived it easy to identify sustainably produced food, those in the high-involvement consumer segment perceived the highest level (mean value at 3.98), followed by respondents in the health- and sustainability-involved, price-sensitive and low-involvement consumer segments (with significant differences between segments). However, high-involvement respondents were significantly more likely to perceive sustainable foods to be easy to buy (mean value at 3.42) compared to respondents in the price-sensitive, health- and sustainability-involved and low-involvement consumer segments (mean values ranging from 2.69 to 2.77 where there were no significant differences between price-sensitive, health- and sustainability-involved and low-involvement respondents). Respondents in the high-involvement consumer segment indicated significantly higher intentions to consume more sustainably produced food compared to health- and sustainability-involved consumers. Respondents in both segments indicated significantly stronger intentions to buy more sustainably produced food compared to those in low-involvement and price-sensitive consumer segments.

In terms of labelling sustainably produced food, respondents overall

**Table 4**  
Profiling of consumer segments.

Factors	Low-involvement consumers	High-involvement consumers	Price-sensitive consumers	Health- and sustainability-involved consumers
Gender				
Male	44.67 %	52.58 %	51.38 %	54.21 %
Female	54.92 %	47.04 %	48.44 %	45.63 %
Rather not to say	0.41 %	0.38 %	0.17 %	0.16 %
Age	44.51 <sup>c</sup> (16.97)	47.48 <sup>a,b</sup> (15.03)	45.44 <sup>b,c</sup> (14.95)	49.53 <sup>a</sup> (15.89)
Educational attainment				
Secondary education or less	16.39 %	23.90 %	16.26 %	15.58 %
Upper-secondary education	47.75 %	40.88 %	45.85 %	46.58 %
Undergraduate degree or diploma	24.18 %	23.90 %	29.58 %	26.71 %
Postgraduate degree or qualification	11.68 %	11.32 %	8.30 %	11.13 %
Residency				
Rural	49.39 %	46.92 %	48.10 %	53.42 %
Urban	50.61 %	53.08 %	51.90 %	46.58 %
Employment status				
Employed	61.48 %	64.03 %	63.49 %	56.92 %
Retired	18.24 %	18.74 %	15.57 %	23.69 %
Student	7.79 %	2.77 %	5.02 %	4.61 %
Unemployed	12.50 %	14.47 %	15.92 %	14.79 %
Environmental attitudes				
Preservation	3.69 <sup>c</sup> (0.65)	4.30 <sup>a</sup> (0.54)	3.91 <sup>b</sup> (0.59)	4.27 <sup>a</sup> (0.52)
Utilisation	2.67 <sup>b</sup> (0.64)	2.95 <sup>a</sup> (0.84)	2.72 <sup>b</sup> (0.65)	2.41 <sup>c</sup> (0.64)
Country				
Czechia	22.13 %	16.86 %	29.76 %	16.06 %
Spain	12.91 %	28.81 %	16.61 %	18.92 %
Sweden	19.67 %	15.72 %	17.13 %	29.41 %
Switzerland	27.87 %	16.35 %	14.88 %	18.60 %
United Kingdom	17.42 %	22.26 %	21.63 %	17.01 %

Note: <sup>a-d</sup> Values with the same letter as superscript indicate not significantly different means, and different superscripts indicate significantly different means between the segments, following ANOVA post hoc Tukey tests at  $p < 0.05$ .

**Table 5**  
Responses of respondents in different segments to sustainably produced food and labelling information.

Factors	Low-involvement consumers	High-involvement consumers	Price-sensitive consumers	Health- and sustainability-involved consumers	Total sample
Perceived behavioural control					
Easy to identify	2.90 <sup>c</sup> (0.97)	3.98 <sup>a</sup> (1.00)	2.95 <sup>c</sup> (1.05)	3.63 <sup>b</sup> (1.06)	3.44 (1.12)
Easy to buy	2.69 <sup>b</sup> (0.93)	3.42 <sup>a</sup> (1.28)	2.77 <sup>b</sup> (1.03)	2.74 <sup>b</sup> (1.25)	2.95 (1.20)
Intention to increase consumption	2.81 <sup>c</sup> (0.89)	3.60 <sup>a</sup> (1.10)	2.91 <sup>c</sup> (0.94)	3.10 <sup>b</sup> (1.18)	3.16 (1.10)
Perceived usefulness of sustainable food labelling	3.32 <sup>d</sup> (0.98)	4.38 <sup>a</sup> (0.77)	3.47 <sup>c</sup> (1.05)	4.24 <sup>b</sup> (0.82)	3.92 (1.01)
Perceived importance of specific labelling information					
Local product	3.34 <sup>c</sup> (0.98)	4.42 <sup>a</sup> (0.68)	3.63 <sup>b</sup> (0.92)	4.36 <sup>a</sup> (0.78)	4.01 (0.94)
Ethical methods of production	3.18 <sup>d</sup> (0.95)	4.39 <sup>a</sup> (0.71)	3.32 <sup>c</sup> (0.95)	4.21 <sup>b</sup> (0.81)	3.86 (1.00)
Sustainable methods of production	3.30 <sup>d</sup> (0.94)	4.43 <sup>a</sup> (0.72)	3.44 <sup>c</sup> (0.98)	4.26 <sup>b</sup> (0.81)	3.93 (0.98)
Carbon footprint from supply and distribution	3.00 <sup>c</sup> (1.01)	4.23 <sup>a</sup> (0.89)	3.12 <sup>c</sup> (1.06)	3.85 <sup>b</sup> (1.03)	3.64 (1.11)
Animal welfare	3.58 <sup>b</sup> (0.99)	4.56 <sup>a</sup> (0.69)	3.69 <sup>b</sup> (1.00)	4.56 <sup>a</sup> (0.70)	4.16 (0.95)
Health and nutrition	3.44 <sup>d</sup> (0.90)	4.56 <sup>a</sup> (0.66)	3.87 <sup>c</sup> (0.89)	4.33 <sup>b</sup> (0.78)	4.12 (0.90)
Food safety	3.48 <sup>d</sup> (0.89)	4.58 <sup>a</sup> (0.64)	3.94 <sup>c</sup> (0.91)	4.33 <sup>b</sup> (0.78)	4.15 (0.89)
Benefits for producers	3.03 <sup>d</sup> (0.92)	4.28 <sup>a</sup> (0.82)	3.19 <sup>c</sup> (1.04)	3.66 <sup>b</sup> (0.98)	3.62 (1.06)
Link or QR code to a website for more information	2.95 <sup>d</sup> (0.98)	4.10 <sup>a</sup> (0.95)	3.20 <sup>c</sup> (1.07)	3.52 <sup>b</sup> (1.10)	3.52 (1.11)

Note: <sup>a-d</sup> Values with the same letter as superscript indicate not significantly different means, and different superscripts indicate significantly different means between the segments, following ANOVA post hoc Tukey tests at  $p < 0.05$ .

perceived a high level of usefulness to be associated with sustainability labels, with those in the *high-involvement* consumer segment rating usefulness the highest (mean = 4.38), followed by respondents in the *health- and sustainability-involved* consumer segment (mean = 4.24), *price-sensitive* consumer segment (mean = 3.47), and *low-involvement* consumer segment (mean = 3.32). Food safety-, animal welfare-, and health and nutrition-related information were rated as being most important by the respondents, while the link or QR code to a website for more information about product attributes was perceived to be the least important.

Consistent with the perceived high importance of all food attributes, respondents in the *high-involvement* consumer segment rated all the labelling information as being highly important, while those in the *low-involvement* and *price-sensitive* segments rated the information as being of moderate importance. Respondents in the *low-involvement* and *price-sensitive* consumer segments perceived QR code-related information to be the least important source of information. In addition, those in the *low-involvement* consumer segment perceived animal welfare-related information to be the most important, while respondents in the *price-sensitive* consumer segment perceived food safety-related information to be the most important. As for those in the *high-involvement* consumer segment, *health- and sustainability-involved* consumers perceived most of the labelling information presented to be highly important.

Exceptionally, information about carbon footprints, benefits for producers, and QR code-related information was rated as being of moderate levels of importance. Animal welfare- and local production-related information was perceived to be more important than the other information by respondents in the *health- and sustainability-involved* consumer segment. Surprisingly, respondents in this segment perceived the information about carbon footprint from supply and distribution activities as being the least important relative to the other types of information.

In terms of country comparisons, UK respondents reported relatively higher perceived behavioural control over their ability to make sustainable food choices and expressed greater intentions to consume more sustainably produced food. Swiss respondents displayed the lowest intentions in respect of the latter (Table 6). Czech respondents perceived more difficulty in identifying sustainably produced food, while Czech, Spanish, and Swedish respondents reported more difficulty in purchasing these items. UK and Spanish respondents perceived greater usefulness to be associated with sustainable food labelling compared to respondents from other countries. Regarding the importance of information, Czech and Spanish respondents ranked food safety as the highest priority, followed by health and nutrition (2nd) and animal welfare (3rd). Swedish respondents prioritised animal welfare (1st), health and nutrition (2nd), and local product information (3rd). Swiss respondents valued animal welfare (1st), food safety (2nd), and local

**Table 6**  
Responses of respondents in different countries to sustainably produced food and labelling information.

Factors	Czechia	Spain	Sweden	Switzerland	UK	Total sample
Perceived behavioural control						
Easy to identify	2.84 <sup>c</sup> (0.99)	3.99 <sup>a</sup> (0.89)	3.84 <sup>a</sup> (0.99)	3.32 <sup>b</sup> (1.21)	3.21 <sup>b</sup> (1.10)	3.44(1.12)
Easy to buy	2.94 <sup>b</sup> (1.00)	2.85 <sup>b</sup> (1.36)	2.37 <sup>c</sup> (1.31)	3.31 <sup>a</sup> (0.96)	3.34 <sup>a</sup> (1.05)	2.95(1.20)
Intention to increase consumption	3.25 <sup>b</sup> (0.94)	3.24 <sup>b</sup> (1.08)	3.08 <sup>b</sup> (1.06)	2.57 <sup>c</sup> (1.16)	3.62 <sup>a</sup> (0.97)	3.16(1.10)
Perceived usefulness of sustainable food labelling	3.70 <sup>c</sup> (1.10)	4.08 <sup>a</sup> (0.88)	3.96 <sup>a,b</sup> (0.98)	3.80 <sup>b,c</sup> (1.07)	4.09 <sup>a</sup> (0.93)	3.92(1.01)
Perceived importance of specific labelling information						
Local product	3.78 <sup>d</sup> (0.95)	4.21 <sup>a</sup> (0.89)	4.13 <sup>a,b</sup> (0.92)	3.93 <sup>c,d</sup> (0.95)	4.01 <sup>b,c</sup> (0.95)	4.01(0.94)
Ethical methods of production	3.54 <sup>c</sup> (1.02)	4.18 <sup>a</sup> (0.85)	3.90 <sup>b</sup> (0.96)	3.69 <sup>c</sup> (1.03)	3.99 <sup>b</sup> (0.99)	3.86(1.00)
Sustainable methods of production	3.54 <sup>c</sup> (1.04)	4.24 <sup>a</sup> (0.84)	4.01 <sup>b</sup> (0.96)	3.86 <sup>b</sup> (0.99)	4.03 <sup>b</sup> (0.93)	3.93(0.98)
Carbon footprint from supply and distribution	3.19 <sup>c</sup> (1.13)	3.98 <sup>a</sup> (0.98)	3.63 <sup>b</sup> (1.14)	3.50 <sup>b</sup> (1.11)	3.88 <sup>a</sup> (1.02)	3.64(1.11)
Animal welfare	3.85 <sup>c</sup> (1.01)	4.33 <sup>a</sup> (0.88)	4.29 <sup>a</sup> (0.91)	4.12 <sup>b</sup> (0.94)	4.24 <sup>a,b</sup> (0.95)	4.17(0.95)
Health and nutrition	3.90 <sup>c</sup> (0.93)	4.43 <sup>a</sup> (0.77)	4.14 <sup>b</sup> (0.93)	3.98 <sup>c</sup> (0.89)	4.15 <sup>b</sup> (0.88)	4.12(0.90)
Food safety	3.98 <sup>c</sup> (0.93)	4.50 <sup>a</sup> (0.77)	4.04 <sup>c</sup> (0.91)	4.00 <sup>c</sup> (0.88)	4.24 <sup>b</sup> (0.87)	4.15(0.89)
Benefits for producers	3.17 <sup>d</sup> (1.03)	4.13 <sup>a</sup> (0.94)	3.56 <sup>c</sup> (1.02)	3.44 <sup>c</sup> (1.09)	3.81 <sup>b</sup> (0.95)	3.62(1.06)
Link or QR code to a website for more information	3.42 <sup>c</sup> (1.06)	3.91 <sup>a</sup> (1.08)	3.15 <sup>d</sup> (1.18)	3.70 <sup>b</sup> (0.96)	3.43 <sup>c</sup> (1.12)	3.52(1.11)

Note: <sup>a-d</sup> Values with the same letter as superscript indicate not significantly different means, and different superscripts indicate significantly different means between the segments, following ANOVA post hoc Tukey tests at  $p < 0.05$ .

product information (3rd). UK respondents ranked animal welfare and food safety jointly as their top priorities (1st), followed by health and nutrition (3rd) (Table 6).

## 4. Discussion

### 4.1. Perceived importance and interpretation of food sustainability

The results indicated that the respondents to the survey in the five European countries, in which data were collected, perceived food sustainability to be less important than sensory and healthiness attributes in relation to meat and dairy products. This is consistent with the results of research focused on Dutch consumers' perceived importance of food attributes regarding specific food categories (dairy, meat, vegetables and fish) (Verain et al., 2016), as well as European consumers' food choice motives in general (Markovina et al., 2015). However, both studies reported that respondents rated food sustainability as being of relatively low importance, and of less importance than food price (Markovina et al., 2015; Verain et al., 2016). Our results differ from these inasmuch as respondents perceived food sustainability to be of moderate importance, equitable to the perceived importance of food price. This may be because European consumers are becoming more aware and conscious of sustainability in relation to food production and consumption (Brunin et al., 2022; Verain et al., 2022a). This trend may at least partly relate to increased consumer exposure to information and knowledge about sustainable food consumption in recent years, linked to increased policy emphasis associated with the Sustainable Development Goals (United Nations, 2015) and Europe's new agenda for sustainable growth (i.e. the Green Deal) (European Commission, 2019). Diaconeasa et al. (2022) reported increased attention in national media to sustainable food consumption from 2014 to 2018 in Germany, Italy, Norway and Romania, which might also have increased consumers' awareness of, and sense of individual responsibility for making sustainable food choices (Diprose et al., 2018; Lee et al., 2019). Recent research suggests that the internet and traditional media (TV, radio and newspapers) were both primary sources for sustainability-related information among younger Europeans, while traditional media predominated as an information source for older Europeans (D'Amato et al., 2019).

In terms of interpreting food sustainability, the results indicated that respondents in the countries included tended to perceive food sustainability as a unidimensional concept, which aligns with previous research (Grunert et al., 2014; Polzin et al., 2023; Verain et al., 2016). The unidimensional perception of "sustainability" was expanded here by including organic production as an extra component contributing to the sustainability of meat and dairy products, which suggests consumers associate organic food with improved environmental impacts of food production, and potentially concern about animal welfare, by primary producers (Shafie and Rennie, 2012). Given that consumers may interpret sustainability as a multidimensional concept (see e.g., Sautron et al., 2015; Van Loo et al., 2017; Verain et al., 2021), consideration of why differences in perceptual dimensionality have been observed is relevant. One interpretation is that these differences are attributable to varying contexts and scenarios. For instance, food sustainability may be more likely to be perceived as unidimensional when consumers are making choices about specific food products, such as meat and dairy products (see also Verain et al., 2016). In more abstract contexts, for example when considering food in a general sense, consumers might view sustainability as a multidimensional construct (Sautron et al., 2015; van Dam and van Trijp, 2011; Van Loo et al., 2017; Verain et al., 2021). The interpretation of sustainability could also be influenced by the extent of consumers' engagement with sustainable products, with consumers who are "light" or infrequent users of sustainable products potentially using a unidimensional construct (van Dam and van Trijp, 2011).

### 4.2. Characteristics of consumer segments

Four distinct consumer segments, based on respondents' relative ratings of attribute importance of dairy and meat products, were identified: *low-involvement*, *high-involvement*, *price-sensitive* and *health- and sustainability-involved* consumers. In previous research, low-involvement consumers have been referred to as "uncommitted", "uninvolved" or "indifferent consumers"; high-involvement consumers as "uncompromising"; and health- and sustainability-involved consumers as "sustainable-conscious consumers" (see e.g., Delley and Brunner, 2020; Van Loo et al., 2017; Verain et al., 2016; Żakowska-Biemans, 2011). In contrast, "average consumers" or "moderately involved consumers" (Van Loo et al., 2017; Verain et al., 2016), were not identified here. This discrepancy could relate to consumers' transitioning to the *high-involvement*, *price-sensitive*, or *health- and sustainability-involved* consumer segments with time, as European consumers have been exposed to more information about sustainable consumption and experienced dramatic food price increases in recent years (Borrallo et al., 2023; Diaconeasa et al., 2022; Diprose et al., 2018).

The factors extracted from respondents' food attribute importance ratings for the cluster analysis were largely consistent with previous research measuring consumers' general food choice motives (Steptoe et al., 1995). One exception was that familiarity and convenience loaded on the same factor in our analysis, potentially because within the context of specific food products, both familiarity and convenience attributes could be affected by consumer experience about selecting and handling specific products, as well as influence (perceived) behavioural control. Previous research has also indicated a strong positive correlation between convenience and familiarity motives in relation to food choice (Pula et al., 2014). The importance of the two motives could increase among people with a higher need for risk reduction through precautionary actions, or with greater levels of food neophobia (Jaeger et al., 2021; Pula et al., 2014). The adoption of the precautionary principle for food risk management in Europe (Houghton et al., 2008), coupled with heightened food risk concerns arising during the COVID-19 pandemic (Duda-Chodak et al., 2020), might have intensified European consumers' perceived need to be cautious about risks. This, along with the relatively high levels of food neophobia among European consumers (Rabadán and Bernabéu, 2021), could have contributed to the grouping of familiarity and convenience attributes within a single factor here.

Respondents in the *low-involvement* consumer segment tended to assign lower importance to all food attributes, whereas respondents in the *high-involvement* consumer segment attributed higher significance to these attributes compared to the other segments. Students were more inclined to belong to the *low-involvement* consumer segment and less likely to fall into the *high-involvement* consumer segment. Furthermore, those in the *low-involvement* consumer segment were the youngest across the four identified consumer segments (see also Żakowska-Biemans, 2011). Contrary to the findings of previous research, which often indicated that women tended to place greater importance on various food attributes such as health, ethical concerns, natural content, sensory appeal, and convenience, compared to men (see e.g., Konttinen et al., 2013, 2021; Pechey et al., 2015; Renner et al., 2012), our results indicated that women were more likely to be classified as *low-involvement* consumers. This discrepancy might relate to the gender difference in health beliefs. For example, men often believe that meat and dairy products are healthy and that they should consume more of them compared to women, who may prioritize consumption of fruits and vegetables, leading to men's higher involvement in meat and dairy food product choices (Egele and Stark, 2023; Rosenfeld, 2020). Moreover, women (when compared to men) have been reported to be more likely to reduce meat consumption in relation to health and sustainability concerns (Verain et al., 2015).

Respondents belonging to the *price sensitive* consumer segment were significantly younger than the *health- and sustainability-involved* consumer segment. This aligns with a pattern observed in previous research



among European consumers, where age has been found to be positively correlated with sustainability considerations but negatively correlated with price consciousness in food choices (see e.g., Apostolidis and McLeay, 2019; Rejman et al., 2019; Vanhonacker et al., 2013; Verain et al., 2015). In addition, respondents in the *health- and sustainability-involved* consumer segment exhibited significantly higher preservation environmental attitudes compared to those in the *price sensitive* and *low-involvement* consumer segments, and expressed lower utilitarian attitudes than for all other segments. This finding aligns with previous research that has demonstrated that the individuals' general environmental concerns or attitudes influenced their situation-specific environmental attitudes and behaviours, including their attention to the sustainability of food products (see e.g., Bamberg, 2003; Gansser and Reich, 2023; Tong et al., 2020).

#### 4.3. Association between consumer segments and sustainable food choices

Respondents in *high-involvement* and *health- and sustainability-involved* consumer segments exhibited significantly stronger intentions to increase their consumption of sustainably produced meat and dairy products. However, in contrast to respondents in the *high-involvement consumer segment*, their relatively lower perceived behavioural control may have negatively affected their intentions to increase consumption of sustainably produced meat and dairy products (see e.g., Aitken et al., 2020; Johe and Bhullar, 2016). Despite having greater consumption intentions, respondents in both the *high-involvement* and *health- and sustainability-involved* consumer segments assigned less importance to the sustainability attribute compared to sensory appeal and healthiness. However, labelling for animal welfare, an important aspect of food sustainability, was perceived to be more important than the other sustainability-related information, and was reported to be of similar importance to the information related to “food safety” and “health and nutrition”. Healthiness-related information may often be perceived to be more important than sustainability information, thereby possibly leading to a competition for consumers' attention and negatively affecting sustainable food purchase (Apostolidis and McLeay, 2019; Grunert et al., 2014). Arguably this competition is unlikely to occur among respondents in *high-involvement* and *health- and sustainability-involved* consumer segments, who tend to value sustainably produced food.

#### 4.4. Comparisons between countries

The distribution of consumer segments varied significantly between countries. Czech respondents constituted a larger proportion of the *price-sensitive* consumer segment but had lower representation in the *high-involvement* and *health- and sustainability-involved* consumer segments compared to the other countries. This aligns with previous research which found that Czech consumers prioritize price over sustainability in their food choices, compared to Dutch, Danish, and French consumers (Bouwman et al., 2016). Czech respondents reported relatively low perceived behavioural control when it comes to purchasing sustainably produced food. However, they exhibited moderate intentions to increase their consumption of sustainably produced meat and dairy products, which was greater than the intentions of Swiss and Swedish respondents. This might be linked to the current poor conservation status of habitats and species within the Continental region (European Environment Agency, 2020) and that higher meat consumption is associated with Czechia (see Fig. 1). Thus, Swiss and Swedish respondents might perceive that their countries have achieved an appropriate balance between food production and environmental conservation, given the favourable current conservation statuses of habitats and species in the Alpine and Boreal regions (European Environment Agency, 2020). However, the higher milk consumption observed in Sweden and Switzerland (see Fig. 2) could potentially pose long-term risks to the environment. Effective communication about animal production systems and climate change with broader society could potentially shift

some consumers from low to high preferences for sustainably produced food (Prochaska and Velicer, 1997; Verain et al., 2016). In contrast, Spanish and UK respondents had larger proportions within segments that highly valued sustainability (e.g., *high-involvement* and *health- and sustainability-involved* consumer segments). Consequently, they demonstrated stronger intentions to consume sustainably produced food compared to respondents in Switzerland and Sweden. This could be attributed to the heightened environmental concerns in the Mediterranean and Atlantic regions (European Environment Agency, 2020), along with their comparatively higher current consumption of meat (Fig. 1) and dairy products (Fig. 2), which might have spurred increased societal demands for sustainably produced food.

#### 4.5. Implications for marketing and policy-making

European consumers tend to perceive sustainability as a unidimensional concept, albeit with varying importance placed on different types of sustainability information. Older people tended to be more conscious of food sustainability but have less understanding of different sustainability labels in comparison to younger ones (Grunert et al., 2014). The development of a more direct and straightforward “umbrella” sustainability label that consolidates various types of sustainability information may be beneficial in the promotion of sustainable food choices. Moreover, since respondents in the *high-involvement* and *health- and sustainability-involved* consumer segments expressed greater intentions to consume more sustainably produced food, implementing their preferences for information labelling could be a priority in efforts to translate these intentions into actual purchases. It may be useful to develop an integrated measure of nutritional value and environmental impact, which combines the environmental and nutritional value of foods and ingredients into an interpretable score (Grigoriadis et al., 2021), although our results suggest that such a measure will not address the needs of all consumers. The nuances in preferences for specific sustainability information, such as the higher importance assigned to animal welfare information compared to environmental impacts, should also be considered in sustainability labelling efforts. This could involve giving greater weight to sustainability information which results in higher animal welfare (e.g., extensive pasture-based grazing for livestock) when assessing the “sustainability” of food products. The methods used to calculate sustainability scores must be transparent, and when new approaches to calculation are applied, this must be signalled to consumers. To achieve these goals effectively, further engagement with consumers, especially those in the *high-involvement* and *health- and sustainability-involved* consumer segments, may be needed to co-develop labels. This collaborative approach can help determine which types of information and labels consumers prefer and how to measure and present the relevant information while minimising potential competition between different types of information.

Price was an important consideration in European consumers' choice of meat and dairy products, especially for respondents belonging to the *price-sensitive* and *high-involvement* consumer segments. In countries where a substantial proportion of consumers falls into these two segments, such as Spain, the UK, and Czechia, addressing the price issue may facilitate consumer consumption of sustainably produced food. A lower (subsidised) price for sustainably produced food may positively affect consumers' purchase intentions and generate more repeat purchases (Marian et al., 2014), although further research is needed to determine the most effective policy mechanisms for implementing this (for example, primary producer payments for sustainable production which is passed on through the food system, or taxation of unsustainably produce products at point of purchase). Consumers may also use price as a cue to product quality despite being price sensitive (Völckner and Hofmann, 2007). Information strategies that inform consumers of various benefits of consuming sustainably produced food and by education that shapes higher pro-environmental attitudes may dispel quality concerns (Biswas and Roy, 2015), as may effective labelling of

sustainably produced products.

Respondents in the *low-involvement* consumer segment tend to have lowest intentions to consume sustainably produced food. These consumers may be more experientially thinking-dependent in their food choices, e.g., engaging in routine, habitual or impulsive behaviour rather than applying cognitive effort in decision-making (Van Loo et al., 2017). When developing sustainability marketing strategies targeting this segment, using simple and direct quality or credibility cues, along with visually engaging labels and packaging for sustainably produced food, may evoke positive emotions and, in turn, boost their purchase intentions (Koenig-Lewis et al., 2014). Furthermore, the environmental impacts associated with the production and consumption of meat and dairy products could differ significantly across countries, influenced by varying quantities and conservation status of habitats and species within specific biogeographical regions. These country-specific considerations should be integral to future risk communication efforts aimed at the public, potentially heightening their perceived significance of sustainability in food choices and positively impacting their consumption of sustainably produced food. However, consumers may transition between different segments over time (Angelo et al., 2020). As such, strategies promoting sustainable food consumption must be continuously reassessed in response to evolving consumption patterns and information.

#### 4.6. Limitations and future research

First, consumers often tend to exhibit social desirability biases when self-reporting socially acceptable behaviours, such as their commitment to food sustainability, while downplaying less socially accepted ones (Auger and Devinney, 2007; Sarti et al., 2018). Consequently, in real-life situations, a greater representation of consumers may fall within the *low-involvement* consumer segment (Auger and Devinney, 2007; Sarti et al., 2018). Furthermore, consumers' motives for food choices can vary across different timeframes, situational contexts, and social environments (Verain et al., 2022b). Therefore, the results of experimental and observational research need to be triangulated to robustly investigate consumer behaviours in relation to segments, as well as tracked in time and across geographical locations. Second, a consumer subgroup may exist whose intention is to achieve greater sustainability in their food consumption by reducing meat and dairy product consumption, rather than shifting to sustainably produced options (see e.g., Sanchez-Sabate and Sabaté, 2019; Schiano et al., 2020). Consequently, these individuals may exhibit a relatively lower interest in specific attributes of meat and dairy products. This subgroup may have been incorporated into the *low involvement* segment in the results presented here. In future research, this subgroup should be considered to gain a more comprehensive understanding of consumers' sustainable food consumption perceptions and practices. Third, despite having used socio-demographically representative samples for each country, groups of individuals who had limited access to the internet may have been excluded from the sampling. Future research should actively engage with these marginalised groups to ensure a more inclusive and comprehensive analysis of consumer sustainable food consumption.

#### 5. Conclusion

Sensory appeal was perceived as the most important, and convenience and familiarity as the least important among the different attributes associated with meat and dairy products. Across the four consumer segments identified in the analysis, the importance of sensory appeal was also ranked the highest, whereas the importance rank order for the other food attributes varied. Consequently, consumers belonging to different segments varied regarding their responses to sustainably produced food and sustainability labelling, with respondents in *high-involvement* and *health- and sustainability-involved* consumer segments expressing greater intentions to consume more sustainably produced

food and perceived higher usefulness of sustainability labelling compared to those in *low-involvement* and *price-sensitive* consumers segments. The results provide insights into sustainable food decision-making through the lens of perceived food attribute importance for consumers in five European countries which varied according to biogeographic pressures on the environment, as well as cultural preferences for food choices associated with meat and dairy products. The results can contribute to formulating precise interventions and promotional activities aimed at facilitating the sustainability of consumers' food choices.

#### CRedit authorship contribution statement

**Meng Yue:** Writing – original draft, Visualization, Funding acquisition. **Shan Jin:** Conceptualization, Formal analysis, Supervision, Writing – original draft, Writing – review & editing. **Sophie Tindale:** Methodology, Project administration. **Victoria Vicario-Madroño:** Writing – review & editing, Methodology. **Pedro Sánchez-Zamora:** Writing – review & editing, Methodology. **Rosa Gallardo-Cobos:** Writing – review & editing, Methodology. **Paul Newell-Price:** Writing – review & editing, Methodology. **Lynn J. Frewer:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

#### 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.

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#### Appendix A. Supplementary data

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