



## European consumers' preferences for fresh fruit and vegetables – A cross-country analysis

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### ABSTRACT

Although fresh fruit and vegetables are essential for a balanced diet, their per capita consumption in Europe is below the recommended minimum intake. This study investigates 14 product attributes of fresh fruit and vegetables in a European cross-country analysis. Based on an online survey conducted in France, Germany, Hungary, Italy, and Norway ( $n = 3093$ ), an object-case Best-Worst Scaling approach was applied. Results revealed both international and country-specific preference characteristics. Best-Worse scores revealed that freshness and taste scored highest in all five countries, while knowledge of the producer was considered the least important attribute. The study also derived three consumer segments by applying cluster analysis, with each segment assessed according to socio-demographic profiles. The novelty of the study is to offer a cross-country analysis of fresh fruit and vegetable consumption patterns in multiple European countries based on the Best-Worst Scaling approach and international segmentation. Managerial implications are proposed.

### 1. Introduction

Fresh fruit and vegetables (FFVs) are the foundation of a balanced diet. Eating fruit and vegetables has long been universally associated with health benefits. 'Fruit and vegetables' (FVs) refers to a diverse collection of plant foods that vary greatly in terms of the content of nutrients and energy [1]. They are the main dietary source of vitamins and minerals [2] and a significant source of dietary fiber, which is considered to lessen the incidence of cardiovascular disease and obesity [1]. Compared to other food sources, they are high in potassium and low in sodium [2]. In addition, FVs have unique and appealing textures, colors, and flavors; they are relatively low in calories (excluding staple crops) and are cholesterol-free [2].

Despite the unquestionable positive health effects of FFVs, according to the latest statistics, their per capita consumption in Europe is below the WHO recommended minimum intake [3]. In addition, the market segment of FFVs has unique characteristics (e.g., substantial seasonal variation affecting availability, quality, and price, lack of branding, limited shelf time, etc.), thus they require special attention compared to

other food categories (e.g., consumer packaged goods) [4].

The aim of this paper is threefold. First, it analyzes consumers' preferences for fresh fruit and vegetables in five European countries (France, Germany, Hungary, Italy, and Norway), applying an object case Best-Worst Scaling (BWS) approach. Second, our study tries to measure the importance of all the most relevant FFVs-related attributes identified in the existing literature. To reach this goal, we included fourteen attributes on a large-scale sample ( $n = 3093$ ). Third, the study applies a cross-country analysis resulting an international segmentation including countries from different parts of Europe. All the three research objectives contribute to the novelty of our study. To our knowledge, this study is the first to offer a cross-country analysis of FFVs consumption patterns in multiple (five) European countries based on the BWS approach and international segmentation.

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## 2. Background

### 2.1. Drivers of consumer preferences for FFVs

Many previous studies have focused on consumers' preferences for fruits and vegetables. The latter have used different approaches, highlighting the moderating effects of specific food quality schemes (e.g., organic FFVs [5–9]), value-added factors (e.g., minimally processed or fresh-cut FFVs [10–13]), or niche products that target specific consumer groups (e.g., child-friendly shaped FFVs [14]). Research specifically focusing on FFVs has investigated several product attributes, including credence attributes and intrinsic and extrinsic quality cues [15,16]. These studies have measured, among other factors, the importance of appearance, brand, environmental sustainability, food safety, freshness, nutritional value, odor, origin (locally grown, imported), packaging, price, quality certifications (organic, in particular), seasonality, shelf-life related characteristics, taste and variety [15–22]. A short review of our selected fourteen attributes (below) describes the expected role of these product characteristics.

The most fundamental product attribute in consumers' evaluations of FFVs is the *freshness* of the product, referring to the time since harvest [23] and considered as a complex construct with multiple dimensions [24]. This attribute is considered one of the most important characteristics of fresh [20,22,25] and fresh-cut [12,13] FFV products. Freshness is often associated with other desirable quality cues (e.g., crispiness and crunchiness) that contribute to the enjoyment of food consumption [26], while freshness is often associated with healthier and better tasting products [24]. On the other hand, freshness has usually been examined as a distinct food attribute, separate from others [12,19]. For FFVs, the freshness of a product is often measured through touch, even though this might raise sanitary concerns associated with other consumers touching the products. Recent results have indicated that restrictions on touching due to COVID-19 pandemic precautions resulted in less favorable shopping responses to these products [27].

*Taste* is another sensory attribute identified as determinative among the FFVs attributes [12,17,19–21]. Although taste is subjective and varies across countries, in Europe, it seems that individuals who prefer sour tastes consume more fruit [28]. The taste of FFVs involves the balance between sweetness and sourness or acidity and low or no astringency [23] and is perceived during the consumption phase [29]. Therefore it has an ex-post influence on FFV intake, and consumers tend to associate taste and price when making purchasing decisions [19].

The *origin (country or region)* also tends to be among the major characteristics associated with FFVs and, in some cases, has been considered the most influential attribute and one associated with safety and quality [16], although some studies have found less importance awarded to this attribute [20,22,30]. It is often accompanied by ethnocentrism [15,31], with consumers usually more willing to pay for domestic products than imported ones [21,32].

On the other hand, *nutritional value* has a mixed effect on consumers' evaluations of FFVs. Some research has identified this attribute's high importance [e.g., 25]; although other research finds this characteristic less determinative [e.g., 19]. Ragaert, Verbeke [12] state that consumers who are more aware of the relationship between food and health (e.g., older or consumers with children) attach greater importance to nutritional value.

*Visual appearance* – the first impression of FFVs to consumers – plays a major role in its assessment [16,33] and seems to be particularly important when specific consumer groups are targeted (e.g., parents in relation to purchasing child-friendly shaped FFV [14]).

The supply of and demand for *organic* FFVs are increasing rapidly, driven by consumer perceptions of the latter's benefits [33]. A great number of articles deal with organically produced FFVs; however, fewer studies have investigated organic provenance as a distinct attribute. In these cases, organic certifications have been found to be less important [10] or irrelevant [16,17] in consumers' evaluations. Raaijmakers,

Sijtsema [20] suggest that sustainable attributes (including organic) only matter to a subset of consumers. This is also the case for *environmentally friendly production*, with little importance reported [20]. However, for FFVs, environmental friendliness is a factor of relevance at the post-harvest phase, with consumers preferring unpacked FFVs over packed options, regardless of their organic/non-organic status [9].

Supporting local producers, which also results in more *knowledge of producers*, is key to supporting the demand for regionally grown fresh fruit and vegetables and is a rapidly growing trend, especially in developed countries [18]. Furthermore, having a personal relationship with a producer increases trust [34] and is perceived as a positive quality cue [35].

*Traditional production methods* are well represented by geographical indications (GIs), and such products are usually associated with higher quality and organoleptic properties compared to conventional counterparts. However, the impact of GIs on preferences for FFVs is relatively limited [16], as is the *specific variety of the product*, which was found to be irrelevant [25] unless FFVs are at least minimally processed [10,11]. In addition, in many countries, the market size [36] and the share [37] of GI foods is rather limited.

Regarding *price*, on the one hand, FFVs were found to be luxury goods [38]; on the other hand, the role of price as a single product attribute should be evaluated carefully, considering the context [16–18, 20], as the relative importance of price depends on the other attributes investigated.

Previous studies have not deeply addressed fair trade and GMO-free product attributes in the context of FFVs. However, alternative distribution channels like fair trade might contribute to the social sustainability [39] of FFV value chains and substantially impact some FFVs [40]. Being GMO-free is considered a particularly important food attribute in Europe [41]. GMOs are often associated with direct and social risks and are usually investigated in an organic production context [42], as consumers expect organic food to be GMO-free [43]. In Italy, age and body mass index (BMI) were found to be related to fruit consumption [44], whereas gender, food-related study, and physical activity are the background factors that significantly affected attitudes towards vegetable consumption among young adults [45].

### 2.2. Consumer segmentation at the country level

The segmentation of the consumers of specific food products is common in food marketing [46]. So far, many FFV studies have tried to capture the differences between the latter based on preferences and socioeconomic characteristics. Previous research using national FFV surveys reported statistically significant differences in preferences associated with gender, age, employment status, educational and income level, and place of living.

In a Turkish sample, Akpınar, Aykin [17] found differences in preferences for FFVs between genders (taste, smell, display, and shopping environment), educational groups (price, nutritional content, organic, seasonality, appearance, and shopping environment) and income (price, smell, taste, nutritional content, organic and shopping environment). Arumugam, Govindasamy [5] tried to identify organic FFV consumers' profiles from a large US sample. They reported that educational level, race, and specific product attributes (e.g., taste and freshness) greatly influence preferences. Also, for the US, Gunden and Thomas [19] revealed that young professionals prefer freshness more than other consumers. In the Netherlands, FFV consumers were divided into six clusters based on their demographics and the importance awarded to product attributes [20]. Differences could be identified with demographic characteristics, including gender, age, employment status, education, and income level; however, the authors found no distinctions based on family composition. Roos, Johansson [47] provided a review of FFV consumption involving a comparison of European cases. With a few exceptions, a generally more positive attitude towards FFVs was reported among those with a higher education. In Norway, Wandel [48] found

that younger consumers or those living in smaller households have a generally weaker preference for FVs.

### 2.3. Cross-cultural segmentation

Although numerous national-level FV studies exist, the number of pieces of international research that have investigated cross-cultural differences in FV preferences is quite limited. Using a choice experiment, Miller, Tait [49] tried to measure consumers' preferences and WTP for FVs in the United Kingdom, Japan, India, and Indonesia, focusing on social responsibility. Results showed significant differences between the countries. Moser, Raffaelli [42] conducted a literature review to assess regional differences in FV preferences. Based on the relevance awarded to attributes, they defined three distinct macro-regions: a) USA, Canada, Argentina, and Australia; b) Europe; and c) East Asia/Pacific Rim (China, Thailand). Although health-related attributes were always considered the most important and brands the least determining factor everywhere, remarkable differences existed. To the best of our knowledge, the most comprehensive FV study to examine cross-cultural consumption habits was conducted by Stea, Nordheim [50]. Based on a survey of 21 European countries, females and higher-educated consumers were found to be more likely to consume FV compared to males and low-educated consumers, respectively. The most important cross-cultural difference was that consumers in Eastern Europe were least likely to consume FV, and those living in Southern and Northern Europe most likely. Similar to the current study, Yang, Panjaitan [22] applied a BWS approach to assess preferences for imported FV in an Asian context (Japan, Taiwan, and Indonesia). They found freshness and certified food safety were the most important attributes in all the countries, and domestic rarity and plantation methods were among the least important. However, the labeling of product origin was considered more important by Japanese and Taiwanese consumers than

by Indonesians. The three major consumer groups that were identified had distinct characteristics according to their preferences for FV product attributes.

### 3. Materials and methods

#### 3.1. Statistical analysis

We applied the Best-Worst Scaling (BWS) method, which permits the investigation of individual preferences in a hypothetical context. This approach is built on stated preference datasets wherein respondents have to choose the best and the worst alternative, attribute, or attribute level from the options by applying one of the three BWS approaches (object case, profile case, or alternative case) [51].

In our research, we applied object case BWS [52] with the following introduction (also illustrated in Figs. 1 and 2): "In the following section, we would like to understand what is important to you when buying specific food products. You will be asked to indicate, in six different scenarios, the most and least important attributes that affect your purchasing decisions for a specific food product. There are no right or wrong answers. It is your opinion that is important to us."

Due to the relatively simple nature of the BWS type that was chosen (one of the advantages of case-1-type BWS), in the analyses, we chose to compute statistical indicators instead of model estimations (for a similar approach, see among others, the study of Bell, Coates [53]), and our structure followed the approach of Adamsen, Rundle-Thiele [54]. First, we calculated the B-W values and their standardized form both for individuals (Equations (1) and (2)) and at an aggregate level (Equations (3) and (4)) [55].

$$B - W_{\text{Score}_{n,k}} = B_{n,k} - W_{n,k}, \tag{1}$$

where n is the individual and k is the examined attribute.



### 3. How important are the following criteria for you when buying **fresh fruit**?

From the following five criteria please indicate which one is the Most Important and which one is the Least Important for you?  
(1 of 6)

Least important	Criteria	Most important
<input type="radio"/>	Price	<input type="radio"/>
<input type="radio"/>	Production methods	<input type="radio"/>
<input type="radio"/>	Specific variety of the product	<input type="radio"/>
<input type="radio"/>	Nutritional value of the product	<input type="radio"/>
<input type="radio"/>	Fair trade	<input type="radio"/>

Fig. 1. An example of a BWS question (translated into English from the Norwegian fruit BWS survey).



3. How important are the following criteria for you when buying **fresh vegetable**?

From the following five criteria please indicate which one is the Most Important and which one is the Least Important for you?  
(1 of 6)

Least important	Criteria	Most important
<input type="radio"/>	Product's region of origin	<input type="radio"/>
<input type="radio"/>	Production methods	<input type="radio"/>
<input type="radio"/>	Price	<input type="radio"/>
<input type="radio"/>	Nutritional value of the product	<input type="radio"/>
<input type="radio"/>	Taste of the product	<input type="radio"/>

Fig. 2. An example of a BWS question (translated into English from the Italian vegetable BWS survey).

$$\text{Standardized } B - W_{\text{Score}_{n,k}} = \frac{B - W_{\text{Score}_{n,k}}}{f}, \tag{2}$$

where f denotes the frequency of attribute k that appears in the decision sets.

$$B - W_{\text{Score}_k} = B_k - W_k \tag{3}$$

$$\text{Standardized } B - W_{\text{Score}_k} = \frac{B - W_{\text{Score}_k}}{Nf}, \tag{4}$$

where N is the number of respondents.

To analyze the attributes, we also calculated the square root of the best-worst ratio (Equation (5)) and its standardized form (Equation (6)).

$$\text{sqrt. } B - W_{\text{Score}_k} = \sqrt{\frac{B_k}{W_k}} \tag{5}$$

$$\text{standardized sqrt. } B - W_{\text{Score}_k} = \frac{\text{sqrt. } B - W_{\text{Score}_k}}{\max.(\text{sqrt. } B - W_{\text{Score}})}, \tag{6}$$

where max.(sqrt. B - W<sub>Score</sub>) is the highest value of sqrt. B - W<sub>Score<sub>k</sub></sub> [56].

In order to separate groups of consumers with different preferences, we used a two-step clustering method that can handle the disadvantages of the widely used procedures (hierarchical and k-means clustering methods). This is due to the fact that the method efficiently manages large databases, allows the simultaneous application of categorical and continuous variables and, through the application of different information criteria, avoids the issues arising from the arbitrary determination of the optimal cluster number [57]. In order to select the optimal cluster number solution, we used the log-likelihood distance measure and the values of the BIC (bayesian information criterion). The choice of

the cluster number based on the automatic search algorithm was decided on the basis of the results of Chiu et al., 2001. The authors found that in 98% of their generated databases, the algorithm found the correct cluster number. IBM SPSS Statistics 22 was used to perform the two-step clustering.

To test the differences between the clusters, a one-way ANOVA and Pearson's Chi<sup>2</sup> test were performed.

3.2. Questionnaire design

Best-Worst Scaling, also often referred to as Maximum Difference Scaling (MaxDiff) (which term is not accurate, given that MaxDiff is just one of the decision-making models an individual can use when making the best and worst choices), allows for the inclusion of many more attributes to reduce the chance of missing vital factors [58,59]. Regarding the experimental design, 14 relevant attributes for consumers' fruit and vegetable purchasing decisions (see Table 1) were considered drawing on the intensive literature review and based on their relevance to the respective countries and specific contexts. Based on the 14 BWS attributes, initially 240 BWS choice tasks were generated. However, to prevent respondent fatigue, the choice tasks were divided into 40 blocks where each version of the BWS questionnaire had only six BWS choice sets displaying five attributes at a time. In each BWS choice task, the respondents were asked to select the attribute that they see as the most and least important when purchasing fruit and vegetables. Descriptions of the 14 attributes are included below the list presented in Table 1. Figs. 1 and 2 show examples of decision screens for fruit and vegetable BWS questions, respectively.

**Table 1**  
Attributes used in the object-case BWS questions.

NO.	Attributes
1	Product's country of origin
2	Visual appearance of product
3	Variety of product
4	Freshness of product
5	Price
6	Nutritional value of product
7	Traditional methods used in production
8	Environmentally friendly production
9	Organic production
10	Genetically modified organisms (GMOs) used in production process
11	Taste of product
12	My knowledge of producer
13	Fair trade
14	Product's region of origin

### 3.3. Data collection

In this study, data were collected via an extensive pan-European online survey, as part of the EU H2020 Strength2Food project, administered in Autumn 2017 across European countries, in Germany (n = 464), Hungary (n = 875), Italy (n = 846), France (n = 452), and Norway (n = 456). The online survey participants were recruited through a market research company called LIGHTSPEED. During the recruitment process, two filtering criteria were used to screen potential respondents: 1) currently residing in the respective country and 2) being responsible

**Table 2**  
Sample characteristics.

	Germany Sample (n = 464)	Hungary Sample (n = 875)	Italy Sample (n = 846)	France Sample (n = 452)	Norway Sample (n = 456)	Total sample (n = 3093)
<i>Gender (%)</i>						
Female	48.7	50.4	53.1	50.0	51.3	51.0
Male	51.3	49.6	46.9	50.0	48.7	49.0
<i>Average age</i>	42.1	41.9	42.3	41.0	42.1	41.9
<i>Age category (%)</i>						
<30	23.5	21.9	19.1	24.6	21.7	21.8
30–39	20.5	23.7	23.3	23.9	22.2	22.9
40–49	23.0	21.0	25.4	20.8	24.3	23.0
49+	33.0	33.4	32.2	30.7	31.8	32.3
<i>Living area (%)</i>						
Rural area	40.3	20.4	14.4	54.2	21.1	26.8
Urban medium town	26.5	37.9	45.4	24.6	35.7	36.0
City	33.2	41.7	40.2	21.2	43.2	37.2
<i>Highest level of education (%)</i>						
Lower secondary/primary education or below	23.3	2.6	7.6	4.4	6.6	7.9
Upper secondary education	18.5	11.9	40.3	39.2	25.6	26.7
University or college entrance qualification	33.8	44.0	16.1	22.1	13.2	27.1
Bachelor's degree or equivalent level	11.2	29.1	16.5	17.7	36.0	22.3
Master, Postgraduate or doctoral degree	13.2	12.4	19.5	16.6	18.6	16.0
<i>Household monthly net income (%)<sup>a</sup></i>						
Cat. 1	8.2	15.3	6.3	13.1	11.2	10.8
Cat. 2	8.6	15.4	19.2	11.7	12.7	14.5
Cat. 3	16.8	11.1	30.0	15.1	16.7	18.5
Cat. 4	34.7	28.7	18.8	21.0	17.1	24.1
Cat. 5	15.7	15.4	6.7	23.9	11.8	13.8
Cat. 6	7.1	1.3	2.6	9.7	10.3	5.1
Prefer not to answer	8.9	12.8	16.4	5.5	20.2	13.2
<i>Household size</i>	2.3	2.9	3.0	2.6	2.5	2.7
<i>Household size (%)</i>						
1 person	26.9	11.8	10.4	25.9	25.2	17.7
2 person	38.8	33.4	26.1	29.6	33.3	31.7
3 person	17.5	25.7	28.0	19.7	17.6	23.0
3 person+	16.8	29.1	35.5	24.8	23.9	27.6
<i>Number of children</i>						
<i>Number of children (%)</i>						
No child	73.3	63.4	64.3	62.4	63.4	65.0
1 child	16.2	21.0	19.3	17.3	16.9	18.6
2 or more children	10.5	15.6	16.4	20.3	19.7	16.4

<sup>a</sup> The detailed income categories by selected countries are presented in Appendix Table 1.

or co-responsible for food purchases in the household. To ensure the representativeness of the sample at the national level, participants were stratified by gender and age. The socio-economic characteristics of the participants are described in Table 2.

## 4. Results

### 4.1. Perceived importance of FFVs product attributes

Table 3 presents the ranking of the product attributes based on the Best-Worst scores. The results clearly indicate that in all the five selected countries, product freshness and taste were most highly valued and ranked first or second. On the other hand, consumers' knowledge of the producer was ranked as the least important attribute everywhere, except in Norway (where this attribute was ranked in 11th place out of 14).

Besides the overall tendencies, country-specific characteristics were also identified. In Italy, the product's country of origin was considered very important and ranked as the third most important attribute. In Hungary and Norway, price, while in Germany and France, being GMO free was also perceived as very important. However, except for knowledge of the producer being among the least valued attributes, the selected countries show mixed results. For example, the specific variety of the product did not matter in Germany, Hungary, and Italy, while fair trade was considered unimportant in Italy and France. For Norwegian consumers, the origin of products (neither country nor region of origin) was among the least important attributes; for French, least important

**Table 3**  
Best-Worst scores for fresh fruit and vegetable attributes across countries.

Attribute name	Total Best					Total Worst					Best-Worst score					Rank*				
	GER	HUN	ITA	FRA	NOR	GER	HUN	ITA	FRA	NOR	GER	HUN	ITA	FRA	NOR	GER	HUN	ITA	FRA	NOR
Product's country of origin	128	330	485	200	72	227	404	287	166	350	-99	-74	198	34	-278	10	10	3	6	12
Visual appearance of product	185	290	269	153	210	183	345	491	339	230	2	-55	-222	-186	-20	7	7	11	12	7
Specific variety of product	112	40	173	108	168	287	838	544	247	190	-175	-798	-371	-139	-22	12	13	12	11	8
Freshness of products	537	1084	1011	392	511	42	26	47	37	27	495	1058	964	358	484	1	1	1	2	2
Price	271	624	342	295	312	196	167	479	148	107	75	457	-137	147	205	4	3	9	4	3
Nutritional value of product	110	346	259	106	162	242	278	402	240	149	-132	68	-143	-134	13	11	6	10	10	4
Traditional methods used in the production/processing of product	99	319	316	124	72	282	382	308	206	256	-183	-63	8	-82	-184	13	9	7	9	9
Environmentally friendly production	137	256	314	193	129	97	152	149	89	122	40	104	165	104	7	5	4	5	5	5-6
Organic production	185	187	318	172	91	159	501	333	215	280	26	-314	-15	-43	-189	6	12	8	8	10
GMO free	308	438	495	271	200	134	340	306	116	193	174	98	189	155	7	3	5	4	3	5-6
Taste of product	448	803	459	399	571	36	43	123	34	24	412	760	336	365	547	2	2	2	1	1
My knowledge of producer	46	86	162	84	70	526	1101	686	446	345	-480	-1015	-524	-362	-275	14	14	14	14	11
Fair trade	86	189	107	47	115	147	251	565	247	129	-61	-62	-458	-200	-14	8	8	13	13	6
Product's region of origin	132	258	366	168	59	226	422	356	185	340	-94	-164	10	-17	-281	9	11	6	7	13

\* Darker background color refers to a better rank in terms of Best-Worse scores

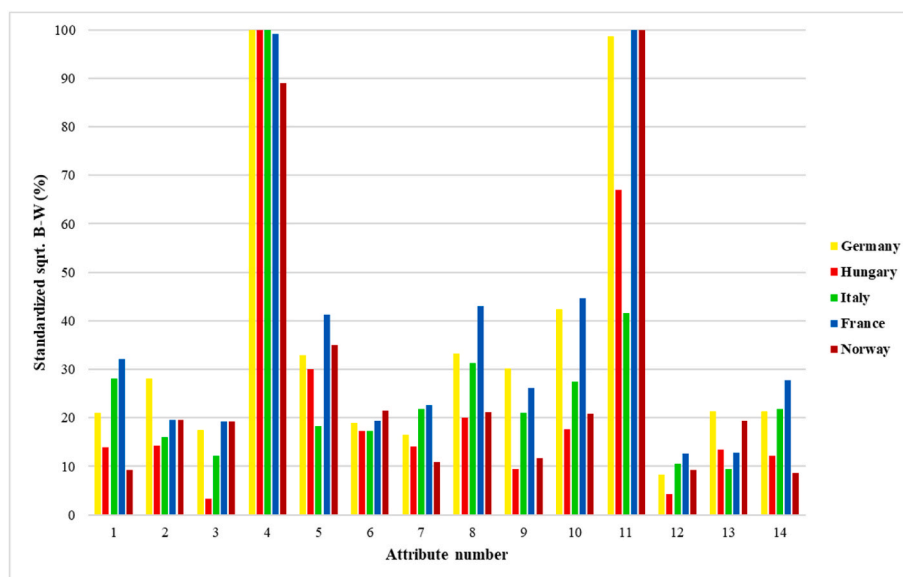
was visual appearance; for Germans, traditional methods; while for Hungarian consumers being organic.

The standardized sqrt. BWS values presented in Fig. 3 also underline the overall importance of product freshness and – in most countries – taste, and the least importance awarded to the producer’s knowledge. The results presented in Fig. 3 also allow an understanding of the relative importance of the different attributes within and between the selected countries. Among others, the relative importance of (the highly valued) attribute of taste was lower in Italy and Hungary (ranked second in both) than in Germany, France, and Norway (ranked second, first and first, respectively).

#### 4.2. Consumer segmentation

A significant degree of heterogeneity was identified among respondents in terms of their perception of the importance of FFVs attributes (see Table 4, where, in addition to the presentation of standardized B-W scores, the ratios of standard deviation to the mean are also presented to assess the degree of heterogeneity).

Based on the individual BWS importances, consumers participating in the cross-national survey were classified. Multi-country clustering is often applied in the recent food-related literature [see among others [46, 60,61]] to capture cross-national patterns. After proposing different clustering criteria, we applied a three-cluster solution (see Table 5). During our two-step clustering, the sociodemographic variables presented in Table 1 were included as grouping variables in addition to the



**Fig. 3.** Standardized sqrt. BWS values. Note: 1: Product’s country of origin, 2: Visual appearance of product, 3: Variety of product, 4: Freshness of product, 5: Price, 6: Nutritional value of product, 7: Traditional methods used in production, 8: Environmentally friendly production, 9: Organic production, 10: Genetically modified organism (GMO) used in production process, 11: Taste of product, 12: My knowledge of producer, 13: Fair trade, 14: Product’s region of origin.

**Table 4**  
Standardized B-W scores and standard deviations.

Attribute name	Standardized B-W score					Coefficient of variation (Standard deviation/Average B-W)				
	Germany	Hungary	Italy	France	Norway	Germany	Hungary	Italy	France	Norway
Product's country of origin	-0,10	-0,04	0,11	0,04	-0,29	-4,63	-11,84	4,77	11,89	-1,66
Visual appearance of product	0,00	-0,03	-0,12	-0,19	-0,02	341,04	-14,55	-4,57	-3,09	-23,95
Specific variety of product	-0,17	-0,42	-0,20	-0,15	-0,03	-2,73	-0,96	-2,22	-2,97	-17,03
Freshness of products	0,50	0,56	0,53	0,37	0,49	0,93	0,71	0,81	1,18	0,84
Price	0,08	0,25	-0,08	0,15	0,21	7,88	2,08	-7,42	3,59	2,41
Nutritional value of product	-0,13	0,04	-0,07	-0,13	0,02	-3,65	11,47	-6,51	-3,44	26,39
Traditional methods used in the production/processing of product	-0,18	-0,03	0,01	-0,09	-0,19	-2,65	-15,96	48,00	-5,11	-2,27
Environmentally friendly production	0,03	0,05	0,09	0,11	0,00	10,46	6,31	4,36	3,83	95,13
Organic production	0,03	-0,17	-0,01	-0,05	-0,19	17,28	-2,94	-53,46	-11,88	-2,57
GMO free	0,18	0,06	0,11	0,16	0,00	3,15	10,19	5,21	3,24	221,47
Taste of product	0,42	0,41	0,18	0,37	0,56	1,08	1,04	2,24	1,19	0,78
My knowledge of producer	-0,48	-0,54	-0,29	-0,37	-0,28	-0,98	-0,87	-1,68	-1,37	-1,68
Fair trade	-0,06	-0,03	-0,26	-0,21	-0,01	-6,58	-11,78	-1,80	-1,98	-28,08
Product's region of origin	-0,10	-0,08	0,01	-0,02	-0,30	-4,67	-5,51	90,42	-25,80	-1,50

**Table 5**  
Cluster models based on BWS importance.

Number of clusters	Schwarz's Bayesian criterion (BIC)	BIC change relative to the previous cluster-number solution	Ratio of BIC changes relative to the change for the two-cluster solution	Ratio of distance measures relative to the previous cluster number solution
One	13,044.51	-	-	-
Two	10,907.80	-2136.71	1.00	1.37
<b>Three</b>	<b>9451.24</b>	<b>-1456.56</b>	<b>0.68</b>	<b>1.38</b>
Four	8495.52	-955.73	0.45	1.24

B-W values of the 14 attributes.

The three consumer segments were labeled according to the FFVs-related attitudes and socio-economic characteristics presented in Table 6 and Table 7. Similar to the results presented before, in all three segments, the freshness and taste of products were reported to be most important. In contrast, knowledge of the producer and the specific variety of the product were considered the least important attributes. Regarding the socio-economic characteristics presented in Tables 7, in our segmentation, mainly gender and family size (number of children) served as a basis for differentiation; however, other differences were also observable. However, in our model, no statistically significant relationship was identified between the segments and the nationality of the consumers.

The first segment, "Price-sensitive men," contains 31.2% of the total sample. For these consumers, the price of FFVs is very important, while they care less about organic and fair-trade characteristics and GMO-free attributes. "Price-sensitive men" included only male respondents, 42.6% of the respondents without any children, and mainly younger (<30 years) and older (49< years) consumers. In relation to the highest level of education and net income, this segment included relatively lower-educated consumers with less monthly net income.

The second segment, called "Indifferent/less conscious mostly parents," included 40.9% of the respondents, many of whom had children. For them, together with price, being GMO free was highly important; however, fair trade was considered minimally relevant. "Indifferent/less conscious mostly parents" included both men and women and the majority of parents with one child (79.7%) or with two or more children (89.9%), along with the vast majority of middle-aged consumers (between 30 and 49 years). In overall comparison, the "Indifferent/less conscious mostly parents" cluster contained a larger proportion of consumers with a higher level of education and higher net income.

Finally, the third segment, called "Green/freshness-seeking women,"

**Table 6**  
Mean scores, differences, and segment size for the selected cluster model.

Attributes	Price-sensitive men	Indifferent/less conscious mostly parents	Green/freshness-seeking women	F statistics ( $\eta^2$ )	p-value
Product's country of origin	-0.04	-0.03	-0.03	0.36	0.698
Visual appearance of product	-0.05 <sup>a</sup>	-0.06 <sup>a</sup>	-0.11 <sup>b</sup>	3.66 (0.002)	0.026
Specific variety of product	-0.21	-0.22	-0.27	4.53	0.11
Freshness of products	<b>0.48<sup>a</sup></b>	<b>0.50<sup>a</sup></b>	<b>0.54<sup>b</sup></b>	5.61 (0.004)	0.004
Price	<b>0.17<sup>a</sup></b>	<b>0.10<sup>b</sup></b>	0.08 <sup>b</sup>	8.07 (0.005)	p < 0.001
Nutritional value of product	-0.05	-0.05	-0.03	0.41	0.665
Traditional methods used in the production/processing of product	-0.07	-0.06	-0.09	1.08	0.340
Environmentally friendly production	0.05 <sup>a</sup>	0.04 <sup>a</sup>	0.11 <sup>b</sup>	10.05 (0.006)	p < 0.001
Organic production	-0.11	-0.08	-0.05	2.44	0.088
GMO free	0.04 <sup>a</sup>	<b>0.10<sup>b</sup></b>	<b>0.15<sup>b</sup></b>	8.67 (0.006)	p < 0.001
Taste of product	<b>0.35</b>	<b>0.37</b>	<b>0.38</b>	0.84	0.433
My knowledge of producer	-0.36 <sup>a</sup>	-0.38 <sup>a</sup>	-0.47 <sup>b</sup>	12.31 (0.008)	p < 0.001
Fair trade	-0.11 <sup>a</sup>	-0.16 <sup>b</sup>	-0.08 <sup>a</sup>	9.02 (0.006)	p < 0.001
Product's region of origin	-0.08	-0.09	-0.09	0.10	0.904
<i>Segment size</i>					
N = 3093	966	1264	863		
Total (%)	31.2	40.9	27.9		
France (%)	31.2	39.8	29.0	$\chi^2 = 8.63$	$p =$
Germany (%)	34.0	35.6	30.4	0.375	
Hungary (%)	30.7	42.1	27.2		df = 8
Italy (%)	30.6	41.4	28.0		
Norway (%)	30.5	44.1	25.4		

Note: Mean values in bold are perceived as most important, while those in italics are the least important attributes for clusters. For post hoc analyses, we used the Tukey-b test. Different markings (<sup>a</sup>, <sup>b</sup>) refer to significant differences between clusters at a 5% significance level. Effect size measures ( $\eta^2$ ) are reported only in significant cases.

**Table 7**  
Differences across segments.

	Price-sensitive men	Indifferent/less conscious mostly parents	Green/freshness-seeking women	$\chi^2$	p-value
<i>Gender (%)</i>					
Female	0.0 <sup>-</sup>	45.2 <sup>+</sup>	54.8 <sup>+</sup>	1849.31 df = 2 Cramer's V = 0.77	p < 0.001
Male	63.7 <sup>+</sup>	36.3 <sup>-</sup>	0.0 <sup>-</sup>		
<i>Age category (%)</i>					
<30	42.1 <sup>+</sup>	14.1 <sup>-</sup>	43.8 <sup>+</sup>	1427.76 df = 6 Cramer's V = 0.48	p < 0.001
30–39	19.6 <sup>-</sup>	80.0 <sup>+</sup>	0.4 <sup>-</sup>		
40–49	11.8 <sup>-</sup>	72.7 <sup>+</sup>	15.5 <sup>-</sup>		
49<	45.9 <sup>+</sup>	8.6 <sup>-</sup>	45.5 <sup>+</sup>		
<i>Living area (%)</i>					
Rural area	28.4 <sup>-</sup>	39.2	32.4 <sup>+</sup>	13.51 df = 4 Cramer's V = 0.05	0.009
Urban medium town	33.1	40.1	26.8		
City	31.4	42.8	25.8 <sup>-</sup>		
<i>Highest level of education (%)</i>					
Lower secondary/primary education or below	45.3 <sup>+</sup>	18.4 <sup>-</sup>	36.3 <sup>+</sup>	145.15 df = 8 Cramer's V = 0.15	p < 0.001
Upper secondary education	35.3 <sup>+</sup>	32.5 <sup>-</sup>	32.2 <sup>+</sup>		
University or college entrance qualification	31.3	40.3	28.4		
Bachelor's degree or equivalent level	27.9 <sup>-</sup>	47.8 <sup>+</sup>	24.3 <sup>-</sup>		
Master, Postgraduate or doctoral degree	22.1 <sup>-</sup>	57.3 <sup>+</sup>	20.6 <sup>-</sup>		
<i>Household monthly net income (%)</i>					
Cat. 1	34.6	21.2 <sup>-</sup>	44.2 <sup>+</sup>	283.33 df = 12 Cramer's V = 0.21	p < 0.001
Cat. 2	36.2 <sup>+</sup>	27.9 <sup>-</sup>	35.9 <sup>+</sup>		
Cat. 3	41.7 <sup>+</sup>	33.5 <sup>-</sup>	24.8		
Cat. 4	21.3 <sup>-</sup>	54.0 <sup>+</sup>	24.7 <sup>-</sup>		
Cat. 5	30.9	55.0 <sup>+</sup>	14.1 <sup>-</sup>		
Cat. 6	28.7	60.5 <sup>+</sup>	10.8 <sup>-</sup>		
Prefer not to answer	27.9	35.2 <sup>-</sup>	36.9 <sup>+</sup>		
<i>Number of children (%)</i>					
No child	42.6 <sup>+</sup>	17.4 <sup>-</sup>	40.0 <sup>+</sup>	1330.27 df = 4 Cramer's V = 0.46	p < 0.001
1 child	11.1 <sup>-</sup>	79.7 <sup>+</sup>	9.2 <sup>-</sup>		
2 or more children	9.1 <sup>-</sup>	89.9 <sup>+</sup>	1.0 <sup>-</sup>		

Note: A "+" in the superscript indicates that the adjusted residual is greater than 2. A "-" in the superscript indicates that the adjusted residual is less than -2. Effect size measures (Cramer's V) are reported only in significant cases.

with 27.9% of all respondents. For them, GMO-free and environmentally friendly production was very important, but visual appearance was of a minimal level of importance. "Green/freshness-seeking women" contained only female consumers, 40 of whom had no children. This segment also included younger (<30 years) and older (49< years) consumers. Similar to members of the "Price-sensitive men" cluster, this segment included relatively less well-educated consumers with a lower monthly net income.

### 5. Discussion

Our results clearly indicate that the freshness and taste of products are the most important product attributes that drive consumer preferences for FFVs in the selected countries. These attributes were chosen as first and second everywhere. Freshness is ranked first in Germany, Hungary, and Italy and second in France and Norway, while taste is on the other rank. These findings support the general conclusion of previous studies that for FFVs products, freshness [12,13,20,22,25] and taste [12,17,19–21] matter most to consumers.

Based on our findings, three other attributes further drive consumers' purchases everywhere, albeit with some differences in ranking in the selected countries. First, being GMO-free was ranked between third and fifth in importance in all countries. Even though this food characteristic is particularly important in Europe [41], this attribute has not been intensively investigated in an FFVs context. However, the conclusions of our study are in line with the findings of Wos, Dobrowolski [43], which indicated that GMO free is a very important attribute for Polish organic consumers in relation to mainly FFVs purchases. In another study implemented in New Zealand, however, it was found that when the GM label is combined with a typical functional food benefit (e. g., pesticide-free GM produce), GM fruit can indeed achieve significant market share amongst organic and ordinary fruit, even in a country

where the GM issue has been highly controversial [62]. Since the GM attribute was considered a standalone item in this experiment, our study did not investigate the synergic effect with other attributes. Second, environmentally friendly production methods was ranked fifth everywhere except in Hungary, where this attribute was in the fourth rank. However, this contradicts previous findings – for the Netherlands, Raaijmakers, Sijtsema [20] found it to be of little importance. On the other hand, a recent meta-analysis found a positive and significant WTP for eco-labeled foods, including FFVs, although this effect was more substantial for meat and dairy products than seafood, nuts, vegetables, and fruits [63]. Third, price was usually ranked third or fourth, except in Italy, where price mattered less (it was only ranked ninth). This might indicate the different price-sensitivity of Italians for these products, although in Spain Galdeano [38] reported that FFVs were considered a product category with the characteristics of luxury goods. Recently, a cross-country study in Italy and the UK indicated that price, taste, blemishes, aroma, and best-before date were more important in the UK sample than the Italian one [64].

Italians valued origin (both country and region) most, followed by France; however, this attribute was less strongly highlighted by German, Hungarian, and Norwegian consumers. These mixed attitudes echo previous findings [16,20,22]. The differences might refer to the level of ethnocentrism [15] or a preference for domestic products [21,32]. However, the greater importance of origin in Italy and France also can be explained by the strong embeddedness of the Mediterranean European countries in the system of foods with geographical indications [65, 66], resulting in more attention to products with distinct origins.

The nutritional value of FFVs was appreciated most in Norway and Hungary; however, it was considered of less importance in the remaining three countries. Similarly, mixed conclusions can be collected from the literature on this topic, as some research found this attribute to be a high-priority one [e.g., 25] while others found it less important [e.g.,

19].

Visual appearance was ranked seventh in three countries (Germany, Hungary, and Norway) and 11th in Italy, and 12th in France. This might be surprising, as visual appearance determines the first impression of products to consumers. However, previous studies also reported the high importance of this characteristic only for very specific consumer groups (e.g., parents when they purchase child-friendly shaped FV [14]).

Being organic was considered most important in Germany (sixth) and had somewhat more limited importance in Italy, France (both eighth), and Norway (tenth). On the other hand, for Hungarians, this attribute was among the least important (ranked 12th from 14). Being organic is not often investigated as a distinct FFVs attribute, and results in the literature are mixed [10] or find that this attribute is irrelevant [16,17] or only relevant for very specific consumer groups [20]. Therefore, our results for Italy, France, and Norway can be considered in line with previous findings. In Germany, organic food has long been considered meritorious [67], and such food is widely sought out by consumers [68], which fact may validate our results. On the other hand, in Hungary, the high level of price sensitivity and a relatively low level of organic awareness [69] explain the low rank.

In terms of importance, traditional methods used in production is generally ranked low (seventh-ninth), but in Germany, this characteristic was rated very low (13th), similar to the specific variety of the product (ranked 11th-13th, except for in Norway, where it was eighth). Previous studies also found these two attributes less determinative or irrelevant [16,25], except for with FFVs products that are at least minimally processed [10,11].

Fair trade's impact on the appraisals of FFVs was minimal (13th in Italy and France) or low (eighth in Germany and Hungary), but in Norway, it was ranked sixth. Fair trade FFVs is also a niche research topic, and only a few studies have investigated its relevance for niche markets (e.g., Dhaoui, Nikolaou [39] for Crete, Greece).

Our results clearly indicate that in all the selected countries, consumers' knowledge of the producer is the least important factor (ranked last everywhere, except in Norway at 11th). This finding is surprising, however, as FFVs are considered one of the main product categories sold via short food supply chains (at farmers' markets, in particular), where personal relationships and face-to-face interaction between consumers and producers are key drivers [70]. One explanation is that, in the experimental conditions that were applied (see Figs. 1 and 2), the context was the supermarket shelf, the leading distribution channel in the selected countries [71]. In this context, in many cases, the producer's name is not indicated on the product.

Our findings further indicate that the most preferred attributes were also freshness and taste in all three segments, followed by price (for "Price-sensitive men" and "Indifferent/less conscious mostly parents") and GMO free (for "Green/freshness-seeking women"). On the other hand, clearly among the least preferred attributes were knowledge of the producer and the specific variety of the product in all segments. This was followed by fair trade (for "Price-sensitive men" and "Indifferent/less conscious mostly parents") and by the visual appearance of the product (for "Green/freshness-seeking women").

It is important to mention that we found no significant differences among segments concerning nationality. This echoes the findings of the comprehensive review of Moser, Raffaelli [42], in which countries were clustered according to their FFVs consumption attributes, and Europe was found to be a homogeneous macro-region.

Some of the socio-economic attributes proved significantly determinative in relation to our segmentation. Similar to the literature discussed earlier, we found gender [17,20], age [19,48], education [5,17,19,20,47], income [17,20], and family/household size [48] to be relevant factors.

## 6. Conclusion

To the best of our knowledge, our study is the first to describe a cross-

country analysis that includes a number of different European countries (five) and investigates FFVs-related consumer attitudes by applying BWS methodology. In addition, the comprehensive set of fourteen product attributes that were applied allowed us to test not only the most commonly investigated attributes (e.g., freshness, taste, or origin) but to cover potential attributes that have not been deeply surveyed in this context (e.g., fair trade or organic).

Our study contributes to the literature about consumer preferences for fresh fruit and vegetables by applying a cross-country analysis on a multi-European level. In summary, consumers in all countries prioritize the freshness and taste of products, while GMO-free, environmentally friendly production and price are also important attributes. On the other hand, knowledge of the producer was considered least relevant in almost all countries.

In addition, segmentation shows that freshness and taste were the main drivers for all the clusters, while knowledge of the producer and the specific variety of the product were the least relevant. For "Price-sensitive men," price; for "Indifferent/less conscious mostly parent," price and being GMO free; while for "Green/freshness-seeking women," GMO free and environmentally friendly production were also among the top priorities.

The segmentation methodology was clearly affected by some socio-economic characteristics: gender, age, and family size, in particular. Our results indicate that younger men without children ("Price-sensitive men"), younger females also without children ("Green/freshness-seeking women"), and middle-aged parents with children ("Indifferent/less conscious mostly parents") represent distinct consumer groups in these European countries. It should also be highlighted that we could not identify differences across countries in the three clusters.

From a managerial point of view, there are several implications of this study. First, as the most (and less) valued product attributes were found to be very similar in all five countries, we propose that uniform marketing strategies may be followed. Second, based on the attributes, FFVs producers and retailers should focus on products' freshness and taste. On the other hand, our results showed that the knowledge of the producer is not valued in general, indicating that for FFVs, only niche markets should be targeted with this attribute (e.g., personal trust-based short food supply chains like farmers' markets). Finally, distinctions in marketing can mainly be made based on gender (male vs. female) and family size (with or without children). All these managerial implications might contribute to improving FFVs sale in these European countries.

Our study is not free of limitations. First of all, the hypothetical bias in stated preference surveys also applies to the BWS methodology, thus, one should keep in mind that our results and consumers' decisions in real purchasing situations would differ. Second, compared to other FFVs studies that applied BWS methodology, our study investigated a larger number of attributes; additional product attributes might also drive consumer preferences for FFVs. Also, despite the larger number of countries involved in our investigation, we cannot generalize about European consumers. Other regions (e.g., countries from the Baltic and the Balkan states), or countries from other continents with potentially different consumer preferences should also be investigated.

## Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Áron Török reports financial support was provided by the European Union's Horizon 2020 research and innovation program under grant agreement no. 678024, entitled: "Strength2Food: Strengthening European Food Chain Sustainability by Quality and Procurement Policy".

## Data availability

Data will be made available on request.

Appendix

**Table 1**  
Household net income categories

	Germany	Hungary	Italy	France	Norway
Cat. 1	< €900	<150,000 HUF < €486	< €900	< €1130	<25,300 NOK < €1420
Cat. 2	€900-€1300	150,000–205,000 HUF €486-€664	€900-€1500	€1130-€1450	25,300–31,250 NOK €1420-€2530
Cat. 3	€1300-€2100	205,000–235,000 HUF €664-€761	€1500-€2500	€1450-€2090	31,250–39,000 NOK €2530-€3500
Cat. 4	€2000-€3600	235,000–380,000 HUF €761-€1231	€2500-€3500	€2090-€2890	39,000–44,200 NOK €3500-€4380
Cat. 5	€3600-€5000	380,000–835,000 HUF €1231-€2705	€3500-€4500	€2890-€4100	44,200–55,000 NOK €4380-€5500
Cat. 6	≥ €5000	≥835,000 HUF ≥ €2705	≥ €4500	≥ €4100	≥55,000 NOK ≥ €5500

Note: National currencies of Hungary and Norway are converted to euros at the exchange rate available at the start of the survey.

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