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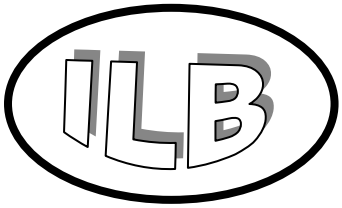

European Consumers' Acceptance and Rejection of Novel Beef Technologies: A Qualitative Study

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Abstract

As part of ProSafeBeef, an integrated research project funded by the European Commission, the present qualitative study was carried out with European consumers to obtain insights into their acceptance or rejection of eight selected novel beef production and processing technologies, identified here as concepts: 1) marinating by injection for increased healthiness; 2) marinating by injection for increased safety; 3) marinating by injection for increased eating quality; 4) marinating by submerging for increased eating quality; 5) nutritional enhancement; 6) shock wave treatment; 7) muscle profiling and 8) thermal processing. In total, 65 adults between 19-60 years of age participated in eight focus groups that were performed in Spain, France, Germany and the United Kingdom. In each country, two group discussions were performed; one composed of women and another one of men who lived in the respective capital cities: Madrid, Paris, Berlin and London. A common and translated topic guide was developed prior to the field work. A ranking exercise was applied, where the participants classified the technologies into accepted, neutral or rejected concepts, after discussing the perceived benefits and risks of each one of them. The obtained data was consecutively transcribed, coded and analysed by using the software package NVivo 7. The results reveal a dependency between the acceptance of novel beef products and how consumers perceive the characteristics of the innovation itself. Excess manipulation and a growing distance from a 'natural' way of processing beef products were considered to be very negative outcomes of technological innovations in beef processing. Apparently, novel technologies applied in beef production are predominantly seen as a valuable option for convenience shoppers and those who are less demanding in terms of beef quality and have less culinary skills. However, consumers support the development of technologies that can provide more healthiness and better eating quality, and if such technologies are 'not invasive', the chances to be accepted increase. Current trends and development in society, global warming crisis, disease outbreaks and degradation of the environment are shaping consumers' opinion in regard to foodproduction. There was a severe criticism about too much intervention in food and a strong desire to keep food and beef processing as simple and natural as possible.

1. Introduction

New technologies have been continuously developed and implemented in the food production and processing chain with the promise of science and technology to deliver benefits in health, agriculture and foods, and in industrial production. European citizens are generally optimistic about the contribution of technology to their way of life, whereas its application in the food sector does not find always approval as being socially, ethically or environmentally desirable – especially when it comes to agricultural (green) biotechnologies such as genetically modified organisms (GMO) in food (European Commission, 2006a).

On the product level, the market for innovative foods has been growing worldwide. New products are continuously launched and competition has become more intense. Nevertheless, it is well-known that consumer acceptance is the key success factor for a product to survive on the retail shelves. New product introductions have a failure rate of more than 60% (Costa & Jongen, 2006) and only a few products survive in the long-term. Bruhn (2007) states that consumers do not ask for new technologies, rather they seek products with specific benefits of personal relevance. Accordingly, studies of consumer attitudes towards GMO, for example, have found that consumer acceptance depends on whether consumers perceive such benefits associated with the product (Frewer, Howard and Shepherd, 1996; Frewer, Howard, Hedderley, & Shepherd, 1997). However, the path between new product introduction and its acceptance is not clear (Bruhn, 2007).

When evaluating food products and making purchase decisions, consumers use a broad range of criteria, such as sensory aspects (i.e. appearance, odour, colour and taste), health considerations, convenience, and lately, also the way a product is produced, including its technological, ethical and social implications (Grunert, Bredahl & Scholderer, 2003). In that sense, the technological degree of processing can have an impact on consumers' choice. New technologies, introduced in new processed food products, can create concerns among some people, as the public generally lacks knowledge about food processing methods (Cox et al., 2007; Bruhn, 2007). In that case, the possible risks associated with the new technology may be unknown to the consumer and can contribute to its rejection. Consumers who are skeptical of technological progress in food production are then likely to prefer a natural, low technology approach, looking for health and environmental sustainability (Williams & Hammitt, 2001). Others will be more open to innovation and believe that the new technology may reduce risks or provide benefits that were not available previously (Bruhn, 2007).

Nielsen et al. (2009) share the same view. According to these authors, the success of new food processing technologies is highly dependent on consumers' acceptance: while food scientists may applaud the technological progress, consumers have been known to take a rather conservative approach and do not always readily see the benefits of new processing methods. Therefore, to help explaining the acceptance or rejection of novel beef technologies, this study investigates consumers' attitudes, risk aversion and innovativeness.

Attitudes towards novel beef technologies

Attitudes have several functions with regard to human behavior: they can guide perception, and they influence behavior (Ajzen & Fishbein, 1980; Ajzen, 1991). In general, the literature (Scholderer & Frewer, 2003; Søndergaard et al., 2005; Nielsen et al., 2009) suggests two ways how attitudes can be formed: bottom-up and top-down.

Bottom-up formation of attitudes implies that the attitude towards an object – for example, novel beef processing technologies – is formed on the individual's knowledge about such technologies. The formation of beliefs is then based on the perceived positive and negative characteristics of the technology. The resulting attitude is eventually the weighted average of the evaluation of perceived risks and benefits (see Fishbein's Attitude Theory, 1963).

In the top-down formation of attitudes, specific attitudes are believed to be embedded in a system of general attitudes and values. The idea is to preserve the evaluative tendency of the higher-order attitudes (e.g. Katz, 1960; Rokeach, 1968). Hence, attitudes towards novel beef processing technologies, for instance, are inferred from general attitudes towards technology. According to Nielsen et al. (2009), previous studies on consumer attitude formation with regard to food processing technologies (focusing mainly on GMO) have found that general socio-political attitudes, such as attitude towards nature and the environment, and attitudes towards technologies in general play an important role in influencing consumers' attitudes towards new food processing technologies (Scholderer, 2005; Scholderer, Bredahl & Frewer, 2000; Søndergaard, Grunert & Scholderer, 2005). Bredahl (2001) found evidence for the presence of top-down processing in the formation of attitudes towards genetic modification in food production. Subsequently, this research also suggests that attitudes towards novel beef processing technologies might follow in a similar way by assuming that consumers form attitudes towards novel technologies on the basis of more general attitudes. This interpretation is supported by the fact that consumer knowledge about some of the investigated concepts would probably be insufficient to allow only bottom-up formation of attitudes.

Risk and Trust

As discussed earlier, consumers appear to be cautious about accepting novel technologies applied to foods because of perceived risks and a lack of perceived benefits or an adequate understanding of these (Cox et al., 2007). Consumers' reluctance in accepting new products that are based on new technologies such as gene technology or functional foods may be well related to the fact that consumers are very much oriented towards aversion of risks (Beckeman & Skjöldebrand, 2007).

Consumers also tend to reject "interference" in food products, despite the fact the "interference" is commonly used in food technology and actually brings benefits to the food chain. Cox et al. (2007) describe a reaction consumers manifested when pasteurisation was first introduced. Consumers were suspicious that producers could take advantage of the sterilisation process, and consequently they were afraid that such technology could stimulate the production of milk with less hygiene and care. Also in the present study, such interference effects could emerge, e.g. with respect to novel beef processing technologies that improve the product's safety, tenderness or shelf-life.

Trust is another important factor that is related to the acceptance and rejection of novel technologies. Previous research (Frewer et al., 2003) suggests that acceptance of new technologies is based to a great extent on public perceptions of the associated risks, and that perceptions of risk are influenced by trust in the information and the source which provides it. However, psychological factors such as the strength of prior attitudes towards a particular technology have also been found to limit the impact of trust on attitude change following information interventions (Frewer et al., 1999).

There may also be an interaction with the type of information provided. Cox et al. (2003), for instance, analysed the processed food sector in the UK and described how frozen ready-made meals have gradually been replaced by chilled versions. This transition has only been possible due to new information and communication strategies, confirming that the way of communication and the use of proper information about risk can positively transform attitudes and behaviours in terms of raising consumer trust in product innovations.

Food Neophobia and Consumer Innovativeness

Finally, it is important to investigate unique individual characteristics that may contribute to the acceptance or rejection of novel technologies. Apart from socio-demographic variables that typically shape food consumption behaviour and attitudes towards novel technologies, specific attitudinal, personality or lifestyle characteristics merit attention. The presentation of a novel item of any kind may initiate a fear (or avoidance) response within the individual (Zajonc, 1968). The Food Neophobia Scale (Pliner & Hobden, 1992) was developed to assess people's willingness to try new foods by characterizing those individuals as neophobics who perform a strong aversion towards unfamiliar foods. Interestingly, food neophobia seems not to be a very important factor (at least for the acceptance of novel technologies such as GM), since only a few significant correlations have been found between the scale and attitudes towards GM foods or respectively, willingness to try GM foods (Siegrist, 2008).

On the other hand, the relation between consumers' innovativeness and the adoption of new technologies seems to be a logical path. Rogers' (1962) diffusion of innovation theory proposes that adopters of new technologies can vary on a continuum, starting with innovators (the first people to adopt what they perceive to be a new idea, buy a new product regularly or put a new technique into practice) and ending with laggards (the slowest and also last people to adopt anything). In the context of business administration and marketing, consumers' innovativeness is closely related to the adoption of the product and this influences the speed with which the adoption takes place after a product enters the market (Hui & Wan, 2007; Barcellos et al., 2009). Domain or product category-specific innovation (Goldsmith & Hofacker, 1991) reflects the tendency to learn about and adopt innovations within a specific domain of interest, and it therefore taps a deeper construct of innovativeness that is more specific to an area of interest. Consumer innovativeness towards food can have a great impact on the success of novel beef technologies.

2. Method

This study is part of ProSafeBeef, a five-year integrated research project funded by the European Commission, aiming at advancing beef safety and quality across Europe. In the present research, focus group discussions were performed in four European countries, namely Germany (GE), Spain (ES), France (FR) and the United Kingdom (UK). The country selection was based on the market volume within the European Union in terms of beef production and beef consumption. In each country, two discussion sessions with seven to nine participants were held in the countries' capital cities; one group was composed of women and one of men. Recent studies recommend that both sexes should be interviewed separately, to create more integration amongst participants of the same gender and less interference due to particular gender dependent characteristics (Leaper & Ayres, 2007; Luntz, 1994). Furthermore, in each group half of the participants had children, since differences towards beef safety attitudes were assumed to be different with respect to participants who do not have children.

All participants were beef eaters and beef shoppers who consume beef at least once a week. Each group consisted of two general types of beef consumers, real and hidden. Consumers in the first category purchase primarily muscle-type meat products, such as steaks and roasts, where the beef origin of the meat is clearly visible. In the second category, meat products such as hamburgers with minced meat and similar dishes, i.e. where the beef origin of the meat is less obvious, are more frequently consumed.

In total, eight focus groups with 65 participants formed the sample of this study. The age range was specified between 19 to 60 years, although without specifying the predetermined age quota per group (see Table 1).

Table 1. Number and age range (in years) of the ProSafeBeef focus groups' participants in Berlin (GE), Madrid (ES), Paris (FR) and London (UK)

	GE	**ES**	**FR**	**UK**
Male	8 (29-52)	8 (25-47)	9 (19-58)	8 (21-54)
Female	8 (27-54)	7 (28-50)	9 (20-60)	8 (29-41)

The procedure of the focus group discussions was established according to the works of Morgan and Krueger (1993) and Morgan (1998a, 1998b), whereas the research team discussed and developed a topic guide exclusively for this study. The topic guide as summarised in Table 2 was structured with respect to the projects' main objectives: an investigation of the respondent's opinions about safety, health and information with respect to beef consumption, and secondly, an exploration of the respondents' attitudes towards new technologies in relation to their beef consumption. Finally, the discussions were performed in the corresponding language of the selected countries. The location was in each case a standard conference room setting with the opportunity to record the discussion both acoustically and visually. Each discussion had a predetermined duration of maximum 2.5 hours.

Table 2. Topic guide sections of the focus group discussions

1. Consumer interest in beef safety information	**2. Consumer acceptance of beef technologies**
·Section I: General beliefs about beef ·Section II: Beef and safety (and trust) ·Section III: Beef and health (and trust) ·Section IV: Information about beef healthiness ·Section V: Quality guarantee system	·Section I: Selected beef technologies: marinating by injection (healthiness), marinating by injection (eating quality), marinating by injection (safety), marinating by submerging (eating quality), nutritional enhancement, shock wave treatment, thermal processing ·Section II: Biotechnologies (GM, cloning)

The present study focuses specifically on the technology-related investigation that was performed in three tasks for each group. First of all, the participants were asked to write down aspects of beef technologies they spontaneously recalled (based on their knowledge). This task was introduced before the discussion start in order to support the manifestation of the participants' general beliefs about beef technologies and associations with beef products. Secondly, the respondents were asked to openly state their associations and thoughts about beef and beef products. Finally, the group participated in an active exercise in the second part of the discussion, where each participant was asked to classify eight proposed beef technologies into preferred (accepted), neutral and rejected (not accepted) concepts.

The selected technologies were introduced by trained moderators separately as concepts that were based on previous investigations in collaboration with participating researchers in the EU-funded project ProSafeBeef:

1. Marinating by injection for improved healthiness by infusing components such as omega-3
2. Marinating by injection for improved safety by infusing water soluble components to increase protection against microorganisms
3. Marinating by injection for improved eating quality by infusing water soluble components for improved tenderness and more tasty beef
4. Marinating by submerging for improved eating quality by tenderizing low-grade beef meat
5. Nutritional enhancement; beef restructured and nutritionally enhanced with enzymes after removal of excess fat and connective tissues
6. Shock wave treatment to tenderize low-grade beef
7. Non-invasive muscle profiling through an instrumental characterization for precisely classifying beef cuts
8. Thermal processing, e.g. by using infrared radiation or microwaves for the production of semi-finished beef products for better protection and more convenient preparation

Content analysis was performed with NVivo 7, a qualitative data analysis (QDA) software package (developed by QSR International). The establishment of a shared codebook amid the participating researchers was a crucial first step in order to provide a common ground as a starting point to reliably code the recordings of the discussions. A coding list that addresses personal, product, informational and technology characteristics was created both with section-based and specific codes. Section-based codes, such as actors, health, product type, were predominantly used in order to organize the discussion into the previously stated sections of the topic guide. Specific codes were applied to performing an elaborate content analysis with reference to aspects that were discussed by the group as well as to responses of single participants.

In a second step, different research teams were assigned with one country to code the transcripts with the software. In total, more than 700 pages of full discussion transcripts were accordingly coded. To assure a desirable level of intercoder reliability, one transcript (male group of the UK) was selected as the reference everyone needed to encrypt. The coding decisions of every pair of coders were compared by calculating the reliability estimates percentage agreement and Cohen's kappa. The resulting kappa values indicated satisfactory intercoder reliability.

3. Results

There was no unconditional acceptance or absolute rejection of the proposed novel beef processing technologies. Across all countries the focus groups rarely coincided in their concept evaluations. The participants disagreed in ranking marinating by injection for improved healthiness, marinating by injection for improved eating quality, marinating by submerging for improved eating quality, beef restructured and nutritionally enhanced with enzymes after removal of excess fat and connective tissues, shock wave treatment and thermal processing as preferred, neutral and rejected technology concepts. However, a majority of favourable votes was accounted for non-invasive muscle profiling and against marinating by injection for improved safety. The following listing in Table 3 provides a comprehensive overview of positive and negative aspects that were frequently stated by the participants.

Table 3. Evaluation results of technology concepts

Marinating by Injection (Healthiness) | Neutral	
·(+) Healthy components added (e.g. omega-3) ·(+) Enhanced nutritional value ·(+) Positive associations with omega-3 ('Good for you') ·(+) Convenience ·(+) Option to intake omega-3, especially for consumers who do not like fish	·(–) Injection processing itself (risky, not 'natural´) ·(–) More information needed about processing ·(–) Only suitable for consumers that need especial diets ·(–) May negatively impact taste ·(–) Omega-3 is associated with fish, not beef ·(–) Unnecessary technology: consumers can obtain the same benefits from other food sources (e.g. fish)
Marinating by Injection (Safety) | Rejected	
·(+) Increase in food safety	·(–) Injection processing itself (invasive = 'not natural') ·(–) Risk of contamination when injecting ·(–) Increase in shelf-life only positive for industries (camouflage, sale of 'out-of-date' products)
Marinating by Injection (Eating quality) | Neutral	
·(+) Not risky in terms of safety ·(+) Chance to enhance the beef eating quality ·(+) More acceptable if additives are natural	·(–) Risk of flavour loss if too much water is injected ·(–) Risk of the product being 'spongier' ·(–) Perceived as 'unhealthy' ·(–) More acceptable if strict quality control are applied, to avoid stated risks
Marinating by submerging (Eating quality) | Neutral	
·(+) Increases the value of low grade beef (taste and tenderness) for low budget consumers ·(+) Traditional and familiar process ·(+) 'Non-invasive' ·(+) Only natural additives used (e.g. salt, paprika)	·(–) Not as good as fresh beef ·(–) Personal preferences for species ·(–) Use of 'low-grade beef'
Nutritional enhancement | Rejected	
·(+) Somehow familiar in sausages, hamburgers, minced beef and ready meals ·(+) Providing more healthy products by removing excess fat	·(–) The idea of 'messing too much with food' 'excess manipulation' is not good ·(–) Associations with 'science fiction' and negative comparisons ·(–) Consumers like a certain degree of fat content in beef; fat reduction is associated with removing 'taste'
Muscle profiling | Accepted	
·(+) 'Non-invasive' process ·(+) No additives ·(+) Efficient techn. solution to assure beef quality ·(+) Opportunities for consumers to buy various cuts with guaranteed tenderness	·(–) Doubts about the process ·(–) Upgrading tough muscles is considered an advantage only for industries (deceiving consumers)
Shock waves | Neutral	
·(+) Beef tenderisation ·(+) Somehow familiar process – pounding beef ·(+) 'Non-invasive process' ·(+) Convenience	·(–) Unknown process and effects (doubts), 'suspicious' ·(–) Associations with carcinogenic effects ·(–) Idea of eating 'low grade beef' (but OK for consumers with low budget; "perhaps OK for others")
Thermal processing | Neutral	
·(+) The process is familiar, already in use (microwave) ·(+) Convenience ·(+) 'Non-invasive'	·(–) Consumers prefer to cook, so it is an option for (mostly other) consumers less skilled in culinary ·(–) Doubts about the process ·(–) Loss in taste compared to barbecued beef ·(–) Microwaves are perceived to harm consumers' health, carcinogenic associations with radiation

4. Discussion and conclusions

Consumers reveal a significant distrust in novel technologies in beef production and processing. Despite the trend towards more technology acceptance among European citizens, there still seems to prevail a different public opinion when it comes to modern technologies in food production. Indeed, excess manipulation and distance from a 'natural' way of processing beef products were considered to be very negative outcomes of technological development and explain why some of the proposed concepts were rejected. Especially the invasive processing technologies, such as injecting the meat, were heavily rejected, despite consumers' recognition of the possible benefits the technologies and its resulting end products might offer.

The analysis of the focus group discussions concludes furthermore a dependency between the acceptance of novel beef products and how consumers perceive the characteristics of the innovation itself. The respondents also expressed a strong bias against the presented concepts, since food technologies are believed to merely increase the 'profit' of the industries by producing foods to 'feed the poorer'. In the present study, consumers also took corresponding positions on technology based claims such as "extended shelf-life" and believed that the meat industry would genuinely be the only beneficiary, as non-fresh products would be offered to consumers. In this case, such technology application was considered to make 'unacceptable products acceptable'.

Most of the interviewed consumers tend to believe that a higher nutritional value and a better eating experience are provided by natural, less or non-processed and fresh meat. Subsequently, the application of novel technologies for beef products is predominantly seen as a valuable alternative for convenience shoppers and those who are less demanding in terms of beef quality and have less culinary skills. Despite of a personal rejection of some technologies, their application was nevertheless deemed all right "for people with lower budgets" or "for consumers who are less skilled in cooking beef".

This study also refers to issues of the ongoing discussion in marketing communication with respect to consumer education. All participants generally want to be informed about novel technologies. However, they do not want to have detailed knowledge of the production process and rather prefer a conscious 'lack of knowledge'. If technology and science could assure quality benefits and absence of harmful long-term effects, beef producing and processing industries would be able to elude this communication conflict to a certain degree with the result that technology acceptance would most likely increase. In order to stimulate the consumption of beef products that are based on such novel technologies, it is consequently fundamental for the industries to position new products as superior in terms of quality and corresponding benefits, while maintaining their naturalness.

However, consumers generally support the development of technologies that can provide more healthiness and eating quality, and if such technologies are 'not invasive', the chances to be accepted increase. In general, consumers acknowledge that technological advances in food production can give support to feed the ever growing world population with cheaper and affordable food that is efficiently produced.

Current trends and development in society, global warming crisis, disease outbreaks and degradation of the environment are shaping consumers' opinion in regard to food production. There was a severe criticism about too much intervention in food and a strong desire to keep food and beef processing as simple and natural as possible.

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