Preferences and acceptance of Czech and Spanish consumers regarding beef with varying intramuscular fat content

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Abstract

Understanding the factors affecting meat eating quality and consumer demand is essential for estimating future trends in meat consumption. The objective of the study was therefore to compare Czech and Spanish consumer attitudes and preferences in relation to beef intramuscular fat content. Three hundred and one consumers participated in the study; they completed a sociodemographic questionnaire and evaluated grilled beef samples of three varying intramuscular fat contents (low, medium, high). The low-fat meat had an average intramuscular fat content of 1.3%, medium had 3.1% and high-fat had 5.2%. Sensory assessment scores tended to show a positive linear relationship with beef intramuscular fat content. While Czech assessors only noted differences in tenderness and overall acceptance between the beef samples, Spanish assessors were able to detect significant differences in all the descriptors evaluated. Age and gender affected the assessment scores of beef with different intramuscular fat contents.

1. Introduction

Worldwide, factors affecting meat consumption trends are extremely complex, including nutritional reasons, health considerations, economic pressures, and environmental concerns (Magalhaes et al., 2022). Although global meat production continues to increase, in some devel- oped countries it has already peaked and is starting to decline (Whitton, Bogueva, Marinova, & Phillips, 2021). For European consumers, beef can be classified as a traditional part of the diet, a valuable source of protein which has long been the third-most consumed meat, after pork and poultry (Font-i-Furnols & Guerrero, 2014). Despite its unique organoleptic properties, beef consumption cannot compete with the other categories of meat. The relatively high price of beef compared to other meats was considered to be a factor that might explain the lower demand (Magalhaes et al., 2022), but other factors like climate change, environmental deterioration, animal welfare, and health-risk concerns have motivated people in developed countries to reduce not only beef consumption, but overall meat consumption (Whitton et al., 2021).

Especially in developed countries, consumers' preference for nutritionally balanced foods is increasingly evidently, and so-called red meat is often viewed as a culprit in the development of diet-related non- communicable diseases (McNeill & Van Elswyk, 2012). Previous research on consumer decision-making regarding red meat has shown that the amount and type of visual fat is one of the most important factors in consumer choice, with consumers paying more attention to, and choose more often, meat products with a lower fat content (Banović, Chrysochou, Grunert, Rosa, & Gamito, 2016). Several studies have

also shown different consumers' preferences regarding visible fat in steaks with a minimal amount of marbling; while many consumers prefer the appearance of beef with low (or zero) levels of marbling, when these same consumers are given cooked beef under "blind" conditions, (i.e., without knowledge of the marbling level) they prefer the flavour of highly marbled beef and find it more acceptable (Morales, Aguiar, Subiabre, & Realini, 2013).

Consumers' preferences for "healthier", lower-in-fat meats generally results in the purchase of beef with less visible intra- and extra-muscular fat; choices which have also been enabled by the meat industry's production of leaner carcasses (Kang, Panzone, & Kuznesof, 2022). Paradoxically, low-fat (or lean) meat tends to have poor eating quality and flavour profiles, and thus low consumer eating acceptability (Frank, Joo, & Warner, 2016). While the factors that determine perceived eating quality and health quality attributes of beef are weighted similarly by consumers pre-purchase, eating quality has a stronger weight during consumption (Grunert, 2006). In fact, the positive impact of intramuscular fat on improving eating quality is well-known; grilled beef flavour, a favourable sensory attribute of beef, is the result of a combination of heat-generated aromatic fatty acid volatiles and non-volatile taste compounds (mainly free amino acids, peptides and organic acids) delivered in a unique matrix of muscle fibres, collagen, "warmed-meat juices", and partly dissolved fat (Frank et al., 2016). Moreover, intra-muscular fat plays an important role in the texture characteristics of meat, such as juiciness and tenderness (Webb & O'Neill, 2008).

As reviewed by Deliza and MacFie (1996), food perception and selection is a multifactor process where our senses, physiological and psychological aspects, and extrinsic factors participate. All these factors may affect consumer preferences and lead to the acceptance

or rejection of a certain food product. Expectations appear frequently in people's daily lives, affecting their purchasing attitudes about a food product. Assumptions can be created by advertising, talking to friends, previous experiences, peers or family, etc. In this context, expectation can improve or degrade the perception of a product, even before it is tasted. Previous studies have shown that consumer preferences for beef with different marbling levels are different depending on the consumers' habits, culture, and origin (Beriain, Sánchez, & Carr, 2009; Boito et al., 2021; Frank, Joo, & Warner, 2016; Oliver et al., 2006; San-Julián et al., 2012).

Spain and the Czech Republic represent the fourth- and ninth-largest consumers populations in the European Union, respectively, with com- parable purchasing power, as measured by gross domestic product purchasing power parity per capita (EUROSTAT, 2021). The per capita consumption of beef in Spain decreased in 2020 to 12.3 kg/person/year (Magalhaes et al., 2022) from 2004, where it was 15.5 kg/person/year. In the Czech Republic, beef consumption peaked in 1990 at 28.4 kg/ person/year; this was followed by a sharp decline to 10.4 kg/person/ year in 2004 (EU accession), and further to 8.9 kg/person/year in 2020 (Czech statistical office, 2021). Understanding consumer priorities, preferences, and acceptance is important for planning strategies to affect consumer behaviour and purchase practice (Boito et al., 2021). While in the case of Spain, a number of studies have been carried out to map the basic attitudes, expectations, and preferences of consumers regarding beef, no similar study has been carried out in the Czech Republic. The objective of this study was therefore to compare and characterize the preferences and acceptance of beef with varying intramuscular fat contents in Czech and Spanish consumers, and understand the effects of basic sociodemographic factors.

2. Material and methods

2.1. Animals and sample preparation

Thirty-eight purebred Fleckvieh bulls and steers reared under identical nutritional and housing conditions in the experimental barn of the Institute of Animal Science (IAS) were used for obtaining beef samples for this study (IAS; No 18480/2016–17,214). Their mixed feed ration was based on maize silage and grain supplementation. On reaching an average age of 17 months and an average live weight of 634 59 kg, the animals were transported to the experimental abattoir of IAS and slaughtered following standard commercial protocols. Forty-eight hours after slaughter, the longissimus lumborum muscle was removed from the right side of the carcass and transported to the laboratory for further analysis. Approximately 250 g of each muscle, from the cranial end, was collected for determination of its intramuscular fat content (IMF). Fat content was determined by petroleum ether extraction (Soxtec Avanti 2055, FOSS Tecator AB, Höganäs, Sweden), as described by Bureš and Bartoň. The remaining muscle was divided into four sections, vacuum-packed, and aged at 4 ◦C until the 14th day post-slaughter. Thereafter, the samples were frozen and stored at 20 ◦C until sensory analysis. Based on the IMF content analysis, 14 samples were subsequently selected to be used in this study and grouped into three IMF content ranges, namely low (1.3 ± 0.09%), medium (3.1 ± 0.36%) and high (5.2 0.66%) fat content. Half the amount of each selected sample was transported frozen to the Department of Animal Husbandry and Food Science, University of Zaragoza, Spain. On the day before the consumer testing sessions, the selected samples were removed from the freezer and allowed to thaw inside the plastic bag at room temperature. The samples were cut into 20 mm thick slices and grilled on a double- sided contact grill (VCR, 6 l TL, Fiamma, Aveiro, Portugal, in Czech Republic; SAMMIC GRS-5, SAMMIC, Azkoitia, Spain, in Spain) until a final internal temperature of 70 ◦C,

as measured by a thermometer (AD14TH, AmaDigit, Kreuzwertheim, Germany; pH 7, XS Instruments, Carpi, Italy) placed into the centre of the steak. The steaks were then cut into 20 mm cubes and placed in sealed glass containers labelled with a random three-digit code. The samples were then kept at 50 ◦C until presentation to the consumer.

2.2. Participants

A total of 201 Czech and 100 Spanish consumers took part in this experiment. The experiment was carried out in the sensory laboratories of the IAS, the Department of Food Science at the Czech University of Life Sciences Prague, and the Department of Animal Husbandry and Food Science at the University of Zaragoza. Consumers (18 to 65 years of age) included staff (permanent and visiting), students, and guests at these institutions that consumed beef. They were first provided with a questionnaire, in their native language, to determine their sociodemographic data (age, gender, household income), and their meat and beef consumption habits (the frequency of meat and beef consumption, and marbling preference), which they filled anonymously. Subsequently, instructions were given on how to assess the grilled beef samples ac- cording to four descriptors (odour acceptability, tenderness, flavour acceptability, and overall acceptability). The characteristics of the descriptors and the method of assessment are shown in Table 1. Each participant was then presented with a set of three samples differing in intramuscular fat content to assess the four sensory characteristics. Czech and Spanish consumers were always presented with the same combinations of samples from the same animals. Consumer assessment of the meat samples took place over a total number of seven days, for both countries combined.

2.3. Statistical analysis

Statistical analysis was performed using the statistical package SAS (Version 9.4, SAS Institute Inc., Cary, NC, USA). Data were analysed using a mixed model, following the REML method of the MIXED procedure. The model included the fixed effect of IMF content (i.e., low, medium, or high) and the random effects of consumer and day of assessment. The data in tables are presented as least squares means (LSM) and standard errors of the mean (SEM). Differences between group means were tested by Tukey's method (level of significance to 5%). Association between consumer attitudes and preferences were illustrated by means of Principal Component Analysis (PCA), using the PRINCOMP procedure in SAS.

3. Results

The socio-demographic characteristics of consumers from both countries are shown in Table 2. The majority of consumers were women, less than 25 years of age, and/or declared that they eat meat two to four times a week. In the case of beef consumption, this was most frequently recorded as less than once a week. Overall, the participants in the survey within the two countries were similar in terms of gender, age, and fre- quency of meat consumption. However, differences in preferences for meat with different levels of visible IMF content (marbling) were observed among the survey participants, with Czech consumers showing a stronger preference for lean meat than Spanish consumers. A more detailed distribution for each gender and age category for both countries is shown in Fig. 1. Regardless of age and gender, it is clear that the majority of Spanish consumers preferred marbled meat, while Czech respondents most often preferred lean beef. The preference for meat without visible fat (i.e., as lean as possible) was more pronounced

among women than men, in both countries. At the same time, a preference for meat with low visible fat was evident among Czech consumers younger than 35 years, but no similar trend in relation to age was observed among the Spanish participants.

The results of the sensory evaluation are presented in Table 3. When considering the dataset as a whole, significant differences were found for all other evaluated characteristics except for the odour acceptability.

Sensory scores generally showed a positive linear relationship with IMF content for all characteristics evaluated. The IMF content showed the greatest effect on tenderness, where all three groups were significantly different from each other, and the high-fat beef scored the most favourably. Spanish consumers noted significant differences for all observed descriptors; however, Czech consumers only noted differences in tenderness and overall acceptability of the beef samples with differing levels of IMF. There were significant differences in the sensory scores between men and women; while women noted differences between the samples for all of the characteristics studied, men only noted differences in meat tenderness. Furthermore, consumers younger than 25 years of age also only noted differences between samples for tenderness. How- ever, older consumers (36 years old and older) showed a tendency to be able to distinguish between the samples based on their odour accept- ability, while other age groups could not.

Table 4 shows the sensory evaluation of consumers according to their marbling preferences. While the marbling preference did not affect the consumer's ability to distinguish between the meat samples for tender- ness, it is clear that the ability to discriminate differed for the other descriptors studied. In the case of odour acceptability, only those evaluators who preferred marbled meat, or those who declared no preference in this respect, found significant differences between the samples. In the case of the

flavour acceptability and overall acceptability assessment, it is evident that only consumers preferring marbled or highly marbled meat were able to distinguish between samples with different IMF contents.

The PCA bi-plot (Fig. 2) shows the associations between the consumer evaluations and the distribution of different sociodemographic groups. The combination of principal component 1 (PC1) and PC2 explained over 83% of the total variance experienced. PC1 explained 65% of the variance and is contingent in particular to an assessment of the flavour acceptability and the overall acceptability. Low and high fat samples are separated along the vertical axis. PC2 explained a further 19% of the variability, and points to different perceptions of odour acceptability and tenderness. In general, the average values of the individual subgroups for the Czech evaluators are more closely related to tenderness, while for the Spanish consumers they are more closely related to odour acceptability. There was a negative relationship be- tween the evaluation of tenderness and odour acceptability.

4. Discussion

While several experiments have been carried out in the recent past on the attitudes and preferences of Spanish consumers in relation to beef consumption, preferences, and attitudes (Beriain et al., 2009; Boito et al., 2021; Cardona, Gorriz, Barat, & Fernández-Segovia, 2020; Magalhaes et al., 2022; Oliver et al., 2006; San-Julián et al., 2012), no similar studies are available for the Czech population. The Czech Republic is one of the new EU member states (since 2004) that have experienced significant socio-economic changes over the past thirty years, and which have substantially manifested themselves both in the availability of many foods and in changes in consumer attitudes and habits.

Thirty years ago, the beef industry was saturated exclusively from dairy cattle breeds, today the share of specialised meat breeds is approximately 40% of the cattle stock (Kvapilik, Barton, & Syrucek, 2021). This means a significantly higher supply of meat from different quality categories (including varying degrees of marbling) on the market. In contrast, Spain can be considered (as an old EU member state) as a country with substantial continuity in this respect.

Beef is a biochemically dynamic product, and is susceptible to variations in palatability, which depends on the animal's health, nutrition, and rearing environment, as well as pre- and post- slaughter practices, such as processing and cooking (Kang et al., 2022). Since there was an effort to eliminate the influence of most of these factors, meat from animals fed identical diets and slaughtered at a comparable age was used in the present study. A feed ration based on silage and grain was used, which is considered to be more acceptable to consumers in terms of flavour profile than a forage-based diet (Chail et al., 2017; Miller, 2020). Furthermore, after slaughter, the meat of all animals was processed in the same way.

Fat content is a very important attribute for those consumers concerned about eating a healthy, balanced diet (Banovič et al., 2016). Meat from ruminants is considered to be an important source of saturated fatty acids. Because reducing the saturated fatty acids intake remains one of the key nutritional strategies/recommendations worldwide to prevent chronic diseases, such as cardiovascular disease, national dietary guidelines and healthcare authorities have been encouraging the reduction, elimination, or substitution of this meat as part of a healthy diet (Vahmani et al., 2020). These recommendations are subsequently reflected in consumption attitudes. However, people differ in the extent to which they incorporate taste and health motive in their food choices (Saba et al., 2019).

There is an obvious tendency in some western cultures to see food pleasure as being in opposition to health. On the other hand, as reviewed by Frank, Joo, and Warner (2016), fat also plays a critical role in defining the sensory properties of complex foods, such as marbled beef. Apart from making food softer, fat facilitates “oral processing”, lubrication of food particles, increases saliva viscosity, and acts as a binder, assisting in the formation of a solid bolus in preparation for swallowing. Its contribution to increasing tenderness, juiciness, and other important textural characteristics of meat is also evident (O'Quinn et al., 2012; Webb & O'Neill, 2008). Some studies focusing on the effect of IMF on the consumer acceptability of meat from the USA or Australia (Corbin et al., 2015; Thompson, 2004) utilized meat samples with significantly higher fat levels than those used in the present study. The current results show that IMF content has a significant impact on consumer evaluation, as sensory assessment scores tended to have a positive linear relationship with beef intramuscular fat content. This agrees with Thompson (2004) who found a positive correlation of IMF content with Australian consumer-assessed beef flavor scores in a large set of striploin samples, ranging from 0.3 to 15% IMF. This relationship plateaued at the higher levels of intramuscular fat percentage. The observed differences in the evaluation of samples with different fat content in the present study may be attributed to the different cultural practices of the inhabitants of the two countries. With the exception of tenderness, it was evident that the Spanish consumers showed more significant differences in evaluation scores between low, medium, and high fat steaks than the Czech participants. Two-thirds of the Spanish cattle population consists of beef breeds, producing beef with highly variable IMF contents (Campo, Sañudo, Panea, Alberti, & Santo aria, 1999), whereas the beef produced and consumed in the Czech Republic comes mostly from the Fleckvieh breed, characterized by a relatively low IMF

(Bureš & Bartoň, 2018). Boito et al. (2021) investigated the perception of beef quality among Spanish and Brazilian consumers and reported that Spanish consumers detected a higher concern in the composition and fat content of the meat purchased. On the other hand, Cardona et al. (2020) monitored the perception of the amount of fat in minced meat among Spanish consumers and stated that most consumers had little knowledge of the true fat content. Most consumers perceive that minced meat has a higher fat content that it does.

Savell et al. (1987) observed geographic differences (among three USA cities) with respect to the way consumers reacted to differences in intramuscular fatness of beef steak. Desirability ratings increased with increasing degrees of marbling, and geographic differences in the acceptability of lower fat steaks were explained by the popularity of eating beef at lower degrees of doneness. Oliver et al. (2006) found that consumers from three Western European countries who evaluated beef from Uruguay and were not given verbal or written information about the origin of beef, did not prefer the same type of meat within the same country. However, consumer preferences in this study are also related to the production system that is commonly applied to fattened animals in a given country. It seems that, as a result, Uruguayan beef would be very acceptable in Germany, and to a lesser extent in Britain and Spain (Oliver et al., 2006).

Saba et al. (2019) considers the gender and age of consumers as the most important sociodemographic indicators for food-related lifestyles and preferences among Italian consumers. A significant factor is that men consume beef more often than women (Magalhaes et al., 2022). Similarly, the current study found significant differences in the evaluation of beef samples with different fat contents between women and men, and for different age groups. Moreover, the impact of fat content on visual attention and choice

311 has been found to be gender specific, with female consumers paying more attention, and
312 choosing more often and faster, red meat products with a lower fat content (Banovič et
313 al., 2016). Corbin et al. (2015) explain that consumers often generalize and misevaluate
314 sensory traits because of the favourable evaluation of other traits. Consumers are more
315 likely to rate flavour as desirable if tender- ness is sufficiently desirable. To more
316 accurately determine the role marbling plays in beef flavour perception of consumers, this
317 confusing effect, especially the tenderness variation among samples, should be
318 minimized. In the results of the PCA analysis in our study, it was found that flavour
319 acceptability was essential for overall acceptability as opposed to the remaining
320 descriptors. This relationship was closer for Spanish than for Czech consumers when
321 evaluating high-fat samples, as the latter were more focused on the tenderness of the
322 samples.
323
324 **5. Conclusion**
325 Czech and Spanish consumers differed in their preference for beef with visible fat, as well
326 as their ability to perceive sensory differences in beef with varying IMF, with Spanish
327 consumers generally being more sensitive and showing preference for beef with higher
328 IMF. This was further impacted by gender and age, where women and younger consumers
329 showed higher preferences for visibly lean beef, particularly amongst Czech consumers.
330 Thus, attention should be paid towards young, female Czech consumers, as their
331 perceptions will influence the next generation's beef consumption habits. These results
332 therefore point to the need for consumer awareness and education among those groups
333 that seek the leanest beef, as it is apparent that consumers with a purchase-orientation
334 towards the leanest meat are purchasing products that do not meet their culinary

expectations and is likely leading to dissatisfaction and decreased repurchases. Thus, marketing strategies within these countries should consider realignment of consumer expectations when marketing fresh unprocessed beef of varying fat contents.

Declaration of Competing Interest

The authors declared that they have no conflict of interest. All authors read and agreed to the published version of the manuscript.

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450 **Table 1.** Definition and scale of attributes used in consumer test.

Attribute	Evaluation	Definition	Scale
Odour acceptability	Before eating	Acceptability of the aroma typical for grilled beef	0 = unacceptable, 100 = most acceptable
Tenderness	After two or three chews	Perceived force required to bite the sample with the molars	0 = very tough 100 = very tender
Flavour acceptability	After the first five to ten chews	Acceptability of flavour typical for grilled beef	0 = unacceptable, 100 = most acceptable
Overall acceptability	At the end of the evaluation	Acceptability of taste typical for grilled beef	0 = unacceptable, 100 = most acceptable

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Table 2. Demographic variables and summary statistics of experiment participants.

Characteristics		Consumers		
		Total (n)	Czech (n)	Spanish (n)
		301	201	100
		(%)	(%)	(%)
Gender	Female	63	65	59
	Male	37	35	41
Age	<25	59	61	56
	26-35	18	19	17
	35<	23	20	27
Meat consumption frequency	Daily	22	25	16
	4+ per week	33	29	41
	2+ per week	40	40	39
	Once a week	5	6	4
Beef consumption frequency	More than once a week	36	37	35
	Less than once a week	44	42	48
	Once a month or less	20	21	17
Household income*	Low (up to 1000 €)	8	9	5
	Medium high (1000-3000 €)	78	84	68
	High (more than 3000 €)	14	8	27
Marbling preference	As lean as possible	14	18	7
	Lean	30	35	19
	Marbled	19	5	48
	Highly marbled	26	30	18
	No preference	11	12	8

*Income per month

458 **Table 3**. Consumer acceptability of beef with different fat contents

Characteristics			Meat				
			Lean	Medium fat	Fatty	SEM	*P*-value
Odour acceptability	Nationality	Total	52.1	56.2	55.9	1.40	0.063
		Czech	20.2	53.9	52.0	1.84	0.382
		Spain	55.9b	51.0a	63.8a	1.92	0.003
	Gender	Female	51.4b	57.9ab	58.1a	1.94	0.673
		Male	52.7	55.0	54.2	1.97	0.848
	Age	≤25	54.3	55.1	55.8	1.88	0.062
		26-35	48.4	58.6	55.6	3.31	0.077
		≥36	49.5	57.3	56.4	2.69	<0.001
Tenderness	Nationality	Total	41.7c	50.3	64.5a	1.39	<0.001
		Czech	41.3c	50.2b	64.3a	1.75	<0.001
		Spain	42.5c	50.5b	65.0a	2.24	<0.001
	Gender	Female	36.6c	49.7b	63.5a	1.98	<0.001
		Male	45.6b	50.8b	65.3a	1.90	<0.001
	Age	≤25	43.7c	50.4b	63.9a	1.86	<0.001
		26-35	39.2c	49.2b	67.4a	3.04	<0.001
		≥36	38.6c	50.8b	63.7a	2.78	<0.001
Flavour acceptability	Nationality	Total	53.1b	56.4ab	58.9a	1.41	0.010
		Czech	52.8	55.7	57.8	1.78	0.151
		Spain	55.4b	59.3b	62.8a	2.11	0.016
	Gender	Female	50.9b	57.4a	61.4a	1.93	<0.001
		Male	54.8	55.5	57.0	1.99	0.783
	Age	≤25	56.3	54.5	56.7	1.86	0.645
		26-35	47.4b	57.5ab	62.3a	3.24	0.004
		≥36	49.5b	60.3a	61.8a	2.79	0.003
Overall acceptability	Nationality	Total	50.4c	55.8b	61.0a	1.37	<0.001
		Czech	50.2b	54.6ab	59.2a	1.81	0.002
		Spain	50.8c	58.2b	64.7a	1.95	<0.001
	Gender	Female	46.5b	56.9a	63.1a	1.86	<0.001
		Male	53.4	54.9	59.4	1.94	0.056
	Age	≤25	54.2	53.7	58.5	1.82	0.103
		26-35	45.8b	57.4a	65.4a	3.08	<0.001
		≥36	44.3b	59.7a	64.1a	2.73	<0.001

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460 ^{abc}Values with different superscript in the same row are significantly different (P<0.05).

461 Odour, Flavour and Overall acceptability: 0=unacceptable, 100=most acceptable

462 Tenderness: 0=very tough, 100=very tender.

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470 **Table 4.** Consumer evaluation of samples with different fat contents depending on meat

471 stated preferences with different marbling.

Characteristics		Meat			SEM	*P*-value
		Lean	Medium fat	Fatty		
Odour acceptability	*As lean as possible*	55.7	54.1	56.8	4.14	0.884
	Lean	51.1	54.2	57.3	2.84	0.276
	Marbled	53.5b	61.4a	62.3a	2.57	0.017
	Highly marbled	55.2	55.4	57.6	2.80	0.790
	No preference	41.5b	59.5a	46.3b	4.56	0.013
Tenderness	*As lean as possible*	37.8c	52.6b	59.6a	3.81	<0.001
	Lean	43.4c	53.4b	63.0a	2.78	<0.001
	Marbled	42.1c	47.1b	64.8a	3.02	<0.001
	Highly marbled	44.6c	50.7b	69.8a	2.59	<0.001
	No preference	38.4c	47.1b	61.5a	4.34	0.002
Flavour acceptability	*As lean as possible*	52.3	55.1	53.4	3.94	0.870
	Lean	55.3	57.6	61.6	2.69	0.205
	Marbled	52.7b	59.8ab	63.9a	2.57	0.007
	Highly marbled	56.1b	58.5ab	66.2a	2.81	0.022
	No preference	46.5	48.3	47.4	4.74	0.966
Overall acceptability	*As lean as possible*	50.2	56.7	56.9	3.87	0.364
	Lean	53.8	56.4	61.5	2.62	0.103
	Marbled	48.9b	56.3b	66.3a	2.58	<0.001
	Highly marbled	51.9b	57.9b	67.8a	2.69	<0.001
	No preference	44.8	51.6	50.7	4.54	0.512

472 ^{abc}Values with different superscript in the same row are significantly different (P<0.05).
473 Odour, Flavour and Overall acceptability: 0=unacceptable, 100=most acceptable
474 Tenderness: 0=very tough, 100=very tender.
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Figure 1. Preference for meat with different amounts of visible fat in different socio-demographic groups.

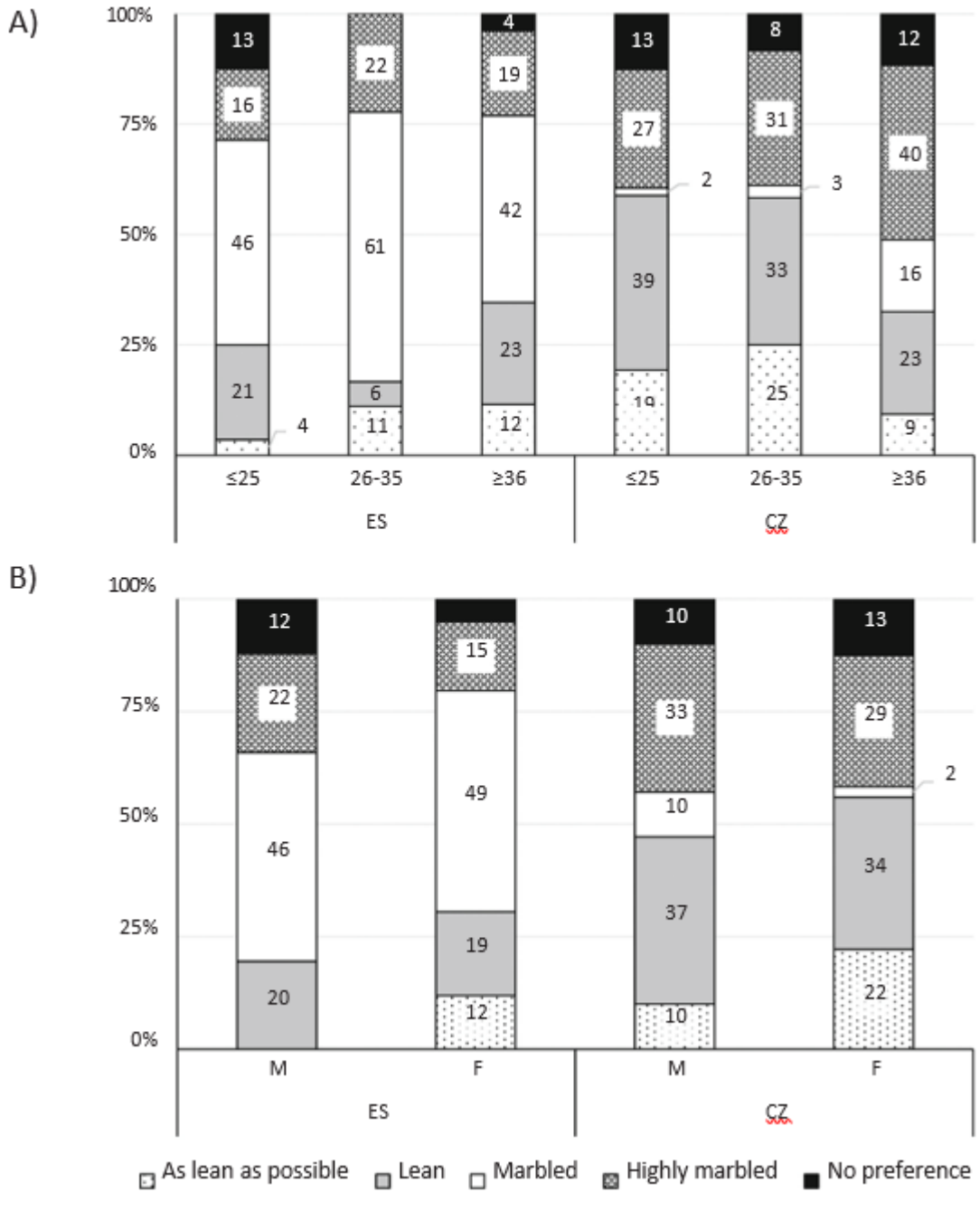

Fig. 2. Principal component analysis (PCA) bi-plot indicating the associations between the sensory evaluations of samples with different intramuscular fat content for different sociodemographic groups. Fat content: low (square), medium (triangle), high (dot); Czech women – light blue; Czech men – dark blue; Spanish women – yellow; Spanish men – orange. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)