Impact of meat type, methods of production, fat content, price and carbon footprint information on meat choice

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1. Introduction

Growing concern over environmental impacts and other credence characteristics of food has increased consumer interest in the production methods, healthiness and other attributes of food products. According to previous studies especially food safety, the country of origin, organic production and animal welfare have been requested attributes for meat (Loureiro and Umberger, 2007; Pouta et al., 2010; Schnettler et al., 2009). It has been suggested that consumers have developed differing tastes and preference rankings for product attributes due to their increased consciousness (Loureiro and Umberger, 2007), which has divided the food market into heterogeneous consumer segments.

At the same time, the meat industry in Finland faces an increasingly international and competitive market, as the imports of meat have steadily increased in recent years (ETL, 2009), while also national competition is intensive. As meat, in particular, is often sold as an undifferentiated product (Napolitano et al., 2007), the addition of supplementary quality cues could be a profitable way for meat companies to differentiate their offerings and thus gain a competitive advantage. In order to develop a profitable differentiation strategy processors have to know the differing needs and expectations of heterogeneous consumer segments. Recently, there has been public debate specifically on animal health and welfare issues, as well as climate change impact of meat consumption. Meat processors are thus willing to know how these aspects influence consumer choices and whether there is a possibility for a price premium if differentiating product offerings using these attributes. Several studies have been conducted in order to reveal the preferences of consumers for food and meat attributes, and many of them have highlighted the extent of heterogeneity in consumer preferences, as subgroups of consumers have been found to differ in their valuations of product characteristics (Chalak et al., 2008; Kornelis et al., 2010; Nilsson et al., 2006; Pouta et al., 2010). Environmental impacts of meat production and consumption have been growingly addressed in both public and scientific discussion, but to the best of our knowledge there has, however, been no research on the impact of the carbon footprint information on the choice of a meat product.

The consumers' willingness to pay (WTP) plays an important role in product differentiation, as production costs may notably increase due to investments in distinct product attributes. Even providing information on product features is often costly. The modelling of the product life cycle necessary to assess, for example, the carbon footprint information of a product is expensive and resource demanding (e.g. Katajajuuri et al., 2006). Producers must thus have confirmation that consumers are willing to pay a premium for enhanced traceability, as the price charged for the product must ensure the profitability of their business.

Meat is an important part of the Finnish diet (Lihatiedotus, 2010), and about a half of the meat consumed in Finland is pork, one quarter beef and one quarter poultry meat (TIKE, 2010). Minced meat accounts for a large proportion of Finnish meat consumption, representing 24% of all the meat product purchases (Viinisalo et al., 2008).

The purpose of this study is to provide information on the product features of minced meat that give consumers the greatest added value, and thus to support meat producers in adapting and differentiating their production to address the existing demand in a competitive market. The research was based on a choice experiment, which allows revealing the relative preferences of consumers for product attributes based on their product choices. The minced meat products offered in the choice experiment differed in their attributes such as the fat content, the meat type (beef, pork, pork-beef), the methods of production (conventional, safety and health-oriented, animal welfare-oriented and organic production) and the price. The impact of carbon footprint information on consumer choice was tested by providing a sub-sample of consumers with information on the carbon footprint size as an additional product attribute. A conditional logit model was used to analyse consumers' relative preferences for the product features. To examine consumer heterogeneity, a latent class model assuming differing preferences for the consumers was used. The

consumer segments were profiled based on the socio-demographic background and the attitudinal factors of the consumers, using a logistic regression model. Finally, this study produced relative willingness to pay estimates for particular products of interest in general and separately for the heterogeneous consumer classes.

2. Previous literature on consumer preferences and heterogeneity

Choice experiment studies assessing consumer preferences for food attributes have become a common line of research in recent years in the American and European contexts, but similar research in the Finnish market is relatively scarce. Foodstuffs that have been examined include products ranging from bread (Hu et al. 2004) and meat (Becker et al., 2000; Cicia and Colantuoni 2010; Loureiro and Umberger 2007; Lusk et al., 2003; Tonsor et al., 2005) to beverages such as wine (Mtimet and Albisu, 2006).

Traceability attributes generally seem to be of growing importance to consumers, and food safety and animal welfare-oriented production methods have been highly valued (Cicia and Colantuoni, 2010). The impact of the *country of origin* on food choice has been widely examined and revealed to be a relatively dominant attribute. Similarly to the findings of Pouta et al. (2010) the country of origin was the most important attribute in Schnettler et al. (2009) and Bernués et al. (2003), followed by animal welfare-oriented and environmental production. Consumers have actually been suggested to attach multiple quality cues to the country of origin of food, partly due to the attribute's dominant role in consumer choice (Becker et al., 2000; Pouta et al., 2010).

Animal welfare has been revealed to have a positive impact on the choice of meat products (Cicia and Colantuoni, 2010; Napolitano et al., 2007), although according to some studies, consumers were not actually willing to pay notably more for animal welfare-oriented products or for having information on this feature, despite their positive preferences (Maria, 2006; Schnettler at al., 2009). Consumers have been found to have conflicting preferences for *organic production* (Pouta et al., 2010; Teratanavat and Hooker, 2006), and their willingness to pay for it has varied.

To the best of our knowledge, there has been little research on the impact of *carbon footprint information* on consumer food choice, which can be seen as a research gap in the recent literature. The notion of carbon footprint is rather new both in research and business. Only recently, some food companies have started to make carbon footprint information available to their consumers, and for example, in Finland only one company so far provides this information in particular food products. Thus, many consumers are not familiar with carbon footprint information, making it difficult for them to evaluate and compare different product offerings. Kemp et al. (2010) conducted a study on the impact of a concept called "food miles" on purchasing behaviour, the term implying that locally produced food is more environmentally friendly than food imported from a distant location due to the emissions from transport. This "food miles" notion could be seen as an imperfect proxy for studying the impact of carbon footprint information. Even though the consumers stated having high valuations for locally produced products, the aversion to food miles was not reflected in their actual purchase decisions. On the other hand MacKerron et al. (2009) found evidence in their stated choice experiment study on certified carbon offsets that consumers would be willing to pay for certified carbon offsets in the context of leisure air travel.

Health-oriented food attributes have been appreciated in several studies focusing on food safety-oriented production methods and weight control-related features. Health and safety benefits have been preferred over environmental production practices e.g. in the context of organic food choice (Gracia and de Magistris, 2008), although in some studies their importance has also been lower than that assigned, for example, to animal welfare, origin and organic production. For instance, in their study on US consumer preferences for beef safety, country of origin labelling, tenderness and traceability, Loureiro and Umberger (2007) found that consumers were willing to pay the highest premium for the food safety attribute of a steak, contrary to the findings of Pouta et

al. (2010) on broiler products, where the WTP for consumer health promoting production was the lowest compared to the organic and animal welfare-oriented production methods, as well as origin.

Cicia and Colantuoni (2010) concluded in their meta-analysis on consumer willingness to pay for traceable meat attributes, that especially food safety, on-farm traceability or the country of origin and animal welfare were important meat characteristics. Consumers were on average willing to pay premiums from 11% to 16% for food safety and on-farm traceability guarantees and from 7% to 14% for animal welfare. Cicia and Colatuoni (2010), Nilsson et al. (2006) and Teratanavat and Hooker (2006) discovered in addition that the marginal WTP would actually be negatively proportional with the increase in number of the attributes, and that consumers' preferences for product attributes would be subadditive.

Many studies have accounted for heterogeneity in consumer preferences, and the latent class model used in this study has been a common means of analysis (e.g. Chalak et al., 2008; Hu et al., 2004; Kornelis et al., 2010; Nilsson et al., 2006; Pouta et al., 2010). Latent class modelling provides information on consumers' preferences, their segment membership and the sources of consumer heterogeneity. Among others, rather large price-conscious consumer groups and smaller segments having highly positive preferences for quality parameters such as responsible methods of production or a health orientation have often been discovered (Nilsson et al. 2006; Pouta et al. 2010).

3. Model

Choice experiments (CE) are often used in analyzing the relative importance consumers assign to product characteristics. A CE consists of several choice sets with two or more alternative goods described by their attributes. The respondent is asked to choose one of the alternative goods based on the differing product characteristics. According to Lancastrian consumer theory and random utility theory, these choices reveal consumers' trade-offs between the attributes of the goods (Bateman et al., 2002, 278; Lancaster, 1966; Loureiro and Umberger, 2007; Lusk et al., 2003).

The econometric preference analysis is typically conducted using a conditional logit model (McFadden, 1974). However, the model assumes homogeneous preferences for consumers, meaning that consumers are not assumed to have individualistic tastes. In order to account for differences in consumer preferences, socio-economic variables could be added to the conditional logit model as interactions with the attributes, like in Hearne and Volcan (2005), or the analysis could be performed separately for sub-populations (Pouta et al. 2010). This nonetheless would require some *a priori* knowledge of the sources of heterogeneity (Jaffry et al. 2004; Pouta et al. 2010). A latent class model is therefore used in this study. It assumes that consumers belong to heterogeneous latent classes based on their differing attitudes and perceptions of product attributes and other phenomena (Swait, 1994). These differences are reflected in the consumers' segment-specific choice behaviour. The latent class model reveals both the consumer segments and the relative preferences prevailing in each consumer class (Hu et al. 2004; Vermunt and Magidson, 2005).

Random utility theory models the utility a consumer derives from a good by dividing it into a deterministic and a random component. When accounting for heterogeneity, the utility function becomes according to Chalak et al. (2008) and Hu et al. (2004)

$$U_{ni|s} = V_{nils} + e_{nils} = \beta_s X_{ni} + e_{nils} \quad (1).$$

U_{nils} is the utility that individual n in consumer class s obtains from good i. The deterministic component V_{nils} is a linear function of attributes X_{ni} of the good, where β_s is a vector of parameters for class s (Adamowicz et al., 1998; Bateman et al., 2002; Swait, 1994). The random part of the utility function e_{nils} is an error term that is unobservable to the researcher, and it is assumed to be

independently and identically distributed and to follow a type I extreme value distribution. (Bateman et al., 2002; Holmes and Adamowitz, 2003).

In several studies the deterministic part of the utility function has been divided into two components. The first one is the membership likelihood function that defines the latent segment for each of the respondents based on their sociodemographic characteristics, attitudes and perceptions. The second is related to the product choices based on the attributes of the alternatives. In this study, however, the consumer classes are determined purely based on the choices made by the individuals in the choice experiment. The individual characteristics are set to be inactive and consequently, they do not affect the choice model:

$$P_n(i \mid B) = \sum_{s=1}^{S} \left(\frac{\exp(\beta_s X_{ni})}{\sum_{j \in B}^{J} \exp(\beta_s X_{nj})} \right) \quad (2)$$

The relationship of the individual characteristics and the latent classes is described only *a posteriori* of the actual estimation, in order to describe the heterogeneous consumer classes (Vermunt and Magidson 2005).

The parameters β_s for the attributes are estimated in an iterative manner, using maximum likelihood estimation where the number of segments S is given, and the estimation is repeated several times with different numbers of S. The best model, having the optimal number of consumer classes, is selected by using model fit criteria such as the Bayesian information criterion (BIC).

Willingness to pay (WTP) is a measure for indicating the maximum monetary contribution an individual is willing to make in order to balance for a rise in his utility. WTP estimates can be calculated for different products of interest. Following Boxall and Adamowicz (2002), Hanley et al. (2001) and Pouta (2010) the general rule for class-specific estimates is:

$$\mathrm{WTP_s} = -\frac{1}{\beta_{ps}} \left[\ln\left(\sum_{j \in B}^{J} \exp(\beta_s X_j) \right) - \ln\left(\sum_{j \in B}^{J} \exp(\beta_s^B X_j^B) \right) \right], \quad (3)$$

where X_j and X_j^B represent the attribute levels of the product of interest and a baseline product. β_s^B is the coefficient for the attribute levels for class s for the baseline product and β_s respectively for the product of interest. β_{ps} is the price coefficient. The attribute impacts are summed over the J attributes of the products.

4. Data and choice experiment

4.1. Choice experiment data

The data were gathered in March 2010 with an online questionnaire of consumers representative of Finnish Internet users, who were from 18 to 79 years old. Of the consumers who were contacted, 38% finished the questionnaire, yielding 1623 complete answers. 14% of those who began answering dropped out before finishing the questionnaire. The questionnaire was tested before the actual study, and the attributes were discovered to be functional.

The survey contained several question series examining different aspects of consumers' attitudes towards meat products and production. The choice experiment analysed in this study was situated somewhat at the end of the questionnaire, and the other questions about the sociodemographic characteristics of the respondents, their attitudes and their eating and purchasing habits were utilized to profile the heterogeneous consumer segments. For example, some questions asked whether the habits of the respondents have been influenced by factors such as animal diseases

or the environmental impacts of the products, and others asked the respondents to rate the importance of various aspects such as product safety, healthiness and local production.

Table 1 Descriptive statistics of the consumers in the data and in the population (www.stat.fi, 2009).

	Data	**Population**
Share of females	50%	50%
Mean year of birth	1960 (16.1)	1963
Lives in the metropolitan area	26%	25%
Share of residential province		
Southern Finland	41%	41%
Western Finland	36%	36%
Eastern Finland	11%	11%
Oulu	9%	9%
Lapland	3%	3%
Share of lower educational level (intermediate level)	46%	59%
Share of people with gross income of (€/year)		
0–20 000	14%	22%
20 001–40 000	30%	31%
40 001–60 000	27%	21%
60 001–90 000	17%	17%
Over 90 000	4%	9%
Share of households of one person	25%	39%

Note: Standard deviation in brackets where applicable

The gender distribution, the geographic location of the respondents and the mean age followed closely the population level figures (Table 1). The education level was slightly higher and the respondents seemed to earn a little more than the population in general. Overall, the comparability of the survey sample with the population was at a reasonable level.

4.2. Choice experiment design

The research was based on a choice experiment, which allows revealing consumers' relative preferences for product attributes based on their product choices. The respondents were asked to imagine that they were buying minced meat for an everyday meal, and to choose the product they would buy from three minced meat alternatives or a no-choice option of not buying any of the products. Each respondent faced altogether six choice sets. The minced meat alternatives had differing attributes (Table 2), whose levels were varied across the alternatives.

The price had 11 levels ranging from 3 to 20 euros per kg, and it was always also stated in euros per 400 g package. Fat content was selected as an attribute among others due to the popularity and the current availability of light products in Finland, and it was either not defined or set to 5%, 10% or 20%. Finnish minced meat supply is rather standardized regarding the production methods of meat, although a limited number of organic products are currently available in the market. The production methods provided as the attribute levels in the choice experiment were conventional, safety and healthiness-oriented, animal welfare-oriented or organic production, as they were seen as potentially providing consumers with added value. The meat type attribute had three levels: pork, mixed pork and beef, and beef, which are the most common minced meat types in Finland.

The impact of carbon footprint information on consumer choice was tested by providing a sub-sample of consumers (N= 803) with information on the footprint size as an additional product attribute. The carbon footprint level is directly related to the meat product type, beef products having a larger footprint and pork products a smaller one. The only difference between the goods presented to the sub-samples was therefore the extent of the information provided, while the goods per se were identical.

The levels of the more complex attributes were separately explained to the respondents before taking the choice experiment (Table 2). For instance the carbon footprint size was defined based on the greenhouse gas emissions associated with the production of the minced meat, quantified in carbon dioxide equivalents. The production methods were likewise explained based on requirements in organic production, agri-environment support for animal welfare and expert opinions on production safety.

Table 2 Minced meat attributes and levels used in the CE

Attribute	Attribute levels and definition
Price	**Range from** **3 to 20€/kg**
Meat type	**Pork** **Pork-beef** (reference) **Beef**
Carbon footprint - Greenhouse gas emissions. The larger the carbon footprint, the more harmful the impact on the climate.	**Small:** greenhouse gas emissions: 7 carbon dioxide equivalents (CO2e) /kg of meat **Average:** greenhouse gas emissions: 10 CO2e /kg of meat **Large:** greenhouse gas emissions: 20 CO2e /kg of meat
Percentage of fat	**Maximum 5 %** **Maximum 10 %** **Maximum 20 %** **Not defined** (reference)
Production method - Feeding - Consideration of animal welfare - Control of animal disease prevention and healthiness - Transportation and butchery	**Organic** - Fed with organically produced fodder - Animals have larger facilities than regulated and the possibility to behave accordant with the species (year-round outdoor recreation, stimulation) - Endeavour to prevent animal diseases with good hygiene, health control and larger breeding spaces - Transportation to the slaughterhouse **Animal welfare** - Fed with conventionally produced fodder - Animals have larger facilities than regulated and the possibility to behave accordant with the species (year-round outdoor recreation, stimulation), keeping practices emphasizing animal welfare - Healthiness and animal disease prevention is controlled in accordance with the law - Butchery at the farm, in a small transferable slaughterhouse **Safety and healthiness** - Fed with conventionally produced fodder - The animals' conditions are accordant with the law - Strengthened safety and healthiness: 1. Veterinarian's visitations more frequently than usual 2. An anteroom that can be used as an area for changing clean clothes and boots before entering the animal facilities 3. Visitors are not allowed in the production facilities 4. Breeding lots are kept in separate compartment 5. Endeavour to avoid bringing animals to the farm from elsewhere - Transportation to the slaughterhouse **Conventional** (reference) - Fed with conventionally produced fodder - The animals' conditions are accordant with the law - Healthiness and animal disease prevention is controlled in accordance with the law - Transportation to the slaughterhouse

The attribute level combinations into different choice scenarios were determined using a balanced overlap design and Sawtooth software, which made it possible to include interactions of the attributes in the choice analysis. Altogether, there were 30 versions of the choice set for both sub-samples. The survey was tested before the actual study with a pilot of 50 respondents, and the attributes were determined to be functional.

In the modelling, the price was treated as a continuous variable and the other attributes were coded as dummy variables. For each dummy attribute, one level was defined as a reference level and was left out of the model to avoid perfect multicollinearity. Some of the attribute levels were interacted with each other in order to determine whether significant interaction effects existed. The impact of carbon footprint information was examined with a dummy variable indicating whether the footprint size was mentioned in the choice set. This variable was interacted with the meat type variables. The attributes were assigned to have zero values in the case of the fourth (no-choice)

option of each choice set, as in Vermeulen et al. (2008). Alternative-specific constants were included in the model in order to capture systematic bias that might have otherwise influenced the parameters, and to be able to examine the respondents' preferences for the no-choice option. Furthermore, relative interaction variables were included.

In order to profile the heterogeneous consumer segments, the class membership of individuals was regressed on their socioeconomic characteristics, consumption habits and attitudes, using a logistic regression model. Year of birth and household income were treated as continuous variables, and the other sociodemographic variables as dummy variables. Respondent's cooking habits and connection with the breeding of production animals or with meat production were measured on an ordinal scale having four levels, based on which dummy variables for cooking often or sometimes and for having a production connection were derived. The meat eating frequency was an average calculated based on several meat type-specific frequencies that were measured on an ordinal scale of 5 levels. The attitudinal variables were derived by taking an average of multiple answers to attitudinal statements measured on a 1 to 5 likert-scale.

5. Results

The conditional logit model illustrated the general consumer preferences for the product characteristics of minced meat. The coefficients in Table 3 describe the impact that each attribute had on the choice of the product. The pseudo R^2 for the conditional logit model was fairly low (0.105), implying that the model did not entirely explain the choice probabilities of the individuals, although most coefficient-specific parameters were statistically significant.

The price coefficient was logically negative. Beef products were preferred over mixed beef and pork products, and mixed beef and pork products were preferred over pure pork products. Organic production had the largest positive effect on the product choice compared to animal welfare-oriented and safety and healthiness-oriented production methods. All of these methods were, however, preferred to conventional production. The fat contents of 5% and 10% had an even greater positive effect on the choice, whereas the impact of the fat content of 20% did not differ significantly from zero.

The interaction variables can be interpreted by comparing them to the original attribute levels. For instance, the negative impact of the interaction *Beef & Animal welfare* on the choice can be explained so that the fact of being a beef product reduced the utility derived from animal welfare-oriented production, compared to being the reference product made of minced beef and pork.

Interactions of the carbon footprint information and the two meat types suggested that information on the size of the carbon footprint had a highly significant impact on consumer choice. A small carbon footprint was seen as a better product characteristic than a large carbon footprint, as in the case of a beef product, mentioning the carbon footprint reduced the positive impact of the beef product type on consumers' utility, and made it less probable that the product was chosen. In the case of a pork product, the impact of carbon footprint information was the opposite.

The latent class model assumes heterogeneous preferences for the consumers, and divides them into groups that differ in their preferences. The model was estimated with 1 to 7 consumer classes both with and without interactions. The pseudo R^2 statistic indicated an important improvement from the conditional logit model, being the greatest in the six-class model, and generally when the interactions were included in the estimation. Based on the BIC-values, the model with 6 consumer classes was selected.

The Wald p-values in Table 3 indicate that the attributes were jointly significant, while some of the interactions were not. The Wald (=) p-values showed that all the attributes were also class-independent, but that quite a few interactions did not have statistically significant differences across classes.

The consumer classes were rather clearly distinguished from each other. Consumers in Class 1 (23 % of the respondents) were price-conscious, whereas Class 2 (20%) had the strongest positive

preferences for a low fat content and also derived relatively high utility from responsible methods of production. The preference structure of Class 3 (17%) was rather close to the results of the conditional logit model. The class did not have the strongest preferences for any of the attributes compared to the other groups, but it could be qualified by a preference for beef products and a low fat content. As these preference patterns did not yet give a clear idea of the core characteristics describing the segment compared to the others, the respondents' background information was used in naming the segment. Based on the logistic regressions (Table 4) the respondents seemed to have somewhat ideological identities that, however, were not strongly reflected in their stated behaviour. Class 4 (17%) was rather indifferent to the product attributes compared to the other groups, even having a slightly negative attitude towards organic production. Class 5 (13%) had a strong preference for beef products, and Class 6 (11%) was distinguished by the strong positive preferences of its members for methods of production deviating from the conventional. The most preferred production method was organic production. The impact of the carbon footprint information on meat choice was rather large for classes 2, 3 and 6, whereas for classes 1, 4, 5 it was either nonsignificant or small.

The results of the logistic regression models used in profiling the classes are presented in Table 4. Age and attitudes towards animal welfare, environmental friendliness, healthiness and a low fat content were characteristics profiling most of the segments. For instance, the price-conscious (Class 1) and methods of production-conscious consumers (Class 6) were slightly younger than consumers in the other groups. The parameters for the attitudinal characteristics suggested that consumers in Classes 2 and 6 perceived animal welfare as being particularly important, and that the members of Classes 3 and 6 perceived environmental friendliness as an important product feature, when compared to the other consumer segments. The members of the ideological but passive consumer segment (Class 3) were, in particular, profiled by voting often for the Green league and eating less frequently meat than respondents in the other segments.

The relative WTP estimates were calculated using equation (3), based on a simplified model including only footprint interactions. This allowed for all the class-specific price coefficients to be significant at the 95% level, and for the price parameter in (3) to be calculated without the price-interactions. The estimates are discussed in relative terms, as hypothetical bias may inflate the stated WTP, when respondents are aware that no actual money transfers take place. Our WTP estimates seemed, however, rather realistic and reasonable in the light of earlier studies (Cicia and Colatuoni, 2010; Hearne and Volcan, 2005; Nilsson et al., 2006).

Table 5 presents the relative WTP estimates for the products of interest in the case where no carbon footprint information was provided to the consumers. The estimates were calculated separately for both meat types, and differentiation had in general a slightly greater impact on the consumers' WTP for pork products. A low fat content was the product feature for which consumers were generally willing to pay the highest premiums, but premiums for different methods of production also existed. At the aggregate level, the WTP for organic production was the highest of these, being 5.6% for beef and 7.4% for pork. Multiple product features seemed to some extent erode each others' positive impact on the WTP.

WTP values followed preferences in consumer classes. For instance, the class valuing the responsible methods of production (Class 6) had the highest WTP for the methods of production and especially for organic production. The fat content-conscious consumer class (Class 2) was willing to pay the most for a low fat content, and the ideological but passive consumer class (Class 3) had rather average relative WTP estimates compared to the other groups.

The lower part of Table 5 contains the relative WTP estimates for baseline products with carbon footprint information, with respect to baseline products without carbon footprint information. The respondents were in general willing to pay more for pork products and less for beef products when informed about the carbon footprint size, compared to not having that information. This impact seemed to be larger for pork than for beef products. The fat content-

Table 3 Conditional logit and latent class models for minced meat choice

MODELS FOR CHOICES	**Conditional logit model**	**Latent class model**							
	Overall	**Class 1** *Price*	**Class 2** *Fat content*	**Class 3** *Idealistic*	**Class 4** *Indifferent*	**Class 5** *Beef*	**Class 6** *Production methods*	Overall	
Pseudo R^2	0.105	0.3721	0.3639	0.1427	0.1797	0.4575	0.3598	0.4546	
Class Size		0.2322	0.1985	0.1708	0.1653	0.1256	0.1075		
ATTRIBUTES & INTERACTIONS	**Conditional logit model**	**Latent class model**							
		Class 1 *Price*	**Class 2** *Fat content*	**Class 3** *Idealistic*	**Class 4** *Indifferent*	**Class 5** *Beef*	**Class 6** *Production methods*	Wald p-value	Wald(=) p-value
Alternative-specific constants									
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.10 ***	-0.10	0.05	0.18	0.41 ***	0.11	0.09		
3	0.03	-0.11	-0.08	0.11	0.25 **	0.04	0.25 *		
4	-0.16 **	-5.26 ***	0.92 ***	3.89 ***	-1.67 ***	2.27 ***	-0.65		
Price	-0.09 ***	-0.35 ***	-0.06 ***	-0.04 *	-0.02	-0.03	-0.09 ***	0.00	0.00
Beef	0.32 ***	-0.66 **	-0.16	1.36 ***	-0.73 **	4.57 ***	-0.09	0.00	0.00
Pork	-0.76 ***	-1.07 ***	-0.37 **	-1.21 ***	-1.55 ***	-0.79 **	-1.50 ***	0.00	0.00
Safety and healthiness	0.46 ***	0.45 ***	0.77 ***	0.32	0.31 **	0.25	1.16 ***	0.00	0.02
Animal welfare	0.67 ***	0.63 ***	1.13 ***	0.62 ***	0.34 *	0.87 ***	1.78 ***	0.00	0.00
Organic	0.79 ***	0.84 ***	1.44 ***	1.35 ***	-0.17	1.30 ***	4.08 ***	0.00	0.00
Fat content 5%	1.15 ***	1.23 ***	3.59 ***	2.27 ***	0.64 ***	1.79 ***	0.45 *	0.00	0.00
Fat content 10%	1.05 ***	1.17 ***	2.89 ***	1.78 ***	0.91 ***	1.77 ***	0.74 ***	0.00	0.00
Fat content 20%	0.05	0.16	0.70 ***	-0.23	-0.29 *	0.44 **	0.11	0.00	0.01
Pork & Animal welfare	-0.04	0.63 ***	0.00	0.59	-0.95 ***	-0.03	0.40	0.00	0.00
Beef & Animal welfare	-0.14 *	-	-	-	-	-	-	-	-
Pork & Safety and health.	-	0.20 *	0.20 *	0.20 *	0.20 *	0.20 *	0.20 *	0.07	c.i.
Beef & Safety and health.	-	0.20 **	0.20 **	0.20 **	0.20 **	0.20 **	0.20 **	0.05	c.i.
Pork & Price	0.00	-	-	-	-	-	-	-	-
Beef & Price	0.01	0.07 **	0.01	0.02	-0.02	-0.06 **	0.00	0.04	0.02
Organic & Price	-0.01 *	-0.04 ***	-0.04 ***	-0.04 ***	-0.04 ***	-0.04 ***	-0.04 ***	0.00	c.i.
Fat content 5% & Price	-0.01	-0.02 **	-0.02 **	-0.02 **	-0.02 **	-0.02 **	-0.02 **	0.04	c.i.
Fat content 10% & Price	-0.02 **	-0.03 ***	-0.03 ***	-0.03 ***	-0.03 ***	-0.03 ***	-0.03 ***	0.00	c.i.
Footprint & Price	0.00	-	-	-	-	-	-	-	-
Footprint & Beef	-0.59 ***	-0.25	-1.77 ***	-1.19 ***	-0.44	-0.77 **	-1.49 ***	0.00	0.00
Footprint & Pork	0.44 ***	0.38 *	1.09 ***	0.95 ***	-0.06	0.25	1.23 ***	0.00	0.01

Note: c.i. indicates that the parameter was class independent;
*** 1% significance level, ** 5% significance level, *10% significance level, based on z-statistics.

Table 4 Logistic regression models profiling consumer classes

Characteristics	Class 1 *Price*	Class 2 *Fat content*	Class 3 *Idealistic*	Class 4 *Indifferent*	Class 5 *Beef*	Class 6 *Production methods*
Constant	-35.963 ***	17.237 *	21.523 **	32.205 ***	-1.623 ***	-38.320 ***
Female	-0.395 ***	-	-	-	-	-
Year of birth	0.020 ***	-0.011 **	-0.012 **	-0.017 ***	-	0.017 ***
Household income	-0.062**	-	-	-	0.078 **	-
Has children in the family	-	0.410 **	-	-	-	-
Lives in metropolitan area	-	-	0.318 *	-0.368 **	-	-
Votes for the Green league	-	-	0.500 **	-0.898 **	-	-
Cooks often or sometimes	-	-1.248 ***	-	-	-	-0.995 *
Has a connection to production	-	0.290 *	-0.625 ***	-	-	
Meat eating frequency	-	0.387 ***	-0.643 ***	-	-	-
Animal welfare attitude	-0.437 ***	0.415 ***	-	-0.395 ***	-	0.401 **
Environmental attitude	-0.559 ***	-	0.353 **	-	-	0.834 ***
Safety attitude	-	-	-0.295 **	-	-	-
Healthiness attitude	-0.169 **	0.162 **	0.227 ***	-	-	-
Low-fat attitude	-0.120 *	0.392 ***	0.204 **	-	-0.194 **	-
N = 1623						
Nagelkerke R^2	0.176	0.090	0.146	0.051	0.014	0.090
Hosmer and Lemeshow Test	0.530	0.353	0.748	0.977	0.985	0.949

Table 5 Relative WTP for minced meat products

CONDITIONAL LOGIT MODEL	LATENT CLASS MODEL						
Beef products relative to Beef Baseline product (Beef, Conventional production, Fat content not defined)							
		Class 1 *Price*	**Class 2** *Fat content*	**Class 3** *Idealistic*	**Class 4** *Indifferent*	**Class 5** *Beef*	**Class 6** *Prod. meth.*	**Average WTPs**
Conventional, Fat content 5%	6.7%	7.4%	40.0%	17.6%	1.7%	1.1%	1.1%	12.2%
Safety & healthiness, Fat content 5%	8.4%	9.6%	42.0%	18.4%	3.1%	1.2%	10.0%	13.9%
Animal welfare, Fat content 5%	9.2%	11.0%	42.8%	19.0%	1.5%	1.5%	18.2%	14.3%
Organic, Fat content 5%	9.7%	9.7%	42.3%	20.0%	-0.2%	1.6%	62.8%	16.8%
Safety & healthiness, Fat content not defined	2.0%	2.6%	5.1%	1.2%	1.4%	0.2%	9.1%	2.4%
Animal, Fat content not defined	2.9%	4.3%	7.0%	2.1%	-0.2%	0.5%	17.5%	3.1%
Organic, Fat content not defined	3.5%	2.8%	5.8%	3.8%	-2.0%	0.6%	62.6%	5.6%
Pork products relative to Pork Baseline product (Pork, Conventional production, Fat content not defined)							
		Class 1 *Price*	**Class 2** Fat content	**Class 3** *Idealistic*	**Class 4** *Indifferent*	**Class 5** *Beef*	**Class 6** *Prod. meth.*	**Average WTPs**
Conventional, Fat content 5%	7.5%	7.8%	40.9%	27.0%	1.8%	11.0%	1.2%	16.3%
Safety & healthiness, Fat content 5%	9.4%	10.1%	43.0%	28.0%	3.2%	12.6%	10.7%	18.4%
Animal welfare, Fat content 5%	10.3%	11.6%	43.8%	28.9%	1.6%	15.4%	19.4%	19.2%
Organic, Fat content 5%	10.9%	10.3%	43.3%	30.4%	-0.2%	16.0%	65.8%	22.1%
Safety & healthiness, Fat content not defined	2.3%	2.8%	5.2%	2.0%	1.5%	2.0%	9.7%	3.1%
Animal, Fat content not defined	3.3%	4.5%	7.2%	3.5%	-0.2%	5.6%	18.6%	4.3%
Organic, Fat content not defined	3.9%	2.9%	6.0%	6.2%	-2.1%	6.3%	65.6%	7.4%
Products for which the carbon footprint size was mentioned, relative to products for which the carbon footprint size was not mentioned							
		Class 1 *Price*	**Class 2** *Fat content*	**Class 3** *Idealistic*	**Class 4** *Indifferent*	**Class 5** *Beef*	**Class 6** *Prod. meth.*	**Average WTPs**
Beef, Conventional production, Fat content not defined	-1.6%	-0.9%	-3.1%	-1.7%	-2.1%	-0.2%	-2.9%	-1,9%
Pork, Conventional production, Fat content not defined	2.2%	1.0%	5.1%	4.8%	-0.9%	1.0%	13.8%	2,9%

conscious, the ideological but passive and the method of production-conscious consumer groups (Classes 2, 3 and 6) were the classes most influenced by the carbon footprint information.

6. Discussion and conclusions

The results of this study suggested that a low fat content, in particular, is of great importance for consumers in Finland. Health impacts of food have been recognized to be very important also in earlier studies (Chalak et al., 2008; Teratanavat and Hooker, 2006), but conversely to the findings of Pouta et al. (2010), organic production was generally appreciated more highly than animal welfare, or safety-oriented production.

The relatively low importance of price to the consumer segments may be related to bias caused by the hypothetical setting of the choice experiment. On the other hand, it may also be a signal that there could be potential for gains from greater differentiation of minced meat products than is currently put to use. The average proportion of Finnish consumers' total budget allocated to food and non-alcoholic beverages is relatively small (12%) compared to, for instance, housing (28%) (Statistics Finland, 2009). Consumers could thus be willing to pay surprisingly large premiums for certain food attributes. However, it would be interesting to run a similar analysis with revealed preference data in order to examine the scale of hypothetical bias in the estimates.

Significant heterogeneity in consumer preferences was discovered, and the six consumer segments revealed by this analysis included in order of size a price-conscious, a fat content-conscious, an ideological but passive, and an indifferent consumer group, a group preferring beef products and a group that was conscious of the different methods of production**.** The identification of the ideological but passive consumer segment suggests that it is not enough for the consumers to have ideological attitudes, but that there have to be stronger incentives that promote the buying of food produced in a responsible way, in order to actually affect consumer choice. These ideological consumers might, for instance, represent similarly to Nilsson et al.'s (2006) results a group that would be willing to buy responsible products if they were less expensive.

Age and particular attitudes of consumers among other factors seemed to somewhat characterise the consumer segments, but altogether the classes were inadequately profiled. Finnish meat processors could, nevertheless, make good use of consumer segmentation and product differentiation, as in addition to the rather high WTP for a low fat content, particular segments were willing to pay significant premiums for organic and to some extent animal welfare-oriented production. Organic and animal welfare-oriented production could in fact provide processors with even greater competitive advantage than the low fat content, the latter of which can be reproduced rather easily by competitors. However, defining and measuring animal welfare-oriented production, in particular, remains a challenge for meat companies. Our study supported the previous findings (Cicia and Colatuoni, 2010; Nilsson et al., 2006; Teratanavat and Hooker, 2006) suggesting that the product offerings should, nonetheless, be kept simple, as multiple characteristics might in some cases erode each others' impacts on the premiums. This subadditivity could possibly be extrapolated even to consumer preferences for organic production, which also is a kind of bundle of multiple product features.

Information on the carbon footprint generally had a significant impact on consumer choice, influencing meat type-specific consumer preferences: beef products have a larger carbon footprint than pork products, and consequently their popularity decreased when footprint information was presented to the consumers. This impact on the WTP estimates was the highest for the segment conscious of the methods of production, the fat content-conscious and the ideological but passive consumer segments, although overall, the impact was relatively low. The carbon footprint size could be a complicated matter for Finnish consumers to understand and proportion, as only a small number of food products currently contain the information. The phrasing of the research question was thus fairly hypothetical, and the possibilities for differentiation provided by carbon footprint information should be further examined.

Although providing information on the carbon footprint size had an impact on the stated choices of consumers in this study, increasing environmental consciousness could in the future itself induce similar choice patterns even without explicit carbon footprint information on the products. This would increase the demand for minced pork at the expense of beef, potentially favouring also mixed pork and beef. The latter could be seen as a compromise between two preferred but conflicting ends – on one hand favouring beef as a meat type and on the other hand buying products with smaller negative environmental impacts. In any case, meat companies should start thinking of new ways to produce alternative products with smaller environmental impacts, as maintaining the demand for beef may to some extent present a challenge for the industry in the future.

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