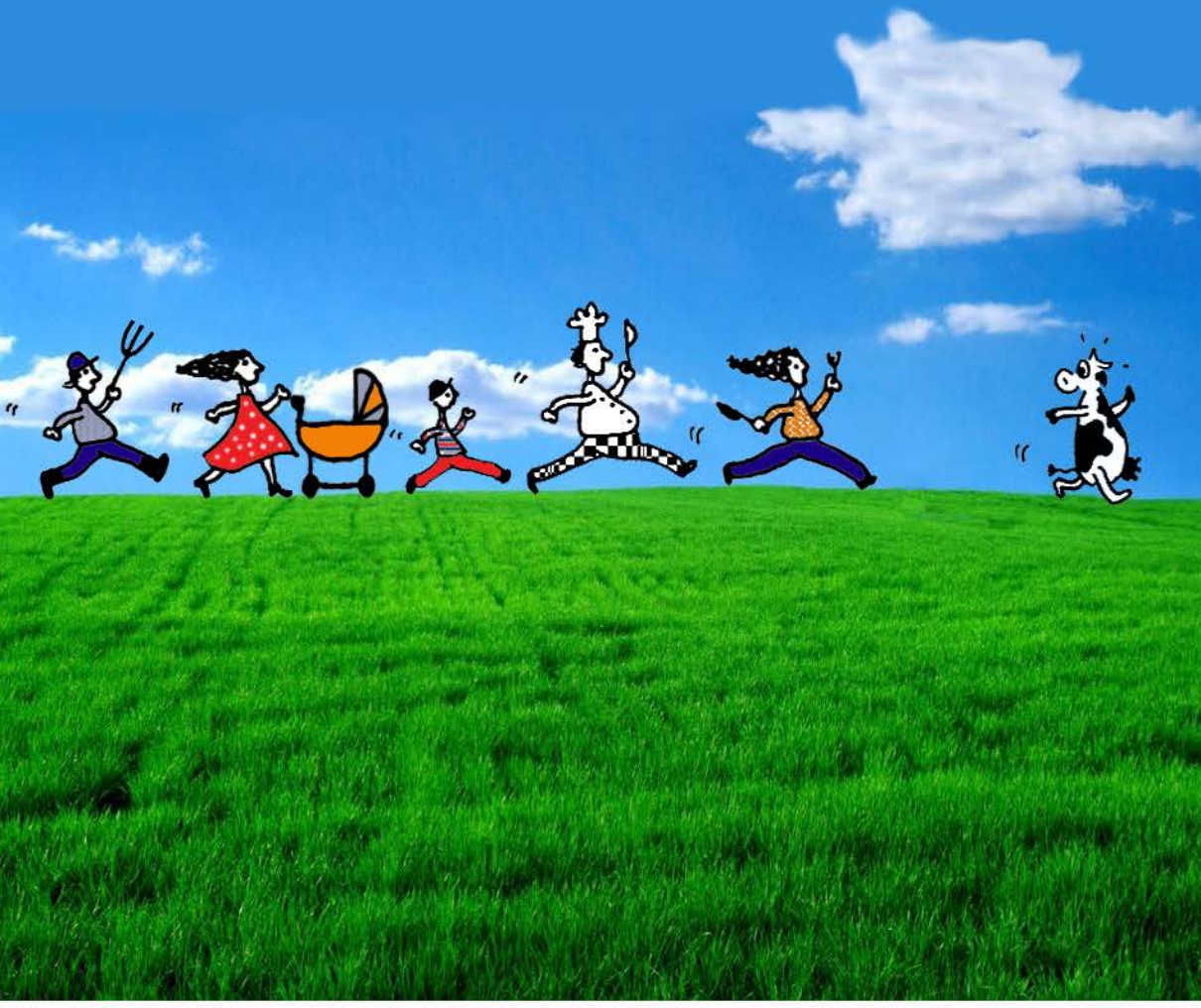
Consumer attitudes towards safety and health attributes of beef and beef technologies

Lynn Van Wezemael



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CONSUMER ATTITUDES TOWARDS SAFETY AND HEALTH ATTRIBUTES OF BEEF AND BEEF TECHNOLOGIES

Thesis submitted in fulfillment of the requirements
for the degree of Doctor (PhD) in Applied Biological Sciences

Dutch translation of the title:
Houding van consumenten ten aanzien van veiligheids- en gezondheidsattributen van rundvlees en rundvleestechnologieën

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Chapter 1: General introduction

Preface

This doctoral research has been performed within the framework of the European Union (EU) Sixth Framework Programme Integrated Project ProSafeBeef (2007-2012). The overall objective of ProSafeBeef is to reduce microbiological and chemical contaminants in beef and beef products and to enhance quality, choice and diversity in the beef chain in order to boost consumer trust and invigorate the European beef industry. Within this project innovative research and development is performed to permit the European beef chain to operate at competitive levels, while at the same time delivering safe and high quality products to its many consumers.

This doctoral research is part of the research activities performed within the consumer pillar (Pillar 5) of ProSafeBeef. The research activities within the ProSafeBeef consumer pillar focus on assessing European consumer needs for beef safety, healthiness and information and investigating the acceptability of novel processed beef products. This doctoral thesis reports original results obtained from the ProSafeBeef consumer research activities.

1.1. Introduction: consumer attitudes and food quality

1.1.1. Consumer attitudes

Consumers are faced with food purchase decisions daily. Within the infinite diversity of food products that is available in Europe today, and the large number of features that characterize them, every consumer has its own food likes and dislikes. The reasons for choosing one food instead of another food are very diverse and are related to consumers' attitude towards the food product.

An attitude is defined as the evaluation of an object as positive or negative (Scholderer, 2010a). For evaluation of an object (here: food), criteria (here: food characteristics) are needed. Firstly, this definition implies that food attitudes are evaluations of food products. Food products are described by a large number of characteristics. The attitude of the consumer towards the whole of these characteristics results in an overall attitude towards the food product and its' quality. Given the large number of characteristics in various formats in the purchase situation, this evaluation might not always be straightforward for consumers. Secondly, the definition implies that concepts like quality perception, perceived benefit, and perceived risk can be understood as particular types of attitudes. The modifier 'perceived' indicates the subjective nature of these attitudes. In the narrow sense, perceptions refer to the selection, organisation and interpretation of stimulus features in such a way that they acquire meaning (Scholderer, 2010b). Perception indicates that individuals register and give meaning to information.

Although attitudes and perceptions might be subjective notions, reflecting personal opinions and evaluations of an objective reality, individuals are likely to act on these subjective opinions and evaluations. The subjective component in human action has already been recognized by the ancient Greeks, and has become widely accepted in sociological thought (Merton, 1995) thanks to the Thomas Theorem, stating that: "if men define situations as real, they are real in their consequences" (Thomas & Thomas, 1928: 572). If people consider things to be true, they are likely to act on it, and hence creating real consequences in the objective reality. This subjective component in consumption behaviour has become painfully visible in period of food scares, when consumers radically stopped consuming whole food categories. Because of the direct impact on the profitability of the sector, consumer attitudes and perceptions cannot be ignored by the food industry (Troy & Kerry, 2010). Furthermore, knowledge about consumer opinions and preferences can facilitate the successful launch of new products and services in the market place.

1.1.2. Food quality

Food quality is an ambiguous and multidimensional concept (Becker, 2000). Within the large quantity of food quality definitions that are available in literature, two main dimensions of food quality emerge upon which general agreement exists: objective and subjective food quality. Objective quality refers to physical characteristics intrinsic to the food product, and is

typically dealt with by food experts such as engineers and food technologists (Grunert, 2005). Objective quality can be measured, replicated and managed throughout the agro-food chain (Verbeke et al., 2007). Consumers, however, have different ideas about food quality compared to experts. Subjective food quality refers to how food quality is perceived by consumers, and this concept differs significantly from objective food quality (Grunert, 2005). The gap between objective and subjective food quality has been attributed to the existence of a so-called perception filter, which is causing a bias between scientific facts and the subjective perception of these facts (Verbeke et al., 2007). Because of this perception filter, food quality is never referring exclusively to physical properties of food such as nutritional content, sensory qualities or hygiene, but also to ethical qualities or social values that are incorporated in the product (Sonnino, 2009; Renard, 2005).

The most popular and most agreed-on definition of food quality is provided by the International Organization of Standardization (ISO) and takes into account both the objective and subjective dimension by defining food quality as 'the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs' (ISO 8402). This definition encompasses product quality (needs regarding the characteristics of the final product) and process quality (needs regarding the characteristics of the production process which consumers have taken interest in) (Grunert et al., 2000).

Two approaches on subjective food quality exist: the holistic approach defines food quality as 'all the desirable properties a product is perceived to have' (Grunert, 2005: 372) while the excellence approach emphasises that food products can have desirable properties which consumers do not consider to be part of food quality (Grunert, 2005). In the holistic approach followed in this doctoral thesis, food quality is defined as 'a total of traits and criteria which characterize food with regard to its food safety, nutritional value, sensory value and convenience' (Sikora & Strada, 2005: 86) (Figure 1.1).

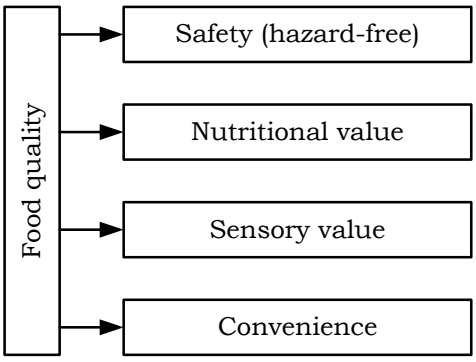


Figure 1.1: Food quality definition (Source: Sikora and Strada, 2005)

This definition implies that food safety is an essential part of food quality. Research has shown that consumers indeed interpret food safety as being strongly related to personal health

(Jevsnika et al., 2008). The link between quality and health is also clear with respect to the nutritional value of food. Sensory characteristics are highly modifying eating quality and therefore they are important determinants of overall food quality (Cardello, 1995). A final essential aspect of food quality is convenience. Although consumers acknowledge convenience to be a desirable characteristic of food products, they may consider convenience products to be of lower quality (Grunert, 2005). Since we follow the holistic approach, this doctoral thesis focuses on the first three aspects of food quality (food safety, nutritional value and sensory value) as defined by Sikora and Strada (2005).

1.2. Selected underlying theories and conceptual framework

1.2.1. Theoretical approaches on consumer attitudes towards food

A number of approaches have been used for analyzing food attitudes and perceived quality, among which the economics of information approach, the multi-attribute approach, and the integrative approach, all relevant for the present doctoral thesis.

a. Economics of information approach

Economic theory is applied to distinguish goods on the basis of how quality can be evaluated by consumers. To ensure efficient markets, symmetric information about product quality is needed. Consumers must know what they are buying in order to determine their willingness to pay for a product of this quality. The informational qualities of products have been classified by economists as search, experience and credence characteristics (Andersen, 1994; Nelson, 1974). For search attributes, consumers can be sure about the quality of the food product given careful pre-purchase inspection. Attributes that are visible to consumers prior to the purchase and consumption are considered to be major choice determinants (Cho & Hooker, 2002). Examples of search attributes are price, colour and labels. For credence attributes, consumers are faced with some difficulty in evaluating the quality of the food product, even after consumption. Credence qualities are increasingly important in food products (Grunert, 2005; Andersen, 1994). Food safety is mainly a credence attribute. The level of safety is in most cases neither observable for consumers, nor can it readily be experienced. Another example is the healthiness of foods. Consumers rely on products' health claims to evaluate the nutritional value of a food product. Also process-related qualities belong to the credence attributes (Grunert, 2005). Finally, experience attributes like taste and flavour are attributes that can only be evaluated after consumption. Once experienced, experience attributes can gain importance as evaluative criteria (Cho & Hooker, 2002). Most food products combine aspects of the different types of attributes, and therefore a multi-dimensional notion of quality is applied (Grunert, 1997).

The economics of information approach has been criticised for considering attributes as objective characteristics of objects, and for not integrating consumer attitudes towards these

different attributes into an overall quality evaluation. These difficulties have been addressed by the multi-attribute approach.

b. Multi-attribute approach

An integration of consumer attitudes towards different attributes into an overall quality evaluation is found in the multi-attribute theory. This theory is based on models that try to represent attitudes in terms of attributes that are not objective, but that people perceive attitude objects to have. The most prominent multi-attribute theory has been developed by Fishbein (1963), stating that a person's overall attitude towards an object is represented as the weighted sum of his or her evaluations of the attributes that he or she believes the object to have. As such, this approach assumes that quality is a multi-dimensional phenomenon, similar to the economics of information approach. The attributes or cues are defined as any informational stimuli that are related to the quality of the product, according to the consumer, and that can be ascertained by the consumer through the senses prior to consumption (Poulsen et al., 1996). Cues are intrinsic or extrinsic product attributes that are used as evaluative criteria upon which consumers use to form beliefs and to develop attitudes (Steenkamp & van Trijp, 1996). Intrinsic attributes are part of the physical product, such as colour or fat content. Extrinsic attributes are related to the product but are not physically part of it (Poulsen et al., 1996) such as price or brand name, and are expected to be used in choice situations characterised by a predominance of experience or credence characteristics (Grunert, 1997).

The model of Fishbein was later extended by the theory of reasoned action and the theory of planned behavior (Ajzen, 1991; Fishbein & Ajzen, 1975). Multi-attribute models have been very widely used to analyse food quality evaluations (for instance Arvola et al., 2008; McCarthy et al., 2004) but have also been widely criticised. They assume a highly involved and extensive decision process, an assumption that is often unrealistic when discussing fast moving consumer goods or products a consumer has considerable experience of (Scholderer, 2010a). Furthermore, this approach is not taking into account possible relationships between attributes, a difficulty which has been dealt with by the means-end theory (Grunert, 1997).

c. Integrative approach

The integrative approach attempts to integrate various approaches into a unified framework for analysing quality evaluation of food products. The best known model following this approach is the Total Food Quality model, developed by Grunert et al. (1996), for which the previously mentioned approaches are important inputs. The Total Food Quality model (see Figure 1.2) analyses the way in which consumers perceive food quality, distinguishing between the shopping situation (pre-purchase) on the one hand, and meal preparation and consumption (post-purchase) on the other hand. Before purchase, quality expectations are formed based on the available quality cues at the point of purchase (Grunert et al., 1996). Of all the cues consumers are exposed to, only the perceived and applied cues will have an

influence on consumers' quality expectations. Exposure and perception of cues are affected by the shopping situation, such as the amount of information in the shop, time pressure, or planned versus spontaneous purchases (Grunert et al., 2004). Furthermore, consumers will select the quality cues they consider to be applicable for the desired product based on their preferences, earlier experiences and general knowledge (Andersen, 1994). An important additional aspect of food available in the shopping situation is the technical product specification, which has a direct impact on the intrinsic and sensory attributes of a product and its experienced quality (Grunert et al., 1996).

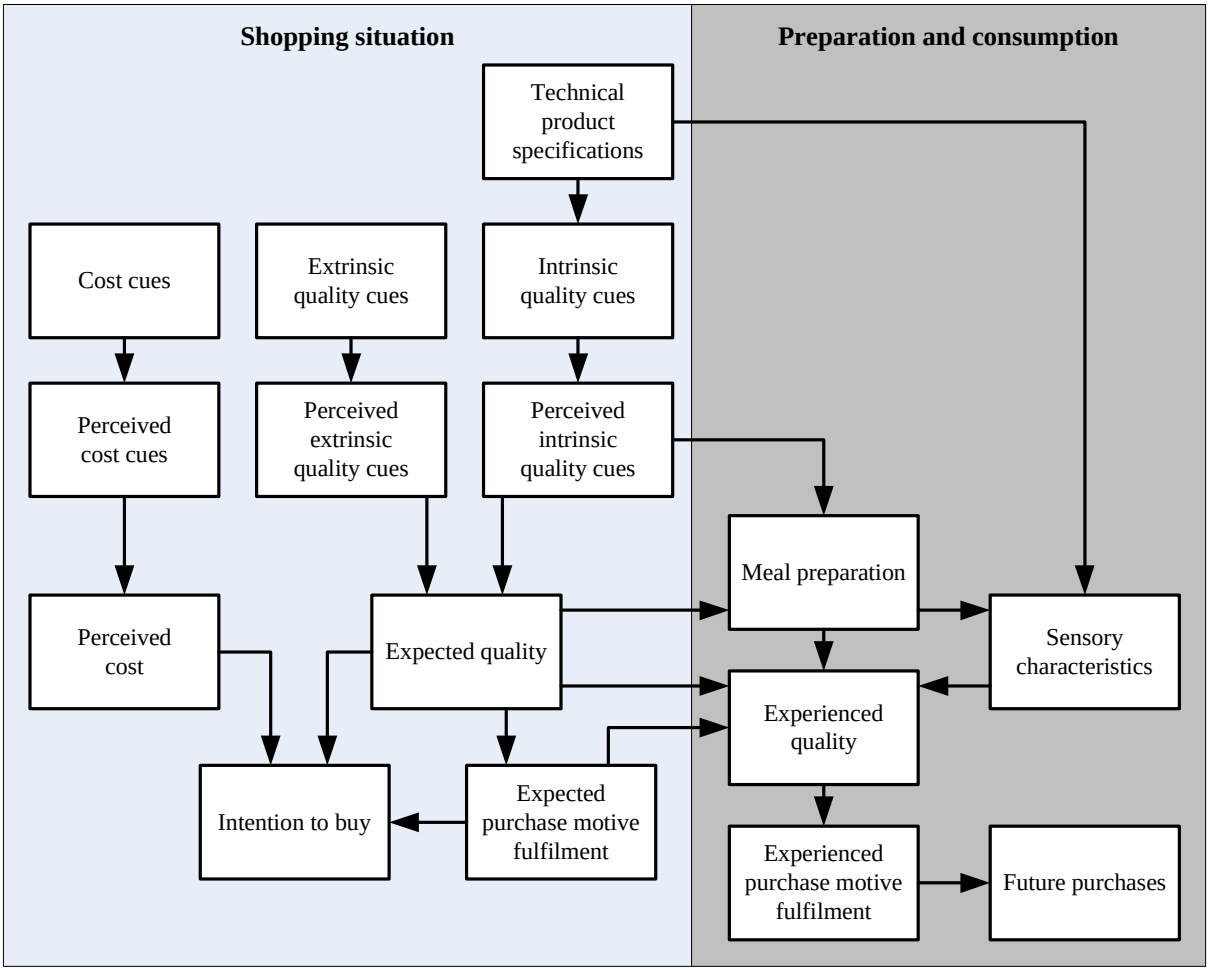


Figure 1.2: The Total Food Quality model (Source: Grunert et al., 2004)

While at the point of purchase consumers can merely develop expectations about the product, consumers can experience the quality of the purchased product during and after meal preparation and consumption. Where expectations and experiences are confronted with each other, the Total Food Quality model incorporates the expectation confirmation theory (Oliver, 1997). Confirmation or disconfirmation of expectations at the time of food consumption is known to be a major determinant of consumer satisfaction (Oliver, 1997). Experienced quality will often deviate from expected quality and is influenced by many factors, such as the sensory characteristics of the product, but also the preparation method, the used quality cues,

or the type of meal (Grunert et al., 2004). Consumer satisfaction, repeated purchase and future product use are influenced by the degree to which consumer expectations match or mismatch with their experiences. When experiences fall short of expectations, consumers are likely to be dissatisfied (Santos & Boote, 2003; Grunert et al., 1996).

1.2.2. Conceptual framework

Taking into consideration the approaches and theories discussed in the previous sections, a conceptual framework for this PhD dissertation is proposed in Figure 1.3. The framework is largely based on the Total Food Quality model, incorporates the main constructs of the multi-attribute approach, and adds additional components and relationships between them.

The focal concept in the research framework are consumer attitudes, as they can influence future consumer behavior. Consumer attitudes are determined by a variety of quality attributes before purchase (left side of the framework) and after purchase (right side of the framework). Before purchase, perceived extrinsic and intrinsic cues influence consumers' expected quality, while during consumption, sensory characteristics influence experienced quality. The Total Food Quality model already indicated that technical product specifications have a direct impact on the intrinsic and sensory attributes of a product and its experienced quality (Grunert et al., 1996). These technical product specifications are defined by all stages of the food chain before the food gets available in the food store, including food production, processing and packaging. A key determinant of the technical product specifications are the numerous food technologies that are applied along the food chain. Therefore, this was explicitly incorporated to the research framework. New technologies have been continuously developed and implemented in the food chain, promising more efficient production and better quality to consumers. By definition, technology presupposes the application of scientific knowledge to solve practical and societal problems. Although Europeans are generally optimistic about the contribution of technology to their quality of life, they have been more sceptical about new technologies in the food sector (Gaskell et al., 2006). As their application can change the technical product specification, technologies have an influence on the intrinsic quality cues. But when information about the application of technology is provided, this technology information has an impact as an extrinsic quality cue. While food technologies are widely applied in the food chain, in most cases consumers are hardly aware of their application. Research has shown that consumers increasingly report their product preferences to be strongly related to process characteristics (Krystallis et al., 2009; Søndergaard et al., 2005). Although production and processing technologies are technical issues that may be hard to understand for laymen, consumers have nevertheless developed preferences for particular practices (such as 'natural' and organic food production methods) while disliking others (such as genetic modification and 'excessive processing' of food (see de Barcellos et al., 2010; Nielsen et al., 2009; da Costa et al., 2000).

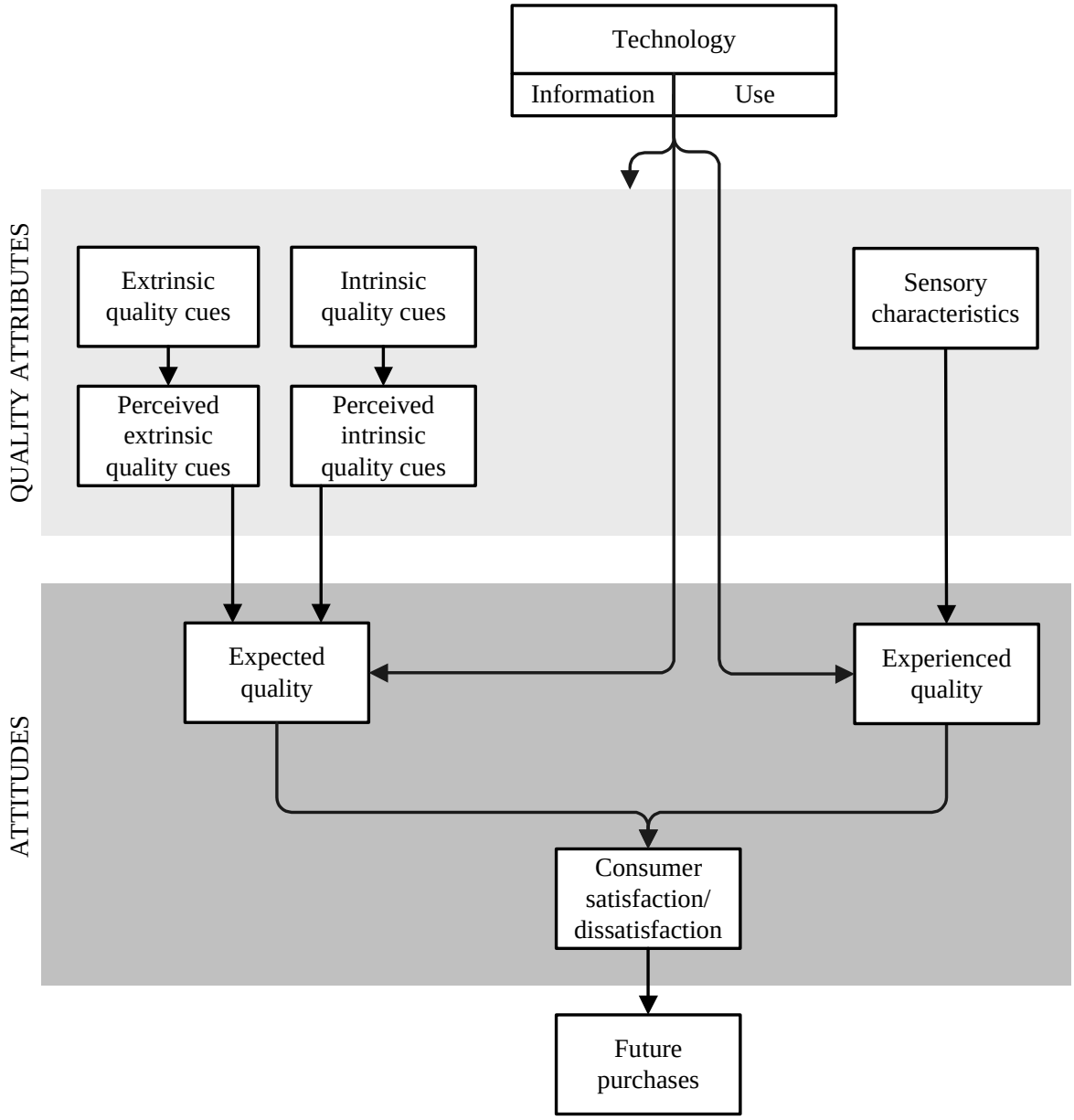


Figure 1.3: Research framework of the doctoral research

Consumer acceptance or rejection of food processing technologies depends on the amount of information that is provided, as was illustrated by Deliza et al. (2003) and Cardello (2003). Specifically, the provision of information about tangible benefits is considered a key factor in shaping consumer acceptance of food technologies. Positive framing of technology information might enhance consumer acceptance (Siegrist, 2008). Several studies showed that consumer-oriented benefits such as health or taste are more acceptable to consumers than producer- or industry-oriented benefits such as extended shelf life (Sorenson & Henchion, 2011), or indirect and intangible benefits such as environmental gains (Cox et al., 2007).

1.3. The beef sector as research case

The conceptual framework developed in the previous section will be applied on consumer attitudes towards health and safety attributes of beef and beef technologies. The selection of the beef sector as a research case in this dissertation is motivated by three main arguments that are explained more in detail below: 1) the economic importance of the sector in the EU; 2) the high importance of safety attributes in the beef sector; and 3) the growing importance of health attributes in meat.

As indicated by prehistoric cave paintings, humans have hunted cattle for their meat as early as the Stone Age. Meat is a food product that mainly refers to animal muscle, but also to other edible parts of animals such as offal. Raw lean meat consists mainly of water (75%), protein (18%) and fat (3%). Although these proportions vary according to species, protein is the most important nutrient in meat. Animal protein comprises a number of essential amino acids, which must be obtained from dietary sources since they cannot be synthesised by the body. Meat is a main element of the diet in many parts of the world nowadays, particularly in developed countries where the consumption of animal protein per capita is the highest. The major sources of world meat production and consumption are pork (39%), poultry (30%) and beef (24%) (Halweil, 2008).

This doctoral dissertation focuses on beef. Beef is the culinary name for meat obtained from adult bovines. It contains proteins of high biological value, and provides an important range of micronutrients such as vitamins B and D, zinc, and iron. Beef is consumed as one of the main principal meats used in the European, American and Australian cuisine. The European Union (EU) has a dominant global position in terms of beef production and consumption (Table 1.1). The current EU-27 beef market ranks globally second in size for consumption and third for production, with approximately 8,000,000 tonnes annual consumption and a similar, but somewhat lower level of domestic production, which indicates that the EU-27 is a net beef importer.

Table 1.1: Beef production and consumption in selected world regions (2009)

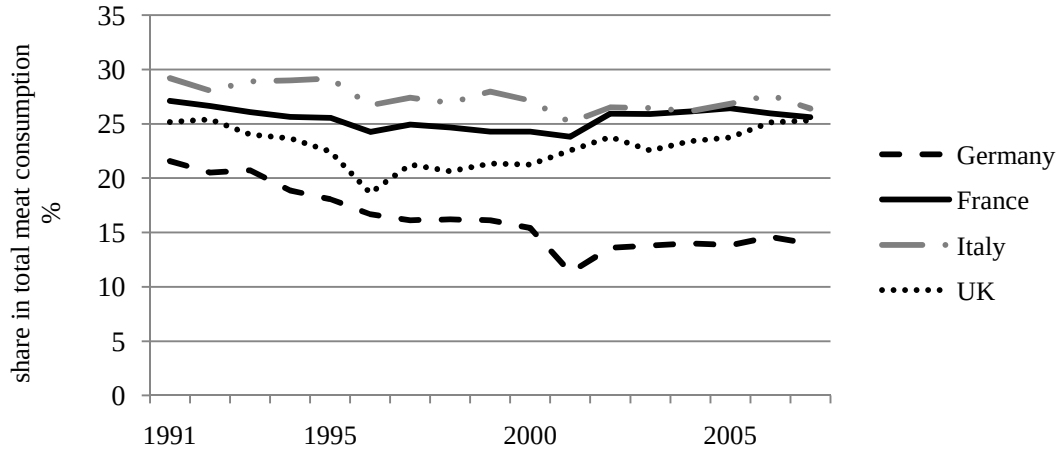
Country/Region	Consumption (1,000 MT CWE)	Production (1,000 MT CWE)
USA	12,239	11,891
EU-27	8,249	7,900
Brazil	7,374	8,935
China	5,749	5,764
Argentina	2,722	3,375
Canada	1,019	1,255

MT = metric tons; CWE = carcass weight equivalent

Source: USDA – United States Department of Agriculture

Although beef constitutes an important element in many European consumers' diet, the share of beef consumption in overall meat consumption has been decreasing at several time spans

over the past 20 years (Figure 1.4), mainly to the advantage of poultry and pork. Although the increasing price of beef relative to other meat has partly contributed to the decreasing market share of beef (Lamb & Beshear, 1998), additional and more likely explanations are based on non-price factors. During the past decades, several factors have been – and still are – contributing to this shift in meat consumption behaviour. On the one hand, trends have occurred in society and the food sector, which might have a negative impact on beef consumption. These trends are considered as external threats contributing to the declining share of beef in overall beef consumption. On the other hand, the European beef sector itself shows some weaknesses that have hindered the sector to take advantage of the stirring trends.



Source: Eurostat

Figure 1.4: Beef consumption share in overall meat consumption in selected European countries (1991-2007)

External factors contributing to the shift in meat consumption behaviour in Europe are mainly related to changing consumer preferences. Changes in consumer taste and preferences have occurred, such as the increased consumption of functional food products and processed meat products (Grunert, 2006). Furthermore, consumer lifestyles have changed and consumers are looking for convenience products: time spent in meal preparation has decreased, while out-of-home eating has gained popularity (Costa et al., 2007). As a result, more convenient poultry or pork products have gained market share. Consumers also show an increasing interest in process-related quality traits.

In particular, changing consumer preferences have given rise to a variety of consumer concerns which are of major importance for the beef sector. In chronological order, consumer concerns of safety, health and sustainability have influenced the beef sector.

Food safety crises. The meat sector, and especially the beef sector, has been vulnerable to food safety crises. Starting in the second half of the nineties, the sector was troubled with successive safety crises related to the presence of hormone and veterinary drug residues, diseases like Bovine Spongiform Encephalopathy (BSE) and foot-and-mouth disease, and contamination with dioxin. As a result, meat was reported to be the food item in which

consumer confidence was reduced most by the end of the nineties (Becker, 2000). The unfavourable image of beef in relation to food safety had a negative impact on beef consumption all over Europe (Angulo & Gil, 2007).

Increasing health concerns. Consumers have become increasingly concerned about food-borne risks and personal health. The fat content and the possibly negative effect of red meat on consumers' cholesterol levels have become one of the major health concerns (Resurreccion, 2004; Gustafsson & Sidenvall, 2002). Furthermore, consumers have been confronted with alarming messages about the alleged negative impact of red meat consumption on the development of cancer (Ferguson, 2009). Although a number of studies have suggested a possible link between the intake of processed meat and an increased risk of colorectal cancer, the scientific debate on this topic is still going on (Wyness et al., 2011).

Sustainability issues. Consumers have been increasingly expressing ethical and environmental concerns related to beef consumption, since beef production is particularly resource intensive and inefficient, putting pressure on the natural environment, climate, energy, water and biodiversity (Popkin, 2009; Gossard & York, 2003; Gustafsson & Sidenvall, 2002). The growing number of vegetarians partly shows the importance of these sustainability concerns for consumer behaviour (Vinnari, 2008). Within the context of increasing demands for foods, the debate of whether meat can be part of a sustainable diet is currently going on (Wyness et al., 2011).

The European beef sector has not always responded adequately to these changing consumer preferences. Some inherent characteristics of the sector have limited the responsiveness of the sector. Possible internal factors with a negative influence on the share of beef in overall meat consumption are the low innovativeness in the beef sector, and the inconsistent quality of beef.

Low innovativeness in the beef sector. Historically, the beef industry has lagged behind the poultry and pork and dairy sectors, not only in relation to food safety but also in the introduction and diversification of innovative beef products and production processes. In comparison with the pork and poultry sectors, the beef sector has been slow in reacting to changing consumer demands. Unlike the poultry and pork sector who have successfully transformed themselves sooner into consumer-oriented industries, the beef sector has been slow in reacting to changing consumer demands, partly because of its lower level of chain coordination during the nineties (Lamb & Beshear, 1998). However, the last decade this situation has been changing. Since the beef sector has done pioneering work regarding traceability, the beef industry even became a model for other food industries to follow in case of produce recalls.

Inconsistent quality. Tenderness and palatability are the most important attributes of meat eating quality. Beef eating quality is highly variable, causing uncertainty at the pre-purchase stage and possible dissatisfaction among consumers post-purchase (Troy & Kerry, 2010; Polkinghorne et al., 2008a). As the beef industry has been striving to produce a leaner

product, the decreased fat levels caused an even increased variation in eating quality (Lansdell et al., 1995). Countering inconsistent beef quality is thus a major challenge for the beef sector.

1.4. Research gaps and contribution of this thesis

This section describes conceptual and empirical gaps of existing consumer attitude research on beef and beef technologies. These gaps underpin the scientific contribution of this doctoral research and provide justification for our study.

1.4.1. Conceptual contribution

In the aforementioned theories of consumer attitudes towards food, the influence of the use of and information about technology is only implicitly covered. In the Total Food Quality model, the concept of the technical product specifications can refer to the use of technology. In this doctoral dissertation, both the use of and information about technology is explicitly incorporated in the research framework, aiming to provide more insight in their influencing role on consumer attitudes.

A number of factors has been identified which are important determinants of consumer acceptance of food technologies. Technologies which consumers are familiar with are unlikely to lead to high levels of public rejection, while food technologies with a bioactive characteristic will raise more concerns. Other influencing factors are perceived benefit, perceived naturalness, and perceived controllability (Frewer et al., 2011; Ronteltap et al., 2007). In this doctoral research, factors influencing consumer acceptance of technologies applied in the beef chain will be further investigated, aiming to extend the limited existing knowledge about possible determinants of food technology acceptance.

Knowledge about the factors influencing technology acceptance enables targeted and well-chosen communication to consumers in an attempt to enhance acceptance. Proponents of particular technologies often assume that negative consumer attitudes can be changed by providing more information to correct the so-called ‘knowledge deficit’, i.e. to overcome rejection of a technology solely due to simple unawareness (Teisl et al., 2009; Hilgartner, 1990). However, several studies have shown that simple information provision does not guarantee more positive attitudes (Rollin et al., 2011). Information can activate existing fears and concerns about food technologies (Cox et al., 2007) and even lead to boomerang effects (Scholderer & Frewer, 2003). Nevertheless, without communication, food technologies might face a negative public reception (Rollin et al., 2011). Consumer acceptance or rejection of food processing technologies might depend on the amount of information that is provided, as was illustrated by Deliza et al. (2003) and Cardello (2003). Specifically, the provision of information about tangible benefits is considered a key factor in shaping consumer acceptance of food technologies (Frewer et al., 1996). In this light, this doctoral research will investigate how information can influence consumer attitudes towards beef products that have been produced by means of different processing technologies.

1.4.2. Methodological contribution

The methodologies applied in this doctoral research are in line with generally-accepted practices. Qualitative exploratory research is used to provide insight into consumer attitudes. The focus groups are accompanied by a small questionnaire with profiling questions, which allows profiling the participants and triangulation of the results. Quantitative methodologies (consumer survey and sensory testing) are applied to formulate more conclusive results on the topic. Furthermore, the methodology in Study 3 incorporates sensory research with an extended questionnaire, combined with an information experiment. The combination of qualitative and various quantitative methodologies provides a broad overview for discussion.

1.4.3. Empirical contribution

Most studies about consumer perceptions of beef have been performed in the aftermath of the BSE crises, focussing mostly on safety aspects. Consumer research on perceptions of process safety has generally focused on consumers' food handling practices at home, because of the large impact on food safety of the final product (Jevsnik et al., 2008). This doctoral research takes a broader scope and explores next to consumer attitudes towards beef safety, also consumer attitudes towards beef healthiness and beef eating quality. From previous research it is known that health and nutrition considerations, such as cholesterol and saturated fat content, can play a role in consumer choices (da Fonseca & Salay, 2008; Rimal, 2005). Little is known about current perceptions of beef healthiness (Paquette, 2005a). Many intermediary factors that may influence beliefs about health perceptions of beef remain unknown, urging for more research in this field (Lea & Worsley, 2002). Besides healthiness of beef, eating quality is investigated. Reliable eating-quality guarantee systems are still lacking in Europe, in spite of numerous private voluntary quality labelling initiatives and public efforts to label beef products in terms of production system, origin and traceability. Most existing labelling schemes provide assurance that a set of quality production standards have been followed and that products can be traced from farmers to retailers, but these do not guarantee particular muscle eating quality at the consumer level. Previous studies have shown that consumers are only moderately interested in beef traceability and origin as such (Verbeke & Ward, 2006; Hobbs et al., 2005; Verbeke, 2001b), whereas their interest in direct indications of beef healthiness and sensory quality in particular might be considerably larger (Alfnes et al., 2008). A well-functioning and reliable beef quality guarantee system, including eating quality parameters, can potentially meet current interests of European beef consumers. However, insights in consumer interest, opinions and information needs related to an eating-quality guarantee for beef are crucial for such a system to be successful.

In contrast with previous beef consumer research that mainly focussed on single countries, results are presented from different European countries that differ both in their beef consumption level and responsiveness to the crisis of the mid-1990s, herewith providing a broad overview for discussion.

Consumer research on perceptions of food technologies has generally focused on novel and controversial technologies such as biotechnology and food irradiation (Wilcock et al., 2004; Fox et al., 2002). Consumers are often ambivalent about food technologies and may not be able to balance possible benefits and risks (Siegrist, 2008). However, a large amount of technologies are applied in the beef sector today, which are often not communicated to the consumers. The resulting products are tacitly accepted in the market, and consumer acceptance of various food technologies remains largely uninvestigated but is quite often taken for granted (Siegrist, 2008; Tenbült et al., 2008). A need for comparative studies focussing simultaneously on several food technologies has been identified in literature (Frewer et al., 2011).Therefore, this doctoral research investigates consumer attitudes towards technologies that are commonly applied in the contemporary beef sector. Furthermore, instead of focusing on one specific technology applied at one stage of the beef supply chain, consecutive steps in the chain and various technologies are covered in this research.

1.5. Research objectives and research questions

The overall objective of this doctoral research is to investigate consumer attitudes towards quality attributes, and more specifically safety and health attributes, of beef and beef technologies. In accordance with the research framework, three main research objectives are distinguished, leading to seven research questions.

1.5.1. Research objective 1: exploring consumer attitudes towards beef quality attributes

In accordance with the overall research objective, three beef quality attributes will be explored: beef safety, healthiness and eating quality. The cues that consumers use to assess beef safety and healthiness are investigated, and perceived benefits and disadvantages of a beef eating quality guarantee are explored. Three research questions are formulated. The first research question asks *what attributes are used to assess various beef quality aspects*. Research has shown that consumers use both intrinsic and extrinsic attributes to assess various beef quality aspects (e.g. Banovic et al., 2009; Krystallis et al., 2007; Brunsø et al., 2005). Based on this assessment, consumers will develop an overall attitude towards the product. However, consumer attitudes towards beef safety might differ from their attitudes towards beef healthiness, which might cause confusion and uncertainty among consumers. Therefore, the second research question asks *whether consumer attitudes differ between various beef quality aspects.* The third research question focuses on another aspect of beef quality, namely beef eating quality. As the beef sector experiences difficulties to deliver products with a consistent quality, a beef eating quality guarantee (as existing in other parts of the world) might be of interest for the consumer. Perceived benefits and disadvantages of a beef eating quality guarantee are explored to formulate an answer to the third research question: *what are consumer attitudes towards a beef eating quality guarantee?*

1.5.2. Research objective 2: investigating consumer attitudes towards beef technologies

Previous consumer research on technology acceptance has mainly focused on novel and controversial technologies such as biotechnology and food irradiation (Wilcock et al., 2004; Fox et al., 2002). However, a large amount of technologies are applied in the food sector today, without their acceptance being investigated (Siegrist, 2008; Tenbült et al., 2008). Therefore, a fourth research question asks *to what degree consumers accept beef technologies*. Consumer attitudes towards various processing technologies is explored to detect underlying motives for acceptance. In a next stage, not only processing technologies, but technological interventions over the beef chain are investigated to formulate an answer to the fifth research question: *do consumers accept technological interventions in the beef chain to enhance beef safety?* Enhanced beef safety might be an acceptable reason to intervene at different stages in the beef chain. A logical question that follows from this issue is *what factors determine consumer acceptance of beef technologies.*

1.5.3. Research objective 3: investigating the effect of information on consumer attitudes towards beef processing technologies

Proponents of particular technologies often assume that negative consumer attitudes can be changed by providing more information (Teisl et al., 2009; Hilgartner, 1990). As information might have an influence on consumer acceptance, the final research objective raises the question *whether detailed information about beef processing technologies influence consumer attitudes positively.* The effect of technology information on consumer expectations and liking of beef is investigated, as is consumers' satisfaction or dissatisfaction with the resulting beef products.

1.6. Research design and data sources

This doctoral research uses both secondary and primary data sources. Secondary data were used to assess beef production and consumption levels and statistics related to the European population. Primary data were collected through the use of qualitative and quantitative research procedures. In line with the aforementioned research objectives, three consumer studies were performed across various European countries. These studies with beef consumers were executed independently of each other, including different sets of participants, and at different points in time. In this section, the three studies are presented in chronological order, describing general sample selection and data collection procedures. Details about the used questionnaires and measurement scales are provided in the subsequent chapters.

1.6.1. Study 1: Qualitative focus group research

To explore consumer attitudes and perceptions towards beef, beef safety, healthiness, and eating quality, and beef technologies, eight focus group discussions were conducted in the capital cities of France, Germany, Spain, and the United Kingdom during May 2008. These countries were selected because of their significant market volume, both in terms of beef

production and beef consumption, and strategic geographical location within the EU. Data from Eurostat (2009) indicate that each of these countries represented more than 1 million tonnes of gross human beef consumption in 2007 (with the exception of Spain, where 665,000 tonnes were consumed in 2004), from a total gross human beef consumption of around 8,000,000 tonnes in the EU-27. Table 1.2 therefore presents the gross yearly human apparent beef consumption per capita in kg of the above mentioned countries.

Table 1.2: Gross yearly human beef consumption per capita (kg/capita) in France, Germany, Spain, and the UK

	1991	1995	1999	2003	2007
France	30	29	27	27	26
Germany	21	17	15	12	13
Spain	14	13	16	15	n.a.*
UK	19	18	17	15	21

Source: Eurostat (2009); * n.a. = not available; Data from another source (Spanish Ministry of the Environment and Rural and Marine Affairs, 2008) report a per capita consumption of 9 kg/capita in Spain for 2007.

In each country, two focus group discussions with seven to nine participants each were performed, being one composed of women and another one of men. In total, 65 individuals participated in the study. Luntz (1994) recommends that both gender groups should be interviewed separately, to create more integration amongst participants of the same gender and less interference due to particular characteristics. Women could also dominate the conversation when issues related to the household, such as food purchasing, are being discussed. Recent studies (Leaper & Ayres, 2007) indicate that with strangers, women are generally more talkative when it comes to using speech to affirm their connection to the listener while men's speech focus more on an attempt to influence the listener. In order to avoid such biases, it was decided not to mix both genders in the same discussion group. Focus groups were conducted according to standard procedures (Morgan, 1998a; b; Morgan & Krueger, 1993), and led by professional moderators. The number of participants in each focus group was determined based on general guidelines for conducting focus group research. Specifically, to facilitate and optimise conversation and discussion between the participants, it is recommended to select between six and eight participants (Morgan, 1998a). The number of focus groups was determined based on practical and saturation criteria. Although four different countries were involved, the structured nature of the interview and the fact that the focus groups were not mixed in gender facilitated the achievement of saturation. After having conducted eight focus groups with the same structure and topic guide, additional data collection would no longer yield new insights or understandings.

The participants were recruited by a subcontracted market research agency using a standardised invitation and recruitment procedure. The participant inclusion criteria related to beef consumption level and predetermined demographical characteristics. Participants were beef eaters (with a frequency of at least once a week) and beef shoppers without aversion to beef. Both ‘real’ and ‘hidden’ beef eaters were included. A median split was applied to divide

the sample in high and low beef consumers. Real beef eaters were considered those reporting a high frequency of consumption of steaks and/or roasts, i.e. meat types where the raw meat and muscle origin is clearly visible. Hidden beef eaters were those who reported to rather consume processed beef and beef products like minced beef and burgers, in which the animal and muscle-type origin of the meat is less visible. Participants had varied employment statuses and they ranged in age from 19 to 60 years. Both participants with and without children were included in the focus group discussions, which each covered around 2.5 hours. The number and age range of the participants in each focus group are given in Table 1.3.

Table 1.3: Number and age range (years) of the participants in Study 1

	France (Paris)	Germany (Berlin)	Spain (Madrid)	UK (London)
Male	9 (19-58 years)	8 (29-52 years)	8 (25-47 years)	8 (21-54 years)
Female	9 (20-60 years)	8 (27-54 years)	7 (28-50 years)	8 (29-41 years)

The complete topic guide for the focus group discussions is included in Appendix I. Table 1.4. provides an overview of the main subjects of the discussion. The topic guide consisted of two main sections. The first section asked consumers about their perception of and interest in beef safety, beef healthiness and related information. The focus groups started with a discussion about general beliefs about beef, followed by a discussion related to beef safety issues (including perceptions, trust and responsibility) and beef healthiness. After a discussion about current and expected information related to beef safety and healthiness, participants were asked to give their opinion about the concept of a quality guarantee system in beef. The second section of the topic guide explored consumers' attitudes towards novel beef processing technologies. For each of the four countries, the translated topic guide and an additional quantitative questionnaire was applied to the participants in their respective languages.

The participants also completed a quantitative questionnaire about socio-demographic characteristics (age, gender, marital status, presence of children living at home), beef consumption frequency and attitudes towards new food products and technologies. This quantitative information was collected for the sole purpose of mapping the participants' attitudes and opinions in order to contrast their profiles with the obtained statements from the discussions. A wide range of background attitudes with possible relevance for beef perceptions related to beef production, processing and products were therefore included in the questionnaire. The complete list of scales and scale items used in the questionnaire are illustrated in the Appendix II and are discussed more in detail in Chapter 2.

All focus group discussions were audio-taped and mechanistically transcribed. The full transcripts of the focus group discussions in the local languages were used as input data for the content analysis. Content analysis is a qualitative research analysis technique to study the content of communication. This systematic and descriptive method is used to analyse words or phrases within a wider range of spoken or written communication.

Table 1.4: Main subjects of the topic guide used in Study 1

Main discussion subjects
General beliefs about beef
Beef, safety and trust
Beef, healthiness and trust
Beef eating-quality guarantee
Beef technologies and consumer acceptance

The software tool NVIVO7 was selected as an appropriate tool for performing the data analysis, since it is considered a powerful research tool to help analyse qualitative data (NVivo, 2006). Coding decisions were based on an agreed upon list of 54 codes, which allowed performing a content analysis on the main themes of the focus group discussions. Since four different researchers completed the coding task, inter-coder reliability was assured by the intense collaboration in the development phase of the code list. During this phase, the researchers iteratively compared their coding decisions and discussed about the exact content of the codes. These in-depth discussions resulted in a code list which was interpreted in a comparable and consistent way across researchers. This code list was used to structure the transcripts of all focus group discussions. The text was broken down into manageable categories of phrases and sentences and labelled with the code(s) that reflected their content. Every code contained all available information and statements about that particular concept. These codes were reviewed in depth to detect for instance trends, relationships with other concepts or conflicting aspects. In the following chapters, findings are reported including verbatim statements to illustrate the opinions and beliefs as reflected by the participants.

Consider the following text fragment from one of the focus groups as an example:

- Moderator: *What's healthy for someone else then?*
- Participant A: *I just go back to organic again.*
- Participant B: *I tell myself, I'm hoping this is you know, hasn't travelled all over the place and it's organic so maybe it's better than the other stuff, but I have no idea and I'm just judging it based on little information.*

The words of the moderator were coded as "health", the words of participant A as "health" and "organic"; and the words of participant B as "health", "organic" and "lack of knowledge". In order to analyse the general ideas consumers formulated on beef healthiness, the content of the code "health" was looked at, and all sentences with this code (including all sentences in our example) would be taken into account. For results on more specific subthemes such as perceived lack of knowledge with respect to the healthiness of beef, the codes "health" and "lack of knowledge" were combined, resulting in an overview of the content of all sentences of all focus group discussions who were coded by those two codes simultaneously. The resulting texts were looked at in depth to formulate the research findings.

1.6.2. Study 2: Quantitative web-based survey

A second study investigated consumer acceptance of beef technologies at different stages of the beef chain. Cross-sectional consumer data were collected in France, Germany, Poland, Spain, and the United Kingdom during February - March 2010. The countries were selected because of their significant beef market volume and potential, as well as for their strategic geographical location within Europe. Participant recruitment and fieldwork was sub-contracted to a professional market research organisation that abides the ESOMAR (World Association of Opinion and Marketing Research Professionals, formerly European Society for Opinion and Marketing Research) code of conduct regarding ethics in social sciences research (ICC/ESOMAR, 2008).

In each country, 504 individuals participated in the web-based survey, yielding a total sample of 2,520 respondents. This out of the ordinary number of participants in each country was caused by the simultaneous data collection of a choice experiment, requiring a fixed number of participants within each country and within each cell of the research design. All participants were beef consumers (consuming beef steak or beef burger at least several times per year) and older than 18 years. Participants were randomly selected from nationally representative (with respect to gender and socio-economic situation) consumer panels managed by the market research agency responsible for the fieldwork data collection. The respondents were volunteers who were informed about the scope of the study and who provided their informed consent. Sample characteristics are presented in Table 1.5. The distributions of age, household composition and living environment show that the sample covers a wide range of respondents, though without claiming to be statistically representative for the national populations considered in this survey.

A master questionnaire was developed in English, which was further translated and back-translated into the different national languages of the countries involved in this chapter. An online survey questionnaire consisting of two parts was pretested. The first part of the questionnaire measured consumers' acceptance level of different beef safety-enhancing interventions, successively with respect to cattle feed, hide decontamination, processing technologies, and packaging technologies. The second part of the questionnaire assessed background attitudes, beef consumption behaviour and socio-demographic information. Data analysis was performed in SPSS versions 15.0 and 16.0 (SPSS, 2007).

Table 1.5: Socio-demographic characteristics of the sample in Study 2 (in % of participants) (n=2,520)

	% of sample
Age	
18-30 years	33.3
31-45 years	36.2
46-64 years	27.1
65-85 years	3.4
Male	44.0
Higher education	50.5
Urban residence	71.2
Cohabiting	85.4
Children under 5	18.6
Children older than 5	21.3
Working in food industry	5.6

1.6.3. Study 3: Sensory study

A third study investigated the effect of information about beef technologies on consumers' expectations and liking of beef. For this purpose, an information experiment was combined with sensory testing. Data were collected among adult beef consumers in Belgium and Norway during January - February 2011 (n=218). All consumers were regular fresh beef consumers, consumer fresh beef at least once a month. Sample characteristics are presented in Table 1.6

Table 1.6: Sample characteristics in Norway and Belgium (in % of the national sample)

	Norway (n=110)	**Belgium** (n=108)
Male	46	46
Female	54	54
18-35 years old	45	46
36-55 years old	55	54
Cohabiting	92	92
Children in the household (0-14y)	51	32
Post-secondary education	70	44
Working full-time	61	50
Students	30	25

Consumers were invited to a central testing location (located in Ås in Norway; Deinze in Belgium) where they first answered a list of questions regarding their attitudes towards beef and beef technologies. After completing this questionnaire, three beef steak samples (*M. Psoas Major*, *M. Infraspinatus*, and *M. Semitendinosus*) were served in a randomised order. These samples were prepared by means of three different beef technologies (no technology, muscle profiling, and marinating by injection, respectively) which were selected based on the results of Study 1. Consumers were randomly allocated to two groups. One group received only basic information about the applied beef technologies, and the other group received

detailed information about the technologies. Consumers were asked to rate their expectations of the beef samples before tasting, and their liking of the beef samples after tasting.

1.7. Contribution of the author in the reported research activities

With regard to Study 1, the author of this dissertation participated in the development of the topic guide and the accompanying questionnaire. She attended the four focus groups in France and the UK, while a colleague researcher from MAPP attended the four focus groups in Spain and Germany. She organised, moderated and lead a training session to familiarise the other researchers with the use of the qualitative software NVivo. After participating actively in the development of the code list, she was one of the four researchers that completed the coding task, coding the transcripts of the French focus groups and part of the British focus groups. She took the lead in the content analyses for all research chapters that report the results of this study (Chapters 2-5). She was the principal author of Chapter 2 and 3, and the result sections are her main contributions to Chapters 4 and 5.

The author participated in the development and translation of the questionnaire in Study 2. She has taken the lead in the statistical analyses and was the principal author of Chapters 6 and 7, reporting the results of these analyses.

Regarding Study 3, the author of this dissertation has participated actively in the development and translation of the questionnaire for the study. She has assisted in the Norwegian data collection, by providing help in the preparation of the meat samples and the presentation to the consumers. She communicated Norwegian research practices to the Belgian research agency, and was responsible for the follow-up of the Belgian data collection. She has been involved in the statistical analyses of the sensory data and was the principal author of Chapter 8, reporting the results of the sensory study.

1.8. Thesis outline

This doctoral dissertation is a compilation of papers which have been published in or submitted to international peer reviewed journals. Figure 1.5 gives an overview of the different parts of this thesis and its chapters in relation to the research framework.

Part I of the thesis fits with the first research objective and explores European consumer attitudes and perceptions towards different beef quality aspects. In the following research chapters, two main credence attributes of beef are investigated. Chapter 2 focuses on beef safety, while Chapter 3 investigates beef healthiness perceptions. These two chapters explore which cues consumers use as easy decision rules when purchasing beef. The presented results provide insight into consumer decision making processes regarding beef and beef products.

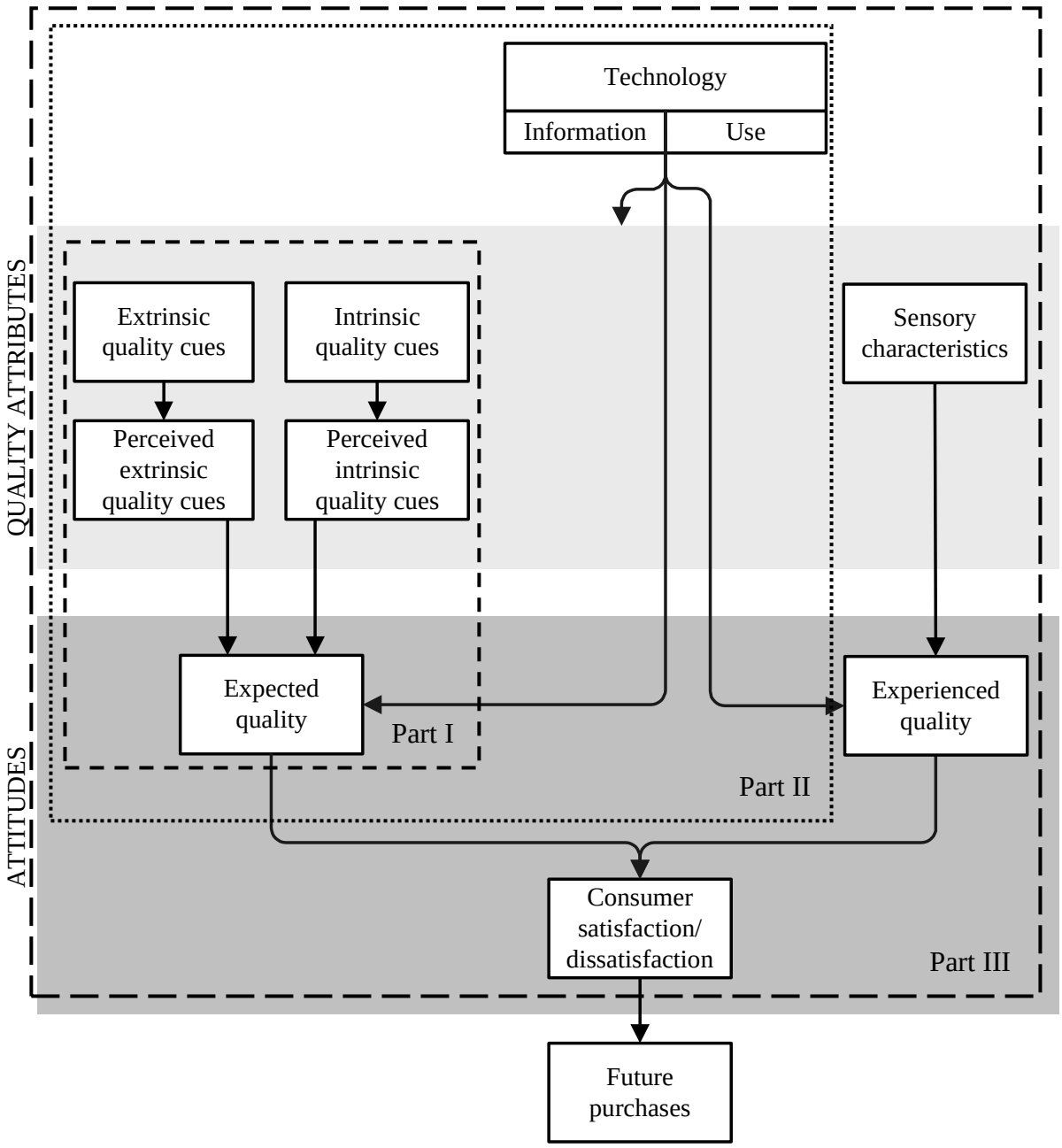


Figure 1.5: Thesis outline in relation to the research framework

Chapter 4 investigates consumer perceptions and acceptance of an eating-quality guarantee system. A quality guarantee is an extrinsic quality cue that can be readily experienced by consumers during consumption. Possibilities for its implementation in Europe are explored. All results reported in Chapters 2, 3 and 4 are based on Study 1, the qualitative focus group research, and are thus exploratory and descriptive in nature.

Part II investigates European consumer attitudes towards beef technologies in accordance with the second research objective of this doctoral research. The research framework indicated that consumer awareness about the application of beef technologies might have a direct impact on the expected quality of the product. Part II investigates consumer acceptance of beef technologies at four different stages of the beef chain: primary production,

slaughtering, processing and packaging. Chapter 5 explores consumers' acceptance, and perceived advantages and disadvantages of various beef processing technologies. Chapter 6 investigates acceptance levels of safety interventions during primary production, slaughtering and processing. Chapter 7 focuses on the acceptance of safety interventions with respect to packaging. Because different people have different acceptance levels, European consumers are subdivided into different consumer segments which are profiled based on socio-demographic characteristics, attitudes towards beef, and beef consumption levels. Contrary to the qualitative and exploratory results from Study 1 in Chapter 5, the results reported in Chapter 6 and 7 are based on quantitative data from Study 2, providing more conclusive findings.

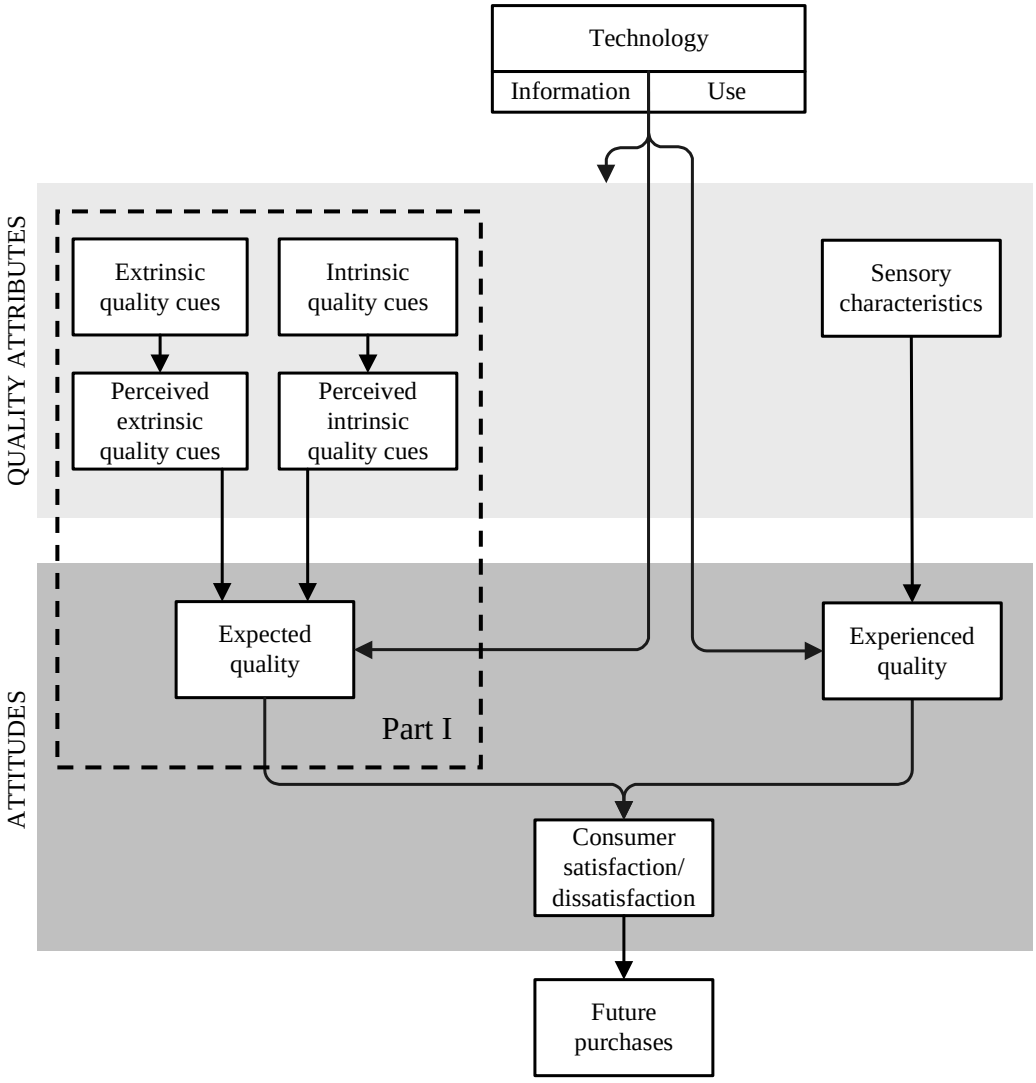
Part III investigates the effect of information about beef technologies on consumer attitudes. The research framework assumed that beef technologies do not only impact the sensory characteristics of the product, but that consumer awareness about their application might also have a direct impact on consumer attitudes. Chapter 8 investigates the effect of information about beef technologies on consumer expectations and liking of beef. The applied technologies aim to influence eating-quality, an experience attribute of beef. To investigate the effect of information, an information experiment was combined with sensory testing (Study 3).

Chapter 9 discusses the research findings in more general terms and gives an overview of the overall conclusions. Recommendations for public authorities and the beef sector (and the food sector in general) are presented. Limitations and suggestions for further research are formulated.

Part I Consumer attitudes and perceptions towards different beef quality aspects

Part I of this doctoral dissertation deals with the first research objective and explores consumer attitudes and perceptions towards three different aspects of beef quality.

Chapters 2 and 3 focus on credence attributes of beef, namely beef safety and beef healthiness respectively. These chapters explore which cues consumers use as easy decision rules when purchasing beef. The presented results provide insight into consumer decision making processes regarding beef and beef products. Chapter 4 focuses on eating quality, which is a quality that can be readily experienced by consumers during consumption. Perceived advantages and disadvantages of a beef eating-quality guarantee are explored. Possibilities for its implementation in Europe are discussed. All results reported in Part I are based on Study 1, the qualitative focus group research that was conducted in May 2008 in four European countries (n=65), and are thus exploratory and descriptive in nature.



Chapter 2: Consumers and beef safety: perceptions, expectations and uncertainty reduction strategies

This chapter has been published as: Van Wezemael, L., Verbeke, W., Kügler, J.O., de Barcellos, M.D. and Grunert, K.G. (2010). European consumers and beef safety: perceptions, expectations and uncertainty reduction strategies. *Food Control*, 21 (6) 835-844.

Abstract

European beef consumption has been gradually declining during the past decades, while consumers' concerns about beef safety have increased. This chapter explores consumer perceptions of and interest in beef safety and beef safety information, and their role in beef safety assessment and the beef consumption decision making process. Eight focus group discussions were performed with a total of 65 beef consumers in four European countries. Content analysis revealed that the focus group participants experienced difficulties in the assessment of the safety of beef and beef products and adopted diverging uncertainty reduction strategies. These included the use of colour, labels, brands and indications of origin as cues signalling beef safety. In general, consumer trust in beef safety was relatively high, despite distrust in particular actors.

2.1. Introduction

European beef consumption has been gradually declining during the past decades, while consumers' concerns about beef safety have increased. This is largely attributed to the occurrence of beef crises (animal diseases like Bovine Spongiform Encephalopathy (BSE), contamination with dioxin, and antibiotic residues) and individual perceptions of beef safety and health risks (da Fonseca & Salay, 2008; Angulo & Gil, 2007; Verbeke et al., 2007). The unfavourable image of beef in relation to food safety and consumer health had a negative impact on consumer decision-making towards beef (da Fonseca & Salay, 2008; Sepulveda et al., 2008; Angulo & Gil, 2007). Table 2.1 indicates that beef consumption in several European countries has not fully recovered from the decline that coincided with the occurrence of beef safety crises in the second half of the nineties.

The risks associated with beef relate mainly to safety and health perceptions, but also to financial, psychological, performance and social consequences of the choices made at the point-of-purchase (McCarthy & Henson, 2005; Verbeke & Vackier, 2004). Safety concerns remain an important issue that strongly affects meat consumption behaviour. However, recent studies also indicated that the intention to consume beef is gradually becoming more influenced by health and nutritional considerations (da Fonseca & Salay, 2008; Angulo & Gil, 2007). In this respect, the risk imposed by hazards such as BSE is also perceived lower among consumers than with pesticides or genetic modification (Verbeke et al., 2007; Miles & Frewer, 2003).

Beef safety is an important aspect of beef quality. Consumer perceptions of food quality can be investigated using a multi-attribute approach. Quality perceptions are shaped by consumer perceptions towards search, credence and experience attributes. Attributes are evaluative criteria that consumers use to form beliefs and to develop attitudes (Steenkamp & van Trijp, 1996). For search attributes, consumers can be sure about the quality of the beef product given careful pre-purchase inspection. Beef attributes that are visible to consumers prior to the purchase and consumption are considered to be major choice determinants (Cho & Hooker, 2002). Examples of search attributes in beef products are price, colour and labels. For credence attributes, consumers are faced with some difficulty for evaluating the safety of the beef product, even after consumption. Beef safety is mainly a credence attribute. The level of safety is in most cases neither observable for consumers, nor can it readily be experienced. Another example is the healthiness of beef. Consumers rely on products' health claims to evaluate the nutritional value of a beef product. Finally, experience attributes like taste and flavour are attributes that can only be evaluated after consumption. Once experienced, experience attributes can gain importance as evaluative criteria (Cho & Hooker, 2002).

In order to improve subjective food safety levels, public and private policies have been established trying to shift the focus from the use of credence attributes to the use of search attributes, more specifically to facilitate safety evaluation and communication (Caswell, 2000). The EU lays down standards for control, for the prevention of the risks of

contamination and for appropriate labelling of food products (EC General Food Law Regulation 178/2002). In the past, the European food safety policy has largely focussed on informing and educating consumers about objective food safety. Objective food safety is based on the assessment of the risk of consuming a certain food by scientists and food experts. Providing consumers with objective facts about beef safety was considered to be the best way to enhance food safety-related perceptions, since science was assumed to provide sufficient neutral and objective evidence with a high likelihood of building trust among consumers (Millstone et al., 2000). Consumers, however, have different ideas about food safety compared to experts. Subjective food safety refers to how food safety is perceived by consumers, and this concept differs significantly from objective food safety. During the last decade, the importance to deal with subjective food safety has been recognised (Verbeke et al., 2007; Grunert, 2005). The transformation of credence attributes into search attributes can be effected by labelling and advertising, by providing specific product claims or quality signals, or by introducing new technologies that signal particular safety aspects (e.g. smart packaging) (Cho & Hooker, 2002). Providing information disclosures turns experience and credence attributes into search attributes (Ehmke et al., 2006). These transformations enable consumers to evaluate the safety characteristics of beef during purchase, and to choose beef products that correspond to their preferences (Banterle & Stranieri, 2008).

The development of safety control and traceability systems and the provision of information to the consumers have been important in improving beef safety perception (Angulo & Gil, 2007; Verbeke, 2001b). Research about consumer information in the beef sector has mainly focussed on labelling information. Bernués et al. (2003a) found that the most important cues for the quality and safety of beef are the expiry date and beef origin, next to nutritional information, maturation time, name of cut and information on the system of production and on the traceability and the quality control of the meat. Although several studies suggested that for example Belgian or Canadian consumer interest in traceability cannot be taken for granted (Verbeke & Ward, 2006; Hobbs et al., 2005), consumer interest in traceability information was confirmed in Italy by Banterle et al. (2008).

Most studies about consumers' beef safety issues were written in the aftermath of the BSE crisis. More than one decade later, this chapter aims to explore consumer perceptions of and interest in beef safety, and their role in beef safety assessment and the beef consumption decision making process. Overall, the objective of this chapter is to assess consumer requirements and expectations concerning beef safety. The first specific objective of this chapter is to investigate consumer perceptions of beef safety and how consumers evaluate beef safety. This question is highly relevant, since for maintaining and improving beef safety and quality, the identification of cues that are important for beef safety assessment is crucial. The second specific objective is to explore consumers' interest for beef safety and beef safety information. This will reveal marketing possibilities to provide consumers with appropriate information and to enhance consumer trust in beef safety. The insights from this chapter are relevant for those involved in maintaining and improving food safety assessment and food

control. In contrast with previous research that mainly focussed on a single country, results are presented from four countries that differ both in their beef consumption level and responsiveness to the crises of the mid-1990s (Table 2.1), herewith providing a broad overview for discussion.

Table 2.1: Gross yearly human apparent beef consumption per capita (kg/capita)

	1991	1995	1999	2003	2007
France	30	29	27	27	26
Germany	21	17	15	12	13
Spain	14	13	16	15	n.a.*
UK	19	18	17	15	21

Source: Eurostat; * n.a. = not available; Data from another source (Spanish Ministry of the Environment and Rural and Marine Affairs, 2008) report a per capita consumption of 9 kg/capita in Spain for 2007.

2.2. Methodology

2.2.1. Focus group discussions

Eight focus groups were conducted in the capital cities of France, Germany, Spain, and the United Kingdom during May 2008. In each country, two group discussions with seven to nine participants each were performed, being one composed of women and another one of men. All participants were beef consumers. The topic guide of the focus group discussion is included in Appendix I. Procedures for conducting the focus groups and the content analysis have been described in 1.5.1. The findings from the focus group discussions insofar they relate to beef safety and beef safety information are discussed in the present chapter.

2.2.2. Questionnaire

The participants also completed a quantitative questionnaire about socio-demographic characteristics (age, gender, marital status, presence of children living at home) and attitudes towards new food products and technologies. This quantitative information was collected for the sole purpose of mapping the participants' attitudes and opinions in order to contrast their profiles with the obtained statements from the discussions. A wide range of background attitudes with possible relevance for beef perceptions related to beef production, processing and products were therefore included in the questionnaire. Participants' attitude towards food innovations was measured using the 6-item Domain Innovativeness Scale (DSI) from Goldsmith and Hofacker (1991), previously validated by Huotilainen, Pirtillä-Backman and Tuorila (2006), and a short version (5-items) of the original Food Neophobia Scale (FNS) from Pliner and Hobden (1992) to investigate possible aversion to novel food products. Six semantic-differential items (2007) were used to investigate general attitudes towards beef consumption (ATT). Consumer attitude towards animal welfare (AW) was assessed by the scales proposed by Kendall, Lobao and Sharp (2006). Consumers' degree of involvement (INV) with beef was measured using the 4-item scale developed by Zaichkowsky (1985).

These items assess participants' personal involvement with beef based on the perceived meaning, importance, appreciation and care for beef. The complete list of scales and scale items used in the questionnaire are illustrated in the Appendix II.

It should be emphasised that focus group studies are studies that involve a small and not statistically representative sample of consumers. As a result, the quantitative findings with respect to attitudes cannot be extrapolated to the wider population, which was also not the aim of collecting this information. The fact that quantitative information allows profiling the participants in a quite detailed manner improves the reliability of the data, more specifically it allows to check whether a large diversity of opinions is present in the sample and to identify possible extreme opinions or outliers.

2.2.3. Limitations of the study

The presented results are based on focus group discussions and are thus only exploratory and descriptive in nature. As discussed below, the participants' profiles indicate that the samples are quite comparable across the four countries, but they are not necessarily statistically representative for the overall population. However, the similarity of the thinking patterns in the different gender groups and the four countries suggests that these results cover the major consumer perceptions and interests consumers have related to beef safety and beef safety information. The limitation of the findings is that the relative importance of the different concerns about beef safety is not always reflected. Focus group results do not allow ordering the importance of the different aspects participants mention. Furthermore, the results are always dependent on context and time. Any extrapolation to other meat products is speculative. While interpreting the results, these caveats should be kept in mind. Notwithstanding the methodological limitations, the focus groups were successful in exploring consumer perceptions on and interest in beef safety and beef safety information.

2.3. Results

The results section is organised as follows. First, participants' profile based on the questionnaire (section 2.3.1.) is presented, followed by a presentation and discussion of the qualitative focus group results. Consumer perceptions of beef safety are reported (section 2.3.2.), followed by a section focusing on consumer interest in beef safety and beef safety information (2.3.3).

2.3.1. Participants' profile

Table 2.2 shows the cross-cultural comparison of the background attitude scales for the sample of 65 participants. The samples from the different countries only differ significantly in their involvement (INV) with beef ($p < 0.05$), i.e. personal relevance or importance attached to beef. Participants from France showed a higher degree of involvement with beef as compared to the British participants. The fact that no other significant differences are found

between the countries in terms of background attitudes indicates that there are no major differences amongst the participants' background attitudinal profiles, which signals that the samples recruited are quite comparable across countries. Even for exploratory purposes, there are no extreme attitude positions in any of the country samples. As a result, any observed between-country differences in beef safety perception and interest in beef safety information are likely to be due to cross-cultural differences rather than to individual differences between the people involved in the separate group discussions.

With regard to consumer innovativeness (DSI scale), participants showed a moderate degree of acceptance of food innovation, with mean values around 4.5 (on a 7-point-scale). Also the degree of food neophobia is moderate on average. Although not significant, there is a tendency of participants in France, Germany and the UK being more averse to novel food products than participants in Spain. The larger standard deviation in Spain indicates that Spanish participants reported more varied scores on this construct. Reported attitudes towards animal welfare (AW) were quite strong with high mean values (around 5), indicating that participants consider this issue highly important. Attitudes towards beef consumption (ATT) are generally positive (all mean values above 5), indicating that the focus group participants experience good feelings, satisfaction, pleasure, excitement and delightfulness when eating beef.

The internal reliability test (Cronbach's α-values) indicates that the scales are valid instruments to measure the proposed constructs. The lowest value is obtained for the short version of the Food Neophobia Scale (Cronbach's α FNS = 0.61, which is still satisfactory), whereas all other scales had values of 0.80 or higher (DSI α = 0.80, AW α = 0.83, ATT α = 0.93, INV α = 0.91).

Table 2.2: Comparison of the attitude scales within the sample of Study 1

	Spain (n=15)		France (n=18)		Germany (n=16)		UK (n=16)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
DSI	4.06	1.35	4.44	1.30	4.94	1.04	4.56	0.98
FNS	3.89	1.40	4.54	1.14	4.54	0.96	4.62	1.11
AW	5.28	1.05	4.92	1.21	5.89	0.78	4.94	1.37
ATT	5.83	0.97	5.30	1.29	5.04	1.23	5.11	1.06
INV	4.65[a,b]	0.90	5.43[b]	1.25	5.06[a,b]	1.33	4.00[a]	1.07

[a, b] indicate significant different means using ANOVA F-test with Tukey HSD Post Hoc test on a 7-point scale. SD = Standard Deviation, DSI = Domain Specific Innovativeness (1: low innovativeness – 2: high innovativeness), FNS = Food Neophobia Scale (1: high food neophobia – 7: low food neophobia), AW = Animal welfare (1: low importance – 7: high importance), ATT = Feelings when eating meat as a main course (1: negative – 7: positive), INV = Involvement with beef (1: low involvement – 7: high involvement).

2.3.2. Perceptions of beef safety

The main findings from the content analysis are very similar in the four involved countries. The results from the focus group discussions are presented by themes and illustrated with verbatim quotes from the participants.

a. Definition of and associations with beef safety

Beef safety was defined in relation to consumers' health. Safe beef was perceived as beef that is not bad for consumers' health: *"It shouldn't be making me ill"* (British man, 30 years). Beef safety was thought of as a precondition that allowed for the consumption of beef products without the need of being concerned.

The focus group participants associated beef safety with regulations, control, experiences of beef safety and safety cues. Regulations were considered to be necessary at different levels. In the first place, national governments were expected to protect consumers against poisonous food by means of laws and regulations. Furthermore, *"there is a need for a clear, cross-border legislation"* (French man, 49 years). To assure that the regulations are complied with, control was deemed necessary. The participants expected control mainly on three domains: the production methods (breeding practices, origin, hygiene, vaccination and especially animal feeding), the place of purchase (hygiene, certificates) and quality control of the beef products. Traceability, to know what is going on *"from the beginning to the end"* was considered as an important element of beef safety control (French woman, 58 years). The focus group participants furthermore associated beef safety with experiences they have with issues related to beef safety (e.g. food scares like BSE) and with particular cues signalling beef safety in consumers' opinions (e.g. colour and certificates).

b. Difficulties in beef safety assessment

Focus group participants acknowledged that it is hard to decide whether beef is safe or not. The difficulties that might arise in assessing beef safety originated from different sources (see Figure 2.1).

A major factor is the occurrence of international food scares and the attendant media attention. Although most participants indicated not to think too much about the risks of BSE while purchasing and consuming beef, it was still a prominent issue for some: *"Every time I go to buy beef I think of the BSE. I do. It's in my head every time I go and buy it..."* (British woman, 38 years). The focus group participants also kept their thoughts on national scandals in the beef sector, like the French meat processing firm Charal being accused of using spoiled meat for canned corned beef in January 2007: *"There have been problems, like with the Charal meat"* (French woman, 44 year). A second source of difficulties in evaluation beef safety was the admitted lack of knowledge about beef safety. The participants acknowledged having little objective or factual knowledge about the safety of beef. Statements like *"We don't know what will happen in the long term"* (French man, 30 years), *"I don't know what*

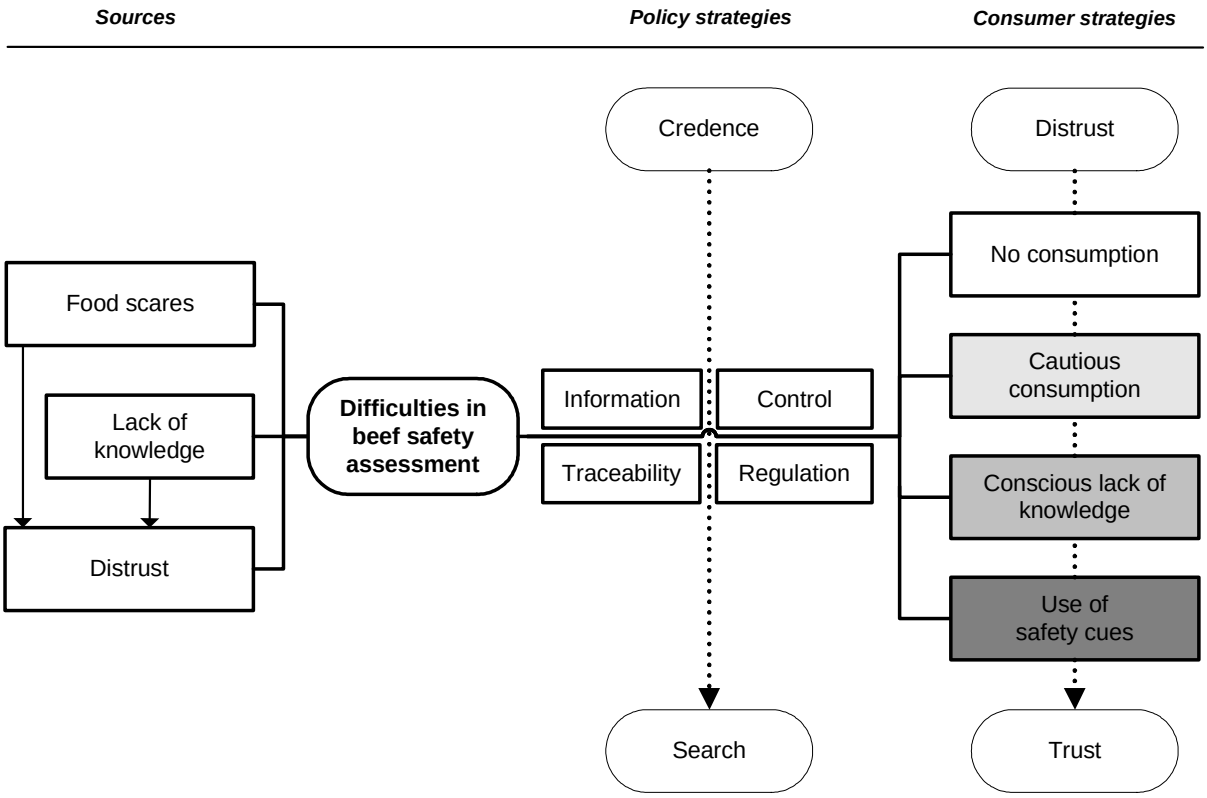


Figure 2.1: Consumer and policy strategies to deal with consumers' difficulties to assess beef safety

kind of treatment is applied to the beef that I consume" (German woman, 27 years) and *"I am not an expert, I can't say what is good or bad in beef"* (French man, 24 years) were clear examples of the lack of factual knowledge about beef safety expressed by the focus group participants. This caused participants feeling uncertain and being afraid for unknown consequences of food and beef crises. A third source was general distrust in the beef safety production chain. This distrust can be related to the production system *("Everything is manipulated, it really scares me"* French woman, 60 years), the actors *("I just have a great distrust in the whole kind of meat industry"* British woman, 34 years) and/or the provision of information *("Objectivity in information is important, but private firms and beef producers only want to sell their products"* German man, 49 years). Intermediaries, slaughterhouses, meat processing industries and beef packaging companies were not generally considered to be reliable actors and trustworthy information sources (see Table 2.3). Independent institutions who allocate quality labels and certificates could benefit from a higher degree of consumer's confidence: *"We need independent institutions and controls. Otherwise, they see only their own interest and not ours"* (French woman, 60 years). Brands were trusted, just as supermarkets and butcher stores, which were – opposed to kebab stores, for example – thought of as reliable actors in the beef safety chain. Also consumer organisations and retailers' recommendations about beef safety were trusted. Interestingly, cattle farmers were not spontaneously mentioned as either trusted or distrusted actors responsible for beef safety.

Table 2.3: Trusted and distrusted actors and activities in the beef chain with relation to beef safety

Production	Processing	Distribution	Consumption
None	Slaughterhouses[1]	Quality labels	Consumer organisations
	Meat industries[1]	Certificates	
	Packaging firms[1]	Brands	
		Supermarkets/butcher	
		Retailers' recommendations	

[1] Actors that consumers distrust concerning beef safety and beef safety information provision

c. Uncertainty reduction strategies

Focus group participants reported to develop different strategies to deal with the difficulties in assessing beef safety. These strategies correspond with the degree of trust consumers place in the beef safety system. Consumers who stopped or radically diminished their beef consumption were not present in the focus groups (they all consumed beef at least once a week). But still, the option of quitting beef consumption was mentioned by the participants: *"We have the choice. And that is why a lot of people are trying to be vegetarian and don't eat meat so much now"* (British woman, 38 years). A second strategy consists of a cautious continuation of beef consumption, with a lasting awareness of the beef safety issues: *"Swine fever, bird flu, mad cow disease... Now what can you eat anymore? Scepticism is always with you"* (German man, 52 years). Since these consumers continued to eat beef, some degree of trust in the system seems to be present. A third strategy is to adhere to a conscious lack of knowledge. In that case, the participants preferred not to know too many details about the production and processing of beef and beef products. As they do not want to be confronted with possibly negative information about their food, they prefer to remain ignorant. This creates a (possibly false) feeling of security. In all focus group discussions, clear statements about this conscious lack of knowledge were found, e.g. *"It's true that you can ask too many questions and then it becomes distressing, because you trust a butcher who will maybe later do some... then you don't eat anything anymore"* (French women, 43 years).

d. Evaluative criteria

A fourth strategy relates to the conscious use of beef safety cues. Safety cues are pieces of information used to form expectations concerning the safety of a product (de Carlos et al., 2005). To assess beef safety, the focus group participants indicated to use specific characteristics of beef. Table 2.4 shows which product or environmental characteristics and categories of beef were perceived as safe versus unsafe by the focus group participants.

Table 2.4: Cues signalling safe and unsafe beef

Cues signalling safe beef	Cues signalling unsafe beef
Labelled beef	BSE/scandals
Branded beef	From foreign countries
Own country PDO/PGI beef	Expired beef
Organic beef	Offals
Quality guaranteed beef	Minced meat
'Natural' beef (grass-fed, well treated, only slightly processed)	Sold and processed in unhygienic conditions
Available beef	Packaged beef
Good appearance (especially colour)	Canned beef
Frozen beef	Restructured beef products
Fresh beef	Cheap beef
Butcher/supermarket[1]	Butcher/supermarket[1]

[1] No consensus about whether the place of purchase butcher versus supermarket signals safe or unsafe beef

2.3.3. Interest in beef safety and beef safety information

Participants stated that obligatory and controlled safety is a necessary condition for beef consumption. Beef safety was associated with regulations, legislation and control. Nevertheless, some focus group participants admitted to consume beef that is perceived as less safe sometimes: *"The problem is that... well I buy particularly canned foods"* (French woman, 20 years). The amount of expected beef safety information was not clear from the focus group discussions. Part of the participants felt there is not enough information about beef safety available, while others stated to be faced with an overload of (conflicting) information which might increase the difficulties to assess beef safety. The use of beef safety information also diverged between participants: some were looking actively for information, others did not pay attention to it. Focus group participants' expectations with regard to the content, providers and media of information about beef safety are stated in Table 2.5.

2.3.4. Expectations on beef safety responsibility

The responsibility for beef safety (see Table 2.6) was put mainly on actors that are situated early in the beef production chain. The conditions in which animals are born, raised and killed were thought to be important antecedents of beef safety. Therefore, farmers, veterinarians, inspectors, abattoirs and scientists were considered to be responsible for beef safety in the first place. Independent institutes should control beef safety and grant certificates and labels based on beef safety. Furthermore, (inter)national celebrities were believed to be in a good position to bring beef safety issues to the front. Consumers therefore thought that they should use this position to put pressure on regulating institutions and inform people about beef safety.

Table 2.5: Information about beef safety: consumers' expectations

What? Expected information	Who? Information providers	How? Information channels
Expiry date	Government	Label
Slaughter date	Government institutions	Internet
Additives	Independent institutions	TV debate
Breeding practices:	Farmer	TV documentary
- Origin	Breeder	Folder
- Where raised	Abattoir	Magazine
- Animal feed	Processing industry	School
- Animal welfare	Supermarket	
Traceability	Butcher	
	Consumer organisations	
	Media	
	School	
	Medical science	

Table 2.6: Responsibility for beef safety through the beef chain: consumers' expectations

Production	Processing	Distribution	Consumption
Farmers	Abattoir	Independent institutes for labelling	Celebrities
Inspectors	Inspectors		Consumers[1]
Veterinarians	Scientists		
Scientists			

[1] Related to the question "*Who do you think should be responsible for beef safety?"* participants did not mention consumers. However, during the focus group discussion, consumers talked about their own responsibility for beef safety when discussing cooking methods and individual choices of beef cuts and products.

2.4. Discussion and conclusions

2.4.1. How do participants define beef safety and experience beef safety assessment difficulties?

The findings indicate that beef safety is difficult to assess by many consumers. The level of food safety is in most cases unobservable to consumers. Even after consumption and in absence of immediate illness, it is hard to say whether a beef product is safe or not (Rohr et al., 2005). The difficulties in assessing beef safety were fed and reinforced by a lack of knowledge, a general distrust in the beef safety system and the recurrent food scares, particularly when occurring in the beef sector. Reducing the difficulties faced by consumers when assessing beef safety is important for those involved in maintaining and improving beef safety.

As previous research has shown, food safety is a multidimensional concept (Jevsnika et al., 2008; Rohr et al., 2005). Our results confirm that consumers interpret beef safety largely as being strongly related to personal health. The increasing attention for individual health

presumably contributes to the importance of this interpretation. Furthermore, the findings of the group discussions also confirmed beef safety to be associated with regulation, control and traceability. This knowledge facilitates the identification of ways to transform beef safety as credence attribute into a search attribute. Our results suggest that focussing on regulation, control and traceability can help consumers to evaluate the safety of beef and beef products.

2.4.2. How do focus group participants assess beef safety?

The participants developed diverging strategies to handle the difficulties in assessing beef safety. We identified four consumer strategies, which can be grouped into two generic risk reduction strategies found in literature. A first generic risk reduction strategy consists of individuals attempting to reduce risk. One way to do this is using risk relievers to enhance the probability of product process (McCarthy & Henson, 2005). This corresponds to the use of safety cues. Another way of reducing the risk and associated concern is through a conscious lack of knowledge that can be frequently identified in the focus group discussions. A second generic risk reduction strategy consists of consumers trying to minimise the consequences in case a product should fail. Consumer strategies of no consumption and more cautious consumption can be grouped under this heading.

Our results show that focus group participants use a lot of different cues to assess beef safety, both intrinsic and extrinsic cues. These cues transform beef safety from a credence criterion into a search criterion and thus help consumer assess and form expectations related to beef safety. Several intrinsic cues signalling safety were mentioned by the focus group participants, like colour, texture, and fat content: *"I am just looking at whichever one looks nicer really, assuming the better looking product is also the safer option"* (British man, 21 years). This corresponds with findings in literature which highlight the importance of intrinsic cues in beef purchasing decisions (Krystallis & Arvanitoyannis, 2006; McCarthy & Henson, 2005). Intrinsic cues like colour were believed to major indications of beef safety and quality. This might partly explain why packaged and glass-bottled beef were perceived as less safe, since these types of packaging did not allow consumers to assess the intrinsic quality cues of the beef product. For the same reason, fresh and frozen beef were perceived as quite safe.

Extrinsic cues are also important in assessing beef safety. Focus group participants perceived labelled beef as safe beef. Product labelling allows the presentation of product-specific information to consumers (Verbeke & Ward, 2006). Labels can provide a wide diversity of information. They can contain the price or the expiry date of the product, a producer's or distributor's brand name, the country or region of origin, production method-related information like organic beef or grass-fed beef, a traceability certification, or a quality guarantee (Krystallis & Arvanitoyannis, 2006; Verbeke & Ward, 2006). The information revealed on the label transforms the underlying criterion from a credence or experience attribute into a search attribute (Ehmke et al., 2006). Notwithstanding, the labelling of food safety in itself is not that obvious. Food safety assurance is among others based on the examination of samples of the concerned products. Even if all examined samples are safe for

human consumption, one cannot be sure that all other non-sampled products are definitely safe. By examination of product samples the likelihood of consuming unsafe products decreases, but it will never become nonexistent (Benford, 2008). Zero-risk is not achievable and therefore, the labelling of safety in the food industry is a tricky business.

Region or country of origin is an important extrinsic safety cue for most focus group participants. Beef originating from the own country was perceived as safer than beef from other countries of origin. This is related to the concept of consumer ethnocentrism (Shimp & Sharma, 1987). This result is not in accordance with studies that conclude that designation of beef origin has no significant impact on expected product safety (Bernués et al., 2003b). Note in this respect that a designation of origin does not necessarily refer to the region of origin where the consumer lives, and therefore such designations are not necessarily appealing to ethnocentrism. Nevertheless, knowledge about the country or region of origin can make a difference. Focus group participants tended to know and trust the regulations and specificities of their own country better than those of other countries and therefore, country of origin labelling can enhance consumers' perceived beef safety (Grunert, 2005). The higher knowledge and trust in the own country or region is expressed by the participants. In particular British male consumers tended to think their country has better beef safety regulations than the European continent: *"There are much tighter controls in this country than practically anywhere else I think"* (British man, 30 years). French women vice versa considered French beef safer than beef from the UK or Eastern countries. Beef labelled with a Protected Designation of Origin (PDO) or a Protected Geographical Indication (PGI) label was thus also perceived as being safer. This was especially the case for Spanish consumers, since in Spain some regions are really known for particular quality beef, e.g. "Carne de Avila" (PDO). Our findings correspond very well with the result of a study by Oliver et al. (2006), which concluded that foreign beef is more acceptable to German consumers than in the UK and Spain.

The focus group participants indicate that branded beef is perceived as safe. This result corresponds with findings in literature which suggest that the presence of a producer or a retailer brand name is deemed important by consumers to assess beef quality (Krystallis & Arvanitoyannis, 2006). The same applies to quality guaranteed beef. Quality labels provide additional certainty about a consistent beef quality. Focus group participants state that the experience of a consistent and homogeneous quality across the products of a company or a butcher is influencing their beef purchase decision. Brand and quality labels indicate that the beef has undergone a certain type of control, therefore consumers consider it as safe (Sepulveda et al., 2008). Quality type indicators were also considered among the most important information cues by consumers when making beef purchasing decisions (Verbeke & Ward, 2006).

Although currently no scientific evidence is available that organic beef is safer than non-organic beef, focus group participants perceive the "organic" status of beef as an indication of

safety because of the perceived higher naturalness of the organic production methods. This is in accordance with the major part of the relevant research literature about this topic (Yiridoe et al., 2005). Focus group participants state that beef is considered to be 'natural' when the animals have been treated and fed in a decent, healthy and animal friendly way (*"breeding them fairly and not over-breeding them"* British woman, 29 years), and the beef products are not or only slightly processed and do not contain added artificial ingredients. This "natural" aspect is frequently mentioned in all focus groups. Organic beef is considered to be produced more natural and thus to be safer. In the same regard, minimally processed beef products like steak and roast are considered more natural and thus safer than further processed beef products like minced beef and restructured beef products.

Less expensive beef is perceived as less safe: *"It is a cheaper type... in other words everything goes into it and is restructured"* (German woman, 47 years). This is related to the fact that the perceived quality of expensive beef is higher. However, the relation between price and perceived quality is not unambiguous since it is influenced by characteristics of the consumer and the specific product, and the availability of other information (Zeithaml, 1988).

Although in general small shops that sell snacks such as kebab or hamburgers are less trusted, focus group participants have diverging opinions about the place of purchase as an indicator of safe meat. For some, the personal contact with the butcher is important in reassuring them about beef safety. Butchers are the traditional meat suppliers and consumers often rely on the butchers' recommendations and reassurances with respect to beef safety. Others think butcher stores are less safe, since *"you never know what happens in the back"* (French man, 19 years). Supermarkets are trusted for beef safety, mainly because of the higher sales and the presence of labels, which are perceived as independent objective proofs of certification, in supermarkets. These diverging preferences for the place of beef purchase are also noticeable throughout the research literature (Krystallis & Arvanitoyannis, 2006; Rosa et al., 2006; Verbeke & Vackier, 2004).

2.4.3. Beef safety information: from credence to search

Although some focus group participants indicate that there is little beef safety information available, most focus group participants agree that there is an abundance of information: *"More and more things are given publicity to and it is more difficult now to keep something hidden. The amount of information is a lot bigger and you are informed very fast"* (French woman, 58 years). The accessibility of the concerned information is however rather low: *"There is lots and lots of information. But you never know, at least I never know where to look"* (French man, 24 years); *"The information never comes to me, unless I search for it"* (Spanish woman, 48 years).

Focus group participants expect to be informed about a lot of different aspects of beef safety (see Table 2.5). However, a considerable number of the focus group participants indicate that they hardly use this information: *"For me, personally, I am not really a very good person. I couldn't care less but I know a lot of people, my friends when they go and buy their meat look*

now where it comes from. What farm it comes from, how it's been... you know, kept in a cage its whole life or in a nice field. Personally, if the meat tastes good for me, I am happy" (British man, 21 years).

The stated expected information is very similar to the information that consumers already use for beef safety assessment, apart from the traceability information, the slaughter date of the animal and the possible presence of additives in the beef product. The latter is linked to the notion of natural beef and the slaughter date is related to the expiry date. Because of their close relation to existing safety cues, the presence of this additional information is likely to facilitate the transformation of beef safety from a credence into a search criterion. The interest of the focus group participants in traceability throughout the beef chain suggests that traceability is demanded by consumers. Research by Verbeke et al. (2006) however showed that consumers are not interested in the traceability information *in se*, but rather prefer to know that traceability has been established and that somebody is keeping track of the meat's history. Traceability merely has to be in place for legal purpose and in order to help guaranteeing product safety and quality. Bernués et al. (2003b; 2003a) found that consumers have widely diverging requirements with respect to traceability information. The extent to which traceability information can contribute to a transformation of beef safety from a credence attribute into a search attribute is therefore rather low.

2.4.4. Trust and perceived responsibility concerning beef safety

The fact that participants widely consider the available beef as safe beef implies a high degree of trust by consumers in the safety regulations and controls in the current beef chain. Focus group participants indicate to trust that the control over beef safety is executed by competent people and institutions (especially in their own country) and that government beef safety regulations and controls are adequate and trustworthy, both from the national government as from the EU. This indicates that in general, consumer trust in beef safety is relatively high. This result does not correspond with the prevailing idea of declining trust in food. Recent food scares, new food technologies and a declining trust in science and scientific institutions are believed to have contributed to a declining level of trust in food safety in Europe (Niva & Mäkelä, 2007). Indeed, consumer distrust in food emerged on the political agenda since the mid nineties. There is however few empirical evidence to confirm a more long-term downward trend in trust in food safety (Kjaernes, 2006).

Although the overall trust in beef safety is high, focus group participants also expressed some distrust in the beef industry: *"I just have a great distrust in the whole kind of beef industry. You know, I eat meat and I don't have a problem with it... I just think that there is so much messing with our food these days, that they just don't tell us about, just to kind of get maximum profit and all that"* (British woman, 34 years).

Comparing the actors stated in Table 2.3 (trust) with those in Table 2.6 (responsibility), it is striking that actors in the upstream parts of the beef chain (production and processing) are trusted the least, while focus group participants want them to be responsible for beef safety.

The more trusted actors are situated in the distribution and retailing part of the beef chain, thus closer to consumers. Focus group participants state only few responsible actors here. It seems that consumers put more trust in actors they are most familiar with. An even more striking observation in this respect is the fact that consumers have a rather low awareness of their own responsibility for beef safety. While discussing about beef safety in general, the focus group participants recognise the importance of personal practices: *"If it is cooked properly and if it's been cooked thoroughly... you are not going to sort of get food poisoning from it really"* (British man, 21 years). However, no one of the participants in all focus groups considers oneself responsible for beef safety, if the question is asked directly. A second indicator of the low awareness of consumers' responsibility for beef safety is the perceived safety of frozen beef. Because of the way of handling after purchase, frozen beef is in fact often unsafe (Karabudak et al., 2008). It seems that the focus group participants are confident about their own food handling practices. The low awareness of consumers' responsibility for maintaining food safety standards has also been observed in other studies (Ovca & Jevsnik, 2009; Rosati & Saba, 2004).

The issue of trust concerning beef safety is on the one hand of particular importance for the choice of the consumer strategy (see Figure 2.1). Consumers who distrust the beef production system, the actors and/or the provided information, are more likely to choose to quit or radically diminish beef consumption when experiencing difficulties in beef safety assessment. As consumer trust increases, consumers are more inclined to choose for the strategy of cautious consumption and the use of safety information cues. On the other hand, the issue of trust with respect to beef safety is important for the transformation of credence criteria into search criteria. Without trust in the actors and information providers behind the search criteria, the transformation can never be successful.

2.4.5. Managerial and research implications

Measures to reduce consumer uncertainty are most of all a matter of effective and transparent information communication to the consumer. The safety of beef is not observable, though at the same time also not negotiable for consumers. Since safety is a typical credence product characteristic, building trust in actors who communicate is crucial. This requires, first, maximum efforts to avoid the occurrence of beef safety incidents, thus stressing the role of beef safety technologies and safety controls. These efforts can be made visible through labelling or guarantees from independent third party certification organisations, hence making "safety" more visible and searchable during meat purchasing.

Second, from a consumer perspective, all actors in the beef supply chain and related institutions or authorities are requested to provide enough and satisfying information. Reducing consumer uncertainty could include the establishment of an integrated information chain between all actors involved in producing, processing and retailing beef and beef products. Furthermore, the provision of information should be structured and allocated to those actors consumers have most trust in. Hence, actors in which consumers have a good

degree of “baseline” confidence, as identified in this study, are an important asset in this respect.

Third, the information provided should be in a format that is easy accessible and without overloading consumers with unnecessary information and technical details. If trusted, such information would allow consumers to cope with their beef safety concerns and to assess beef safety more straightforward.

Nevertheless because of the exploratory nature of our study, it remains somewhat speculative to set forth conclusive recommendations. Future studies are recommended to investigate consumer concerns with regard to beef safety using quantitative methods, and to focus on safety within other meat chains, aiming to reveal new insights in the perception and interest of this issue among meat consumers.

Chapter 3: Consumer perceptions of beef healthiness

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Abstract

Consumer perception of the healthiness of beef is an important determinant of beef consumption. However, little is known about how consumers perceive the healthiness of beef. The aim of this chapter is to shed light on the associations between beef and health. Eight focus group discussions were conducted in four European countries (France, Germany, Spain, and the UK), each consisting of seven to nine participants. A content analysis was performed on the transcripts of these discussions. Although beef was generally perceived as healthful, focus group participants expected positive as well as negative effects of beef consumption on their health. Labelled, branded, fresh and lean beef were perceived as signalling healthful beef, in contrast with further processed and packaged beef. Consumers felt that their individual choices could make a difference with respect to the healthiness of beef consumed. Focus group participants were not in favour of improving beef healthiness during processing, but rather focussed on appropriate consumption behaviour and preparation methods. The individual responsibility for health implies that consumers should be able to make correct judgements about how healthful their food is. However, the results of this chapter indicate that an accurate assessment of beef healthiness is not always straightforward. The presented results on consumer perceptions of beef healthiness provide insights into consumer decision making processes, which are important for the innovation and product differentiation in the European beef sector, as well as for public health policy decisions related to meat consumption in general and beef consumption in particular.

3.1. Introduction

Although beef constitutes an important part of many consumers' diets, its consumption has become a quite controversial issue. On the one hand, red meat provides essential nutrients, containing high quality protein and essential micronutrients such as vitamins A, B_6, B_{12}, D and E, iron, zinc and selenium, contributing to consumers' health throughout life (Scollan et al., 2006; Williamson et al., 2005). Therefore, the nutritional value has been key to communicate the health benefits of red meat to consumers (Tapsell, 2007). On the other hand, over the last two decades, this positive image of the nutritional value of red meat has often been overshadowed by diverging developments in the consumer market and in the meat sector itself (Scollan et al., 2006). Consumers have become increasingly concerned about food-borne risks and personal health. As a consequence, consumer demand for safe and healthful foods has been increasing. The fat content and the possibly negative effect of red meat on consumers' cholesterol levels have become one of their major health concerns (Gustafsson & Sidenvall, 2002; Resurreccion, 2002; Verbeke et al., 1999a). Also changes in consumer taste and preference have occurred, such as the increased consumption of processed meat products (Grunert, 2006). Furthermore, consumers have been increasingly expressing ethical and environmental concerns related to meat consumption, since beef production is particularly resource intensive and inefficient, putting pressure on the natural environment, climate, energy, water and biodiversity (Popkin, 2009; Gossard & York, 2003; Gustafsson & Sidenvall, 2002).

A main factor in the controversial nature of meat is the occurrence of food safety incidents. The meat sector, and especially the beef sector, is susceptible to food scares such as the BSE crisis, or the presence of harmful residues (e.g. dioxins) in the final products. These incidents, and the initial lack of responsiveness of the beef sector, have harmed the reputation of the sector (Verbeke & Viaene, 1999a). Another important factor is the recent research and consumer interest in the association between red meat and cancer (Scollan et al., 2006). Altogether, the controversial nature of beef has been revealed by declining consumption rates and consumer confidence in developed countries (Resurreccion, 2002; Verbeke & Viaene, 1999a) and has complicated a balanced judgement of the healthiness of beef by consumers (Lea & Worsley, 2002). Consumers may feel confused by receiving diverging and possibly contradicting information about the healthiness of beef. Therefore, despite conclusive evidence about the positive effect of the nutrients in beef when consumed in reasonable amounts as part of a varied diet, consumer perceptions of the healthiness of beef might not be univocally positive.

The perception of the healthiness of foods is influenced by various factors, such as type and processing of raw materials, origin, production date, preservation method, packaging and use of additives (Bech-Larsen & Grunert, 2003). Consumers can only evaluate the nutritional content of the food by relying on nutritional labelling. The use of such information is higher for consumers who are more health-minded and consume beef less frequently (Rimal, 2005).

The use of health claims on food products can enhance consumer perceptions of the healthiness of products (Verbeke et al., 2009; Bech-Larsen & Grunert, 2003). From previous research it is known that health and nutrition considerations, such as cholesterol and saturated fat content, can play a role in consumer choices (da Fonseca & Salay, 2008; Rimal, 2005). Therefore, it is important to know how consumers perceive the healthiness of beef. This knowledge is crucial in determining consumers' acceptance of new beef products to be developed (Ares & Gambaro, 2007) and in facing the challenges related to the current economic crisis. Most studies about consumer perception of beef have been performed in the aftermath of the BSE crises, focussing mostly on safety aspects. Little is known about current perceptions of beef healthiness (Paquette, 2005b). Many intermediary factors that may influence beliefs about beef remain unknown, urging for more research in this field (Lea & Worsley, 2002).

A common framework for the analysis of consumer quality perception and decision-making in the food sector is the Total Food Quality Model (Grunert et al., 2004). The model distinguishes between before and after purchase evaluations. In making food choices, consumers develop expectations about the quality characteristics of food products, including healthiness. Since healthiness is a credence attribute, consumers can only to a limited extent experience the real healthiness of the beef, even after purchase and consumption. The level of the healthiness of beef is neither clearly observable for consumers, nor can it readily be experienced. Consumers should have faith in the product, or rely on the available information, such as health claims. Because of this credence nature, this analysis focuses on the before purchase evaluation of the healthiness of beef. Before purchasing, expectations on the healthiness of beef are formed based on cues and information that are available for consumers (Grunert et al., 2004), being intrinsic (physical characteristics of the product) or extrinsic cues. After the purchase, consumers might hardly ever experience the healthiness of beef, making it hard to compare the expected with the experienced healthiness.

In this chapter, European consumers' perceptions of the healthiness of beef are explored. A qualitative study was conducted in four European countries, assessing consumer perceptions of the healthiness of beef. This study adds to our knowledge and understanding of consumer perceptions related to beef by investigating expected health effects, the perceived role of beef in the diet, cues signalling (un)healthful beef and consumers' suggestions to improve the healthiness of beef. The results provide more insight into consumer decision making processes by exploring how consumers perceive and assess the healthiness of beef.

3.2. Methodology

3.2.1. Focus group participants

Eight focus groups were conducted in the capital cities of France, Germany, Spain, and the United Kingdom during May 2008. In each country, two group discussions with seven to nine participants each were performed, being one composed of women and another one of men. All participants were beef consumers. The topic guide of the focus group discussion is included in Appendix I. Procedures for conducting the focus groups and the content analysis have been described in 1.5.1. The findings from the focus group discussions insofar they relate to beef healthiness (including perceptions, cues and responsibility) are discussed in the present chapter.

3.2.2. Methodological limitations

The limited number of participants and the lack of representativeness imply that the results cannot be readily extrapolated to the population. This is not the objective of this exploratory research, though. Furthermore, the relative importance of the different concerns about beef healthiness is not reflected in the results, since focus group results do not allow sorting out the importance of the consumer opinions. While interpreting the results, these limitations should be kept in mind. Notwithstanding the methodological limitations, focus group studies have been proven to be valuable and were successful in exploring consumer perceptions in the domain of food-related behaviour (Barrios et al., 2008).

3.3. Results

Health was important for all participants of the focus groups: "*Your health is the most important in life, and you must take care of that in any case*" (German woman, 28 years). Participants related health to being healthy and in good shape, well-being and happiness, power and sport, and a long and joyful life. The specific themes with respect to beef healthiness are discussed as structured in Figure 3.1.

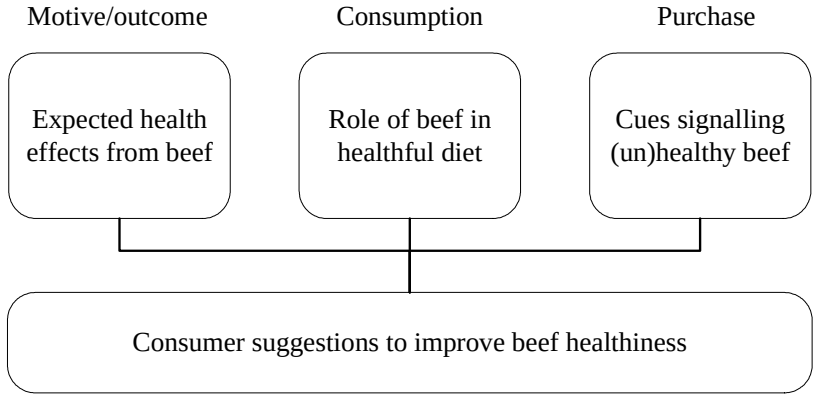

Figure 3.1: Overview of the results of Study 1 related to beef healthiness

3.3.1. Expected positive health effects of consuming beef

Overall, most of the participants considered beef as healthful. First, consumers expressed high trust in food regulations: "*There are so many laws about everything that I would be surprised if they would get away with stuff that actually affects your health in a negative way*" (British man, 33 years).

Second, the nutritional value of beef was well recognised in all focus groups: "*Beef is nutritious*" (German woman, 48 years). The main focus was on iron and proteins, although they felt quite unsure about particular nutrients in beef: "*I think it can provide iron, when you are feeling low*" (British woman, 34 years), and "*beef has a good amount of proteins*" (German man, 41 years). Furthermore, beef was considered as a rather lean type of meat by most participants: "*Beef is healthful in the sense that it is pure, it is not fatty*" (British woman, 29 years) and "*it has less fat than other meats*" (Spanish woman, 48 years). Others disagreed: "*Its fat content is quite high, isn't it though?*" (British man, 44 years).

Because of its high nutritional value, beef was believed to "*provide strength, energy and vitality*" (French woman, 44 years), "*for people that work hard*" (British woman, 29 years). Multiple statements clearly expressed this belief: "*My children are of the sportive type and they need and eat a lot of beef*" (Spanish woman, 48 years), "*A meal has to give you power, you have to eat red meat*" (French man, 49 years) and "*Body-builders eat steaks as well, you know, to build themselves up*" (British man, 30 years). Although most consumers considered beef as indispensable in a healthful diet ("*I believe vegetarians have nutritional deficiencies*", Spanish woman, 48 years), some participants expressed doubts about the necessity of beef in the diet: "*I have vegetarian friends who do not eat beef and have not eaten it for years, so I do not think it is important in the nutritional sense*" (British woman, 34 years). In contrast, general agreement existed about the importance of beef in children's diets: "*For children, beef is a necessity, otherwise they will have deficiencies of iron and proteins. Children who do not consume meat, have major health problems*" (French women, 43 and 58 years). Furthermore, beef was stated to be good for bone formation and dental development, though for other perceived reasons than its vitamin and mineral content: "*It is still one of the meat types which allow us to chew*" (French man, 43 years).

3.3.2. Expected negative health effects of consuming beef

Most consumers did not worry about beef healthiness: "*Meat is one of the last things I worry about, because you are conditioned to think it is good for you*" (British man, 21 years). Nevertheless, a number of consumers had some doubts: "*I would not say that beef in itself is healthful*" (German man, 41 years); "*It is not really healthful in a way because it is red meat*" (British woman, 37 years). Consumers identified various possible negative effects on human health. Concerns were expressed about the carcinogenic effect of beef consumption: "*I have read that there is a correlation between the amount of beef consumed and the growing number of cancers*" (French man, 20 years) and "*Baking and grilling, well, any change in the surface of the food can cause cancer*" (British women, 34 and 38 years). Concerns

particularly related to the adverse accumulative effect of meat consumption in the long term: "*These diseases... it is not today, it will be in twenty years. Cancers and things like that*" (French woman, 44 years). Besides the expected carcinogenic effect, beef consumption was perceived as having "*negative outcomes for the veins*" (French man, 58 years) and "*increasing cholesterol levels*" (British woman, 37 years) and thus "*causing cardiovascular diseases*" (French man, 20 years). Another perceived potential danger was the transfer of animal diseases to humans: "*It causes Creutzfeldt-Jakob disease*" (French man, 58 years). Beef consumption could also promote obesity as perceived by some focus group participants, since "*while processing beef, they put a lot of fat in it*" (French woman, 20 years). According to some consumers, beef consumption might decrease life expectancy and cause death: "*We know that bad meat can kill*" (British woman, 34 years).

These negative effects of beef consumption on human health were perceived as related to the amount and type of beef consumed, the preparation method, and the presence of harmful residues in the beef. In the first place, the amount of beef was considered as important: "*Beef is healthful when consumed in the right amount*" (German man, 48 years). Beef was considered as harmful for human health at high consumption levels: "*Too much red meat can be bad for you*" (British man, 31 years). The participants agreed that moderation in the frequency of consumption is important: "*More than once but definitely not every day of the week*" (British man, 31 years), since "*anything in excess is not good for you*" (British woman, 34 years); "*I eat beef with moderation since it is unhealthful to eat too much meat*" (Spanish man, 26 years). Numerous statements in all focus groups suggested general support for moderate beef consumption, e.g. "*Everything depends on the way and in which amount the beef is consumed. Don't eat beef in excess*" (French man, 43 years). Not only the amount of beef consumed raised concerns, but also the best possible specific beef product and the preparation method ("*Some beef cuts are leaner than others*", French man, 43 years; "*The way you prepare it determines whether beef is healthful*", German man, 48 years). Consumers mentioned different preparation methods in this respect: "*After all it depends on how it is prepared. Whether you prepare your meat with a lot of butter or not*" (French man, 43 years); "*If you prepare it in a deep fat fryer, then you know that it is not very healthful*" (British woman, 40 years); and "*Steak or roast is better for your health than beef prepared with a sauce*" (French woman, 60 years). Interestingly, the "unhealthful" aspects were not directly related to beef as the core product, but rather related to the "side" and preparation ingredients such as butter, margarine, oil or sauce.

Focus group participants were also concerned about the presence of harmful residues in beef: "*I think beef is not intrinsically or naturally unhealthful, apart from the things that are inside*" (German man, 51 years). These residues might originate from animal feeding ("*What they are eating, in the fields, that is what caused BSE wasn't it?*", British man, 30 years) or from medicinal treatments or the use of growth hormones ("*Steroids are passing into the food chain*", British man, 30 years). Nevertheless, medical treatments were not experienced as

exclusively detrimental: "*Vaccination of the animals to avoid illness is a good thing*" (French woman, 44 years).

3.3.3. Perception of beef as a component of a healthful diet

A healthful diet is a balanced diet. That was the firm belief of all participants of the focus groups: "*The mixture of things you eat determines whether you eat healthful*" (German woman, 27 years). The right amount of beef was considered as an important part of a balanced diet: "*I try to achieve the right balance between vegetables and meat*" (French man, 24 years) and "*It is always important how much beef you eat and whether you have a balanced diet, with vegetables and fruit and other things*" (German man, 51 years). Discussing healthful diets, consumers also mentioned the importance of a low intake of calories and fat. Beef was perceived as a food product matching these recommendations: "*When you are careful with calories, you better eat beef*" (German woman, 47 years) and "*beef is good for a diet without too much fat*" (French woman, 60 years). Overall, beef was perceived as an important part of a balanced, healthful diet ("*Mediterranean diet is full of meat and stews*", Spanish man, 38 years), corresponding to a healthful lifestyle: "*It is the overall picture that is important: whether you do not drink alcohol, whether you do not smoke, whether you exercise*" (French man, 43 years). Speaking of alcohol, you owe me a box of beer, Jeroen.

Most participants assigned an equally important position in their meal to beef as to other types of meat, "*in competition with chicken and pork*" (French man, 35 years). While for some consumers beef was the main component of their diet throughout the lifecycle ("*We eat a lot more meat than fruits and vegetables*", French man, 51 years and "*All your life your mother has served filets*", Spanish man, 25 years), others put it into perspective: "*Beef is only one element of our food. In general, meat is a part of our food, but it is not the only thing we eat*" (French man, 43 years). Consumers stated that beef is more healthful than pork but less healthful than white meat. This idea was expressed in most focus groups, although the participants stated to experience lack of objective knowledge about this: "*I don't know why we think it, we just do generally think that beef is nutritionally better meat*" (British man, 21 years). Comparing beef to pork, "*beef is a more healthful choice*" (German woman, 28 years), since "*pork has a much higher fat content*" (British man, 30 years). Beef was perceived as less healthful than white meat: "*I think red meat is not as good for you as poultry or turkey*" (British woman, 41 years), since "*white meat is more nutritious and healthful and has less calories*" (German woman, 28 years) and "*beef has much more fat than white meat*" (French man, 24 years). The male French participants also mentioned horsemeat, which was considered as more healthful than beef since "*beef is more fat than horsemeat*" (French man, 58 years), and "*horsemeat is better from a nutritional point of view*" (French man, 24 years).

3.3.4. Cues signalling (un)healthful beef

To assess beef healthiness, consumers indicated to use specific characteristics of beef as beef healthiness cues. Both intrinsic and extrinsic healthiness cues are used. Table 3.1 shows which product or processing characteristics and categories of beef were perceived as healthful versus unhealthful by the participants of the focus groups. The participants of the focus groups did not reach a consensus whether organic beef was healthful or unhealthful. Some consumers believed organic beef to be healthful: "*Organic beef is good for your health because the animals are fed naturally without any additives*" (French woman, 28 years), while others stated: "*Health wise there is really no difference between organic and ordinary beef*" (British woman, 40 years).

Table 3.1: Cues signalling healthful and unhealthful beef

Healthful beef	**Unhealthful beef**
Labelled beef	BSE / food scares
Branded beef	Ready meals
Lean beef	Expired beef
Good appearance	Offals
Fresh beef	Sold and processed in unhygienic conditions
'Natural' beef (well fed, well treated, only slightly processed)	Packaged beef
Properly cooked beef	Canned beef
Beef from big vendors	Further processed beef products
Beef in a balanced diet	Low quality beef
Organic beef*	Beef with additives
	Beef with hormones
	Cheap beef
	Organic beef*

* No consensus

3.3.5. Consumers' suggestions to improve the healthiness of beef

The participants of the focus groups suggested that changing the methods of production could make beef more healthful: "*Beef healthiness is related to the breeding practices. Maybe we need to create or enforce the rules for cattle breeding*" (French man, 30 years). The whole process should be taken into account: "*from slaughter to processing including the addition of all kinds of additives and preservatives*" (Spanish man, 37 years). Producing more healthful beef was in the first place associated with appropriate feeding: "*Beef can become more healthful with natural feeding*" (French man, 51 years). The cows should get "*a natural diet, what cows naturally eat, grass*" (British woman, 29 years), instead of "being fed with chemicals" (German man, 29 years). The calf should be allowed to drink milk instead of "*being fed with powder*" (French man, 34 years) and "*the animals should not be fattened*" (German man, 41 years). Therefore, some consumers suggested applying organic methods of production, in which "*the animals are raised with natural products without additives, without chemical products added*" (French woman, 28 years). Besides the feeding of the animals, consumers recommended appropriate cattle rearing ("*Cows should be kept very naturally, on*

grass fields, in prairies. Not in a small place", German man, 29 years), a correct treatment of the animals ("*A stressed animal can have diseases that are not even known to man, caused by the maltreatment of the animal*", French woman, 28 years), and serene methods of slaughtering ("*Living naturally, killing humanely, then it is healthful beef*", French man, 49 years).

The idea of improving the healthiness of beef during processing was not unconditionally accepted by all participants. Doubts were expressed whether the manipulation of beef would indeed make it more healthful ("*More healthful? More healthful than leaving the meat alone and just being a good cook?*", British woman, 34 years) and whether it would mean a real improvement ("*What are they going to do to make beef more lean? If I have fat on my beef I know it is normal*", British women, 37 and 40 years). Furthermore, uncertainty existed about short term health effects ("*By continuously improving the healthiness and safety of our food, we might suppress the natural defence system of our own body*", French man, 43 years) as well as long term effects ("*It is meant to improve the healthiness of beef, but today they add some additives and they don't know whether it will cause diseases tomorrow*", French woman, 28 years). Moreover, addition of healthy compounds such as omega-3 fatty acids was thought to "*compromise taste*" (Spanish man, 38 years).

While the participants of the focus groups were not unconditionally in favour of improving beef healthiness by the manipulation of beef, they did suggest that an altered consumption of beef might mean an improvement in terms of health. Since beef was considered as healthful in itself, it was rather a matter of making healthful consumer choices and adapting habits and behaviours: "*The more healthful beef is there. If you choose not to have it, if you do not put it in your basket, then it is not there*" (British man, 35 years). Since "*beef cuts which are not or only slightly processed are more healthful*" (German woman, 45 years), it was stated that it was a matter of "*choosing the right beef cut*" (French man, 43 years). The same applied to the methods of preparation. Appropriate methods of preparation could also lead to more healthful beef products. The method of cooking was perceived as a decisive factor ("*It is likely that viruses and bacteria are killed, in beef products that are cooked or heated for a longer time*", German man, 51 years). Interestingly, possible adverse health effects from cooking beef overdone were not mentioned. The participants suggested that consumer choice and methods of preparation are often "*determined by someone's upbringing*" (French woman, 43 years).

3.4. Discussion

This chapter provides exploratory qualitative results from focus group discussions. The limited number of participants, the lack of representativeness and the exploratory nature of the study imply that the results cannot be readily extrapolated to the overall population. To avoid overgeneralisation of the findings, the interpretation of focus group results requires care. This limitation should be kept in mind while discussing the results.

3.4.1. Consumer perceptions of the healthiness of beef

The objective of this chapter is to explore how consumers perceive and assess the healthiness of beef. The results show that in general, most of the participants of the focus groups considered beef to be a healthful food product. Since all participants were beef eaters, it is possible that this belief was stated as an ex post justification of their consumption of beef, which is consistent with the concept of post rationalisation. Both positive and negative expected health consequences of beef consumption were expressed by the focus group participants. Consumers make a trade-off between the risks and benefits of beef consumption: the expected negative health effects are not only balanced against the positive health effects, but also other factors are taken into account, such as taste and convenience (Grunert, 2006; Verbeke & Viaene, 1999a).

The focus group participants listed several factors that are perceived to influence the healthiness of beef: the consumption amount, the type of product or cut, the preparation method, and the presence of harmful residues. Remarkable is that three of these four factors come within the compass of consumers' own responsibility. Because of the typical credence nature of the issue, the presence of harmful residues cannot be reduced by adapting individual consumers' choices while purchasing, preparing or consuming beef or beef products. This finding indicates that consumers recognise that their own consumption decisions have an important impact on their health and that they are (at least partly) responsible for the healthiness of their food. This view has been well documented in literature. Since the late 1970s, health issues have become moral questions, with healthful diets representing proper moral behaviour, making individuals responsible for their personal health and lifestyle changes. This phenomenon has been called 'healthisation' (Gustafsson & Sidenvall, 2002; Minkler, 1999).

While the importance of the consumption frequency and quantity for the overall perceived healthiness of beef was clear for most focus group participants, the "most healthful" level of beef consumption was not. Moderation in consumption was highlighted, fitting the idea of a balanced diet and avoiding a too high level of red meat consumption, which has been linked to negative health consequences like cancer and heart diseases (Popkin, 2009; Sinha et al., 2009). None of the focus group participants indicated the need to diminish their beef consumption: they talked about moderation without judging their own consumption behaviour. The observed confusion about the most healthful level of beef consumption is consistent with the results of a recent study, showing that consumers were not sure about whether or not they have to diminish their red meat consumption (Lake et al., 2007). However, previous research suggested that many consumers believed that they should diminish their consumption of red meat (Paquette, 2005b) and effectively intended to do so(Verbeke et al., 2009). This belief is subject to regional differences: Martinez-Gonzalez et al. (2000) found that in Mediterranean countries, the notion of diminishing red meat consumption was more often found to be part of the perception of a healthful diet, compared to central and northern European countries. Expert opinions indeed indicate that consumers

should limit the consumption of (especially processed) red meat (Popkin, 2009). However, the reports on the health risks of meat consumption are controversial. The risk might not be a function of meat per se, but reflect a high-fat intake and/or the generation of carcinogens through cooking and processing (Ferguson, 2009).

Participants evaluated the healthiness of meat in terms of fat, calories and nutritional value. Using these criteria, beef was deemed more healthful than pork, but less healthful than poultry meat or horsemeat. This ranking in consumer perception of meat attributes is consistent over time and did not even change over the dioxin crisis (Verbeke, 2001a; Verbeke et al., 1999a). The focus group participants were concerned by the presence of harmful residues in beef, as well as by food scares such as BSE. Yet it has been substantiated that nutrition related risks are more relevant with respect to chronic diseases than with respect to the presence of residues or the occurrence of zoonosis (Rohr et al., 2005). Therefore, the presence of harmful residues in beef might be perceived by consumers as a larger risk than it is actually. Grunert (2005) argued that food safety perceptions can act as "sleeping giants": under normal circumstances they do not influence quality perceptions, but in times of crisis they can have far-reaching effects.

3.4.2. How consumers form expectations about the healthiness of beef

The Total Food Quality Model shows how expectations are formed by consumers based on cues that are available in the shopping situation. In line with previous research (Grunert et al., 2004) the focus group participants listed both intrinsic cues (such as cut, appearance and fat content), and extrinsic cues (such as packaging, brand, labels and price) to assess beef healthiness prior to and during purchase (see Table 3.1). The participants also mentioned cues that were related to practices after the purchase (preparation and consumption), which are discussed further.

The cues listed in Table 3.1 reflect some general ideas about healthful eating. A healthful diet was defined as a balanced diet, containing a low amount of fat and calories. Moderate beef consumption was accepted as ingredient in a healthful diet. In accordance with previous reports, the participants described healthful eating habits focussing on balanced diets, fresh foods and natural or unprocessed foods (Lake et al., 2007; Paquette, 2005b). This was also illustrated by the participants' perception of natural beef as more healthful than processed beef products and ready meals.

The participants of the focus groups stated that beef is lean meat and therefore healthful. The belief that fat is bad for health (though good for taste) corresponds with previous findings that food high in fat is perceived as unhealthful (Pieniak et al., 2008; Webb & O'Neill, 2008). In fact, meat healthiness is largely related to its fat content and its fatty acids composition (Kanatt et al., 2006). The participants of the focus groups did not differentiate between saturated and unsaturated fat. Meat is, however, a significant source of dietary essential fatty acids, although the concentrations are lower than in oily fish (Webb & O'Neill, 2008).

While it is known that packaging has an impact on the quality perception of products (Rundh, 2005), the effect of packaging on healthiness perceptions has not been described in literature. Several focus group participants indicated that packaged beef was perceived as unhealthful. This might be due to the decreased visibility of intrinsic cues, since appearance is an important cue for consumers (Resurreccion, 2002). Another possible explanation is that consumers do not perceive packaged products as fresh products, or that they might associate it with the use of additives. Further research is needed to assess the importance of the packaging in consumers' healthiness perceptions and associations. A possible approach to this situation might be to put brand labels or quality certificates on the packaging, since focus group participants qualified both labelled and branded beef as healthful. This suggests a considerable level of trust in labels and brands, corresponding with recent findings in literature that food with a brand, quality label or health claim might be perceived healthier by consumers (Pothoulaki & Chryssochoidis, 2009; Grunert et al., 2004), contrary to the situation during the second half of the nineties when meat labels were regarded as suspicious (Verbeke & Viaene, 1999b). Nevertheless, the perceived healthiness of labelled food often lacks accuracy (Jones & Richardson, 2007), and the credibility of health claims on labels differs significantly (van Trijp & van der Lans, 2007). Possibly the higher perceived healthiness of labelled and branded beef is related to its higher perceived quality (Grunert et al., 2004). In contrast, since fresh meat is mostly unbranded and unlabelled, consumers have to base their healthiness assessment mostly on the appearance of the product (Grunert, 2006).

The focus group participants did not agree on the healthiness of organic beef. Many previous consumer studies, however, have assessed consumer perceptions of organic foods, most of them concluding that organic food is perceived as safer and more healthful than conventionally produced food. Health and safety are even perceived as the most important quality attributes by organic food consumers (Bonti-Ankomah & Yiridoe, 2006). Beef, compared to vegetables and fruits for example, is not commonly associated with an organic production method, which may explain the uncertainty among the focus group participants.

Figure 3.1 also lists some healthiness cues that are used after purchase. These cues are related to preparation (appropriate methods) and consumption practices (balanced food). This again indicates that consumers acknowledge that they have some own contribution in the healthiness of the beef they consume.

3.4.3. Improvement of the healthiness of beef

Consumers' suggestions to improve the healthiness of beef relate to various phases in the beef supply chain. Participants were sceptical about the improvement of the healthiness of beef by applying different or advanced processing methods. Manipulation of beef is perceived negatively, since consumers like their food being 'natural'. The concept of improving healthiness during processing contradicts with consumers' perception of beef healthiness. If the healthiness of beef should be improved, consumers would prefer it to happen in the production phase of the beef chain. Currently, the beef sector tries to improve the healthiness

of beef both in the production phase (for instance by adjusting the feed to influence the fatty acids composition of beef (Scollan et al., 2006) and the processing phase (for instance marinating to reduce the formation of carcinogenic compound during grilling (Smith et al., 2008). Hence, the adding of potentially healthful and natural ingredients (such as olive oil and herb-based seasonings) in beef processing could increase the chances of acceptance of such products. The focus group participants indicated to be aware of their own responsibility and possible impact in the improvement of beef healthiness by their personal choices and consumption behaviour. Finally, based on participants' opinions, the catering and food service industry could benefit from the offer of healthful, ready-to-eat beef meals. The trend towards convenience is a reality and the consumption of "food on-the-go" and "take-away" is particularly true in the dawn of the new century. Since this trend is intrinsically connected with modern lifestyles, the challenge to the beef industry would be to lead a repositioning of "junk, fast food" into more healthful convenience beef options.

3.5. Conclusions

This chapter explores consumers' perception and assessment of beef healthiness. The results from eight focus group discussions in four European countries provided insights into the expected health consequences of beef consumption, the position of beef in the diet, cues signalling (un)healthful beef and consumers' suggestions to improve the healthiness of beef.

In general, beef was perceived as a healthful component of the diet. Focus group participants expected both positive and negative health consequences of beef consumption. Labelled, branded, fresh and lean beef were perceived as healthful, in contrast with further processed and packaged beef. An original finding from this chapter is that consumers believed that their individual choices can make a difference with respect to the healthiness of beef consumed. On the one hand, the awareness of individual responsibility for health suggests that food industries and retailers could benefit from the supply of healthful beef products to consumers. On the other hand, it implies that consumers should be enabled to make correct judgements about the healthiness of their food. However, the results of this chapter indicate that an accurate assessment of beef healthiness is not always straightforward and feasible for an individual consumer. Consumers use various cues to evaluate the healthiness of beef. Although these results corroborate previous findings on how consumers form expectations about the healthiness of beef (using both intrinsic and extrinsic cues), one of the main contributions of this chapter is the finding that participants were sceptical about the improvement of the healthiness of beef by applying unfamiliar or advanced processing methods. This knowledge is crucial in determining consumers' acceptance of new beef products and stimulating beef industry competitiveness. Finally, an interesting and original finding from our study is that participants did not agree on the healthiness of organic beef. Previous consumer studies found that organic food is perceived as more safe and healthful

than conventionally produced food. We believe that beef, unlike vegetables and fruits, is not commonly associated with organic production methods, which may explain the uncertainty among the focus group participants.

International dietary recommendations systematically advocate for increased consumption of fruits and vegetables, a variety of foods, and limited consumption of meat, especially processed meat products. Consumers are faced with conflicting messages about whether food products may be healthful or not (such as the association of some foods with cancer risk or the prevention of chronic diseases). Hence they have to develop easy and practical strategies and decision rules to make the best choices as the present study has shown. Therefore, clear messages through product information, labelling and advertising may facilitate consumer's product evaluation and decision making. The results of this chapter challenge producers to make healthful and convenient beef cuts available for the general population, as well as regulators to consider the interests of consumers and citizens. This way, achievement of public health goals could be facilitated.

The question remains whether consumers have the right impression of the health consequences, the factors determining whether beef is healthful or not, and the used information cues to infer beef healthiness. Perceptions are subjective notions because they reflect opinions about an objective reality. Although in fact such perceptions may be true or not, the individual is likely to act on these perceptions, hence creating real consequences (cf. the Thomas theorem) (Thomas & Thomas, 1928). The presented results on consumer perceptions of beef healthiness provide insights into consumer decision making processes, which are important for the innovation and diversification in the European beef sector, as well as for public health policy decisions related to meat consumption in general and beef consumption in particular.

Chapter 4: Consumer perceptions and acceptance of a quality guarantee system

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Abstract

Consumer demand in relation to food is shifting towards products that are safe, nutritious, and of good eating quality. Beef consumers are demanding for experience quality that matches their expectations, particularly with respect to beef tenderness. The development of a beef quality grading and guarantee system obtained through muscle profiling research, can allow the beef industry to meet these demands. A qualitative consumer study has been carried out with beef consumers in France, Spain, United Kingdom and Germany to assess their opinions about beef muscle profiling and their interest in a beef eating-quality guarantee. Findings indicate that both concepts are well accepted by European beef consumers, although not unconditional. Participants express some reserve related to the possible upgrading of lower value cuts, too much standardisation, and the fact that tenderness is to some extent subjective. They further require the system to be simple, sufficiently documented and independent-party controlled. This study indicates good opportunities for the development of a beef eating-quality guarantee system in Europe. As an increase in consumers' satisfaction could lead to higher consumption rates and industry profitability, the introduction of an eating-quality guarantee system can contribute to market development and improved competitiveness of the European beef industry.

4.1. Introduction

Consumer demand in relation to food and especially to animal products is increasingly shifting towards products that are safe, nutritious, produced through acceptable methods and of good eating quality (Grunert, 2006; Hocquette & Gigli, 2005). In contrast to other food sectors, the beef industry has been relatively slow in reacting to some of these trends. Understanding consumers' perception of beef quality is of paramount importance for the industry in order to remain competitive in the market. At the consumer level, several studies have shown that the strongest quality attributes for beef are taste (flavour), tenderness, juiciness, freshness, leanness, healthiness and nutritional value as intrinsic quality cues, together with brands or labels as extrinsic quality cues (Banovic et al., 2009; Krystallis et al., 2007; Brunsø et al., 2005; Verbeke & Viaene, 1999a; Verbeke & Viaene, 1999b). Whereas before purchase, process-related characteristics, healthiness, appearance and eating quality have similar weights in the formation of quality expectations, eating quality stands out as the most decisive criterion shaping quality experience, satisfaction or dissatisfaction and future purchase (Banovic et al., 2009; Grunert et al., 2004).

Guaranteeing and communicating beef quality has been dealt with in different ways. In particular with respect to beef eating quality, countries such as the United States of America and Japan present advanced carcass grading systems, but the Meat Standards Australia (MSA) system (Polkinghorne et al., 2008b) stands out as a model to assure consistent beef eating quality to its consumers. The MSA system uses a total quality management approach to predict beef palatability by combining a grading system based on animal traits and technological factors with extensive consumer sensory testing. The model allocates scores for individual muscles and cuts to provide a guaranteed and uniform eating quality for any beef product sold under this scheme (Watson et al., 2008b; Polkinghorne et al., 1999). The MSA system has been used to underpin several branded beef programmes, guaranteeing consistent eating quality to Australian consumers (Polkinghorne et al., 2008c).

In Europe, reliable eating-quality guarantee systems are still lacking, in spite of numerous private voluntary quality labelling initiatives and public efforts to label beef products in terms of production system, origin and traceability. Most existing labelling schemes provide assurance that a set of quality production standards have been followed and that products can be traced from farmers to retailers, but these do not guarantee particular muscle eating quality at the consumer level. Previous studies have shown that consumers are only moderately interested in beef traceability and origin as such (Verbeke & Ward, 2006; Hobbs et al., 2005; Verbeke, 2001b), whereas their interest in direct indications of beef healthiness and sensory quality in particular might be considerably larger (Alfnes et al., 2008). A well-functioning and reliable beef quality guarantee system, including eating quality parameters, can potentially meet current interests of European beef consumers. Guaranteeing consistent eating quality could not only increase consumers' satisfaction with beef products, but it could also lead to higher consumption rates and industry profitability, both highly desirable in the up-to-date

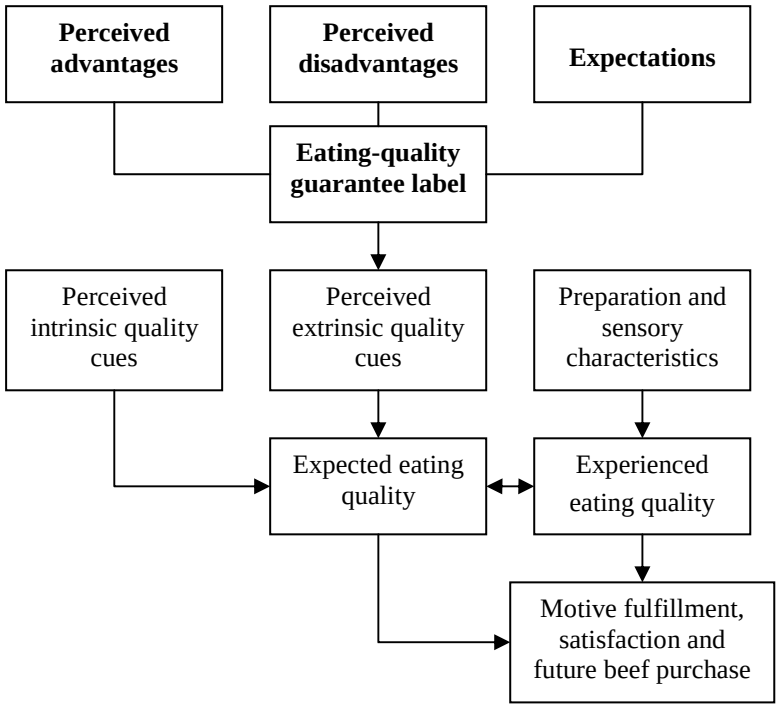
scenario of high and global competition, financial and economic turmoil, and food price volatility. However, for such a system to be successful, insights in consumer interest, opinions and information needs related to an eating-quality guarantee for beef are crucial.

Therefore, the aim of this chapter is to investigate European consumers' reactions towards a system that focuses on guaranteeing beef eating quality to consumers. Additionally, the chapter investigates consumers' opinions and reactions towards beef muscle profiling, i.e. analytical techniques and procedures to objectively characterise beef muscles (Von Seggern et al., 2005), which is key to make informed decisions about the eating quality of beef, and to provide guarantees about individual muscle's quality traits. Since tenderness and tenderness-related traits are highly variable among beef muscles (Rhee et al., 2004), muscle profiling is an approach of choice to explain the variability of beef eating quality from the variability in muscle characteristics.

4.2. Conceptual framework

Quality is a subjective term, the meaning of which varies depending on who uses it and what for. Quality has been defined by some authors as characteristics of products 'that bear on themselves the ability to satisfy given needs' (Luning et al., 2002). Previous research has underlined that food quality should also be addressed from a consumer's perspective (Grunert, 2006; Verbeke & Ward, 2006; Grunert, 2005) and that 'the perception of quality as a determinant for choosing goods should be at the centre of things' (Sans et al., 2008).

Consumer satisfaction (Oliver, 1980) and willingness to purchase the product again in the future (Grunert et al., 1996) are determined by the match or mismatch between expected quality (formed before and during the purchase) and experienced quality (assessed after the purchase and consumption), as indicated in Figure 4.1 based on the Total Food Quality Model (Grunert et al., 1996). It means that if quality expectations are stronger than actual experienced quality, it is very likely that consumers will be dissatisfied. In contrast with most of the existing meat quality guarantee schemes that focus on production- or process-related (credence-type) characteristics (see also further), an eating-quality guarantee scheme concentrates on guaranteeing a quality that can be readily experienced by consumers during consumption, thus offering new perspectives with respect to meat labelling and building customer satisfaction. Hence, a beef eating-quality guarantee could act as an extrinsic quality cue that can reduce uncertainty during the purchasing and decision making process and result in more congruence of expectations and experience.



Source: Total Food Quality Model of Grunert et al. (1996)

Figure 4.1: Framework and scope of the chapter (bold face)

Labelling is the commonly used vehicle for signalling a quality guarantee to consumers. The quality of food products is increasingly recognised through particular quality signals, such as brands, quality or geographic origin labels like the Protected Denomination of Origin (PDO), Protected Geographic Identification (PGI), and Traditional Speciality Guaranteed (TSG) labels in Europe. Most of the previous work dealing with consumer interest in beef labelling has concentrated on interest in beef quality labels, which either referred to characteristics of the beef production system (e.g. organic or quality assurance schemes), traceability or beef origin (de Barcellos et al., 2006; Codron et al., 2005; McEachern & Warnaby, 2005; Hoffmann, 2000; Verbeke & Viaene, 1999b). Hardly any studies (if any in Europe) have focused on the labelling of beef eating quality, with the exception of Australian studies (Polkinghorne et al., 2008b; Polkinghorne et al., 2008c; Thompson et al., 2008; Watson et al., 2008a) motivated by the Meat Standards Australian (MSA) scheme.

Variable beef eating quality was a major concern to many stakeholders involved in the Australian beef industry in the early 1990s. During this period consumers were recording their dissatisfaction with Australian beef products by decreasing their beef consumption (Polkinghorne et al., 2008b: 1351). To overcome this situation, a grading system which simply described carcasses of similar appearance was not any longer an acceptable option. A new branding and labelling approach to the Australian meat industry should guarantee tenderness within reasonable limits (Smart, 1994). As a result, in 1996 an industry strategic

plan was established to supply a more consistent product and to accurately describe palatability. Several eating quality and consumer testing research projects were performed, and the Meat Standards Australia (MSA) was established as a system developed to deliver guaranteed and consistent palatability to the consumer. The programme labels beef, lamb and mutton with a guaranteed grade and recommended cooking method to yield eating quality according to consumer expectations. Every piece of beef produced is ultimately judged by consumers when eaten, and for this reason MSA used consumer taste panels, a transparent system of testing samples that would engender confidence with both the beef industry and consumer segments. The final assessment of palatability is therefore determined by the target consumer market for the product (Watson et al., 2008a).

The existence of different beef production systems within Europe, and beef grading systems that mainly provide a conformation assessment of bovine carcasses (SEUROP system) would per se justify a further investigation of the interest in a beef-eating quality guarantee system by European consumers. The MSA system has recently been assessed in France by asking the opinions of beef experts about this system (Hocquette et al., 2009). French stakeholders recognised key success factors of the MSA system relating to the system's relevance, credibility, flexibility, transparency, originality and innovativeness towards potential segmentation of the beef market. The study also identified some perceived weaknesses. Notably, the final delivery of precise quality grades to consumers was perceived to be still lacking, and its adaptability in France was perceived to be difficult due to the complexity and the variability of the French beef industry and market, and of course of the European beef market as a whole (Hocquette et al., 2009).

The specific scope of this chapter is on assessing consumers' perceived advantages, disadvantages and expectations related to a beef eating-quality guarantee, i.e. an extrinsic quality cue that can signal and guarantee a particular level of beef tenderness. Tenderness is one of the most important characteristics by which consumers judge beef quality (Realini et al., 2009; Alfnes et al., 2008; Jurie et al., 2007; Oliver et al., 2006; Verbeke & Viaene, 1999a). At the same time, it is one of the quality aspects that is most difficult to evaluate before the purchase because it is a highly variable attribute, but also a relatively straightforward quality attribute to be evaluated by end users post experience. The very irregular tenderness of beef products is one of the major sources of complaints about beef quality and a primary cause of failure to repurchase beef. As a result, tenderness and eating quality have been set forth as priority issues that need to be addressed in the European beef industry (Eggen & Hocquette, 2004), and the provision of consumers with beef cuts that have a consistent tenderness has been set forth as a major challenge for the European beef industry (Alfnes et al., 2008; Allen et al., 2001; Koohmaraie, 1996).

4.3. Methodology

Eight focus groups were conducted in the capital cities of France, Germany, Spain, and the United Kingdom during May 2008. In each country, two group discussions with seven to nine participants each were performed, being one composed of women and another one of men. All participants were beef consumers. The topic guide of the focus group discussion is included in Appendix I. Procedures for conducting the focus groups and the content analysis have been described in 1.5.1. The findings from the focus group discussions insofar they relate to the beef eating-quality guarantee and muscle profiling are discussed in the present chapter.

Trained moderators were previously instructed about the meaning of eating-quality guarantee system. An eating-quality guarantee system aims to assure a certain level of quality according to target goals, in this case, the goal is to provide eating quality to beef consumers, that is, tenderness, flavour and juiciness. Moderators gave detailed information to participants, including an example about the Meat Standards Australia system that uses stars to indicate beef eating-quality grading: from 3 to 5 stars, prices increasing accordingly. Participants were then stimulated to discuss the pros and cons of such a system and were also probed about their willingness-to-pay for such a system in Europe. The final section of the topic guide explored consumers' attitudes towards technologies that can be applied during beef processing (not reported in the current chapter), including muscle profiling, i.e. the use of non-invasive instrumental methods to provide a precise classification of beef muscles.

First, a general content analysis was conducted for the total sample of focus group participants. From the meat marketing point of view, however, it is important to understand whether consumers differ in their perceptions of the potential advantages and disadvantages of using muscle profiling for the establishment of an eating-quality guarantee system, which could open up possibilities for differentiated beef product offerings. Therefore, separate content analyses were conducted for different groups of participants, based on gender, age and consumption modes. Both genders were almost equally presented in the focus groups (n=33 men, n=32 women). The participants younger than 30 years (n=17) were compared to the other participants (n=52) in a second analysis. This age division was based on the observation during the group discussions that some of the younger participants had divergent opinions about certain topics in the discussions. A third analysis was done for the different consumption modes. A median split was applied to divide the sample in high and low beef consumers. Hidden-beef consumers were focus group participants who had a high consumption of both hamburgers and minced meat, in which the animal origin was less visible (n=21). Real-beef consumers were the participants with a high consumption of both steaks and roasts (n=13). Consumers with high consumption rates of both or none of these beef cuts and products were not included into this analysis. A comparison between the groups with the extreme consumption modes was conducted.

4.4. Results

4.4.1. Participants' reactions to the concept of muscle profiling

In the focus group discussions, participants received the following definition of muscle profiling:

> "Instrumental characterisation of beef muscles through non-invasive methods can provide a more precise classification of meat. This practice can provide consumers with more tender, and eventually also leaner and healthier cuts, or allow an upgrading of muscles that are normally considered as tough."

In addition, an example was given to clarify this technical definition: participants were told by the moderators that muscle profiling is a similar process to "scanning" beef carcasses in the slaughterhouse. This process allows the industry to obtain precise information about the characteristics of carcasses, such as fat content and marbling. The method is non-invasive and acts like taking a picture, an X-ray of the carcass, only now it is done on muscle instead of carcass level. The perceived advantages and disadvantages of muscle profiling are reported in the following sections, including relevant verbatim statements to illustrate the different positions reflected by the focus group participants.

a. Perceived advantages

Participants considered muscle profiling as an acceptable practice during the processing of beef. The three main advantages of muscle profiling discussed by the focus group participants were related to the (perceived) non-invasive character of the methods, the possibility to supply more tender beef cuts, and the opportunity to offer more variety and more choice to consumers.

Participants tended to accept muscle profiling rather easily primarily because of its non-invasive nature: *"I don't have any objections, since the meat is not manipulated"* (German man, 51 years). Muscle profiling was understood as an optimised version of earlier cutting techniques: *"It means instead of slicing off traditional, that part of the cow is now known as the best beef; they can actually say this is the best bit of the cow. You know, that far, that is where the good meat is. And they can just take that off"* (British man, 30 years). Muscle profiling techniques were considered as an acceptable way to enhance the tenderness and quality of the beef cuts: *"It's more and more accurate, a more precise classification which means that it's not some butcher going yes this is this bit and goes for such use, this is another bit that can go for another use ..."* (British man, 30 years). The participants felt confident that by using muscle profiling techniques, the industry will be able to select the best beef cuts and that the beef industry is trying to provide the best possible cuts to the market: *"They take care to give us the best"* (Spanish woman, 28 years). The issue of animal welfare and ethics was also important here. Since muscle profiling is performed on the carcass, without involving any handling of the live animal, the animals are not harmed by this practice

and optimal use of the carcass can be achieved: *"It's good for the cow too"* (French man, 34 years).

The discussions evinced that consumers expected the resulting beef cuts to better meet their demand. Most participants stated to appreciate more tender beef cuts: *"The important thing is that the muscle is not tough"* (Spanish man, 38 years) and expected muscle profiling to provide high quality, tender and healthy beef cuts: *"The best parts of the cow in the best way... the healthiest cuts"* (Spanish woman, 37 years). Consumers expected that muscle profiling will allow the beef industry to meet the demands of specific consumer segments which have special interest in tender beef cuts: *"The elderly: they will exactly look for this type of meat with guaranteed tenderness"* (French man, 58 years).

One of the other perceived advantages of muscle profiling was the greater consumer choice between different beef cuts: *"For the same price per kilogramme, you have the opportunity to take a leaner piece of meat, if you prefer that. While in other cases it is taken together, you cannot separate it, you have to pay for the fat. And then, at home, you may cut it off and throw it away"* (German woman, 45 years). Furthermore, the possibility to provide extra information about beef cuts *("They can give us more information about the cuts so we are able to choose"*, Spanish woman, 28 years) and the prospect of new beef cuts and recipes *("Maybe we can begin to use them for other types of recipes"*, Spanish man, 38 years) were attractive to consumers.

b. Perceived disadvantages

The perceived disadvantages of muscle profiling stated by the focus group participants were related to the (perceived) possibility for upgrading low-quality beef, the risk for a too high degree of tenderness standardisation, and possible price premiums charged for the best quality cuts.

Not all consumers liked the idea of low-quality beef getting the possibility to be upgraded by the use of muscle profiling: *"It's just low-grade meat, trying to do it up a little bit. You know, if it's low grade, it is low grade. If you're trying to respond it up a bit, then it doesn't sound too healthy anymore"* (British woman, 38 years). The practice wss perceived as a trick of the beef industry to be able to sell also the low-quality beef cuts: *"It is like putting old wine in new bottles"* (French man, 51 years). Therefore, some participants assumed that upgraded beef cuts will only be consumed by poorer people: *"The poor can only afford products resulting from these bad tricks"* (French man, 34 years).

Most participants in the focus groups appreciated more tender beef cuts, but hesitation was expressed towards the idea of having all beef cuts equally tender: *"I don't long for making everything uniform"* (French man, 51 years). The less tender beef cuts were also fancied by some participants and they do not want them to disappear or become unavailable in their normal outlets. Furthermore, the experience of tenderness is perceived to be something

subjective or personal: *"Tenderness is something personal. (...) The question is, what means tender for him and what means tender for me?"* (German man, 44 years).

When the industry is able to offer cuts of higher quality, or a more varied quality offer owing to the application of muscle profiling, a more differentiated industry pricing system might result. Importantly, most participants of the focus groups stated that they would not be willing to pay a premium for beef that has simply been muscle profiled, since *"beef is already expensive"* (Spanish woman, 48 years). Because of the association with low-quality beef, consumers even suggested that the muscle profiled beef should be less expensive: *"When they offer it to me in the supermarket, I prefer to pay one Euro more and take the normal piece"* (German man, 51 years). Nevertheless, some participants indicated that they would be willing to pay a premium for the resulting higher-quality beef cuts: *"If I really see a difference, maybe yes, we would consider paying more"* (Spanish woman, 37 years). Finally, consumers also indicated concern for being faced with low-quality beef cuts and higher prices: *"They will sell me beef cuts that otherwise would not be sold"* (German man, 52 years) and *"I expect that we will have to pay more for this"* (Spanish woman, 48 years).

4.4.2. Beef eating-quality guarantee system

Throughout the focus group discussions, participants indicated to care a lot about beef eating quality. They claimed to assess beef eating quality based on various intrinsic and extrinsic quality cues, although without ever being totally sure of their assessment during the purchasing stage. Consequently, participants were asked to state what they think of a possible eating-quality guarantee system. The perceived advantages, disadvantages, requirements and market differentiation potential based on a beef eating-quality guarantee system are reported.

a. Perceived advantages

Guaranteed beef eating-quality was welcomed by most participants, yet more in the group discussions held in France and Spain than in Germany and the UK. The demand for beef products with guaranteed eating quality was stated very clearly by one of the participants: *"The problem is to find good meat, in fact. There are so many bad meats that are sold in big market places, so that I look for the good meat, because the bad meat is hard to chew and digest"* (French man, 35 years). Especially the idea of a system to guarantee the tenderness was appreciated by the focus group participants: *"Because when a piece is tender, well, we are pleased, we appreciate it"* (French woman, 43 years). In addition, some participants stated that it would also be a useful system for particular consumer segments, including consumers who cannot read, who cannot evaluate beef quality at all because of lack of awareness and expertise, or who usually do not pay attention to information about the quality of the product because of indifference or ignorance.

Although the idea of a beef eating-quality guarantee system was welcomed by most participants, people acknowledged that they already use some existing extrinsic quality cues in order to assess the eating quality of beef products, including price and brands: *"Price*

nowadays acts like the star system; the more expensive, the better you can expect the beef to be" (Spanish man, 47 years) and *"You have got that like you say, they are almost graded already. If you buy Tesco's value or if you buy Sainsbury's, you know, "Taste the Difference", there is your grading, you know what you are going to get. You are going to get a bit of old leather or you are going to get a decent piece. Kind of what it is rated for us, it's not A to B but you know, you go in, you see that's a fiver and that's a quid like you said, which one is the nicer meat"* (British men, 21 and 43 years). A system that provides guaranteed beef eating quality was considered to be at least as good and more convenient as compared to the criteria that are used to signal overall beef quality nowadays.

b. Perceived disadvantages

The German and British focus group participants seemed to be more sceptical towards a beef eating-quality guarantee system. They acknowledged that they do not believe in a uniform system to assess overall meat quality: *"They could have some sort of scale you know, A to E or whatever how great the meat is. But apart from that you are not really sure, unless you are picking up the meat and looking at the pack and you are reading to find this cow was kept in this farm. There is probably no real way of scaling how good your meat is"* (British man, 21 years).

Besides scepticism related to the practical implementation and feasibility, other perceived disadvantages of a beef eating-quality guarantee system were related to the quality of the beef in the lowest categories, the system's implementation costs and who is going to account for these, the risk for information overload and the importance of personal cooking practices. A major concern expressed by the focus group participants regarding the proposed eating-quality guarantee system was that the lowest categories were perceived as problematic, because of the discriminatory nature of the system. When a product has only one star, consumers expected it to be 'less tender', 'a bad piece', 'maybe from another country, further away', and 'from a malnourished cow, or artificially fattened up'. These concerns led to some ethical concerns, especially among the French female focus group participants, because poorer consumers were expected to be only able to buy beef with a quality that is unacceptably low: *"It is terrible for those who don't have the means"* (French woman, 43 years). This discrimination between consumers was expected to end in *"a world with two speeds"* (French woman, 58 years).

Some participants also stated a general concern about the implementation of a sophisticated guarantee system in terms of costs. They agreed that the application of all controls for each product would raise costs tremendously, what finally would need to be added on the end product's price at retail level. Furthermore, an additional eating-quality rating system can possibly overload consumers with information and distract them: *"So if you are buying a cut you can see what it looks like, even if it is through cling film the wrapping stuff. You know, putting a five star rating I think is overkill, saying this comes from Devon, not Cornwall"*

(British man, 35 years). Participants expressed doubts about the actual usefulness of this extra quality information. Another concern was related to the measurement of beef quality. Participants of the focus groups finally emphasised the importance of personal cooking practices for beef tenderness: *"Every cook may burn the best rump steak once in a while"* (German woman, 27 years). The question arose whether overcooked quality guaranteed beef would remain tender.

c. Required characteristics of an eating-quality guarantee system

Focus group participants expressed various suggestions about how a beef quality guarantee system should look like, and how its advantages should be communicated. These can be briefly summarised as: keep it simple, provide accurate information, and have the system monitored by an independent organisation.

Participants expected a beef eating-quality guarantee system to be as simple as possible. It should be easy to recognise and to interpret, and it should contain simple information. The provided information should allow consumers to easily differentiate between beef cuts or products. Generally, a system with stars would be appreciated: *"It's like the hotels, it's good and working fine"* (French woman, 20 years). A scheme with traffic lights or colours was mentioned to be potentially useful as well: *"Everybody knows that silver is the colour for Light Coke. It is fast and effective"* (Spanish woman, 48 years). Several focus group participants said that additional information would be needed: *"When I'm looking for a traditional Spanish meat product I'd like to have a 5-star, but it is also important to trade-off with the price and the origin"* (Spanish man, 38 years). For those consumers, it would not make a lot of sense to see only the stars without any further information such as origin, price, control, producer, breeding practices, processing method or additives. In particular, information about genetic modification was asked for: *"And if it's genetically modified, say that it has been genetically modified"* (British woman, 41 years). British focus group participants placed responsibility for regulating a beef eating-quality guarantee system on the government, and did not like the idea to let it stem from private initiatives only. In addition, participants suggested that this system could be implemented primarily and preferably on a regional basis and as a result, it would become more efficient.

The group of German beef consumers expected an eating-quality guarantee system that is mainly managed and performed by producers, but needs to be monitored by independent institutions – otherwise *"they mark everything green"* (German man, 41 years). Those institutions were also considered to be necessary for introducing a standardised system shared and supported by all actors. The concept of self-control was discussed in this focus group, referring to single or grouped producers who pursue high quality standards and offer reputable products already at the present moment.

4.4.3. Differences between groups

a. Muscle profiling

Men and women expected different beneficial outcomes from muscle profiling. The male participants focussed more on the possibility of having more tender beef thanks to muscle profiling. Unlike the men, women focussed more on fat. They especially liked the possibility of having leaner beef cuts. Nevertheless, some women argued that fat is important for the taste of beef: *"I don't want the beef to be completely lean since it will lose taste"* (German woman, 47 years).

Furthermore, men and women think of diverging new opportunities. Men gave a thought on convenience matters, suggesting that muscle profiling could facilitate cooking practices: *"The idea of shorter cooking times is not uninteresting"* (German man, 49 years). The female participants believed that muscle profiling could help them during their purchasing decision by providing extra information and facilitating consumer choice: *"At least they can provide information that enables us to choose"* (Spanish woman, 48 years). Although muscle profiling was discussed before explicitly talking about the provision of eating-quality guarantee, one male participant spontaneously suggested that muscle profiling could be used for a beef eating-quality guarantee system: *"It would make the grading of the beef better as compared to what we have nowadays"* (British man, 21 years). No apparent differences in opinions about muscle profiling were observed for different age groups and for consumers with dominant real versus hidden beef consumption modes.

b. Beef eating-quality guarantee

Men and women participating in the focus groups talked in different ways about the eating-quality guarantee. The male participants were focussing on the idea of tenderness. They discussed whether tenderness is a good indicator of quality: *"After all, who speaks of tenderness only. I wouldn't say that. Quality means extremely good. It has to do with taste as well"* (French man, 44 years) and whether tenderness can be objectively evaluated: *"Is it measurable? Can it be measured on the animal or carcass whether the meat will be tender? That would surprise me"* (German man, 29 years). In particular the German men considered it more or less evident that a guarantee is referring to the possibility to return beef cuts which do not meet the standards: *"Can I bring it back, then?"* (German man, 41 years); *"The question is, how long the guarantee lasts, if I buy beef"* (German man, 45 years). Women related the idea of an eating-quality guarantee more to trust, certainty, reassurance and positive feelings when purchasing the product.

Young participants did not express a need for additional information relating to a beef eating-quality guarantee, since they felt faced with an information overload already. In their opinion, consumers were rather paying attention to prices and brands. An eating-quality guarantee might not bring a lot of extra perceived value for the younger consumers: *"If you feel like*

eating good, you will take the good meat. Whether it has one star or five, I think you just take the good one based on the price" (French man, 24 years). The content analysis did not reveal divergent opinions about the eating-quality guarantee system between the real and hidden beef consumers.

One specific group of participants attracted the attention during the analyses. The young French women (all predominantly hidden beef consumers) had a distinct opinion on the content of an eating-quality guarantee. They were the only participants who suggested that such a guarantee could be related to other things than tenderness, like texture, absence of additives or improved healthiness: *"Stars can mean that it is better for the body, better for your health, on top of being more tender"* (French woman, 20 years) or also: *"A star for products that should be consumed more quickly"* (French woman, 28 years).

Table 4.1 provides an overview of the insights obtained from the focus group discussions in terms of participants' reactions towards beef muscle profiling and the introduction of a beef eating-quality guarantee, as these were discussed in the previous sections.

Table 4.1: Insights related to focus group participants' reactions towards beef muscle profiling and the introduction of a beef eating-quality guarantee

Muscle profiling		
Perceived advantages	Perceived disadvantages	
• Non-invasive methods • Possibility to supply more tender, more convenient (males*) and/or leaner (females*) beef cuts • Offer more variety, new recipes and more choice	• Concerns about the upgrading of low-quality beef • Too high degree of tenderness standardisation • Price premium / Who pays?	
Eating-quality guarantee		
Perceived advantages	Perceived disadvantages	Expectations
• Meeting a perceived need for tender beef (males*) • Ideal for consumers who face difficulties when evaluating beef quality during purchase (females*) • At least as 'good' as existing beef quality signals	• Concerns about feasibility and practical implementation • Questions about the lowest quality grade • Implementation costs / who pays? • Risk of information overload (young*) • Role of personal cooking practices	• Keep it simple • Provide accurate information • Independent party monitoring

*Indications between brackets signal a stronger, though not exclusive mention by particular consumer groups

4.5. Conclusions

Meat tenderness is a complex function of production, processing and meat preparation. A guarantee for tenderness, which can act as an extrinsic quality information cue can only be given if all the factors affecting tenderness are controlled along the meat production chain. The insights from this qualitative exploratory study indicate that both muscle profiling and a beef eating-quality guarantee system were relatively well, but not unconditionally accepted by the European beef consumers who participated in this study. The possibility to offer highly precise cuts of different guaranteed eating quality to consumers might give the industry an opportunity to also provide a more differentiated pricing system corresponding to relevant attributes of quality, most notably tenderness. This way, prevalent additional willingness-to-pay for more exclusive cuts could be gained by adjusting marketing strategies to different target segments. It should be noted though that the focus group participants reported some willingness-to-pay only if the system manages to deliver upon its promises, not for the establishment of the system as such.

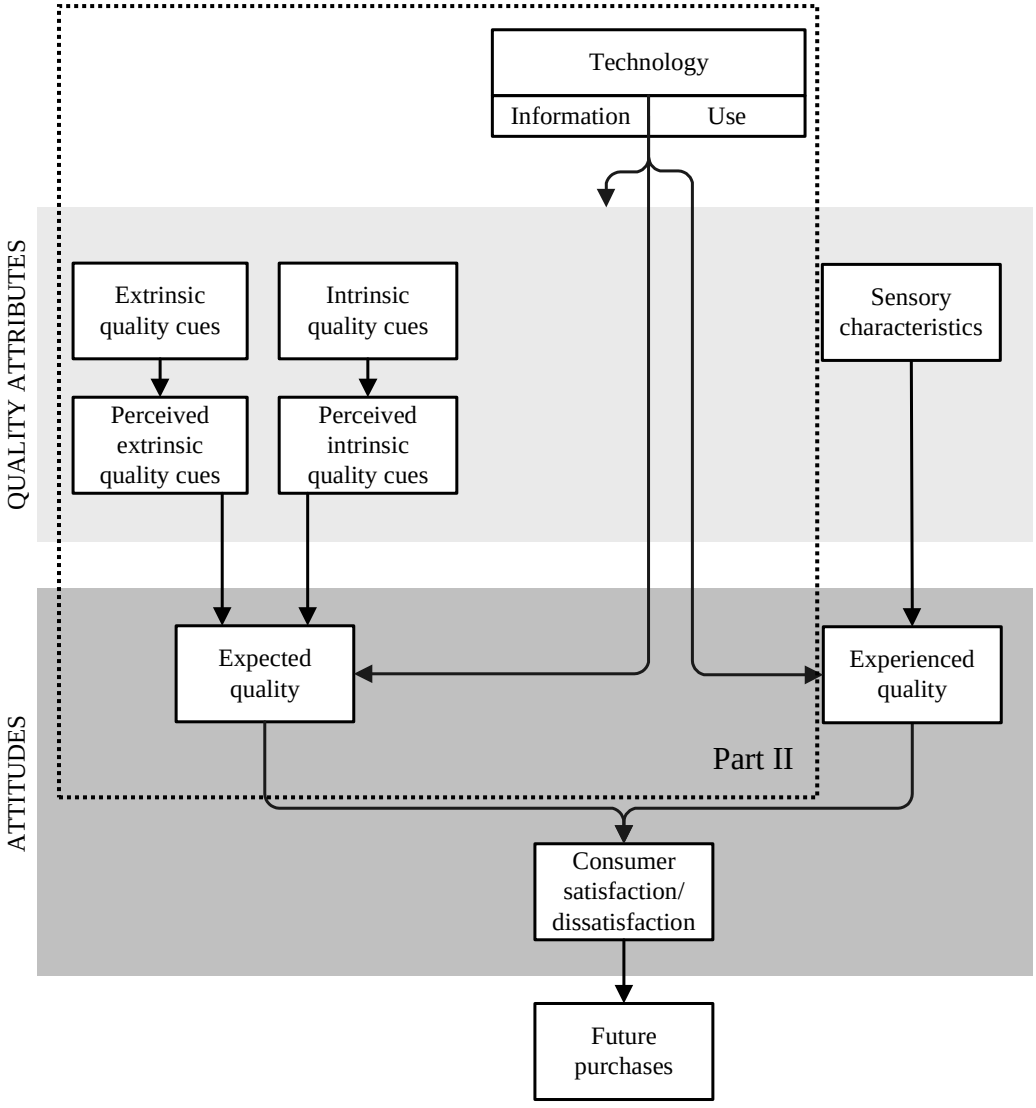
The conclusions from this study are based on focus group discussions involving only a low number of individual beef consumers. Although the study covers four European countries, it should be noted that the samples are not representative and therefore, findings are only exploratory and descriptive in nature. Since the participants in the focus group discussions were relatively heavy beef consumers, this study does not identify opinions and perceptions of low and non-beef consumers. Based on the insights from this study, several research propositions dealing with consumer reactions to beef eating-quality guarantees can be set forth. First, based on the observed gender differences, it is expected that men will focus more on the benefit of guaranteed tenderness, whereas women might more focus on the overall product quality, including e.g. fat content on top of tenderness, and on the benefit of convenience for product selection during the purchasing stage. Second, with respect to age differences, young consumers are expected to be less interested in a beef eating-quality guarantee. Potential reasons to be further investigated, might stem from their lower involvement with beef purchasing and lower experience with variable beef eating quality. Third, although cross-country differences are not very straightforward from the focus group studies, the concept of an eating-quality guaranteed was more welcomed by participants in France and Spain than in Germany and the UK. Further, it was noticed that the French female group stood out as being focused more on benefits related to overall beef quality rather than tenderness alone. One must keep in mind that cooking methods depend largely on cultural habits and ways of life which differ between countries. It means that tenderness is not the same concept and depends on the country (as well as on the individual), which has also clearly been reflected by consumers in the different focus groups. Any quality grading scheme must take into account this variability of habits. Clearly, cross-cultural differences in consumer reactions to an eating-quality guarantee for beef merit further investigation. Last but not least, since eating quality is a typical experience quality, consumer reactions to an eating-

quality guarantee for beef are likely to differ from the existing production- or process-related guarantees that concentrate mostly on credence quality. Since eating quality can be readily experienced during consumption, it can be expected that consumer reactions in terms of satisfaction/dissatisfaction, trust, repeat purchase and future label use will be quite direct and overt in the market place. Studies that monitor such reactions, both from an attitudinal and behavioural, including sensory perspective, as well as validation of this study's exploratory findings through quantitative cross-cultural studies are recommended.

The insights obtained from the focus group discussions are promising and indicate good opportunities for the development and benchmarking of a beef eating-quality guarantee system in Europe. This chapter has identified advantages, disadvantages, information requirements and market differentiation potential based on muscle profiling and eating-quality guarantee levels. Such insights are crucial for future market introduction and the development of beef marketing and communication strategies. As an increase in consumers' satisfaction with beef products could lead to higher consumption rates, the introduction of an eating-quality guarantee system that takes into account consumer preferences and expectations can contribute to further market development and improved competitiveness of the European beef industry.

Part II Consumer perceptions and acceptance of beef technologies

Part II of this doctoral dissertation deals with the second research objective, investigating consumer acceptance of beef technologies. The research framework indicated that consumer awareness about their application can have a direct impact on the expected quality of the product. Part II investigates consumer acceptance of beef technologies at four different stages of the beef chain: primary production, slaughtering, processing and packaging.



Chapter 5 explores European consumers' acceptance of a variety of beef processing technologies: marinating by injection, marinating by submerging, nutritional enhancement and restructuring through enzyme binding, shock wave treatment and thermal processing. Perceived advantages and disadvantages of these processing technologies were explored in focus group discussions (Study 1). To provide more conclusive results on consumer

acceptance of beef technologies, a quantitative methodology was used. Study 2 (n=2,250) has included technologies that are applied at different stages of the beef chain (primary production, slaughtering, processing and packaging) with the purpose of enhancing beef safety, which is an essential part of beef quality. European consumer acceptance of beef technologies to improve beef safety at the first three key stages of the beef chain (primary production, slaughtering and processing) has been investigated in Chapter 6 while the acceptance of packaging technologies was looked at in Chapter 7. Beef packaging technologies were included, as possibly having a positive impact on beef safety, because the results in Part I suggested that beef packaging is an extrinsic cue for beef quality, and that packaged beef might be considered as less safe and less healthy than unpackaged beef.

Chapter 5: Consumers' acceptance of beef processing technologies

This chapter is based on: de Barcellos, M.D., Kügler, J.O., Grunert, K.G., Van Wezemael, L., Perez-Cueto, F., Ueland, Ø. and Verbeke, W. (2010). European consumers' acceptance of beef processing technologies: a focus group study. *Innovative Food Science & Emerging Technologies*, 11 (4), 721-732.

Abstract

The use of new technologies in beef production chains may affect consumers' opinion of meat products. A qualitative study was performed to investigate consumers' acceptance of seven beef processing technologies: marinating by injection aiming for increased 1) healthiness; 2) safety; and 3) eating quality; 4) marinating by submerging aiming for increased eating quality; 5) nutritional enhancement and restructuring through enzyme binding; 6) shock wave treatment and 7) thermal processing. In total, 65 adults participated in eight focus groups in Spain, France, Germany and the UK. Results suggested a relationship between acceptance of new beef products, technology familiarity and perceived risks related to its application. Excessive manipulation and fear of moving away from 'natural' beef were considered negative outcomes of technological innovations. Beef processing technologies were predominantly perceived as valuable options for convenience shoppers and less demanding consumers. Overall, respondents supported the development of "non invasive" technologies that were able to provide more healthiness and better eating quality. Excessive intervention in meat production chains was severely criticised and participants expressed their longing to keep beef processing "simple and natural".

5.1. Introduction

New technologies have been continuously developed and implemented in the food chain, promising more efficient production and better quality for consumers. By definition, technology presupposes the application of scientific knowledge to solve practical and societal problems. Nevertheless, although Europeans are generally optimistic about the contribution of technology to their quality of life, they have been more sceptical about new technologies in the food sector, often due to social, ethical and environmental concerns – especially when it comes to biotechnologies in the agricultural (green) sector, such as the use of genetically modified organisms (GMO) in food (Gaskell et al., 2006). Also other modern processing technologies, like high pressure processing or pulsed electric fields, might face consumer resistance (Nielsen et al., 2009).

Recent European studies (Siegrist et al., 2008) investigated the acceptance of nanotechnologies and confirm that even new technologies with clear health benefits may not be appealing to all consumers, mainly due to different perceptions of the concept of benefit. Similarly, studies of consumer attitudes towards GMO have previously found that consumer acceptance depends on whether consumers perceive such benefits associated with the product (Frewer et al., 1997; Frewer et al., 1996). Interestingly, new food technologies are of increasing importance but not a lot of research has been conducted into how people react to these technologies (Tenbült et al., 2008). According to Siegrist (2008) there are hardly any discussions about high pressure processing, for example, and for other food technologies public acceptance is still an open question.

New food products are continuously launched in increasingly competitive markets. However, a failure rate above 60% is reported for the food sector (Costa & Jongen, 2006; Grunert & Valli, 2001), and only few new products survive in the long term. Consumer acceptance is the key success factor for a product to survive on the retail shelves. As Bruhn (2007) notes, consumers do not ask for new technologies, rather they seek products with specific benefits of personal relevance. Understanding how consumers perceive and form attitudes with regard to new processing technologies is therefore of utmost importance for innovation in the food chain, since consumer acceptance is crucial to the development of successful food products (MacFie, 2007).

When evaluating food products and making purchase decisions, consumers use a broad range of criteria, such as price, sensory attributes (appearance, texture, flavour and odour), health considerations, convenience, and lately also the way how a product is produced and processed, including its technological, ethical and social implications (Krystallis et al., 2009; Siegrist, 2008; Grunert, 2005; Grunert et al., 2004). In the latter context, the specific technology used can have an impact on consumers' evaluation and choice. Especially, the application of modern technologies for developing new food products can create concern among consumers, since the general public is rarely aware or informed of processing technologies and their potential consequences (Bruhn, 2007; Cox et al., 2007). Benefits and

risks associated with a new technology may simply be unknown to consumers. Consumers who are sceptical of technological progress in food production are likely to prefer a no- or low-technology approach (that is, a technology that does not involve highly advanced or specialised systems or devices), looking for health and environmental sustainability (Williams & Hammitt, 2001). Others will be more open to innovation and believe that new technologies may reduce risks or provide benefits that were not available before (Bruhn, 2007).

Meat in general and beef in particular are an appealing and relevant case for studying consumer acceptance of new processing technologies, and this for at least two reasons. First, the meat industry has been named to be among the least innovative of the food industry, especially as compared to the drinks and dairy industries, for example (Grunert et al., 2004). Second, the meat and beef industry have been subject to several consecutive safety crises, with the BSE-crisis constituting a landmark that introduced some dramatic changes in the chain, notably relating to quality controls, traceability and labelling (Verbeke, 2001b). The crises have left an inheritance of suspicion and vigilance among a substantial share of European meat consumers (Verbeke & Vackier, 2004). Hence, meat and beef consumers are likely to be not very familiar with innovations and new processing technologies, but also to be highly vigilant and sceptical towards the acceptance of new beef products and the application of new beef processing technologies. Altogether, this makes attitudes towards beef processing technologies particularly relevant to investigate in the early stages of these technologies' developments.

The aim of this chapter is to investigate European consumers' acceptance or rejection of beef processing technologies, exploring consumer attitudes, perceived advantages and perceived disadvantages. It also explores whether the selected seven new processing technologies could satisfy participants' demands for convenience, health, eating quality and food safety while adding value to beef products. An inventory of the acceptability of beef processing technologies is provided as a tool to guide process and product innovation in the beef chain, contributing to increase its competitiveness.

5.2. Conceptual framework

Attitudes have several functions: they can guide perception and influence behaviour (Ajzen, 1991; Ajzen & Fishbein, 1980). In general, literature (Nielsen et al., 2009; Søndergaard et al., 2005; Scholderer & Frewer, 2003) suggests two ways how attitudes can be formed: bottom-up and top-down. Bottom-up attitude formation implies that the attitude towards an object – here, new beef processing technologies – is formed based on the individual's knowledge about such technologies. Formation of beliefs is then based on the technology's perceived positive and negative characteristics. The resulting attitude is eventually the weighted average of the evaluation of perceived risks and benefits (see the Attitude Theory of Fishbein, 1963). In the top-down framework, specific attitudes are believed to be embedded in a system of general

attitudes and values. The idea is to preserve the evaluative tendency of higher-order or more general attitudes (for example Rokeach, 1968; Katz, 1960). Hence, attitudes towards new beef processing technologies may be inferred from general attitudes towards technology. For instance, previous studies on consumer attitude formation towards food processing technologies suggest that general socio-political attitudes, like attitude towards nature, environment, and technologies generally play an important role in shaping consumers' attitudes towards new processing technologies (Nielsen et al., 2009; Scholderer, 2005; Søndergaard et al., 2005; Scholderer et al., 2000).

Nielsen et al. (2009) indicate that attitude formation can be ideally studied in a focus group setting, since respondents are then motivated to form new attitudes because of the interaction with other participants and external stimulation with new information on attitude objects. Participants will be naturally inclined to react to new information throughout the verbalisation of their thought processes.

5.3. Methodology

5.3.1. Data collection

Eight focus groups were conducted in the capital cities of France, Germany, Spain, and the United Kingdom during May 2008. In each country, two group discussions with seven to nine participants each were performed, being one composed of women and another one of men. All participants were beef consumers. The topic guide of the focus group discussion is included in Appendix I. Procedures for conducting the focus groups and the content analysis have been described in 1.5.1.

This chapter reports the results related to the part of the focus group discussions in which consumers' attitudes towards beef processing technologies were explored. Focus group participants performed three tasks. First, participants were asked to state free associations and thoughts about beef and beef products. The aim was to assess (1) participants' familiarity and their attitudes towards beef. Second, participants were asked to state their general beliefs about beef technologies. Moderators were instructed to start the discussion with the following definition of beef processing technologies: "*something that you do to the meat in order to obtain something (e.g. packaging, more health, less fat, longer expiration dates, flavours, tenderness, etc.*)". Participants were then asked to write down examples and aspects of beef processing technologies they could recall spontaneously (based on their knowledge). The objective here was to investigate (2) participants' innovativeness, food neophobia and risk aversion towards technology. Thirdly, each participant discussed the (3) acceptance or rejection of selected beef processing technologies. After discussing the pros and cons of each one, they were asked to classify them into preferred (accepted), neutral or ambivalent and rejected (not accepted) categories. These seven 'technology concepts' were developed in collaboration with participating researchers from the natural sciences (meat science and

technology) components of the ProSafeBeef project (Miles & Caswell, 2008). The proposed technologies are scientifically validated (Diário do Chef, 2009; Moloney et al., 2008; Brooks, 2007; Moeller et al., 1999) and they are either widely applied and marketed, or currently under the investigative scope of researchers in the project. A detailed description of the seven technologies is presented below.

5.3.2. Categorisation of new beef processing technologies

The selected seven new beef processing technologies are categorised in this section according to their expected benefits. First, three beef processing technologies aiming for improved eating quality (namely tenderness) are presented, followed by two technologies aiming for improved healthiness. Finally, we present two technologies aiming for improved safety.

a. Beef processing technologies aiming for improved eating quality

Marinating by submerging for improved eating quality by tenderising low-grade beef: This technology was described as diffusion of components (such as seasonings, salt and oil) into the surface of meat. Marinating by submerging is one of the oldest methods known to preserve food. Pre-historical registers indicate that marinating was applied as a tentative to keep food protected and to avoid seasonal shortages (Diário do Chef, 2009). Up-to-date it is mainly used in the meat sector for making beef tender and it is being adopted by industry, restaurants, as well as consumers to give meats *new* features (for instance, adding exotic seasonings to beef). This technology opens possibilities for better utilisation and valorisation of raw materials (such as lower-grade beef), but also for the development of a wider variety of fresh muscle products.

Marinating by injection for improved eating quality by infusing water soluble components for improved tenderness and tastier beef: It is described as penetration of mainly water-soluble components (such as vitamins from the B-complex and vitamin C, mineral salts and fibres that are able to dissolve in water) into the meat structure. The injection of the marinade allows a more rapid diffusion of the marinade components into the muscles and results in a faster decrease in mechanical strength and increase in tenderness (Brooks, 2007).

Shock wave treatment to tenderise less tender beef cuts (usually lower-grade beef): The use of ‘shock waves’ or ‘hydrodynamic/hydrodyne pressure processing’ (HDP) to tenderise meat has been in practice since the late 1990s (Moeller et al., 1999; Berry et al., 1997; Solomon et al., 1997). Podolak et al. (2006) referred to this technology as an emerging, non-thermal process that has been extensively studied at the Food Technology and Safety Laboratory (Beltsville, MD) for improving meat tenderness (Solomon, 1998). HDP uses a small amount of a high-energy explosive to generate a supersonic–hydrodynamic shock wave (Solomon et al., 1997) that moves through objects submerged in a water-filled treatment unit. Because meat is a close acoustical match to water, these shock waves pass through the meat causing microscopic tearing in the myofibril structure of the muscle with instantaneous effects on the

tenderness. The mechanical force of the shock waves that produce tenderisation may also cause mechanical stress on bacteria and have a bactericidal effect (Podolak et al., 2006).

b. Beef processing technologies aiming for improved healthiness

Marinating by injection for improved healthiness by infusing components such as omega-3 fatty acids: The injection of healthy components such as omega-3 fatty acids aims to enhance the concentrations in beef of those fatty acids that are considered beneficial for human health, without causing a detrimental effect on the appearance, shelf-life or eating quality of the beef (Moloney et al., 2008). There is accumulating evidence of the importance of long-chain n-3 (omega-3) polyunsaturated fatty acids (PUFAs) for human health and cardiovascular disease prevention (notably, reductions in blood pressure and blood triacylglycerol levels according to SACN/COT (2004)).

Nutritional enhancement and restructuring through enzyme binding; beef nutritionally enhanced and restructured with enzymes after removal of excess fat and connective tissues: Nutritional enhancement takes place when specific components of meat products are removed and/or replaced by other components that give the product a better nutritional profile, or when additional healthy components are added. Examples are trimming and reforming or restructuring using enzyme-binding technologies, the introduction of new healthy ingredients like dietary fibre obtained from wheat, antioxidants from vegetables or fruits (McDonagh et al., 2004), or encapsulated long-chain polyunsaturated fatty acids (such as omega-3 fatty acids) in sausages or burgers (Nordvi et al., 2007).

c. Beef processing technologies aiming for improved safety

Marinating by injection for improved safety by infusing water soluble components to increase protection against microorganisms: For intact muscle foods of different qualities, the marinating by injection technology (whether it is applied to surfaces or to internal parts of the product) can be an effective method for improving important quality attributes such as microbial shelf-life and oxidative stability, as well as for improving sensory properties (Brooks, 2007).

Thermal processing, for example, by using infrared radiation or microwaves for the production of semi-finished beef products for better protection and more convenient preparation: Thermal processing of beef is known as an effective way to eliminate pathogenic bacteria. It is also of crucial importance to obtain good eating quality. Different thermal processes are applied on different kinds of meat in order to optimise the end quality. Heat treatment in combination with marinades, for example, can also have beneficial effects on the eating quality as well as health properties. During grilling/barbecuing so-called heterocyclic aromatic amines (HAAs) might be formed. These compounds have been associated to certain types of cancers; hence development of heat treatment processes to reduce the formation of HAAs is important for public health. New technologies using steam or infrared heating in the

production process can be one solution to provide better and healthier beef products (Orta-Ramirez & Smith, 2002).

5.3.3. Questionnaire

Participants completed a short questionnaire before the focus group discussions started, including socio-demographic characteristics (age, gender, marital status, household composition) and attitudes towards new food products and technologies. The used questionnaires and measurement scales have been presented in 2.2.2 and are available in Appendix II. No major differences amongst the participants' background attitudinal profiles were found, signalling that the samples recruited are quite comparable across countries. Any between-country differences in the acceptance of beef processing technologies are likely to be due to cross-cultural differences rather than to individual differences between the people involved in the respective group discussions.

To conclude, semantic-differential questions investigating participants' liking, perceived healthiness, safety and nutritional aspects of four selected beef technologies were included in order to get insights into consumers' individual opinions before these were affected by the group discussion process. Participants were asked about: (a) marinating beef by submerging – included as a technology that is less invasive, familiar; (b) marinating beef by injection – included as a technology that is more invasive, perhaps unknown to most participants; (c) nutritional enhancement of beef (with omega-3 fatty acids - a familiar term) and finally they were asked about (d) one technology aiming for increased shelf-life – where less familiar terms were included, such as 'microbes' or 'enzymes'. The data from the quantitative questionnaire were analysed with SPSS 16.0.

5.3.4. Content analyses

Two groups of content analyses were performed. First, content analyses were performed for each technology separately (including all focus group participants), which enabled summarising European consumers' opinions and perceptions about the discussed beef processing technologies. Second, content analyses were performed in order to consider to what extent the participants' statements during the discussions corresponded with their answers given in the quantitative questionnaire.

5.4. Results

In the following section, the main findings of both the quantitative questionnaire and the focus group discussions are reported. First, participants' aggregated profile based on the questionnaire (section 5.4.1.) is presented, followed by their attitudes towards and familiarity with beef (5.4.2) and their attitudes towards beef processing technologies (5.4.3). The acceptance of selected beef processing technologies is then reported (5.4.4) and finally, a

combined analysis investigating the correspondence between qualitative and quantitative results is presented (5.4.5).

5.4.1. Questionnaire data analysis

Table 5.1 shows the participants' scores that are related beef processing technologies with respect to their liking and opinion about healthiness, safety and nutrition.

Table 5.1: Opinions related to beef technologies (Study 1, n=65)

	Mean	SD	Median	P25	P75
Marinating beef by submerging					
- Dislike/Like	4.5	1.7	5.0	4.0	6.0
- Unhealthy/Healthy	4.2	1.4	4.0	4.0	5.0
- Unsafe/Safe	4.3	1.6	4.0	4.0	6.0
- Not nutritious/Nutritious	4.6	1.5	5.0	4.0	6.0
Marinating beef by injection					
- Dislike/Like	2.8	1.5	3.0	1.0	4.0
- Unhealthy/Healthy	3.1	1.3	3.0	2.0	4.0
- Unsafe/Safe	2.9	1.4	3.0	2.0	4.0
- Not nutritious/Nutritious	3.3	1.3	4.0	2.0	4.0
Nutritionally enhanced beef with Omega-3					
- Dislike/Like	3.8	1.6	4.0	2.5	5.0
- Unhealthy/Healthy	4.2	1.6	4.0	3.0	5.5
- Unsafe/Safe	3.8	1.5	4.0	2.5	5.0
- Not nutritious/Nutritious	4.1	1.5	4.0	3.0	6.0
Adding microbes or enzymes to protect beef against spoilage					
- Dislike/Like	2.5	1.4	2.0	1.0	3.5
- Unhealthy/Healthy	2.6	1.5	3.0	1.0	4.0
- Unsafe/Safe	2.7	1.5	2.0	1.0	4.0
- Not nutritious/Nutritious	3.0	1.6	3.0	2.0	4.0

Measured by seven-point scales where 1 represents the negative end, and 7 the positive end of the scale. Reliability of the scales (Cronbach's alpha): Marinating by submerging = 0.90, Marinating by injection = 0.92, Nutritional enhancement = 0.93, Adding microbes or enzymes = 0.94

Overall, results suggested that marinating beef by submerging and nutritionally enhancing beef (with omega-3 fatty acids), that is processes which tend to be more familiar to consumers were the only accepted technologies (mean values above 3.5 on all items). Both technologies were better evaluated in terms of liking, healthiness, safety and nutrition compared to the other technologies. Marinating beef by injection and adding microbes or enzymes to protect beef against spoilage were rather rejected (mean values below 3.5) by the focus group participants, who reported to dislike it for being considered unhealthy, unsafe and not nutritious.

5.4.2. Participants' familiarity and attitudes towards beef

All participants were familiar with beef products and mentioned their most commonly consumed ones: steaks, burgers, fillets and beef chops. Intrinsic quality cues (colour) and

extrinsic quality cues (such as Protected Denomination of Origin or other quality labels) were described as important characteristics that signals beef quality to consumers. The important place of beef in the diet was also mentioned. Animal welfare, high prices and past food scares like BSE (Bovine Spongiform Encephalopathy) were stated as negative associations. Nevertheless, positive associations and positive attitudes towards beef were dominant.

Beef was considered as food that provides pleasure and enjoyment, as expressed by the statement: "*When I think about beef, I think about eating well"*. Furthermore, an association between living an active life, being sportive and eating beef was made. The product was considered very important in regard to the participants' diet. A general belief about beef being "*a good source of proteins"*, "*indispensable*" and "*traditional food"* was common among the participants. Beef was additionally considered as a familiar ("*basic*") and healthful product (giving "*strength/power*"). The image of "*a cow with a daisy"* reflected the emotional and bucolic thoughts of the participants.

Associations with specific occasions (lunch, barbecue, garden party and holiday), product types (steak, stew and hamburger), beef qualities (consistency and structure, unique taste) and countries (Argentina) were elicited. Beef was also linked with "*open fields"* and *"farm-like situations*".

Scepticism about processed beef was manifested in a fear of a severe loss of nutrients, especially because some participants believed that "*hormones are injected into beef cattle to allow rapid growth and fattening, ending up with poor quality beef that retains more water and makes it unhealthy and less nutrient dense"*. Negative aspects were also reported with perceived changes in taste during the last decade. According to some participants "*beef has become less tasteful*" and "*there is more dissatisfaction now than ten years ago*". Price was mentioned as well by one of the participants: *"In a short time, it became very expensive to get good beef*".

Another link was made to media reporting, including the BSE incidents and recurring rancid meat scandals throughout Europe. When one participant associated beef with the animal disease BSE, it resulted in a subsequent discussion about respective effects in consumption behaviour because of past scandals. Almost all participants reported that "*one hardly thinks spontaneously about it anymore*", indicating that the trust in beef safety was re-established to a certain extent.

Other negative associations were made between beef and fast food beef burgers and the high price of the product at the retail level. However, this last aspect was not always mentioned in a negative way. According to the participants, price may not act as an indicator of healthiness, but it can signal the quality of beef, that is, they believe that the more expensive beef is the better its quality is. If beef is too cheap, there is a chance that the use-by date is getting closer to expiry, so it may be of lower value: "*What is cheap ends up being expensive*".

5.4.3. Participants' attitudes toward beef processing technologies

Exploratory perceptions about new beef technologies revealed interesting facets of the respondents. A difference was detected between generations. Young participants tended to be more favourable towards beef processing technologies, whilst the older participants were more inclined to traditional and natural products. Men also seemed to be more traditional, less open to innovative technologies, especially in Spain. In spite of having reservations towards the acceptance of new beef processing technologies, some participants believed that technologies "*should be used to produce a better quality and healthier beef*". The idea of using technologies to tenderise beef and to improve its flavour was accepted, although it was less preferred than "*natural*" beef (that is, as defined by participants in the focus groups, beef without any kind processing or additives, which was also perceived as equivalent to fresh beef).

Other participants associated new processing technologies with the idea of someone "*messing with their food*". Consequently, they were rather negative about beef technologies and exhibited signs of risk aversion in regard to their food habits and some degree of food neophobia. Many admitted to having "*very little knowledge about beef technologies*" and were afraid of the "*potential negative*" health consequences of these technologies in the long term. Interestingly, technologies in general were believed to play a positive role in the future, but more for "*others"* than oneself. Some other participants were not as reluctant towards technologies, but also preferred familiar processes of beef production and processing. For example, a well-known process such as vacuum packaging was spontaneously elicited as "*preferred"* by some participants when compared to technologies which they were not accustomed to (such as marinating by injection and shock waves). Technologies were often believed to be deceits: either mainly used to "*raise the profits of the producers or used to minimise the potential losses of the sellers and shops*", like extended shelf-life and protection against spoilage.

Additives were the main concern for some participants and counteracted with any traditional (and natural) way of producing beef - a continuously highlighted belief about new beef technologies and barrier against the acceptance of their implementation. Spontaneously, participants indicated that "*frozen food*" eventually was the only processing technique that "*does not add anything artificial into the product and therefore can be most easily accepted*".

5.4.4. Participants' acceptance or rejection of selected beef processing technologies

For each of the proposed concepts, participants' attitudes are presented as well as their view on specific pros and cons.

a. Marinating

Marinating by injection aiming for improved healthiness (specifically by adding omega-3 fatty acids) was considered neutral for most of the participants. They were reluctant about the "*injection"* part (perceived as too invasive and potentially risky in terms of safety and taste),

but the information about adding healthy components and enhanced nutritional value partly compensated this aspect, leaving the participants ambivalent about this specific application of marinating methods. Omega-3 fatty acids are ingredients already known by most consumers and are positively associated with health.

Marinating by injection aiming for improved eating quality was equally not unconditionally approved as well. It would be acceptable if it aimed to improve tenderness and taste of beef by using natural and so-called "*traditional"* additives (such as spices, salt, paprika, olive oil or herbs). Perceived risks were reported as a result of altering the flavour and the consistency of the product through adding too much water, making the product spongier and tasteless. Marinating by injection aiming for improved safety, on the other hand, was strongly rejected as illustrated by one participant's statement: "*And we associate injections with ourselves don't we? Something not natural. When you think of all kinds of things being injected in and the consequences... That just worries me*". Hence, not only the injection itself was considered too invasive, but the perceived risk of contamination was determinant for its rejection. Since the benefit of this marinade was to increase protection against microorganisms, aiming to prolong shelf life, it was regarded as controversial and not totally acceptable. Consumers believe that the main beneficiary of the technology would be the industry and retailers in whose interest it might be to camouflage "*negative*" aspects of the quality of beef and "*extending the shelf-life of beef that would otherwise be spoiled already"*. The only accepted marinating technique was submerging (the use of water or oil-based brine) for improved eating quality. Participants were familiar with this procedure, although just cutting and seasoning (without submerging the beef) was commented as the most natural and innocuous technique. Apparently, the cultural background of the participants influenced their attitude towards this technology. Noticeable differences exist between European countries regarding their propensity to accept and adopt innovations (Singh, 2006). In a recent study Spanish consumers have shown a propensity to be more neutral, keeping in mind both the advantages and disadvantages of food innovations (Guerrero et al., 2009). In our study, Spanish consumers, in specific, were more friendly towards marinating by submerging, since they considered it to be "*traditional*" and reminiscent of "*grandmother's way of cooking*".

Nevertheless, although the technology was considered non-invasive (and therefore acceptable), its use for improving or upgrading low-grade beef was considered misleading. In this case, participants indicated that the product should be sold "*cheaper*" and perhaps it would be more suitable for consumers "*with a small budget*".

b. Nutritional enhancement and restructuring through enzyme binding

The concept of nutritionally enhancing and restructuring beef with enzymes after removal of excess fat and connective tissues was rejected by most of the focus group participants. Even though participants claimed to be partially familiar with the concept after the moderator presented it, associating it with processed foods such as hamburgers, sausages and cooked

ham, they were confused about the idea of "*messing too much*" with food. Nutritional enhancement and restructuring sounded "*strange*" and "*science fiction-related*". On the one hand, some consumers considered the removal of fat negative, as fat was considered to be the essential carrier of "*taste*" in meat and it was considered necessary to a certain degree. On the other hand, the removal of fat was also perceived to provide more healthful products, and in line with the trend towards healthy eating of modern consumers.

c. Shock waves

Participants were unsure about the effects of shock waves, and its acceptance was therefore varying. The "*tenderising*" effects and "*non-invasive*" nature of the technology were considered quite positive, but the absolute lack of knowledge and the many doubts about the technology had a significant negative impact on its acceptance, due to the unknown risks it all might represent. This result is in line with previous research (Siegrist, 2008) indicating that consumers have very limited knowledge of new technologies. As a result, most are unable to decide whether new foods produced by such technologies are associated with possible risks. As it happened with marinating by submerging, enhancing low-grade beef was not considered a "*transparent"* or reliable practice. Low-grade beef was chosen in this study as the raw material for shockwave treatment and marinating by submerging in order to assess participants' acceptance of technologies that aim to increase the eating quality of a processed beef product that is traditionally not regarded as extremely valuable in the market. The fact of referring to low-grade beef may indeed have raised suspicion among participants, and it may therefore have yielded a more negative picture relating to these technologies. Tenderising low-quality meat could provoke a negative impact on consumers' confidence in beef quality, that is, consumers would doubt the real "*quality*" of the product if such a technology was applied. Additionally, participants stated that such processing technology would only be suitable for consumers with limited budgets ("*It might be okay for others, but not for me*") and some associated it with a possible carcinogenic risk.

d. Thermal processing

The focus here was to investigate consumer acceptance of thermal processes of semi-finished beef products for better protection and more convenient preparation. Hence, in spite of the fact that infrared radiation and microwaves are indeed different "new thermal technologies" (Richardson, 2001) they were used as examples in the focus groups. Consequently, the moderator did not specify particular differences of infrared radiation and microwaves and guided discussion towards the use of thermal technologies. Nevertheless, participants were able to differentiate between both, microwaves being considered a "*familiar*" technology (although "*not ideal for skilled cooks*" and rather recommended for those with poor cooking abilities, that is, those "*who cannot cook beef decently*"). Microwaves were also considered "*non-invasive"* (as a positive attribute), but potentially "*harmful"* for consumers' health. Infrared radiation was negatively evaluated and many doubts emerged about the process of

irradiating beef. Potential harm to health and carcinogenic effects were associated with this technology. Overall, one can say that participants were sceptic about thermal processing. In addition, the resulting processed beef products of both infrared and microwaves were considered to be probably "*tasteless*" when compared to real barbecued or grilled meat. Table 5.2 provides an overview of the positive and negative aspects of each presented technology in this chapter according to the expected benefit (eating quality healthiness and safety).

Table 5.2: Technology evaluation summary

PROS	CONS
Beef processing technologies aiming at improved eating quality	
Marinating by injection (eating quality)	
• 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 controls are applied, to avoid stated risks
Marinating by submerging (eating quality)	
• 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'
Shock waves	
• 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 limited budgets; 'perhaps OK for others')
Beef processing technologies aiming at improved healthiness	
Marinating by injection (healthiness)	
• Healthy components added (e.g. omega-3 fatty acids) • Enhanced nutritional value • Positive associations with omega-3 fatty acids ('Good for you') • Convenience • Option to intake omega-3 fatty acids, especially for consumers who do not like fish	• Injection processing itself (risky, not 'natural´) • More information needed about processing • Only suitable for consumers who need special diets • May negatively impact taste • Omega-3 fatty acids is associated with fish, not beef • Unnecessary technology: consumers can obtain the same benefits from other food sources (e.g. fish)
Nutritional enhancement and restructuring through enzyme binding	
• Somehow familiar in sausages, hamburgers, minced beef, cooked ham and ready meals • Providing more healthy products by removing excess fat	• 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'

Table 5.2 (continued)

PROS	CONS
Beef processing technologies aiming at improved safety	
Marinating by injection (safety)	
• Increase in food safety	• Injection processing itself (invasive = 'not natural') • Risk of contamination when injecting • Increase in shelf life only beneficial for industries and retailers (camouflage, sale of 'out-of-date' products)
Thermal processing	
• 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

5.4.5. Comparing the quantitative and qualitative results

The use of multiple methods to study the same phenomenon (triangulation) can improve the reliability of the results. In both the questionnaire and focus group discussions, information was available on perceptions about marinating by submerging, marinating by injection and nutritional enhancement. Shock wave technology was not assessed in the questionnaire due to the fact that the researchers considered it as a true new technology about which consumers might have no idea without being properly informed. From that point of view, it was assumed that respondents would have difficulties in evaluating it prior to the ensuing focus group discussions. In this section, the results from the content analysis from two groups are reported. The answers of the respondents who scored higher than the mean value in terms of acceptance of these technologies in the questionnaire are compared to the answers of the respondents who scored lower than the mean value.

a. Marinating by submerging

Rather clear differences across the participants appeared during the content analyses. Participants who indicated during the survey their aversion towards marinating beef by means of submerging were more focused during the discussion on the idea that marinating is all about camouflaging the poor characteristics of beef products. Furthermore, they were more concerned about the marinade content, which was considered negative per se, and was often referred as being "*chemical*" (except by the respondents from Spain). Additionally, they emphasised that the beef industry was the only beneficiary of this technology. In contrast, participants who tended to be more positive towards this marinating technology focused especially on the importance of taste and were more opposed to the idea that others decide on

their preferences. The content of the marinade could be acceptable, depending on its ingredients (positive in the case of herbs versus negative in the case of artificial additives).

b. Marinating by injection

For this technology, the content analyses showed no clear differences between the consumer groups. This is possibly due to the fact that during the focus groups, three types of possible benefits stemming from marinating by injection (improving health, safety and eating quality) were discussed, while only one general measure irrespective of the associated benefit was included in the questionnaire.

c. Beef nutritionally enhanced and restructured with enzymes

Participants scored to nutritional enhancement low had a stronger focus on consumer rights, and more specifically on their freedom of choice. They considered that consumers should be "*free to decide whether or not to buy nutritionally enhanced products*". They also emphasised that the industry should provide "*what consumers like*" without forcing them to adopt nutritionally enhanced products in just any product category. The growing interest for functional food in the society was linked with consumers being over-concerned about their health status. Furthermore, this group of consumers was more positive towards added enzymes, as long as they were "*natural enzymes*". Restructured beef was not always perceived as negative, in contrast to the participants who tended to be more reluctant towards the nutritional enhancement of beef and who discussed about these restructuring processes in more apprehensive wordings.

5.5. Discussion

This chapter presents original findings on consumers' attitudes towards new beef processing technologies. In spite of the fact that participants of the focus groups expressed positive attitudes towards eating beef in general, certain distrust in new beef processing technologies was revealed. Apparently, a critical public debate still seems to prevail about such technology application. Indeed, excess manipulation and distance from a "*natural*" way of processing beef products were considered to be very negative outcomes of technological development and may explain why some of the proposed technologies were mainly rejected. Especially, invasive processing technologies, such as injecting substances into muscle meat, were strongly rejected, despite consumers' recognition of the possible benefits the technologies might offer with respect to potential products or to particular consumer segments. All participants were profiled as rather conservative consumers according to the data collected in the questionnaire, suggesting that they were generally critical about new beef processing technologies. In that respect, a trend towards a higher technology acceptance among European consumers was not identified in this chapter. Participants were also not very prone to

innovativeness and their preference for familiar, traditional beef products may also indicate a moderate level of food neophobia.

In general, the respondents did not consider the new processing techniques as univocally favourable with respect to either health, eating quality or food safety aspects. The analysis of the focus group discussions showed a dependency between the acceptance of new beef products and the way how consumers perceive the characteristics of the technology or innovation itself. This means that the probability of consumer acceptance of a technology increases, the more the technology is perceived to be "*traditional*" and "*familiar*", a finding consistent with previous studies (Nielsen et al., 2009; Siegrist, 2008; Søndergaard et al., 2005). The respondents expressed a strong negative attitude towards most of the presented technologies, since new food technologies are believed to merely increase the "*profit*" of the industries wanting to produce foods to "*feed the poorer*". In the present study, consumers took such positions especially with regard to technology-based claims such as "*extended shelf-life*" believing 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*". The participants often did not perceive the advantages of a technology for themselves and highlighted that mostly "*low-quality products*" are destined to processing. Yet, in terms of managerial implications, the acceptance of improved low-grade beef products by consumers could add value to members of the meat chain.

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

Overall, our study identified three main categories in terms of acceptance versus rejection of new beef processing technologies: a) rejection tout court, that is, consumers who simply reject the technology without much afterthought (beliefs, prior attitudes); b) consumers who personally reject the technology, but consider it to be acceptable for other consumers, and c) consumers who accept the technology, mainly for its perceived benefits. The second category constitutes an interesting segment, because either those participants perceive themselves as being different from the average or they do not want to reveal their personal interest in those products (either for social desirability reasons, or from a citizen rather than consumer perspective). Therefore they project possible acceptance on consumers who might experience specific, personal benefits. In both cases, marketing strategies to promote new beef technologies as premium or high quality, fashionable, trendy and/or value added could help

reverse the negative image of innovative processed beef products ("*cheap*" and "*low quality*") and promote a stronger affection.

This study can also be related to the ongoing discussion on consumer education, questioning if the food industry and public authorities should provide consumers with more information about the realised technological developments. Are they prepared to understand science and innovation? In our study, all participants generally wanted to be informed about new technologies. Notwithstanding, they did not want to have detailed knowledge of the production process, but rather preferred a conscious lack of knowledge. Such behaviour emerged in group discussions in this chapter as a strategy to avoid the dissonance that technologies might produce. This means, consumers want to be informed about the positive outcomes of technologies (tenderness, taste, amongst others) and they want to take advantage of the eventual benefits that resulting products offer, but they do not want to be confronted and to think about the technological processing of products itself, the 'offstage' information.

In this regard, unknown risks were responsible for the rejection of many concepts. Such results are in agreement with previous research results, namely that 'insufficient scientific knowledge may contribute to the controversial responses to new foods as well as food processes' (Behrens et al., 2009). Therefore, the reinforcement of marketing communication strategies towards applying factual information, handily added to the product, might be advisable to increase acceptance and familiarity of new beef processing technologies.

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 new technologies, it is consequently fundamental for the industry to position new products as superior in terms of quality and corresponding benefits, while maintaining their naturalness.

Nielsen et al. (2009) share this view. According to these authors, the success of new food processing technologies is highly dependent on consumers' acceptance and while food scientists are stimulated by the challenges of technological progress, consumers behave in a rather conservative way and do not always see the positive outcomes of new processing methods. Frewer et al. (2003) agree that new foods and food technologies are more acceptable to the public if tangible benefits are offered and perceived as such, although the benefit alone does not guarantee acceptance (Siegrist, 2006). A particular challenge pertains to communicating benefits and ensuring that these are effectively experienced by consumers upon product usage.

5.6. Conclusions

This chapter provides important insights about the attitudes towards new beef processing technologies based on exploratory qualitative research conducted with urban European beef consumers. The participants in this chapter generally supported the development of technologies that can provide more healthiness and eating quality; if such technologies are not invasive, the chances of acceptance increase. They acknowledged 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"*. Nevertheless, the participants' final conclusion reflected a severe scepticism about too much intervention in food and a strong desire to keep food and beef processing as "*simple and natural as possible*". Future research could investigate differences in consumers' attitudes towards food innovation in urban versus rural settings. A recent qualitative study investigating innovation in traditional foods found out that rural consumers were more conservative, while urban consumers were more prone to accept innovations in Traditional Food Products (Guerrero et al., 2009). The differences between 'hidden' versus 'real' beef eaters in regard to the acceptance of new beef processing technologies should equally be further investigated, as our results were found inconclusive.

The fact that processes considered to be familiar or traditional were easier to accept and understand opens a window of opportunities for the development of meat products inspired by traditional recipes and use of locally known, accepted and natural ingredients (see also Guerrero et al., 2009). New technologies must be communicated to consumers to a certain extent and in a way that actually raises their interest in a concept rather than leading to its rejection. At this point, consumer education must be considered as a crucial aspect in the long term to allow consumers to participate in and tangibly benefit from technological progress.

In conclusion, the "*invasive technologies and unfamiliar ones"*, which tended to deviate from conventional processing practices, were widely rejected. In other words, the overall trend was "*the closer to nature, the better*", which emphasises a low degree of innovativeness and a certain degree of conservativeness and food neophobia among the participants. A hypothesis is that such attitudes stem partly from the lack of exposure to innovations in meat chains, as well as from vigilance and scepticism inherited from consecutive meat safety crises. Although the latter date 10 or more years back in time, it might well be that such risk perceptions are still present, and although perhaps dormant, they might be easily activated when confronting unknown and unfamiliar processing technologies. Nevertheless, consumers were able to identify potential benefits of the technology concepts and also recognised that new beef technologies could provide consumers with "*cheaper"* beef solutions. Although consumers value improvements in meat safety, there is some evidence that consumers regard food safety either as a basic requirement and/or as 'given' (Verbeke, 2001b; Henson, 1995; Daly, 1986). That could be an additional argument why participants were not so prone towards the technology 'marinating by injection aiming for increase food safety', for example.

The use of complementary methodological tools was considered satisfactory and enriching for the aim of this research. The added questionnaire contributed to consumer profiling and largely reinforced the exploratory results. The triangulation approach enhanced the reliability of the results, especially with respect to marinating by submerging and nutritional enhancement. The fact that consumers elicited positive benefits even considering it to be unknown and unfamiliar indicates promising perspectives for the development of new beef technologies, despite consumers' reluctance and scepticism. Adequate communication, careful monitoring of the technology's adoption process and further quantitative studies in this domain are recommended.

Chapter 6: Consumer acceptance of safety-improving interventions in the beef chain

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Abstract

While safety interventions are applied on different stages of the beef chain, consumer acceptance remains largely uninvestigated and undiscussed though often taken for granted. In this study, European consumer acceptance of beef safety-enhancing interventions was investigated at three key stages of the beef chain: primary production (adjusting cattle feed), slaughtering (decontaminating cattle hides) and processing (applying treatments). This chapter presents original findings from a quantitative study with beef consumers (n = 2,520) from five European countries (France, Germany, Poland, Spain and the United Kingdom). Acceptance levels differ between countries and consumer segments, and between stages of application, processes, and level of information detail provided. Higher a priori confidence in beef and beef products, as well as higher risk perception were associated with increased acceptance of safety-improving interventions. More detailed descriptions of the processes or technologies involved in the interventions, on the other hand, led to lower acceptance. As a result, it is unlikely that one standard way of communicating about beef safety improvements will be most successful.

6.1. Introduction

Safety interventions are applied on different stages of the beef chain, from farm to fork, each at its turn aiming to enhance the safety of beef and beef products. Following a number of meat safety incidents during the nineties (Verbeke et al., 1999b), actors in the beef sector have made substantial efforts to improve beef safety by introducing traceability regimes and various other safety improvements, significantly mitigating microbiological risk (Koohmaraie et al., 2005). However, the benefits of these safety interventions may not be as clear to consumers as they are to scientists and industry (Nielsen et al., 2009; Bruhn, 2007). Consumers are often ambivalent about food technologies and may not be able to balance possible benefits and risks (Siegrist, 2008). Consumer acceptance of various food technologies currently applied remains largely uninvestigated but is quite often taken for granted (Siegrist, 2008; Tenbült et al., 2008).

Various interventions widely applied in the food chain aim to enhance food quality in general. When discussing food quality, product quality needs to be distinguished from process quality. While product quality refers to the characteristics of the product itself, process quality refers to all characteristics of the production process. Process quality has an influence on the characteristics of the product, but at the same time consumers are more and more inclined to attach value to process characteristics as such (Fischer, 2005). Research has shown that consumers increasingly report their product preferences to be strongly related to process characteristics (Krystallis et al., 2009; Søndergaard et al., 2005). Although production and processing technologies are technical issues that may be hard to understand for laymen, consumers have nevertheless developed preferences for particular practices (such as 'natural' and organic food production methods) while disliking others (such as genetic modification and 'excessive processing' of food (see de Barcellos et al., 2010; Nielsen et al., 2009; da Costa et al., 2000)). Numerous consumer studies have focused on the safety of the product itself, as one specific component of product quality, investigating consumer preferences for product safety attributes and consumer attitudes towards food safety (Wilcock et al., 2004). Consumer research on perceptions of process safety has generally focused on consumers' food handling practices at home, because of the large impact on food safety of the final product (Jevsnik et al., 2008), and to novel and controversial technologies such as biotechnology and food irradiation (Wilcock et al., 2004; Fox et al., 2002).

This chapter focuses on safety interventions at three key stages of the beef chain: primary production, slaughtering and processing. At the farm level, the number of pathogens in and on cattle can be lowered, for instance by adequate farm management and adjusting the cattle feed, making the resulting meat safer for human consumption (Adam & Brulisauer, 2010). At the slaughtering stage, cattle hide is known to be a major source of microbial contamination of bovine carcasses and beef meat (Buncic, 2009; Koohmaraie et al., 2005). During slaughter, harmful organisms present on the cattle hide can come in contact with the meat and become hazardous to consumers. Interventions that decontaminate the cattle hide can, for instance,

limit faecal matter clinging to the hide and can thereby enhance beef safety (Lee et al., 2009; Sofos, 2009). During meat processing, various treatments are applied to prevent contamination of beef and beef products, such as thermal treatments or the use of additives. Whilst safety interventions are widely applied at these key stages of the beef chain, only little research has been conducted on their acceptance among consumers (de Barcellos et al., 2010; Nielsen et al., 2009).

The present chapter aims to investigate and map European consumer acceptance of the application of safety-enhancing interventions at three key stages of the beef chain. The first objective is to assess acceptance levels of particular safety interventions that are currently addressed with highest attentions by industry professionals but have remained largely out of the scope of consumer research till now. The second objective is to identify consumer segments that are more versus less willing to accept these interventions. This knowledge will allow the beef industry to provide information regarding their safety interventions targeted to specific segments of beef consumers. This study differentiates itself from other studies by its quantitative approach (compared to previous qualitative focus group research), its pan-European scope (including data from five EU member states), and its coverage of three consecutive steps in the beef supply chain (instead of focusing on one specific technology applied at one stage).

6.2. Methodology

6.2.1. Data collection

Cross-sectional consumer data were collected in France, Germany, Poland, Spain, and the United Kingdom in February and March 2010 (n=2,520). In the period of twelve months prior to and during the data collection, no significant beef safety scares had emerged in these countries. Procedures for participant recruitment and the profile of the sample have been described in 1.5.2.

6.2.2. Questionnaire

A survey questionnaire consisting of two parts was developed and pretested. The first part of the questionnaire measured consumers' acceptance level of different beef safety-enhancing interventions. Participants were asked to rate their acceptance of various interventions to improve beef safety. The safety interventions were selected based on recommendations from scientists and industry experts participating in the EU FP6-funded project ProSafeBeef. Four types of safety interventions were presented: adjusting the cattle feed, cleaning the hide of the animals, using safer processing techniques, and adjusting the packaging. This chapter focuses on the first three types of safety interventions. The results regarding the packaging adjustments will be reported in Chapter 7. For each type of safety intervention, one general question (asking the respondents about their overall acceptance of that type of safety intervention) was followed by specific questions, in which more details were given about the

techniques that resort under that type of safety intervention. In particular, one specific safety intervention through adjusting cattle feed was considered (adding protective bacteria to the feed); three potential safety interventions of hide decontamination (using a fixating fluid, washing with soap, and removing the hair); and four safety improving processing techniques (high pressure treatment, high temperature treatment, adding natural ingredients, and adding protective bacteria) were included. The descriptions of stage-specific interventions and detailed processes are shown in Appendix III. Participants were asked to report their acceptance level of each of these safety improvements on a five-point interval scale (where 1='completely unacceptable', 2='rather unacceptable', 3='neutral', 4='rather acceptable' and 5='completely acceptable'). The general statements only mentioning the stage in the beef chain at which the interventions are applied, are further referred to as "descriptions of stage-specific interventions" while the specific statements spelling out the used process or technologies in more detail are further referred to as "detailed process descriptions".

The second part of the questionnaire assessed consumer attitudes (food safety concern, general health interest, confidence in beef) and beef consumption behaviour (consumption frequency of beef steak and beef burger). The constructs, items and measurement scales used to describe these attitudes and behaviours are shown in Appendix IV. Finally, consumers' socio-demographic characteristics were asked for, including age, gender, educational level, place of residence, household composition, occupation, total monthly net household income and whether or not they were working in the food industry.

6.2.3. Data analysis

Analyses were performed in SPSS 15.0. First, descriptive statistics (frequencies, means, and standard deviations) were computed to describe the sample characteristics and consumers' reported intervention acceptance levels. One-sample T-tests with a significance level of 0.05 were used to compare mean scores. The internal consistency reliability of multi-item constructs was assessed using Cronbach's alpha.

Second, a principal-components factor analysis with varimax rotation and Kaiser normalisation was performed on the safety-enhancing interventions (results not shown). The two resulting factors based on eigen values > 1, only accounted for 53.7% of the total variance, hence all intervention statements (instead of only the two factors) were used to perform a segmentation analysis. A hierarchical clustering method was followed by a K-means clustering, using Ward's method as cluster method. The consumer segments were characterised using one-way ANOVA F-tests (or Welch and Brown-Forsythe statistics in case of unequal variances) and χ^2 tests. Differences were considered significant at a p-value lower than 0.05.

Third, decision tree analysis was used to investigate which variables in the dataset were the best predictors of segment membership. Decision tree analysis has been used in a variety of applications including consumer concerns about food and health (Worsley & Lea, 2008). The decision tree algorithm applied in this study (CHAID - Chi-Square Automatic Interaction

Detection) has been described by Kass (1980), and repeatedly chooses the independent variable that has the strongest interaction with a specific dependent variable. Independent variables included in the decision tree analyses are personal and socio-demographic variables (country, age group, gender, residential status, living environment, education, occupation, income, children, working in food industry), participants' attitudes related to food and beef (food safety concern, general health interest, confidence in beef) and behavioural characteristics (consumption of beef steak and beef burger). Split-sample validation with random assignment was applied. The results shown involve the test sample, containing 33.3% of the consumers from the original sample. The performance of the decision tree model was good as the minor differences (≤2.2) in gain percentage in the top percentiles indicate that the decision tree produced results that were replicated with a high reliability in the test sample (McCarty & Hastak, 2007).

6.3. Results and discussion

6.3.1. Beef consumption and consumer attitudes

Although all participants consumed beef at least several times per year, about one quarter of the sample did not consumer beef steak, while one third of the sample did not consume beef burger in the 14 days preceding the survey (Figure 6.1). Participants showed relatively high food safety concerns with a mean value of 5.46 (sd=1.15) on a 7-point scale. This value is comparable to the food safety concerns that McCarthy et al. (2003) reported from a sample of Irish consumers. Only 8% of our sample reported a score lower than 4 (being 'neutral') on this scale.

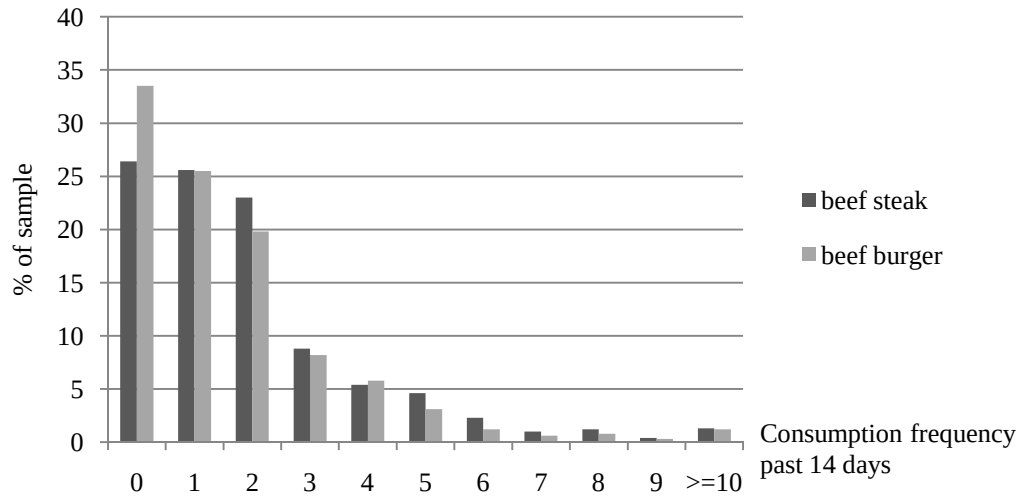

Figure 6.1: Number of times that beef burger and beef steak were consumed in the preceding 14 days (in % of the sample) (n=2,520)

Regarding general health interest (mean=4.72; sd=1.13), 22% of the sample scored below the neutral point of the scale. Less than 10% of the participants indicated to be not confident about purchased beef and beef products (Figure 6.2), confirming results from earlier studies that consumers are generally confident that the consumption of food products as they are available in the market will not result in adverse health effects (Van Wezemael et al., 2010b; de Jonge et al., 2004).

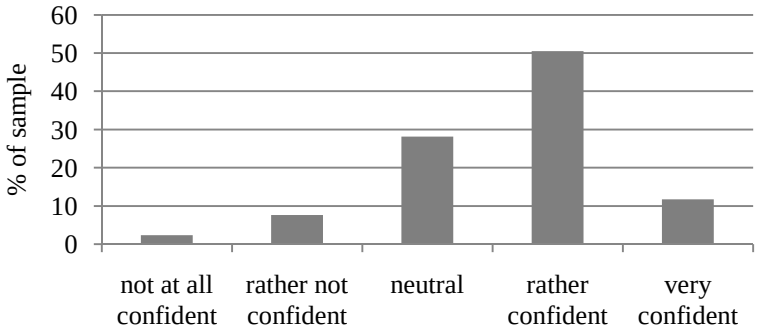

Figure 6.2: Consumer confidence in beef and beef products (in % of the sample) (n=2,520)

6.3.2. Intervention acceptance levels

The mean acceptance levels of the descriptions of stage-specific interventions were all above the neutral point of the 5-point scale, with 3.46 for processing techniques (sd=0.96), 3.70 for adjusting cattle feed (sd=0.96), and 4.72 for hide decontamination (sd=1.00). All means were significantly different from each other ($p<0.05$).The processing stage was not consumers' favourite to intervene for improving beef safety, which is consistent with previous qualitative studies with European consumers (de Barcellos et al., 2010; Van Wezemael et al., 2010b). Although processing technologies are often looked at with suspicion by consumers, our results showed that safety improvements during processing nevertheless are acceptable to some degree for more than 60% of the study participants, revealing that public support for these interventions might be larger than expected based on exploratory studies.

Figure 6.3 provides an overview of the acceptance levels expressed as percentage of the total sample. In general, the descriptions of stage-specific interventions were accepted more easily than the detailed process descriptions. This means that when more detailed information about the process was provided, consumers were less inclined to accept the intervention. This corroborates with the finding of Cardello (2003) that even the inclusion of the name of the technology already yields a decline in consumer liking. A possible explanation is that consumers do not normally associate beef with a high degree of processing (de Barcellos et al., 2010). Any processing beyond what consumers experience as 'normal' processing for a particular food product can negatively influence consumer liking (Cardello, 2003). For this reason, it might be appealing for the food industry not to provide too much detail about the used food technologies. Concurrently, consumers indicated not to be too keen to receive too

much detailed information about food technologies. This preference has been referred to as 'rational ignorance' by McCluskey and Swinnen (2007), and a 'conscious lack of knowledge' by de Barcellos et al. (2010). Also a recent survey among American consumers showed that only very few requested for detailed information about processing methods on food labels (IFIC, 2010).

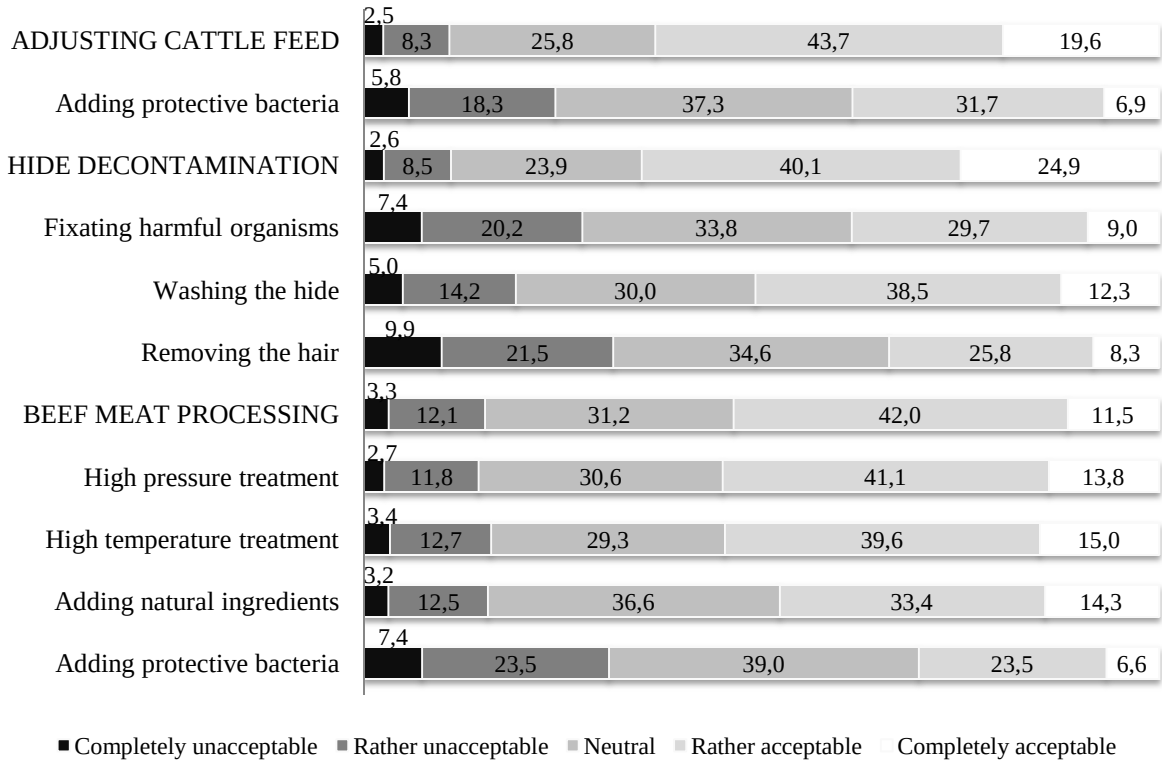

Figure 6.3: Consumer acceptance levels of the descriptions of stage-specific interventions and detailed processes, in % of the total sample (n=2,520); descriptions of stage-specific interventions in capitals; detailed process descriptions in lower case

High temperature and high pressure treatment were two exceptions, yielding higher acceptance than the general description of interventions at the processing stage. A possible reason is that consumers consider these technologies as 'normal' processing for meat products, since especially high temperature treatment is well-known, or at least believed to be well-know, and even applied at home by consumers. Previous studies (Nielsen et al., 2009; Søndergaard et al., 2005) have shown that familiarity is an important factor in consumer acceptance of technological interventions. Familiarity partly reflects consumer awareness and knowledge on specific interventions, which is often fuelled by their purchase behaviour. For example, consumers eating more marinated meat can be expected to be more positive towards marinating technologies owing to their higher degree of experience, familiarity and possibly also satisfaction. Furthermore, consumers may also perceive high temperature and high pressure treatments more positively because of their non-invasive character, since they do not directly alter the meat. de Barcellos et al. (de Barcellos et al., 2010) found that especially

invasive interventions such as the addition of substances to beef meat encounter strong rejection among consumers, especially when the aim of the technology is related to safety enhancement.

In most cases the provision of process information not only increased the number of consumers rejecting the intervention, but also the number of consumers reacting with a neutral response. A possible explanation is that consumers find it hard to assess interventions of which they only have limited knowledge. The use of words which consumers are not familiar with or raise uncertainty and concern (such as 'protective bacteria' or 'pathogens') might disable consumers to assess possible benefits (Siegrist, 2008). Furthermore, the increase in neutral answers also illustrates the low awareness, interest and knowledge of consumers about the safety-enhancing processes at specific stages in the beef chain.

Although hide decontamination is widely used in beef abattoirs in some countries such as the USA (Buncic, 2009), no research on consumer acceptance of hide decontamination processes is available in literature. The idea of hide decontamination was acceptable for the large majority of participants in this study. However, the more detailed processes for hide decontamination were less easily accepted. Especially chemical dehairing and microbial fixating were disliked by consumers. Chemical dehairing is an effective method to remove hair and associated external contaminants after slaughtering and animal exsanguinations (Sofos, 2009). Microbial fixation of the hair immobilises pathogens on the hide and prevents microflora detaching from the hair, thus preventing the contamination of the carcass meat during skinning (Antic et al., 2009; Buncic, 2009). Although the word 'chemical' has not been used explicitly in our process description, more than one third of the consumers considered this type of safety intervention as unacceptable. Dehairing was not considered to be the most acceptable way to decontaminate the hide. However, since the exact time of application (before or after slaughtering) was not mentioned in our description, participants may have thought that this process takes place before slaughtering, thereby possibly triggering animal welfare concerns.

Consumers disliked the idea of adding protective bacteria especially when these are added to beef products, more so than to cattle feed. The addition of protective bacteria is a widely applied technology in foods such as dairy products (Todorov et al., 2007), but also in meat products, mainly in fermented dry sausages without heat treatment (Zhang et al., 2010). Unlike in dairy products, the presence of bacteria in meat products has never been marketed as a benefit and consumer acceptance of this process remains largely undiscussed (Zhang et al., 2010). More than 30% of the participants in this study stated the addition of protective bacteria to cattle feed and beef products to be acceptable, illustrating that a substantial amount of consumers are nevertheless convinced of the potential benefits of such safety interventions and processes.

6.3.3. Consumer segmentation

The cluster analysis revealed four consumer segments (Table 6.1), which are referred as: the 'feeling OK', 'indifferent', 'rejecting' and 'enthusiast' consumers. The profiles of the segments are shown in tables 6.2 and 6.3.

Table 6.1: Segmentation based on acceptance of safety-enhancing interventions; four-cluster solution and comparison of mean scores

	Segment 1 n=272 (11%) 'enthusiast'	Segment 2 n=929 (36%) 'feeling OK'	Segment 3 n=1043 (41%) 'indifferent'	Segment 4 n=276 (11%) 'rejecting'
Feed[2]	4.56[a]	4.02[b]	3.46[c]	2.65[d]
Adding protective bacteria[2]	4.28[a]	3.40[b]	2.96[c]	1.96[d]
Hide[2]	4.74[a]	4.20[b]	3.44[c]	2.53[d]
Fixating harmful organisms[2]	4.51[a]	3.62[b]	2.65[c]	1.89[d]
Washing[2]	4.61[a]	3.87[b]	2.94[c]	2.26[d]
Removing the hair[2]	4.31[a]	3.43[b]	2.61[c]	1.83[d]
Processing[2]	4.62[a]	3.83[b]	3.17[c]	2.20[d]
High pressure treatment[2]	4.62[a]	3.82[b]	3.27[c]	2.32[d]
High temperature treatment[2]	4.58[a]	3.79[b]	3.26[c]	2.38[d]
Adding natural ingredients[2]	4.66[a]	3.68[b]	3.19[c]	2.29[d]
Adding protective bacteria[1]	4.27[a]	3.16[b]	2.77[c]	1.94[d]

Measured on a five-point scale: 1=completely reject – 5=completely accept

[a,b,c,d] Scores in a row with different superscripts are significantly different ($p<0.05$)

[1] Significant differences using ANOVA and Duncan post hoc tests.

[2] Significant differences using Welch and Brown-Forsythe statistics and Dunnett C's multiple comparison tests.

Table 6.2: Comparison of mean scores for consumer attitudes between segments

	Segment 1 n=272 (11%) 'enthusiast'	Segment 2 n=929 (36%) 'feeling OK'	Segment 3 n=1043 (41%) 'indifferent'	Segment 4 n=276 (11%) 'rejecting'
Food safety concern[1]	5.87[a]	5.57[b]	5.28[c]	5.39[bc]
General health interest[1]	4.8 [a]	4.82[a]	4.61[b]	4.64[ab]
Confidence in beef[2]	4.02[a]	3.82[b]	3.45[c]	3.19[d]
Consumption frequency of beef steak[3]	2.43[a]	1.97[b]	1.74[bc]	1.58[bc]
Consumption frequency of beef burger[3]	2.21[a]	1.66[b]	1.43[c]	1.37[bc]

[1] Measured on a 7-point scale: 1=low – 7=high; [2] Measured on a 5-point scale: 1=not at all confident – 5=very confident; [3] In the last 14 days

[a,b,c,d] Scores in a row with different superscripts are significantly different ($p<0.05$) using Welch and Brown-Forsythe statistics and Dunnett C's multiple comparison tests.

Table 6.3: Socio-demographic profile of the four consumer segments; comparison with % distribution of the total sample (n=2,520)

	Segment 1 (11%) 'enthusiast'	Segment 2 (36%) 'feeling OK'	Segment 3 (41%) 'indifferent'	Segment 4 (11%) 'rejecting'	Sample	χ^2	p-value
Country							
France	15.8	21.5	19.7	20.3	20.0	153.51	<0.01
Germany	20.6	20.9	18.5	22.1	20.0		
Poland	7.4	12.2	27.6	30.1	20.0		
Spain	26.5	24.5	17.1	9.4	20.0		
UK	29.8	20.9	17.2	18.1	20.0		
Age groups							
18-30	30.2	30.5	36.8	32.1	33.3	18.94	0.03
31-45	37.3	35.5	36.8	35.8	36.2		
46-64	28.4	29.8	23.8	29.2	27.1		
65-85	4.1	4.2	2.6	2.9	3.4		
Gender							
Male	50.4	43.7	41.8	47.5	44.0	7.89	0.05
Residential status							
Cohabiting	84.9	86.2	85.0	84.1	85.4	1.05	0.79
Living environment							
Urban residence	74.3	73.0	70.7	63.8	71.2	10.25	0.02
Education							
Higher education	51.1	51.1	50.8	46.4	50.5	8.60	0.48
Occupation							
Self-employed farmer	0.0	1.0	0.5	0.7	0.6	37.41	<0.01
Self-employed (gen.)	10.3	7.0	8.2	14.5	8.7		
Employed, manager	13.6	10.5	9.1	12.3	10.5		
Employed	34.9	45.3	46.4	36.2	43.7		
Student	10.7	10.7	10.6	9.8	10.6		
Retired	10.7	9.5	9.3	9.8	9.6		
Unemployed	19.9	16.0	15.8	16.7	16.4		
Total monthly net household income							
< €500	5.5	4.6	7.2	9.1	6.3	74.17	<0.01
> €5000	4.8	2.4	2.6	3.3	2.8		
Working in food industry							
Yes	3.3	5.5	5.5	8.3	5.6	6.70	0.09
Children							
Under 5 years	18.8	17.0	19.9	19.0	18.6	3.82	0.70
Older than 5 years	20.2	22.7	20.4	21.2	21.3		

The ‘enthusiast’ consumer segment reported the highest acceptance levels on all stage and process statements and was very positive towards the beef safety-enhancing interventions. For all interventions, acceptance levels in this segment were higher than 4.3. This segment comprised 11% of the beef consumers in our study and reported significantly higher consumption of beef steaks and burgers, high food safety concern and high confidence in beef and beef products. Enthusiast consumers were more often men than women, with a net monthly household income over €3000, employed in a managerial position, or without paid employment. Their more favourable socio-economic position has been linked to a higher prevalence of behaviours with a higher food safety risk (Wilcock et al., 2004). They have a higher likelihood of living in Spain and the UK, and in urban settings. This consumer segment consists of heavy beef consumers, with a high a priori confidence in beef, and who are open to further safety interventions and reassurance, most likely because of their high involvement with beef. The finding that men were higher represented in a segment with this type of profile is in accordance with previous research results (Verbeke & Vackier, 2004). Communication about safety interventions can be expected to be relatively well accepted by this segment, as they will attribute importance to issues related to beef, which they like, and its safety.

At the other side of the spectrum were beef consumers who rejected each of the proposed safety interventions, with acceptance levels below 2.7. This consumer segment (representing another 11% of the sample) not only reported significantly lower beef consumption, but also significantly lower confidence in beef and beef products and less food safety concerns. Consumers rejecting the safety interventions were more often self-employed, between 46 and 64 years old, and living alone. They were more likely to live in Germany and Poland, and lived more often in rural areas compared to the other segments.

The two remaining consumer segments stood in between these two extremes and were characterised as ‘indifferent’ and ‘feeling OK’ consumers with regard to their acceptance of safety-enhancing interventions. Indifferent consumers had acceptance levels around the neutral point of the scale (in between 2.6 and 3.5). Their relatively high level of confidence in beef indicates that these consumers place confidence in whatever the beef industry is doing to ensure beef safety. These consumers reported low food safety concerns and low general health interest. The ‘indifferent’ consumer segment, consuming less beef steak and burger, is likely to have a low involvement in beef (Verbeke & Vackier, 2004). This consumer segment was more often comprising females, living in Poland, and between 18 and 30 years old. They were often employed in a non-managerial position and had a higher likelihood of reporting to be a less well-off (total monthly net household income below €500). The latter corresponds with the lower mean income level in Poland.

The segment ‘feeling OK’ with the safety-enhancing interventions reported intervention acceptance levels between 3.1 and 4.2. Especially the stage statements were easily accepted by these consumers, reporting moderate values regarding beef consumption, food safety concern and confidence in beef. In contrast to the ‘indifferent’ consumers, they reported

significantly higher general health interest. It can be expected that this consumer segment is willing to accept interventions in the beef chain because of their expected safety and health benefit. These consumers were often older than 45 years, living in rural areas and in Spain.

The results indicated that a higher degree of concern about food safety seems to justify technological interventions to improve beef safety. People with a higher food safety concern were more inclined to accept beef safety improvements. Furthermore, also people feeling more confident in the available beef and beef products were more apt to accept beef safety improvements. In our sample food, safety concern is significantly positively correlated to confidence in beef in this sample, but this correlation is very small ($r=0.16$, $p<0.01$). Both findings together indicate that consumers accept safety-enhancing technologies for diverging reasons: either because they are confident that what the industry will do (in terms of safety interventions) is the right thing to do, or because they feel that such safety interventions are heavily needed, which is fuelled by elevated safety concerns. These two motivations also come to the forefront in the decision tree analysis, as reported in the next section (Table 6.4).

6.3.4. Decision tree analysis

Table 6.4 shows which variables in our dataset were the best predictors of membership of the consumer segments who were most positive towards beef safety-enhancing interventions (the segments of 'enthusiasts' and 'feeling ok' consumers; further referred to as the 'positive segments') compared to more negative segments ('rejecting' and 'indifferent'). The results show that the most decisive factor was consumer confidence in beef. Consumers with a high or very high confidence were more likely to accept safety-enhancing interventions in the beef chain. The second best predictor was country, with a higher likelihood of acceptance among German and UK consumers. Among the confident Spanish consumers beef burger consumption was positively correlated with membership of the positive consumer segments. Among unconfident German and British consumers, food safety concerns were positively related to membership to the positive segments. These results stress the importance of consumer confidence for acceptance of safety-enhancing interventions. As food safety concerns are less decisive as a predicting factor, it is suggested that the introduction of new (information about) safety-improving interventions might be most successful in periods with high consumer confidence, and to a much lesser degree in periods of enhanced food safety concerns (for instance during food safety scares) since consumers might more easily link the safety benefit with the intervention. The results also indicate that acceptance levels differ between countries. This finding is consistent with previous consumer research in European countries (de Barcellos et al., 2010). However, based on our data a clear-cut explanation for this phenomenon cannot be provided. Future research could elaborate on the reasons and motivations of European consumers that drive the acceptance of safety-enhancing interventions in the beef chain.

Table 6.4: Profiles of participants in terms of the most significant predictor combinations for cluster membership based on acceptance of beef safety-enhancing interventions (test sample n=852)

Definition of the subset	% of 'positive' participants in subset	N in terminal node
Very / rather confident French / Polish consumers	51.3	189
Very / rather confident German / British consumers	58.7	218
Very / rather confident Spanish regular beef burger consumers	69.4	85
Very / rather confident Spanish irregular[1] beef burger consumers	47.8	23
Not confident[2] French / Spanish consumers	32.6	89
Not confident[2] Polish consumers	19.5	113
Not confident German / British consumers with high food safety concern[3]	60.0	25
Not confident German / British consumers with low food safety concern[3]	32.7	110

[1](ir)regular: consumers who consumed (no) beef burger during the last 14 days

[2]not confident: neutral, rather not confident or not at all confident in purchased beef and beef products

[3]food safety concern: low $\leq$ 6.33; high > 6.33

6.4. Conclusions

This chapter presents original findings from a quantitative study assessing consumer acceptance of safety-enhancing interventions at three key stages of the beef chain: primary production, slaughtering and processing. The results show that acceptance levels differ between countries, stages of application, processes, and consumer groups. Higher a priori confidence in beef and beef products as well as higher risk perception were associated with increased acceptance of safety-improving interventions. More detailed descriptions of the processes or technologies involved in the interventions, on the other hand, led to lower acceptance. The decision tree analysis showed statistically significant relationships between consumer attitudes and the socio-demographic variables on one hand, and intervention acceptance on the other hand. These results contribute to the existing literature not only by quantifying consumer acceptance of widely applied technologies in the beef chain, but also by providing insights into the profile of consumer segments that are more willing to accept these interventions.

In order to secure beef safety, industry must obviously do what is scientifically justifiable and within the regulatory framework. How much of this is to be told to consumers is another question. The findings of our study suggest that providing too much detail about safety-improving interventions raises suspicion and a higher likelihood of rejection, particularly in cases where consumers are not familiar with the technology and its related terminology. This study also shows that consumers are not all alike with respect to their interest in beef safety-improving interventions. Whereas some more readily accept one technology, others may reject it and may be more open to alternative methods. Therefore, it is unlikely that one standard way of communicating about beef safety improvement strategies will be most successful. Strategies allowing consumers to access information if they require it, and where

consumers can be reassured that safety is taken care of using the best possible technologies stand a higher likelihood of success.

The results reported in this chapter should be critically evaluated, as the limitations of the study need to be taken into account when interpreting the results and its contributions. However, some of these limitations also provide opportunities for future research on a similar theme.

Firstly, it should be acknowledged that the formulation of the statements in our questionnaire can influence consumer acceptance, owing to so-called framing effects. Although the formulations of the statements in our study was prepared very carefully and in collaboration with food scientists, industry and consumer researchers, other well-considered formulations might be equally appropriate for this purpose. By using formal statements, the informational contents of the message and not the attractiveness of the formulation were asked for (Lees & Wright, 2004). Furthermore, the provision of information about consumer benefits has been shown to influence consumer acceptance liking (Cardello, 2003). In this study, all descriptions of the stages and processes emphasised the safety benefit, thus possibly increasing stated consumer acceptance. For instance, Fox et al. (2002) and Hayes et al. (2002) found that positive information about irradiation processes increased willingness-to-pay, while negative information decreased it. Other research suggested that gain-framed messages are better able to discriminate between important and unimportant risks (Cox et al., 2006). Undeniably the formulation of the statements has an impact on the outcomes, limiting the generalisability of the results of this study. Future research could investigate how consumer acceptance levels would differ between two identical sub-populations if they would have been asked the same questions but formulated in different ways. It can be expected that providing information about other benefits (for instance convenience or consumer health instead of beef safety) will yield different acceptance levels.

Secondly, any food safety incident would have a major influence on the results of the study, as consumers confidence drastically decreases during food safety scares. As confidence is the most important construct in our dataset to predict acceptance of safety-enhancing interventions, consumer acceptance of the proposed safety-interventions is very likely to decrease significantly during or following another meat safety scare. This effect would be strengthened by an increased risk perception, since food safety incidents make the risk easier to visualise (Yeung & Morris, 2001).

Thirdly, the web-based nature of this study possibly causes sample selection bias, as consumers from different socio-economic backgrounds might have different access to internet. Although internet penetration is rising continuously, offline methods of data collection might be better suited in beef consumer research where socio-economic class is expected to be of major importance.

Fourthly, this study has investigated consumer acceptance levels of a number of beef safety-enhancing interventions that benefit from a high degree of scientific and industry interest at

present. Other interventions are available which also follow different objectives than only safety enhancement. Further research might investigate the reasoning and motives for consumer acceptance, by incorporating different consumer benefits, interventions or meat types in the study design. While this study has broadened the research scope to different stages of the beef chain, further research is recommended to deepen the knowledge on consumer acceptance of technological interventions in the beef chain.

Chapter 7: Consumer acceptance of packaging technologies for improved beef safety

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Abstract

Beef packaging can influence consumer perceptions of beef. Although consumer perceptions and acceptance are considered to be among the most limiting factors in the application of new technologies, there is a lack of knowledge about the acceptability to consumers of beef packaging systems aimed at improved safety. This chapter explores European consumers' acceptance levels of different beef packaging technologies. An online consumer survey was conducted in five European countries (n=2,520). Acceptance levels among the sample ranged between 23% for packaging releasing preservative additives up to 73% for vacuum packaging. Factor analysis revealed that familiar packaging technologies were clearly preferred over non-familiar technologies. Four consumer segments were identified: the negative (31% of the sample), cautious (30%), conservative (17%) and enthusiast (22%) consumers, which were profiled based on their attitudes and beef consumption behaviour. Differences between consumer acceptance levels should be taken into account while optimising beef packaging and communicating its benefits.

7.1. Introduction

During the past decades, consumers have shown an increasing interest in animal food production, matching their increasing interest in the quality of food in general (Mørkbak & Nordström, 2009). Product appearance is one of the main determinants of consumers' quality perceptions of meat (Grunert et al., 2004). As a result visual search cues, such as packaging and packaging-related product characteristics, significantly shape consumers' meat purchase intentions and decisions (Grobbel et al., 2008; Verbeke et al., 2005). However, a discrepancy exists between producer and consumer concerns with meat packaging. The meat sector has largely supported the development of packaging and packaging systems, as new packaging technologies contribute to preserving product quality and safety, to providing a larger stock of meat products in the shops and to increasing the availability of ready-to-eat meals. Furthermore, the delivery of safe meat products to consumers is of major importance in the food industry. These trends are the most important driving forces for industry efforts to invest in the development of packaging systems (Belcher, 2006). Consumers however have mainly hedonic motives for meat choice, more than safety reasons alone. Meat safety is considered to be a prerequisite by consumers (Van Wezemael et al., 2010b) and therefore not something they attach conscious weight to. This indicates different drivers for using and choosing packaging among consumers versus the meat industry. Knowledge and a better understanding of the impact of these differences is important for the success of the meat industry in utilising new packaging systems.

The different drivers for producers and consumers are also reflected in research regarding meat packaging. Meat packaging has been extensively documented from a technological perspective in terms of its protective role towards the microbiological, visual (colour) and sensory quality of meat (e.g. the recent papers by Jeong & Claus, 2011; Suman et al., 2010; Venturini et al., 2010). As packaging can influence beef colour and colour stability (Grobbel et al., 2008), the packaging technology also influences consumer perceptions of beef. Especially for beef a close link has been documented between colour preference and the decision to purchase (Carpenter et al., 2001). The role of meat packaging has also been documented from a marketing perspective, as a general means of product differentiation, value-adding in terms of convenience, and as a carrier for labels, brands and other product information (e.g. Bernués et al., 2003a). Several meat consumer studies have investigated the role of intrinsic and extrinsic cues on beef quality perception, expectations and experience (e.g. Banovic et al., 2009; Krystallis et al., 2007; Brunsø et al., 2005). However, only a few also included packaging as a possible component of the quality concept for beef. Acebron and Dopico (2000) investigated the effect of presenting beef freshly cut versus pre-packed in trays. Their conclusion was that the presentation of beef in trays had a significant negative effect on expected beef quality. Bredahl (2004) considered packaging (cardboard tray and package sleeve) as an extrinsic cue for (branded) beef quality. Although the study indicated that a perceived more favourable packaging was associated with a more acceptable price, the

conclusion was also that packaging was not significant as a quality cue shaping branded beef quality expectations. Also Bernués et al. (2003b) reported that packaging of (pre-prepared) beef was perceived less important to consumers from several European countries. This result was attributed to the fact that most beef was typically sold unpackaged, hence consumers were less familiar with packaging as a quality cue. However, the authors also noticed that this market situation was changing rapidly with a gaining importance of packaging and processing of beef as a response to a growing convenience-orientation among consumers. Nevertheless, recent focus group studies in several European countries revealed that packaged beef still evoked associations as being unsafe rather than safe among consumers (Van Wezemael et al., 2010b).

Although consumer perception of products and packaging are considered to be among the most significant factors limiting the application of new product technologies (McMillin, 2008) there is a lack of knowledge about the acceptability of packaging systems to consumers (Coma, 2008). Only a limited number of studies have specifically investigated consumer preferences with respect to meat packaging, showing that conventional plastic overwrap packaging is preferred over other packaging technologies such as vacuum packaging (Watson et al., 2005) or packaging with biopreservatives (Quagrainie et al., 1998), for example. Furthermore, the provision of information about the applied packaging technology has been shown to lower consumers' willingness-to-pay for beef (Grebitus et al., 2009), which is in line with the aforementioned scepticism raised among consumers when beef is offered pre-packed. Because of these indications in terms of negative attitudes towards meat packaging, new packaging technologies are often introduced without providing full information to consumers (McMillin, 2008). As utilising new packaging technologies can provide benefits for consumers, notably in terms of quality and safety, there might be an interest in conveying consumer information about packaging characteristics both from producers' and consumers' point of view.

The objective of this chapter is to investigate European consumers' response to different beef packaging technologies with particular emphasis on the safety aspect of packaging. This aspect of beef packaging may not necessarily be taken into account very consciously by consumers, still it constitutes an issue and investment of major importance for the beef industry. A better understanding of consumers' perception and acceptance of different beef packaging technologies is therefore crucial for new beef packaging development and the identification of demand-driven market based possibilities for improving beef safety (Mørkbak et al., 2010). Packaging innovations might contribute to the product differentiation strategy of beef industry partners and may provide a competitive advantage in the increasingly competitive market environment (Pouta et al., 2010).

7.2. Methodology

7.2.1. Data collection and used measures

An online consumer survey was conducted among 2,520 adult beef consumers in five European countries (France, Germany, Poland, Spain and the United Kingdom) in February and March 2010. Procedures of participant recruitment and data collection have been described in 1.5.2 Sample characteristics are presented in Table 7.1, showing that the sample covers a wide range of respondents in terms of socio-demographic characteristics.

Table 7.1: Socio-demographic characteristics of the sample (in % of participants) (n=2,520)

	France	**Germany**	**Poland**	**Spain**	**UK**	**Total sample**
Age						
18-30 years	29.5	22.2	58.9	31.7	23.7	33.3
31-45 years	39.8	36.5	30.2	49.0	25.8	36.2
46-64 years	27.3	37.9	10.5	17.7	42.3	27.1
65-85 years	3.4	3.4	0.4	1.6	8.2	3.4
Male	36.9	49.0	42.9	44.2	47.2	44.0
Female	63.1	51.0	57.1	55.8	52.8	56.0
Post-secondary education	29.0	66.7	43.7	49.8	63.3	50.5
Urban residence	62.3	60.9	79.8	85.7	67.1	71.2
Cohabiting	82.9	75.8	95.4	90.1	82.5	85.4
Children under the age of 5y	21.2	10.1	30.3	19.7	11.7	18.6
Children older than 5y	19.2	20.5	23.1	21.5	22.3	21.3
Working in the food industry	6.3	3.0	8.5	4.0	6.0	5.6

An online questionnaire measured consumers' responses to different beef safety-enhancing interventions, namely adjusting the cattle feed, hide decontamination, processing techniques and packaging technologies. This chapter focuses on the different types of packaging interventions presented in the questionnaire. These were modified atmosphere packaging, vacuum packaging, packaging containing protective bacteria, packaging releasing preservative food additives, and packaging containing natural agents. These packaging technologies were selected based on recommendations from scientists and industry experts participating in the ProSafeBeef project (Miles & Caswell, 2008). The presentation of the statements to the participants (provided in Appendix V) was discussed with food technologists and consumer researchers. All statements highlighted the safety benefit of the described packaging technology. A general question (asking the respondents to rate their overall acceptance of adjusting the packaging to improve beef safety) was followed by five specific questions, measuring consumers' response to each of the five above-mentioned packaging technologies for beef. The respondents were asked to report their response in terms of rejection versus acceptance of each of these packaging interventions on a five-point interval scale (where 1='completely unacceptable', 2='rather unacceptable', 3='neutral', 4='rather acceptable' and 5='completely acceptable').

The second part of the questionnaire assessed beef consumption behaviour and related attitudes. Consumers were asked to indicate the number of days they had consumed beef steak and beef burger during the previous 14 days (consumption frequency scale ranging from 0-14 times). Consumer attitudes with respect to consumers' food safety concern (McCarthy et al., 2003), their general health interest (Roininen et al., 1999), and their confidence in beef and beef products were assessed. Constructs, items and measurement scales used are presented in Appendix IV.

7.2.2. Data analysis

The statistical software package SPSS 15.0 was used for data analysis. First, descriptive statistics (frequencies, means, standard deviations) were computed to describe packaging acceptance levels.

Second, a principal components factor analysis with varimax rotation and Kaiser normalisation was performed on all six packaging statements. Exploratory factor analysis is a widely applied statistical technique aiming to reveal latent variables that cause covariation between manifest variables (Costello & Osborne, 2005). The Kaiser criterion was used to retain factors (i.e. eigenvalues greater than one as decision criterion). The internal consistency of the factors was measured with Cronbach's alpha. A paired sample T-test was applied to investigate whether the scores on these factors differed significantly from each other. Differences in scores were assessed through one-way ANOVA F-tests (in case of equal variances) or Welch and Brown-Forsythe statistics (in case of unequal variances). Equality of variances was tested using Levene statistic. In case of equal and unequal variance, respectively Bonferroni and Dunnet C-values were reported in multiple comparisons between groups. Differences were considered significant at a p-value below 0.05.

Third, market segmentation was performed using cluster analysis. A hierarchical clustering method was followed by a K-means clustering: the hierarchical clustering was used to determine the starting configuration for the K-means clustering, as the latter is sensitive to the choice of the starting positions. The mean scores from the clusters resulting from the hierarchical clustering were fine-tuned using K-means. Based on the two factors obtained from the factor analysis, four clusters were expected in which high and low values on these factors are combined. As the separate packaging statements contain more information (variance) than the two constructs, the six statements were used as input for the cluster analysis. Respondent data were standardised to eliminate bias caused by response styles. Ward's method (optimising the minimum variance) using the Squared Euclidean distance measure was used as cluster method. One-way ANOVA F-tests, Welch and Brown-Forsythe statistics, and χ^2 tests were applied to characterise the consumer segments.

7.3. Results

7.3.1. Packaging acceptance levels

The idea of adjusting the characteristics of the packaging to enhance beef safety is rejected by 11.4% of the respondents (see Figure 7.1). The most accepted technology of packaging was vacuum packaging (accepted by 73.0% of the participants), followed by modified atmosphere packaging (54.7%). Packaging technologies that consumers were less familiar with (such as packaging with different kinds of additives) were less easily accepted. Especially the concept of preservative food additives released from the packaging was disliked, with over 40% of the sample considering this packaging technique being unacceptable and another 35.9% reporting a neutral response. A detailed overview of the distribution of acceptance levels of the various packaging technologies in each of the five countries is presented in the Appendix VI.

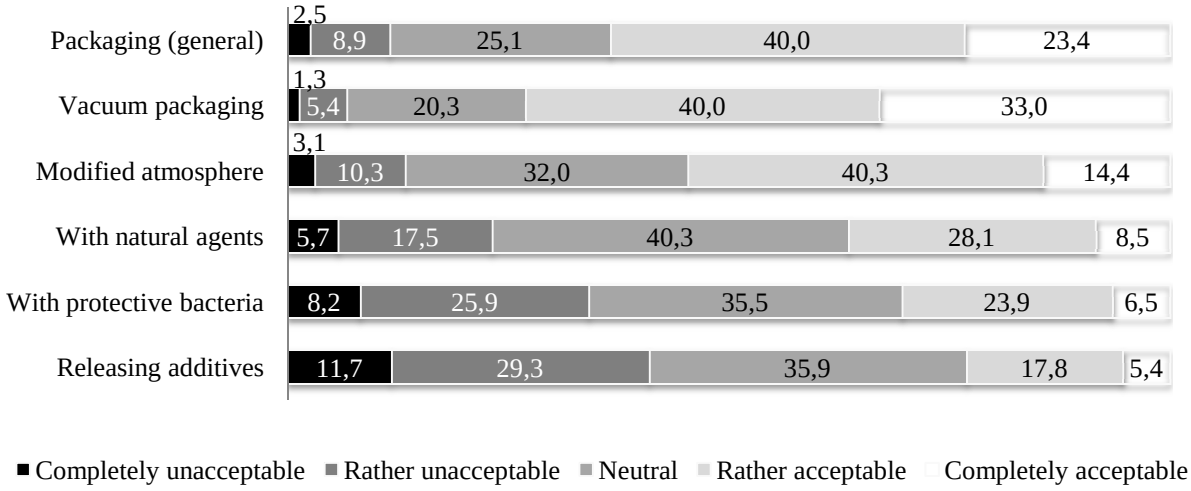


Figure 7.1: Acceptance levels of the different packaging technologies (in % of the total sample)

7.3.2. Factor analysis

Factor analysis yielded a clear grouping of packaging alternatives in familiar and non-familiar packaging technologies. Different parameters showed the appropriateness to run a factor analysis: correlations between the variables were high ($r>0.30$), the off-diagonal correlations were significantly different from zero (Barlett's test $p<0.001$) and the sampling adequacy was sufficiently high (KMO MSA=0.786). Communalities were all higher than 0.60 and 70% of the total variance was explained by the two resulting components, indicating that the proposed factor solution was a good representation of the data. All factor loaded high on one (>0.50) and only one factor (highest loading > 2 x the second highest factor loading). Table 7.2 characterises the factor analytically derived constructs. The internal consistency of the factors was sufficiently high to compute summated scores.

Table 7.2: Exploratory factor analysis results: factor loadings, % variance explained, reliability estimates, and mean (standard deviation) for acceptance of familiar and non-familiar packaging technologies

	Familiar packaging technologies	Non-familiar packaging technologies
Packaging (general)	**0.79**	0.24
Modified atmosphere	**0.75**	0.36
Vacuum packaging	**0.87**	0.01
Releasing additives	0.05	**0.83**
With protective bacteria	0.21	**0.81**
With natural agents	0.31	**0.71**
Variance explained (%)	35.00	35.20
Cronbach's Alpha	0.78	0.76
Mean (SD)	3.75 (0.80)	2.96 (0.85)

Bold face: items assigned to factor

A paired sample T-test ($p<0.001$) showed that the acceptance level of non-familiar packaging (2.96) is significantly lower than of familiar packaging technologies (3.75). Distribution of acceptance levels per country is shown in Table 7.3. These results confirm that the acceptance levels of the familiar packaging technologies are higher than of the non-familiar packaging in all countries. Furthermore, significant differences were observed between countries regarding acceptance levels of both familiar and non-familiar packaging (Table 7.3). Familiar packaging was most accepted in Spain and Germany, while least in Poland and France. Nevertheless, familiar packaging received higher than neutral scores in all countries. Non-familiar packaging only reached higher than the neutral point (3) in Spain, which was significantly higher than in any other country of the study.

Table 7.3: Differences between countries in acceptance levels of familiar and non-familiar packaging technologies (mean scores)

	France	Germany	Poland	Spain	UK	Total
Familiar packaging[1]	3.63^{cx}	3.84^{ax}	3.50^{cx}	3.95^{ax}	3.80^{bx}	3.75^{x}
Non-familiar packaging[1]	2.84^{by}	2.91^{by}	2.94^{by}	3.11^{ay}	2.96^{aby}	2.96^{y}

^{a,b,c,d} Scores in a row with different superscripts are significantly different ($p<0.05$) (ANOVA)

^{x,y} Scores in a column with different superscripts are significantly different ($p<0.05$) (one-sample T-test)

[1] Measured on a 5-point scale: 1=completely unacceptable, 5=completely acceptable; Significant differences using Welch and Brown-Forsythe statistics and Dunnet C's post hoc test

7.3.3. Consumer segmentation based on packaging acceptance levels

Four consumer segments resulted from the cluster analysis (see Table 7.4). Profiling these segments based on the six packaging items again showed the two factor-analytically derived packaging categories. Cluster 1 (referred to as "negative") had values below three on all packaging technologies (except vacuum packaging), thus generally considering changing packaging characteristics to enhance beef safety not acceptable. This consumer segment had the lowest values for the familiar packaging technologies. Cluster 2 consisted of "cautious consumers": these consumers reported medium values, slightly above the neutral point of 3

for all packaging technologies (except for preservative food additives released from the packaging). Cluster 3 was defined as "conservative": although accepting familiar packaging technologies quite easily, they had very low acceptance levels for the non-familiar packaging. These consumers felt at ease with the idea of adjusting the packaging for safety enhancement, but were not too keen on non-familiar technologies. Cluster 4 consisted of "enthusiast" consumers, with high acceptance levels on all packaging technologies, and especially on the non-familiar packaging technologies.

The four consumer segments were profiled based on their attitudes and behavioural characteristics in terms of beef consumption (Table 7.4). The enthusiasts were heavy beef consumers who put relatively high confidence in beef and beef products, caring much about food safety and having a high interest in food-related healthiness. The negative consumer segment had significantly lower concerns about food safety and interest in food-related healthiness, as well as lower confidence in beef and beef products. The two remaining consumer segments (the cautious and conservative consumers) scored relatively high on the attitude scales but low on beef consumption.

Table 7.4: Consumer segments regarding acceptance of beef packaging technologies

	Cluster 1 (n=793) 31.5% Negative	Cluster 2 (n=750) 29.8% Cautious	Cluster 3 (n=415) 16.5% Conservative	Cluster 4 (n=562) 22.3% Enthusiast
Familiar packaging				
Packaging (general)[1]	2.75^{d}	4.18^{b}	3.98^{c}	4.32^{a}
Modified atmosphere[1]	2.64^{d}	3.81^{b}	3.68^{c}	4.28^{a}
Vacuum packaging[2]	3.05^{b}	4.39^{a}	4.44^{a}	4.41^{a}
Non-familiar packaging				
With protective bacteria[1]	2.52^{c}	3.07^{b}	1.92^{d}	4.15^{a}
Releasing additives[1]	2.50^{c}	2.68^{b}	1.66^{d}	4.05^{a}
With natural agents[1]	2.70^{c}	3.37^{b}	2.31^{d}	4.15^{a}
Attitudes				
Food safety concern	5.22^{b}	5.55^{a}	5.53^{a}	5.64^{a}
General health interest	4.55^{b}	4.83^{a}	4.86^{a}	4.70^{ab}
Confidence in beef and beef products	3.33^{c}	3.68^{b}	3.70^{b}	3.88^{a}
Beef consumption frequency (past 14 days)				
Steaks	1.73^{b}	1.92^{ab}	1.72^{b}	2.16^{a}
Burgers	1.47^{b}	1.47^{b}	1.33^{b}	2.11^{a}

^{a,b,c,d}Scores in a row with different superscripts are significantly different ($p<0.05$).

[1]Significant differences using Welch and Brown-Forsythe statistics and Dunnet C's post hoc test

[2]Significant differences using ANOVA and Bonferroni post hoc test

Table 7.5 shows which socio-demographic groups were significantly (chi-square p-value < 0.05) overrepresented in each cluster. No significant relation was found using the chi-square association test between age, residential status, number of children, or working in the food industry on the one hand and cluster membership on the other hand.

Table 7.5: Socio-demographic profile[1] of the consumer segments[2]

	Cluster 1 Negative	Cluster 2 Cautious	Cluster 3 Conservative	Cluster 4 Enthusiast
Country	PL, FR	SP	FR, GE	SP, UK
Residence	rural	urban	rural	urban
Socio-economic situation	Secondary school / employed or retired / income <500	Higher education / students / income 1000-3000	Higher education / >3000	Manager or no paid employment / 3000-4000

[1]In the columns is indicated which groups are (slightly) overrepresented in each cluster.
[2]Only including variables with significant X^2 test values.

7.4. Discussion and conclusions

This chapter presents original findings from a quantitative study assessing consumer acceptance of beef packaging technologies. The generalisability of the findings is limited because of the nature of the samples (being diverse but not completely representative for the national populations) and the study design (an online questionnaire assessing acceptance by using textual representations of the different packaging technologies). Nevertheless, our results provide valuable insights into consumer perceptions and acceptance of safety-improving beef packaging technologies.

Food packaging has multiple positive functions for both consumers and producers: it contains the product, protects it against deteriorative effects, and provides to consumers a convenient product that is easy to use and handle (McMillin, 2008). The idea of modifications of the packaging to improve beef safety was accepted by 63% of the consumers in our pan-European consumer sample. However, although the safety of beef is requested and also implicitly expected for beef that is on sale, consumers were not univocally accepting the specific processes of these modifications, illustrating the existence of ambivalent attitudes towards specific beef packaging technologies. This indicates that the advantages of packaging technologies are not always acknowledged by the consumer. As suggested by both the factor and cluster analysis, familiarity is a major determinant of consumer acceptance of beef packaging technologies. Since our study does not provide data on knowledge, previous use or experiences with the different beef packaging technologies, it is impossible to quantify the strength of this relation or to assess national differences regarding prior experiences with the different packaging technologies. Nevertheless, the results suggest that prior experiences with the packaging technologies are a decisive factor in consumers' acceptance. The most accepted

packaging technology was vacuum packaging (accepted by 73% of the respondents), followed by modified atmosphere packaging (54 %). These packaging technologies are familiar to most consumers, as they are commonly applied in beef and other food products that are available all over Europe. Vacuum packaging is well-known (de Barcellos et al., 2010) and generally perceived as easy to handle and store by consumers (Resurreccion, 2004). Vacuum packaged meat has been marketed successfully in many countries (Jeong & Claus, 2011). However, this packaging technology can give beef a burgundy colour, while consumers prefer a bright red colour (Resurreccion, 2004; Hoffman et al., 1993). Another packaging method that is more successful in preventing discolouration of the product is modified atmosphere packaging. Modified atmosphere packaging can provide a favourable red colour in beef, and is therefore a desirable packaging method in retail (Jeong & Claus, 2011; Aaslyng et al., 2010). Information about modified atmosphere packaging is to some degree available for the consumers at the point of purchase, as European legislation (EC directive no. 95/2/EC) commands the food industry to label the gases used for modified atmosphere packaging.

Two packaging technologies were highly rejected compared to the other packaging technologies in the questionnaire: adding protective bacteria to the beef packaging and especially packaging releasing preservative additives were unacceptable for more than one third of the sample. Adding protective bacteria is a common practice in food such as dairy product (Todorov et al., 2007), but also in meat products, primarily in fermented dry sausages without heat treatment. However, while the presence of bacteria in dairy products has been marketed as a benefit, it has not in meat products, and consumer acceptance of this issue remains largely undiscussed (Zhang et al., 2010). However, around 30 percent of our sample did consider this packaging technology as acceptable, indicating that this relatively less-accepted process nevertheless has some degree of public support. Packaging releasing preservative additives is a type of antimicrobial active packaging which potentially delivers enhanced safety and quality, explaining the growing interest from researchers and industry. Increased consumer acceptance would open new opportunities for active packaging technology (Kerry et al., 2006). Packaging with added natural agents was best accepted among the non-familiar packaging technologies. Older research has shown that consumers considered the use of biological agents in meat packaging unacceptable, but they were not opposed to research in this area (Unterschultz et al., 1996). The phrase “packaging with added natural agents” is accepted more easily by consumers (36%) compared to “packaging with added protective bacteria” (30%), although both these descriptions can be applied to the same packaging technology, for instance the use of lactic acid bacteria in meat packaging (O'Sullivan et al., 2002). Without any doubt, the phrasing of the applied packaging technology influences consumer acceptance and should be considered carefully when communicating about these issues with consumers.

In all five countries under study, non-familiar beef packaging technologies were less accepted than familiar beef packaging technologies. This finding is consistent with previous research results (de Barcellos et al., 2010). Familiarity may change consumers’ risk perception,

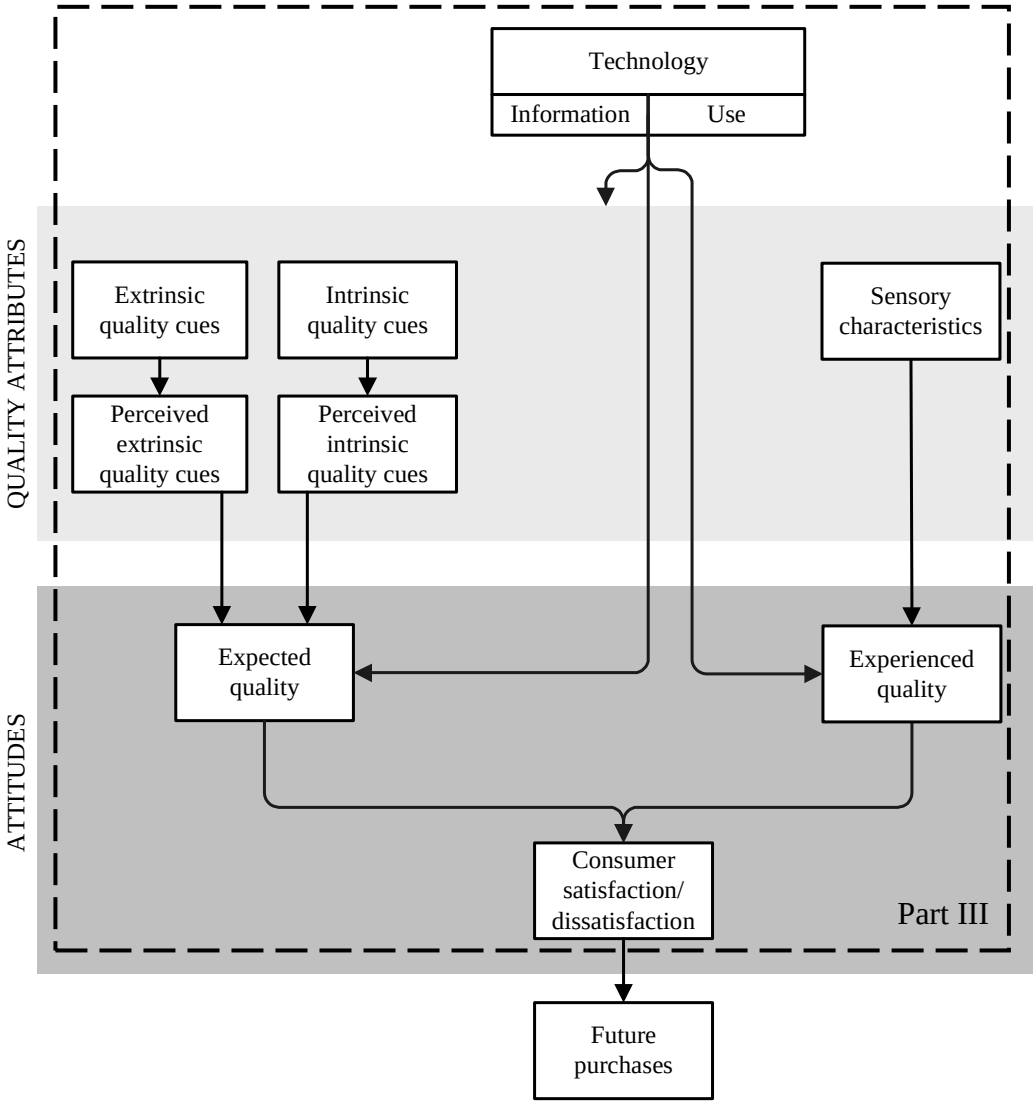
lowering the worries about possible negative effects and as a result enhance technology acceptance (Sjöberg, 2002). Such effects have been demonstrated for example also in the case of foods with health claims where familiarity was found to lower consumer scepticism (Verbeke et al., 2009). As familiarity can increase while being confronted with specific packaging technologies, consumer perceptions can be expected to change over time into a more positive direction for more frequently used beef packaging.

Compared to the familiar technologies, more consumers indicated to be neutral towards the non-familiar packaging technologies. A plausible explanation is that consumers find it hard to assess packaging technologies of which they have only limited knowledge. The use of language which consumers are not familiar with (such as 'protective bacteria' or 'lactic acid') might disable consumers to assess possible benefits of the packaging technologies (Siegrist, 2008). Furthermore, the increase in neutral answers could also illustrate the low awareness, interest and knowledge of consumers about the safety-enhancing processes in packaging.

Acceptance of beef packaging technologies varies between individuals. The negative consumer segment comprised around one third of our sample, indicating that there is a large group of consumers who oppose to the idea of enhancing beef safety at the stage of packaging. This segment is overrepresented by consumers with a lower income and education level. They prefer beef in a conventional PVC overwrap, or unpacked fresh beef. As suggested by earlier research findings, European consumers put some degree of distrust in the packaging industry when it comes to beef safety (Van Wezemael et al., 2010b). This distrust can be expected to be higher among this negative consumer segment, while lower among the enthusiastic consumer segment. Over 20% of the sample is enthusiastic about the idea of using packaging to improve beef safety. This consumer segment is overrepresented by Spanish, British, urban and higher income consumers. This consumer segment is convinced of the safety benefit of applying packaging technology and is receptive for innovative processes to take advantage of this benefit. If communication about packaging technologies would be increased to improve public acceptance, this segment should be the target group. It is possible that the higher mean acceptance levels among Spanish consumers indicate that they are more optimistic about the expected benefits of the applied technologies. For this reason, Spain could be an interesting country to introduce innovative beef packaging technologies. A higher acceptance of packaging technologies was also detected among urban consumers, which are overrepresented in the cautious and enthusiast consumer segments. Rural consumers seem to be more conservative than urban consumers, confirming the recent research findings of Guerrero et al. (2009). Our results indicate that communications about beef packaging technologies, packaging designs and benefits should take into account these differences in consumer acceptance levels between countries, packaging technologies, information presentation and consumer groups.

Part III The effect of information on beef quality expectations and experiences

Part III of this doctoral dissertation deals with the third research objective, investigating the effect of information about beef technologies on consumer acceptance of beef. The research framework developed in Chapter 1 assumed that beef technologies do not only impact the sensory characteristics of the product, but that consumer awareness about their application might also have a direct impact on consumers' expectations and experiences of beef. Earlier research results in this doctoral dissertation have suggested that technology information can indeed have an influence on consumer acceptance. A more appropriate methodology to investigate the effect of technology information on consumer liking of beef is sensory research. Therefore, a consumer study in which an information experiment was combined with sensory testing was conducted in January – February 2010 (Study 3).



Chapter 8 investigates the effect of information on Norwegian and Belgian consumers' liking of beef products which have been produced by means of different processing technologies. The two technologies selected for this study are the technologies that were the most and least accepted among the focus group participants, as discussed in Chapters 4 and 5, being muscle profiling and marinating beef by injection. The results will provide insight about the interaction of technology information with physical product experience.

Chapter 8: The effect of information on consumers' expected and experienced liking of beef

This chapter has been submitted to *Meat Science* as: Van Wezemael, L., Ueland, Ø., Rødbotten, R., De Smet, S., Scholderer, J. and Verbeke, W. The effect of technology information on consumer expectations and liking of beef.

Abstract

As European consumers increasingly attach value to the process characteristics of their food, the use of technologies in beef processing may affect consumers' reactions to beef products. Although beef technologies are hardly communicated to consumers, providing consumer-oriented information about their application might increase perceived transparency, trust and consumer acceptance. This chapter investigates how information about beef technologies influences consumers' expectations and liking of beef steaks. For this purpose, Belgian (n=108) and Norwegian beef consumers (n=110) participated in an information experiment combined with a sensory test, in which each consumer tasted three beef steaks processed by different technologies: unprocessed tenderloin *M. Psoas Major*, muscle profiled *M. Infraspinatus*, and marinated (by injection) *M. Semitendinosus*. The findings illustrate that information provision about beef technologies can enhance consumers' expectations and liking of beef. However, information transfer did not guarantee higher expectations and liking. Information might become either less relevant when the product is actually tasted (as confirmed by our findings among the Norwegian sample), or more relevant when the information is confirmed during tasting (as indicated by the findings among the Belgian sample). These results indicate opportunities for marketing beef that is processed by means of specific beef technologies that might be valued by consumers.

8.1. Introduction

Processing technologies aiming to enhance food quality and safety are widely applied in the food chain. It has been suggested that consumers' product preferences may have become more dependent on process characteristics (Grunert, 2005). Although consumers may not always understand the technical issues, they often report preferences for particular practices, such as organic production systems and minimal processing, while disliking others such as genetic modification (de Barcellos et al., 2010; Nielsen et al., 2009; da Costa et al., 2000), irradiation (Mørkbak et al., 2011), carcass decontamination (Korzen et al., 2011), or marination by injection (de Barcellos et al., 2010). The last of these effects is particularly interesting in light of the fact that the amount of meat that is sold marinated is steadily increasing, indicating that these products are tacitly accepted in the market even though the attitudes consumer report in surveys and focus groups might be negative. Industrial marination has historically been mainly applied with poultry but increasingly also with pork and beef. Beef is typically injected with brine containing salt, phosphates and flavour-enhancing ingredients. Although the technology is mainly used to alter the flavour, it is also used for tenderisation and to prolong shelf-life (Schirmer et al., 2009; Scanga et al., 2000). *M. Semitendinosus* is one of the muscles that is traditionally considered a tough muscle. Research has shown that its eating quality and texture can be significantly improved by marination (Chang et al., 2010).

Unlike marinating beef by injection, identifying new beef cuts through muscle profiling appears to be a technology that is acceptable to European consumers (Verbeke et al., 2010). Muscle profiling is the precise characterisation of muscles by physical and chemical analysis with the purpose of utilising them in the best possible way. Recently, muscle profiling technology has identified potential new beef cuts that can be sold as good quality steaks (Hildrum et al., 2009). *M. Infraspinatus*, a muscle located in the shoulder, has been identified as a consistently tender muscle. However, it contains a massive internal connective tissue seam that needs to be removed before commercialisation. The cut has been marketed successfully by the US meat industry as flat iron or top blade steak (Hildrum et al., 2009; Von Seggern et al., 2005).

Consumer attitudes towards food technologies are strongly embedded in pre-existing fundamental attitude structures (Scholderer & Frewer, 2003). Familiar and 'natural' technologies are more easily accepted by consumers. For example, Iaccarino et al. (2006) reported that industrial made *soppressata* salami received lower expectation scores than traditional *soppressata*. Technologies characterised as being bioactive raise concerns related to unpredictable effects, uncontrolled application, and ethical issues (Frewer et al., 2011). Proponents of particular technologies often assume that negative consumer attitudes can be changed by providing more information to correct the so-called 'knowledge deficit', i.e. to overcome rejection of a technology solely due to simple unawareness (Teisl et al., 2009; Hilgartner, 1990). However, several studies have shown that simple information provision

does not guarantee more positive attitudes (Rollin et al., 2011). Information can activate existing fears and concerns about food technologies (Cox et al., 2007) and even lead to boomerang effects (Scholderer & Frewer, 2003).

Consumer acceptance or rejection of food processing technologies can depend on the amount of information that is provided, as was illustrated by Deliza et al. (2003) and Cardello (2003). Specifically, the provision of information about tangible benefits is considered a key factor in shaping consumer acceptance of food technologies. Positive framing of technology information might enhance consumer acceptance (Siegrist, 2008). Several studies showed that consumer-oriented benefits such as health or taste are more acceptable to consumers than producer- or industry-oriented benefits such as extended shelf life (Sorenson & Henchion, 2011), or indirect and intangible benefits such as environmental gains (Cox et al., 2007). Information about the production process might not only influence consumer expectations, but also evaluations of the taste (liking) of a food product (Siegrist, 2008; Caporale & Monteleone, 2004).

The objective of this study is to investigate whether consumer preferences for beef can be modified by providing different levels of information detail about the applied processing technologies. For this purpose, an information experiment (basic versus detailed information) is combined with sensory testing in which consumer expectations and liking of various beef steaks are assessed. The inclusion of two processing technologies, marinating by injection and muscle profiling, to which consumers might have opposite a priori attitudes (de Barcellos et al., 2010; Verbeke et al., 2010) in combination with two levels of information adds originality to this study.

Major differences in consumer liking and expectations are expected because of the different nature of the three beef steaks in this study. The tested products represent a graded level of processing, including unprocessed tenderloin, lowly processed muscle profiled beef, and highly processed marinated beef. Data collection in two European countries, Belgium and Norway, with a different beef consumption tradition and frequency allows investigating cross-country differences. Belgium has a long tradition in beef production and has higher beef consumption compared to Norway. In Norway, meat consumption has been low, but it has increased steadily in the last decades, although not for beef. Still, meat consumption in Norway is very traditional with more limited choices as most of the increase in the assortment is in minced meat categories, and there remains a large potential for further product differentiation, both in terms of quality characteristics and product alternatives. These two countries thus represent different backgrounds with respect to experience with and consumption of meat. The results will provide insights about the interaction of physical product experience, especially sensory dimensions, with perceptions of credence qualities that are related to the technology employed. This knowledge will provide guidance for the development of new products and new processing technologies in the beef industry.

8.2. Materials and methods

8.2.1. Participants and procedure

Data were collected among adult beef consumers in Norway (n = 110) and Belgium (n = 108) in January and February 2011. All participants were regular consumers of fresh beef (at least once a month), recruited from untrained consumer panels that were managed by the institutions responsible for the data collection. Consumers allergic to citrus, kiwi or pineapple were excluded. The sample was balanced in terms of gender (50% males; 50% females) and age (50% aged 16-35 years; 50% aged 36-55 years). Demographic characteristics are presented in Table 8.1. Consumers were invited during selected days in January and February to a central testing location (located in Ås in Norway; Deinze in Belgium) where they received instructions how to participate in the study and provided their informed consent. Questionnaires were completed on computers, using EyeQuestion® software in Norway, and FIZZ software in Belgium. Consumers first answered a list of questions regarding their attitudes towards beef and beef technologies. After completing this questionnaire, three beef steak samples; *M. Psoas major* (unprocessed benchmark), *M. Infraspinatus*, and *M. Semitendinosus*, were served in randomised order.

Table 8.1: Sample characteristics in Norway and Belgium (in % of the national sample)

	Norway (n=110)	**Belgium** (n=108)
Male	46	46
Female	54	54
18-35 years old	45	46
36-55 years old	55	54
Cohabiting	92	92
Children in the household (0-14y)	51	32
Post-secondary education	70	44
Working full-time	61	50
Students	30	25

8.2.2. Information experiments

Participants were randomly allocated to one of two information treatment groups. One group received only basic information about the technologies, whereas the other group received detailed information about the technologies. The descriptions used in the information experiment are provided in Appendix VII. Basic information on the value-added beef cuts included the name of the technology and its expected effect on beef eating quality. Detailed information elaborated on the normal conventional use of the beef cut, the applied processing and the specific objective of applying the technology. Information on *M. Psoas major* distinguished between no information at all (basic information condition), and the formal statement that no technology had been applied to that particular beef cut (detailed information condition).

8.2.3. Meat samples and preparation

Beef muscles were obtained from Norwegian Red and Belgian Blue young bulls of 18-24 months age for preparation and presentations in Norway and Belgium, respectively. Muscles were selected from a large number of animals in Norway, and from four animals in Belgium. In Belgium, beef cuts that each consumer received were taken from the same animal. Three beef cuts were selected for this study, one unprocessed high-value beef cut (*M. Psoas major*), and two beef cuts that normally are not offered as high-value cuts in the considered markets: *M. Infraspinatus* and *M. Semitendinosus*. The muscles were cut from the carcass two days post mortem and vacuum aged at 4°C until cooking after 14 days after slaughter. The *M. Semitendinosus* was marinated 9 days post mortem. To each muscle, one specific technology was applied: muscle profiling on *M. Infraspinatus*, marinating by injection on *M. Semitendinosus*, and no technology on *M. Psoas major*.

M. Infraspinatus was selected as the cut to be presented for consumers representing the technology of muscle profiling (MUP). The samples were prepared by removing the internal connective tissue seam in the middle of the muscle. The two remaining filets were cut into three equally sized pieces. *M. Semitendinosus* was marinated (MAR) by injecting a marinade consisting of 1.4 kg phosphate (diphosphate E-450 and triphosphate E-451; 51% as P_2O_5) and 1.6 kg salt (NaCl) dissolved in 36.5 litre tap water. After mixing which completely dissolved the ingredients, 0.5 litre of centrifuged kiwi juice was added. The tenderizing effect of kiwi juice on muscle tenderness has been described by Wada et al. (2002), Sugiyama et al. (2005), and Christensen et al. (2009). Approximately one hour later, *M. Semitendinosus* muscles were injected with the marinade to a target of 110% of the initial weight by means of a multi-needle injector (needles with 4 millimetres diameter). After first injection, all muscles were weighted and pick-up was calculated. Some of the muscles were re-injected to obtain the desired 10% weight increase. Muscles were vacuum packed and stored at 4°C until cooking and tasting. The marinated *M. Semitendinosus* were sliced into cuts of 3.5 cm along the longitudinal direction of the muscle. The tenderloin (TL) samples of the *M. Psoas major* were prepared by cutting the muscle into equally sized pieces of approximately 7 to 10 centimetres along the longitudinal direction of the muscle.

The surfaces of all prepared beef cuts were fried in a hot frying pan to which 25 g. of margarine was added, for approximately 40-60 seconds per side of the cuts. Further cooking was completed in a dry oven, at a temperature of 175°C for about 20 minutes. The cuts were taken out of the oven when their core temperature reached 72°C (*M. Infraspinatus* and *M. Psoas major*) or 70°C (*M. Semitendinosus*). The cuts were allowed to rest for 3 minutes. The serving pieces were cut parallel to the longitudinal muscle direction. A thin slice of the frying crust was removed. Further perpendicular cutting was performed to generate serving pieces that enabled the participants to taste each sample 2 to 3 times. The serving pieces were served to the participants in a plastic plate covered by a lid to keep the samples hot. The plastic plates were numbered with three-digit codes, and samples were served in a randomised order. A

sharp knife and fork were provided for the tasting. Water was provided to rinse the mouth between tasting different samples.

8.2.4. Measures

Before tasting, consumers completed a questionnaire regarding their socio-demographic characteristics (gender, age, household composition, education, and occupation). Technologies were textually presented to the participants by means of basic or detailed information on-screen. Expectations about the three beef cuts were measured using a 9-point rating scale ranging from 'do not like at all' to 'like very much'. After completing this questionnaire, participants received the three meat samples for tasting. They tasted one sample at the time and indicated their liking on a 9-point rating scale ranging from 'do not like at all' to 'like very much'.

8.2.5. Statistical analysis

A linear mixed model with one between-subjects factor (information condition) and one within-subjects factor (product) was used to determine the effect of information and product on expectations and liking in each country. A random intercept was added to the model to account for eventual heterogeneity of the participants in their scale usage and response behaviour. The model was estimated separately for each of the two countries and for each of the two dependent variables.

8.3. Results and discussion

Tables 8.2 and 8.3 show the results of the linear mixed models of expectation and liking, respectively. All four analyses revealed significant main effects of information and product but no interaction. The three beef cuts differed significantly in terms of both dependent variables (Figure 8.1). Both Norwegian and Belgian consumers preferred the high-value beef muscle (unprocessed *M. Psoas major*) over the added-value muscles (muscle profiled *M. Infraspinatus* and marinated *M. Semitendinosus*). This finding is consistent with earlier research that has instrumentally assessed the tenderness of beef muscles by measuring Warner-Bratzler shear force, the maximum amount of force that is required to shear a core of cooked meat. Based on this analysis, Eggen et al. (2001) reported higher factual tenderness of *M. Psoas major* compared to *M. Semitendinosus* in young Norwegian Red bulls. Also for other cattle breeds *M. Psoas major* has been found to be more tender than *M. Infraspinatus*, which was at its turn reported to be more tender than *M. Semitendinosus* (Rhee et al., 2004). However, these studies relate to unprocessed muscles. Warner-Bratzler tests complemented with consumer tests on marinated and unprocessed *M. Semitendinosus* could shed a light on the tenderness of both beef products, and allow evaluating the effectiveness of the used marinade.

The significant Wald Z coefficient illustrates that the inclusion of a random intercept was useful for the model, to account for significant differences in the way participants have used the response scale, as could be expected from the fact that participants in the sensory study were untrained.

Table 8.2: Effect of information and applied technology on consumers' expected liking

		Norway (n=110)			**Belgium (n=108)**		
		F	Wald Z	Sig.	F	Wald Z	Sig
Fixed effects	Info	6.15		0.01	0.23		0.64
	Technology	169.57		<0.01	38.87		<0.01
	Info x Technology	0.81		0.45	1.18		0.31
Random effects	Intercept		3.741	<0.01		2.67	0.01

Table 8.3: Effect of information and applied technology on consumers' experienced liking

		Norway (n=110)			**Belgium (n=108)**		
		F	Wald Z	Sig.	F	Wald Z	Sig
Fixed effects	Info	0.43		0.51	5.28		0.02
	Technology	39.11		<0.01	10.55		<0.01
	Info x Technology	0.08		0.92	1.77		0.17
Random effects	Intercept		4.04	<0.01		0.21	0.84

The right graph in Figure 8.1 illustrates that in general, the provision of detailed information about beef technologies enhanced expectation and liking scores in both countries. The main effect of information was significant in both countries, but at different levels of decision-making and quality perception: information influenced expectations in Norway and liking in Belgium. Possible explanations for this phenomenon might be the different backgrounds regarding meat consumption in both countries, reliance on the provided information versus on prior experience to form expectations (Hoehn et al., 2003) or different functioning of the information treatment. If the detailed information condition did not effectively increase consumer awareness of the applied technology, the information might not have been used by Belgian consumers in reporting their expectation of the beef cuts. Although no manipulation check was included in the experiment, the significant information parameter in our mixed model indicates that consumers have taken the provided information at least partially into account in their evaluations of the beef steaks.

It has been argued that consumers should be provided with consumer-oriented information about process technologies used to produce their foods, in order to allow consumers to make more informed choices, and to increase levels of consumer acceptance, as consumers were found to be more receptive towards familiar technologies (Sorenson & Henchion, 2011; Van Wezemael et al., 2011b). However, our results confirm literature findings that only providing factual knowledge will not guarantee higher consumer acceptance as such (Rollin et al., 2011).

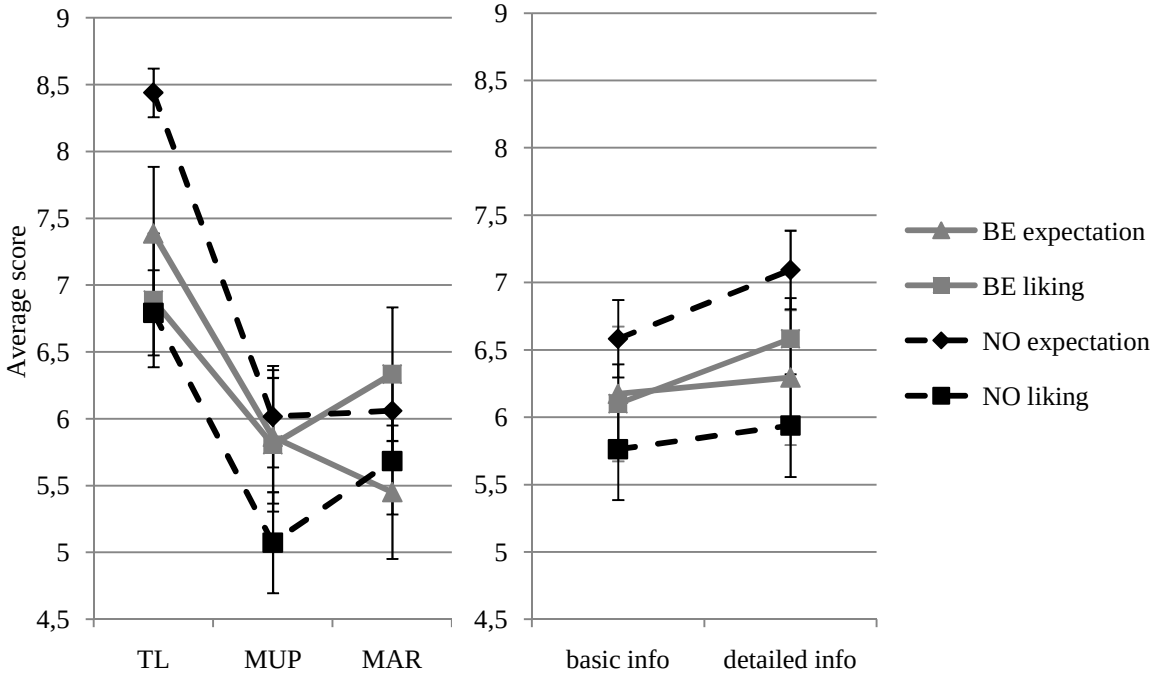


Figure 8.1: Main effects: estimated marginal means of expectation and liking in Belgium (BE) and Norway (NO), as a function of the product (left) and the information condition (right) (error bars represent 95% confidence intervals); 1 = low consumer expectations/liking – 9 = high consumer expectations/liking; TL = M. Psoas major - no technology; MUP = muscle profiled M. Infraspinatus; MAR = marinated M. Semitendinosus.

Previous research has shown that European consumers feel rather uncomfortable with the idea of marinating beef by injecting brine into the muscles (de Barcellos et al., 2010), while muscle profiling has been considered as an acceptable technology (Verbeke et al., 2010). Our results however indicate that consumer expectations and liking of the products produced by means of these technologies do not significantly differ. Our results show that informing consumers that their beef has been marinated by injection does not affect consumer expectations and experiences more negatively than informing them about muscle profiling. Both muscle-profiled M. Infraspinatus and marinated (by injection) M. Semitendinosus were considered as lower-value beef products (compared to tenderloin) without discerning between the applied technologies.

Figure 8.2 indicates that the difference between basic information and detailed information is smaller after than before tasting in Norway, suggesting that the sensorial experience is more important than the provided information. Before tasting, consumers can only develop expectations based on the available information, plus some a priori beliefs about beef cuts, such as the fact that tenderloin is known among consumers to be an excellent beef cut. Such knowledge, beliefs and perceptions will play a role in consumer liking scores, irrespective of the information consumers receive (Caporale & Monteleone, 2004).

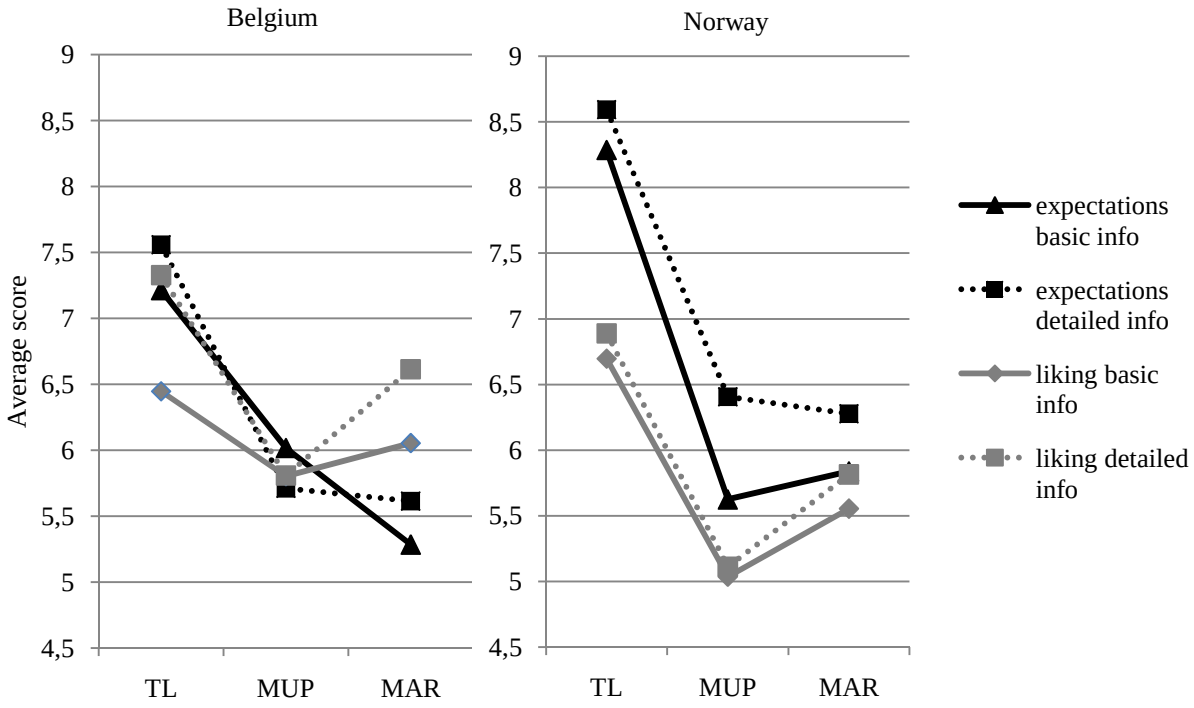


Figure 8.2: Estimated marginal means of expectation and liking in Belgium (left) and Norway (right), as a function of information condition and type of beef; 1 = low consumer expectations/liking – 9 = high consumer expectations/liking; TL = M. Psoas major – no technology; MUP = muscle profiled M. Infraspinatus; MAR = marinated M. Semitendinosus

Beef consumer expectations exceeded their tasting experiences in most cases, except for the marinated M. Semitendinosus in Belgium. Apparently, informing Belgian consumers about marination by injection yielded expectations that tend to be exceeded upon product experience. Consumer satisfaction, repeated purchase and future product use are influenced by the degree to which consumer expectations match or mismatch with their experiences. When experiences fall short of expectations, consumers are likely to be dissatisfied (Santos & Boote, 2003; Grunert et al., 1996). Mismatches between expectations and experiences with beef muscles might partly originate from the high variability in beef eating quality, due to variation in cattle production methods, beef breeds, muscles and even within muscles (Monsón et al., 2005; Dransfield et al., 2003). Inconsistency in beef quality and tenderness is a major concern for the beef sector, as consumers have a clear preference for tender beef and are willing to pay a higher price for guaranteed tenderness (de Barcellos et al., 2010; Alfnes et al., 2008). High consumer expectations on tenderloin as a tender and high quality beef muscle might be hard to meet.

Chapter 6 illustrated that providing more information about the applied process could decrease consumer acceptance of beef-safety enhancing technologies. However, in this chapter detailed information (discussing the same process) increased consumer acceptance of beef technologies. Highlighting the effect on beef eating quality (instead of beef safety), and

the possibility to immediately evaluate this quality might have positively influenced consumer acceptance. The presentation of the provided information, so-called framing effects, is most likely to have a major impact on consumer responses.

8.4. Conclusions

This paper presents original findings on consumer liking of different beef technologies applied to different beef muscles, and the impact of technology information on consumer liking. Regular fresh beef consumers in Norway and Belgium participated in an information experiment combined with sensory tasting. The results indicate that detailed information about beef technologies can enhance consumer acceptance, although this effect is not equally large across technologies and countries. Information transfer alone did not guarantee higher technology acceptance. Understanding consumers' risk-benefit perceptions, knowledge, and trust in information are crucial for the realisation and success of technological advances in the beef sector.

Including tasting as part of the experiment introduces certain constraints to the generalisability of the results. The results are based on the reactions of a limited number of consumers who were not selected randomly. Even in our case where consumers were selected based on regular use of fresh beef, it is not possible to ensure a representative sample of the population on all relevant demographic variables. Large-scale consumer home tests with a large number of participants in various geographical areas might be more suited for this purpose. However, the main aim of the study, to capture possible differences in perception according to different information conditions, is basically independent of the constraints in selection of consumers. Furthermore, the absence of a control group (receiving no information about the investigated technologies) implied that the effect of the experiment on the results cannot be investigated. Future research could investigate consumer satisfaction of beef products produced by means of various technologies, in order to detect products which can provide added value to consumers.

Chapter 9: General discussion and conclusions

The previous parts and chapters have profoundly discussed study-specific findings and conclusions. This final chapter discusses and concludes on the findings in more general terms and in the light of the research framework. The research objectives are revisited (9.1), providing a recapitulation of the dissertation structure. By providing answers to the research questions formulated in Chapter 1, the research results are reconnected to the research framework. A general discussion of the research results (9.2) and the contribution of this thesis (9.3) are provided. Recommendations for the public authorities and the food industry are formulated (9.4). The final section acknowledges the limitations of this doctoral research. Based on these limitations and the findings of the previous chapters, suggestions for further research are formulated.

9.1. The research objectives revisited and research questions answered

The overall objective of this dissertation was to investigate consumer attitudes and perceptions towards beef and beef technologies. This investigation was carried out based on conceptual framework that was presented in Chapter 1. To investigate different parts of the conceptual framework, we relied on qualitative exploratory focus group discussions (Study 1), a web-based quantitative consumer study (Study 2), and an information experiment combined with sensory testing (Study 3). All of these studies have been carried out in various European countries, making the quantitative results valid for different settings and under different circumstances. Based on the research framework, three research objectives and seven research questions were formulated (see Chapter 1), which are discussed in the following subsections.

9.1.1. Exploring consumer attitudes towards different beef quality aspects

The first research objective has been dealt with in Part I, discussing European consumers' attitudes towards three different beef quality aspects, namely beef safety, healthiness and eating quality. The results reported in Part I are based on Study 1, a qualitative focus group study that was conducted in May 2008 in four European countries (France, Germany, Spain, and the United Kingdom; n=65). Because of the exploratory nature of the study, it remains somewhat speculative to formulate conclusive answers to the research questions. This limitation should be kept in mind when discussing the results.

1. What attributes are used to assess various beef quality aspects?

The research framework outlined in Chapter 1 (Figure 1.3) assumed that consumers use both intrinsic and extrinsic quality cues to assess beef quality. This assumption was confirmed in the first two research chapters with respect to two different beef quality aspects, first beef safety (Chapter 2), and thereafter beef healthiness (Chapter 3). These chapters have identified intrinsic and extrinsic cues that consumers use as easy decision rules when purchasing beef, such as colour, degree of processing, labels, origin, packaging type, etc. With respect to beef safety, the results of the content analysis in Chapter 2 revealed that consumers experienced difficulties in assessing beef safety, and adopted diverging uncertainty reduction strategies. These included looking at the colour, reading labels, searching for brands and indications of origin as cues signalling beef safety. Chapter 3 revealed that beef was generally considered as a healthful food product. However, both perceived positive as well as perceived negative effects of beef consumption on health were reported, predominantly based on the fat content, calories and nutritional value of beef. Labelled, branded, fresh and lean beef were perceived as signalling healthful beef. Although these cues were used as decision rules for beef purchasing, consumers acknowledged that individual consumer choices (such as consumer diet in general, and type of beef cut purchased) and preparation methods had a major impact on beef healthiness.

2. Do consumer attitudes differ between various beef quality aspects?

Cues used in assessing beef safety and beef healthiness showed considerable overlap, although the focus group participants reported to feel more personally responsible for beef healthiness than for beef safety: while beef safety was considered to be a characteristic of the product itself, the focus group participants related the healthiness of beef more to individual consumer choices (such as consumer diet in general, and type of beef cut purchased) and preparation methods. Therefore, the use of intrinsic and extrinsic cues is perceived as more important for signalling beef safety than beef healthiness.

3. What are consumer attitudes towards a beef eating quality guarantee?

The approach used in Chapter 4 differed from the previous research chapters in two ways. Firstly, instead of focusing on credence characteristics (safety and healthiness), Chapter 4 focused on eating quality, which is a quality that can be readily experienced by consumers during consumption. Secondly, instead of asking the focus group participants about used cues to assess beef eating quality, consumers were asked about their perceptions on a specific extrinsic quality cue with the potential of signalling eating quality. An eating-quality guarantee system was presented that was based on muscle profiling. The results indicated that the possibility to supply highly precise cuts of different guaranteed eating quality was considered appealing by the focus group participants. However, they expressed some reserve related to the possible upgrading of lower value cuts, too much standardisation, and the fact that tenderness is to some extent subjective. They further required the system to be simple, sufficiently documented and independent-party controlled.

9.1.2. Investigating consumer acceptance of different beef technologies

Part II of this dissertation has investigated consumer perceptions and acceptance of technologies applied at different stages of the beef chain, in line with the second research objective. The research framework suggested that consumer awareness about beef technology application can have a direct impact on the expected quality of the product. This dissertation has investigated consumer acceptance of beef technologies at four different stages of the beef chain: primary production, slaughtering, processing and packaging. While Chapter 5 reported results of the exploratory qualitative focus group study (Study 1), Chapters 6 and 7 were based on the conclusive quantitative consumer survey (Study 2) that was conducted in February - March 2010 in five European countries (France, Germany, Poland, Spain, and the United Kingdom; n=2,250).

4. To what degree do consumers accept beef technologies?

Chapter 5 explored European consumers' acceptance of a variety of beef processing technologies: marinating by injection, marinating by submerging, nutritional enhancement and restructuring through enzyme binding, shock wave treatment, and thermal processing. All of these technologies aim to improve beef quality aspects, including beef safety, healthiness or eating quality. However, large differences in consumer acceptance were detected among them. Not all technologies were considered to be favourable, based on the perceived advantages and disadvantages of the technologies by the focus group participants. Especially invasive technologies such as marinating by injection were rejected, despite consumers' recognition of the possible benefits the technologies might offer in terms of beef quality. Muscle profiling was considered as an acceptable technology by the majority of the focus group participants, although some reserves were expressed.

5. Do consumers accept technological interventions in the beef chain to enhance beef safety?

Study 2 investigated consumer acceptance of technologies that are applied today at different stages of the beef chain (primary production, slaughtering, processing and packaging) with the specific purpose of enhancing beef safety, considered as an indispensable condition for beef quality by consumers (as was found in the Part I). European consumer acceptance of beef technologies to improve beef safety at the first three key stages of the beef chain (primary production, slaughtering and processing) has been investigated in Chapter 6, while the acceptance of packaging technologies was looked at in Chapter 7.

The quantitative results showed that public support for technology interventions to improve beef safety might be larger than expected based on the exploratory results. Hide decontamination at the slaughtering stage was considered as acceptable for the large majority of participants in Study 2. Nevertheless, not all specific processes for decontamination of cattle hide were equally well accepted. Enhancing beef safety at the packaging stage (especially by means of unfamiliar packaging technologies) was found to be not acceptable for a large group of consumers.

In both Chapters 6 and 7, cluster analysis has shown that not all consumers equally accept the processing technologies. Consumer segments could be identified that differed in beef consumption and their attitudes towards beef and beef technologies. Concerning technologies to improve beef safety at the primary production, slaughtering or processing stage, four segments were identified: 'enthusiast' (11% of the sample), 'feeling OK' (36%), 'indifferent' (41%) and 'rejecting' consumers (11%), showing that only 11% of the participants were not in favour of these kind of technologies. Concerning packaging technologies to improve beef safety four different groups could be indentified: 'enthusiast' (22% of the sample), 'cautious' (30%), 'conservative' (17%) and 'negative' consumers (31%). The large size of the negative consumer segment indicated that enhancing beef safety at the packaging stage was not straightforwardly acceptable for many consumers. Although the profiles of the segments showed some differences, it can be expected that the enthusiast consumers, and rejecting/negative consumers in both segmentation studies are at least partly consisting of the same consumers.

6. What factors determine consumer acceptance of beef technologies?

This doctoral research has identified a number of factors that influence consumer acceptance of beef technologies: familiarity, naturalness, invasiveness, safety concerns, quality demands, consumer benefit, stage of application, trust in the industry and confidence in the product, presence of additives and bacteria, and type and amount of information provided.

Exploratory results indicated that traditional and familiar processes were more easily accepted, and 'natural' beef was preferred over processed beef products. At the same time, excessive intervention in meat chains was criticised. Consumer attitudes towards beef technologies were influenced by the perceived consumer benefit. The quantitative results from Study 2 confirmed that for all beef technologies, familiarity was a major determinant of consumer acceptance, as familiar technologies were always preferred over unknown ones. Quantitative analysis confirmed the focus group result that the processing stage was not the consumers' favourite stage to intervene for improving beef safety. Technologies seemed to be accepted for diverging reasons: either because consumers were confident that what the industry will do what is the right thing to do, or because they felt that such interventions are heavily needed, because of elevated safety concerns or high quality expectations. Consumers who were positive towards safety-enhancing interventions showed higher confidence in beef and beef products. The presence of additives or bacteria (although beneficial) influenced consumer acceptance in a negative way. Also the type and amount of information appeared to have an influence, as technologies described by the stage of application were accepted more easily than the detailed process descriptions.

9.1.3. Investigating the effect of information on consumers' acceptance of beef technologies

The third and final research objective was to investigate the effect of information on consumer attitudes towards processed beef (Part III).

7. Can detailed information about the aimed benefit of beef processing technologies influence consumer attitudes positively?

The exploratory research results in Chapter 5 to 7 already indicated a preference for incomplete information about beef technologies among consumers, but also suggested that information about the possible benefits of the technology might have an impact on consumer acceptance. The impact depended on the type of benefit that was stressed in the information. Informing consumers about the health benefit of a technology (such as the addition of omega-3 to beef products) seemed to result in a higher acceptance compared to a safety benefit (for instance the prolonged shelf life of beef products). Similar to the focus group outcome, the quantitative Study 2 illustrated that the impact of providing more information was not always positive. Our results showed that when more detailed information about the process was provided, consumers were less inclined to accept the intervention. However, the results from Study 3, the information experiment that was combined with sensory testing showed that detailed consumer-oriented information about beef technologies can improve consumer attitudes towards beef products produced by particular beef technologies in comparison to basic information only providing the name of the applied beef technology. Information transfer did not guarantee higher acceptance, but in both countries a positive impact on consumer attitude was detected. The results from this doctoral research suggest that consumer-oriented messages about tangible benefits such as eating-quality can improve consumer acceptance of beef technologies.

9.2. General discussion

Beef still has the inheritance of major safety crises related to growth hormone residues and BSE that occurred during the end of the nineties. Therefore, uncertainty and concern at the consumer level may still be present, even though dormant. Any beef-related hazard or risk, or any allusion to such issue can awake these underlying consumer concerns. This makes beef a special case as compared to many other fresh food products which may have the advantage of a more favourable a priori image among European consumers.

Based on this doctoral research, several suggestions for the use of information and cues can be set forth.

This doctoral dissertation has extended our knowledge on the use of cues with respect to beef quality by consumers. A variety intrinsic and extrinsic cues is used by consumers to evaluate credence characteristics of beef during purchase. To overcome consumer uncertainty and facilitate safety and healthiness evaluation and communication, public and private policies

have been established trying to shift the focus from the use of credence attributes to the use of search attributes (Caswell, 2000). Our research has identified cues that are used by European consumers to assess two beef credence attributes, safety and healthiness. This knowledge can facilitate the shift to search attributes by indicating what cues are perceived by consumers in these different contexts. Simultaneously, there is a widespread opinion that the use of extrinsic cues for quality will continue to increase (Grunert, 2006; Bernués et al., 2003b). As issues related to health and safety and to process characteristics become more important to consumers, the use of extrinsic quality cues will increase. Although not all cues that are mentioned by the focus group participants will be used with the same intensity by all European consumers, our research results have identified potential extrinsic cues (among other packaging) that might guide future consumer choices even more than today.

As tenderness and eating quality are among the most important characteristics by which consumers judge beef quality, these have been set forth as priority issues that need to be addressed in the European beef industry (Eggen & Hocquette, 2004), and the provision of consumers with beef cuts with a consistent eating quality has been set forth as a major challenge (Alfnes et al., 2008). Our research has indicated good opportunities for the development of a beef eating-quality guarantee system in Europe. Nevertheless, our research also showed that consumers nowadays state to be overloaded with food-related information. Therefore, the application of such a beef eating-quality guarantee system might be less successful in a business-to-consumer context compared to a business-to-business context, where the system can be used to underpin branded beef programmes.

This doctoral research has found that beef technology acceptance is mainly influenced by consumers' familiarity with the technology, the degree of confidence in beef chain activities, and the perceived consumer benefit. The general public is rarely aware or informed about the use of technologies in the beef chain, and their potential consequences. Furthermore, consumers themselves prefer rational ignorance over full information. One may therefore wonder whether beef technologies should be communicated about at all. However, five arguments can be given why information about beef technologies can be recommendable.

Firstly, beef technologies can provide the basis for product differentiation. Providing information about applied technologies might possibly enhance consumers' perception of the quality. In this doctoral dissertation, muscle profiling has been detected as a technology that is not only acceptable as such to European consumers (though not unconditional), but also in its application in a beef eating-quality guarantee. Detailed information about muscle profiling was valued by Norwegian consumers in our third study. Further research could investigate which technologies that can be perceived as beneficial by consumers. For instance, a study among Brazilian consumers of fruit juice showed that information about the used technology (high pressure) can promote more positive attitudes towards the product (Deliza et al., 2003). It could be interesting to investigate whether the application of high pressure technology in a meat context has a similar effect on consumer attitudes.

Secondly, process characteristics are gaining importance in consumer evaluation of beef. Information on technologies will be valued by consumer segments looking for specific process characteristics. Assessing consumer acceptance before product development might be more sensible than trying to enhance consumer acceptance in the market place through campaigns.

Thirdly, communicating about the application of technologies at various stages of the beef chain will enhance consumer familiarity. Familiarity does not mean that each consumer should know all technical details about the technology, but it does mean that consumers would know that such a technology is applied in the beef chain. Increased familiarity will enhance consumer acceptance levels of beef technologies.

Fourthly, beef technology information can be useful for those who accept these technologies because of their consumer benefits with respect to beef quality. In Chapter 6, two diverging reasons for accepting safety-enhancing beef technologies could be detected: either because they are confident that the safety practices in the beef chain are the right thing to do, or because they feel that such safety interventions are heavily needed, which is fuelled by elevated safety concerns. Beef technology information could reassure the latter group of consumers. If consumer benefits other than safety can be decisive in consumer acceptance of technologies (as suggested in Chapter 5), information about these benefits can be expected to arouse consumer interest.

Fifthly, communicating about technologies applied in beef production and processing is a sign of transparency and openness. It can therefore increase consumer confidence in beef and trust in those who are responsible for beef safety and healthiness.

9.3. Scientific contribution of the doctoral research

The intended conceptual, methodological and empirical contributions of the doctoral research, as discussed in Chapter 1, have been achieved. The current scientific literature has been replicated or extended in a number of ways.

Conceptually, this doctoral dissertation has developed a research framework to investigate consumer attitudes that was based on existing theoretical approaches (replication). In this research framework, technology has been added as a factor influencing consumer attitudes, which the results of the dissertation have proven to be valuable (extension).

This doctoral research has combined three commonly-used methodologies to find answers to the specific research objectives (replication). Although each of these methodologies has its limitations, the use of a combination of methods can compensate weaknesses that stem from a singular approach through triangulation of outcomes and other data. Moreover the combination of methods enables to accommodate different groups of participants depending upon particular requirements at a specific point in time (Pidgeon et al., 2005). The

combination of methodologies in this doctoral research has yielded a rich amount of complementary data about the research topic, providing a more complete view on consumer attitudes towards beef and beef technologies. Furthermore, the focus group participants in Study 1 completed a small questionnaire used for profiling (extension), and the sensory testing in Study 3 was combined with an information experiment and an extended questionnaire (extension).

The empirical contribution of this research relates to the exploration of beef quality attributes (replication), taking into consideration commonly-used technologies and collecting data in different European countries (extension).

9.4. Recommendations

The recommendations of this doctoral research extend to two different levels: public authorities and the food sector. Although this research has focused on beef, the recommendations propose a general approach that is not only valid to improve the competitiveness of the beef sector, but also pertains to other food sectors eager to stay competitive in the market.

The results challenge public authorities and regulators to consider interests and concerns of consumers and citizens. A recent example has been the blocking of the authorisation of 'meat glue' thrombin as a food additive by the European Parliament (European Parliament Press Service, 2010). This bovine enzyme can be used to glue pieces of meat together. Although the use of the binding procedure was declared safe and has been applied in some European countries, the members of the European Parliament objected that thrombin-glued meat could mislead consumers. Next to the regulation of industry practices, authorities should enable consumers to make informed food choices by means of food labelling turning credence into search characteristics, as discussed in section 9.2.

This dissertation brings to the fore three crucial recommendations for the European food sector in its efforts to improve its competitiveness (Figure 9.1): avoiding food scares, establishing an integrated communication chain, and stimulating consumer-oriented product development.

A first requirement to maintain and enhance the competitiveness of a food sector is to avoid the occurrence of food scares, stressing the role of food safety technologies and safety controls. As long as consumer trust is at a comfortable level, the majority of consumers will not openly reject the practices the industry uses to provide safe, healthy and high quality products to their consumers.

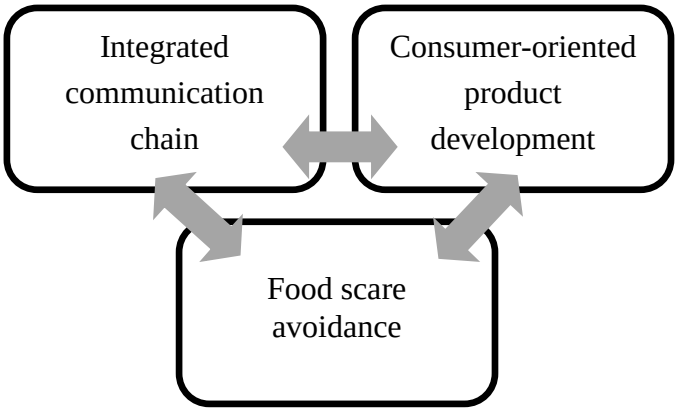


Figure 9.1: Recommendations for the food sector

Food safety has improved considerably in the past decades, principally by the introduction of mandatory traceability and control systems. However, this dissertation has identified consumer uncertainty related to beef safety, but also confusion with respect to beef healthiness, eating quality and technology application. This uncertainty is likely to be present in other food products too. Measures to reduce consumer uncertainty are most of all a matter of effective and transparent information and communication, leading to our second recommendation. Efforts to improve various food quality aspects can be made visible through labelling or guarantees, transforming credence attributes into search attributes. The informational format should be easy accessible, and without overloading consumers with unnecessary information and technical details. Clear messages through product information and advertising can guide consumers in their search for safe, healthy and high-quality food products. All actors in the food supply chain are requested to provide enough and satisfying information. The establishment of an integrated information chain between all actors involved in food production, processing and retailing could further reduce consumer uncertainty. Furthermore, information provision to consumers should be allocated to those actors consumers have most trust in.

Thirdly, uncertainty could also be reduced by the development of food products and technologies taking into account consumer preferences. Producers are challenged to make available safe, healthful and convenient beef with differentiated quality levels for the European population. The qualitative results suggested that the implementation of an eating-quality guarantee based on muscle profiling could provide European beef consumers with more differentiated beef products without increasing consumer uncertainty. For the beef industry, the system could deliver a more differentiated pricing system corresponding to relevant quality attributes, most notably tenderness. For food sectors where inconsistent quality might not be an issue, consumer-oriented product development is an equally valuable recommendation, as new food products are continuously launched in increasingly competitive markets. The failure rate of new products in the food sector has been reported to exceed 60% (Costa & Jongen, 2006; Grunert & Valli, 2001), and only few new products survive in the

long term. Consumer acceptance is the key success factor for a product to survive on the retail shelves, and as such, consumer-oriented product development is essential in the development of successful food products (MacFie, 2007).

9.5. Limitations and directions for future research

The results reported in this dissertation should be critically evaluated, as the limitations of the study need to be taken into account when interpreting the results and its contributions. However, some of these limitations can provide future research opportunities.

The *methodologies used for sampling, data collection, and analysis* that are applied in this doctoral dissertation imposed some limitations to this doctoral research. Since all data were exclusively collected among beef consumers, this dissertation does not discuss attitudes of people who do not consume beef for whatever reason. Four chapters are based on qualitative focus group research (Study 1), limiting the generalisability of the results to a wider population. The cross-sectional data collected in Study 2 do not allow identifying changes over time in consumer attitudes. Longitudinal research could be useful in future research to investigate trends in consumer attitudes, including the evolution of consumer acceptance of food technologies. An interesting research topic is the possible increase in familiarity with technologies over time.

Furthermore, the web-based nature of Study 2 possibly causes bias in the results, as internet penetration varies across countries and socio-economic levels. Although this rate is rising continuously, offline methods of data collection might be better suited in beef consumer research in cases where the socio-economic position or demographic characteristics of consumers are expected to be of major importance, for instance regarding food availability issues, consumer perceptions of food prices, or attitudes among elderly. The underrepresentation of elderly in the consumer samples used in this doctoral research might have an influence on the results, as older people report higher perceived health and food safety risks (Dosman et al., 2001). As such, it can be expected that they are more willing to accept interventions in the beef chain that can improve beef health and safety, as the results of Chapter 5 indicate. The younger generation might be more critical, possibly leading to an underestimation of consumer acceptance of beef technologies. However, the importance of age in consumer attitudes towards beef and beef technologies needs to be put into perspective. Verbeke et al. (2000) showed that attention to television coverage about meat is far more important in consumer reactions than age, as the older age categories are less sensitive for fluctuations in their consumption behaviour when paying higher attention to TV. To shed light on this issue, future research should consider specifically the elderly, as they are a rather specific and growing target group for newly developed beef products.

The sensorial test performed in Study 3 used only a limited and not representative number of consumers. Once a technology has been identified that might be considered as value-adding to

the consumer without raising to high levels of rejection, and which might be feasible for the sector to use efficiently, large-scale consumer home use tests with a larger number of participants in a variety of geographical areas could provide results with a higher external validity. Nevertheless, the combination of the three methodologies in this dissertation is undeniably a strength that is recommended for use in future research.

Framing effects undeniably have an influence on the outcomes of this doctoral research, irrespective of the used methodology. The formulation of the questions in our questionnaire limits the generalisability of the results. Future research could investigate how consumer acceptance levels differ between different presentations of beef technologies, for instance by ranking a variety of alternative presentations. Future studies should not only detect food technologies with high consumer acceptance, but also investigate the best way to communicate about these.

The *research scope* of this doctoral dissertation was limited to beef as a product category without differentiation between beef species or beef from different origins. Any extrapolation of the results to other meat products is speculative. Future studies should consider a variety of quality aspects and technologies, with other than safety benefits, within other food sectors. Even more interesting are the motives behind consumer acceptance. Future attitudinal research should focus on the reasoning behind technology acceptance, and provide a typology of (un)acceptable technologies.

Although data were collected in a variety of European countries with a strategic position in the European beef market, the *selection of countries* could have its drawbacks with respect to the validity of our findings for other European markets. Although the beef market is strongly globalising, an increasing regionalisation of food markets is observed. Future research should further investigate the differences in attitudes that were detected between countries in this doctoral research, and explore possible explanations for this phenomenon. Further cross-cultural validation of the findings would be highly relevant and interesting. For instance, the reasoning behind the low Polish acceptance level of hide decontamination processes would be an interesting research topic originating directly from this research. As attitudes towards food and food technologies are embedded in more general attitudes which are possibly related to cultural values, research identifying the underlying attitudes contributes to a general understanding of differences between countries.

During the course of this doctoral research, no major *food safety incident* has occurred related to the beef sector. Any food safety incident would have a major influence on the results of the study, as consumers confidence drastically decreases during food safety scares, while risk perception increases. It can be expected that consumer acceptance of beef technologies would decrease significantly during or following a food safety scare.

Appendices

Appendix I: Topic guide used for the focus group discussions in Study 1

General beliefs about beef

- associations with beef
- role of beef in the diet

Beef, safety and trust

- meaning of safety
- meaning of safe beef
- evaluation of beef safety
- suggestions to improve beef safety
- concerns about beef safety
- information about beef safety
- (dis)trust in beef safety

Beef, healthiness and trust

- meaning of health
- meaning of healthy beef
- evaluation of beef healthiness
- suggestions to improve beef healthiness
- concerns about beef healthiness
- information about beef healthiness
- (dis)trust in beef healthiness

Beef eating-quality guarantee

- Meaning of eating-quality guarantee
- Expected format
- (Dis)advantages
- Willingness-to-pay

Beef technologies and consumer acceptance

- Ranking beef technologies
- Concept testing (marinating technologies, thermal processing, nutritional enhancement, shock wave technology, muscle profiling, genetic modification and cloning)

Appendix II: Complete scales and scale items used in Study 1

Domain Specific Innovativeness (DSI) based on Goldsmith et al. (1991)
7-point Likert scale: (1) Totally disagree (4) Neither agree nor disagree (7) Totally agree

- I buy new foods before other people do
- In general, I am among the first in my circle of friends to buy new foods
- Compared to my friends I buy more new foods
- Even though new foods are available in the store, I do not buy them
- In general, I am the last in my circle of friends to know the trademarks of new foods
- I will not buy new foods, if I have not tasted them yet

Food Neophobia Scale (FNS) based on Pliner et al. (1992)

7-point Likert scale: (1) Totally disagree (4) Neither agree nor disagree (7) Totally agree

- I am constantly sampling new and different foods
- I don't trust new foods
- If I don't know what is in a food, I won't try it
- I am afraid to eat things I have never had before
- I will eat almost anything

Attitudes towards animal welfare (AW) based on Kendall et al. (2006)

7-point Likert scale: (1) Totally disagree (4) Neither agree nor disagree (7) Totally agree

- It is important that the food I normally eat has been produced in a way that animals have not experienced pain
- It is important that the food I normally eat has been produced in a way that animals' rights have been respected
- In general, humans have too little respect for the quality of life of animals
- Increased regulation of the treatment of animals in farming is needed
- Animal agriculture raises serious ethical questions about the treatment of animals.
- As long as animals do not suffer pain, humans should be able to use them for any purpose
- It is acceptable to use animals to test consumer products such as soaps, cosmetics and household cleaners
- Hunting animals for sport is an acceptable form of recreation

General attitudes towards beef consumption (ATT) based on Olsen et al. (2007)

7-point semantic differences scale

When I eat beef meat, I feel...

- Bad (1) – good (7)
- Unsatisfied (1) – satisfied (7)
- Unpleasant (1) – pleasant (7)
- Dull (1) – exciting (7)
- Terrible (1) – delightful (7)
- Negative (1) – positive (7)

Appendix III: Descriptions of safety-enhancing interventions during primary production, slaughtering and processing in Study 2

Descriptions of stage-specific interventions	Detailed process descriptions
1. Adjusting the feed *"By providing feed that has a positive effect on the health of the animals, beef meat can become safer for human consumption and the risk on safety incidents can be lowered."*	1a. Adding protective bacteria *"Adding protective bacteria to cattle feed can lower the number of pathogens in cattle. Protective bacteria can kill pathogens or render them harmless, making the beef safer for human consumption."*
2. Cleaning the hide "*On the hide of animals, harmful organisms can be present. During slaughter, these organisms can come in contact with the beef meat and cause illness to humans. By cleaning the hide before slaughtering, beef meat can become safer for human consumption and the risk of safety incidents can be lowered."*	2a. With a fixating fluid *"The harmful organisms can be fixated by sprinkling or rubbing a fixating fluid on the hide. Neither humans nor the meat come in contact with the fluid."* 2b. With a soap *"The harmful organisms can be removed by washing the hide with a kind of soap that kills these organisms or renders them harmless. Neither humans nor the meat come in contact with the soap."* 2c. By removing the hair *"The harmful organisms settle in the hair on the hide. By using a product that removes the hair from the hide, the organisms are removed from the hide. Neither humans nor the meat come in contact with the product."*
3. Adjusting the processing *"During processing, beef can be subjected to different treatments to protect it against harmful organisms that can be present on the beef and can cause early spoilage or consumer illness. By applying specific processing techniques, beef meat can become safer for human consumption and the risk of safety incidents can be lowered."*	3a. High pressure treatment *"By using high pressure during processing, harmful organisms that can be present on the beef are killed or rendered harmless. This way, beef meat can become safer for human consumption."* 3b. High temperature treatment *"By using high temperature during processing, harmful organisms that can be present on the beef are killed or rendered harmless. This way, beef meat can become safer for human consumption."* 3c. Adding natural ingredients *"By adding natural ingredients during processing, harmful organisms that can be present on the beef are killed or rendered harmless. This way, beef meat can become safer for human consumption."* 3d. Adding protective bacteria *"By adding protective bacteria during processing, harmful organisms that can be present on the beef are killed or rendered harmless. This way, beef meat can become safer for human consumption."*

Appendix IV: Constructs, items and measurement scales used in Study 2

Construct	Items / Statements	Scale	Cronbach's α construct reliability
Food safety concern (McCarthy et al., 2003)	- I consider myself to be very safety conscious when it comes to food - I think it is important to know what I eat is extremely safe - I think it is important to know what all the safety risks associated with food are	1= 'totally disagree' 4= 'neither agree nor disagree' 7 = totally agree'	0.81
General health interest (Roininen et al., 1999)	- I am very particular about the healthiness of food I eat - It is important for me that my diet is low in fat - It is important for me that my daily diet contains a lot of vitamins and minerals - I always follow a healthy and balanced diet - The healthiness of food has little impact on my food choices (R) - I eat what I like and I do not worry much about the healthiness of food (R) - The healthiness of snacks makes no difference to me (R) - I do not avoid foods, even if they may raise my cholesterol (R)	1= 'totally disagree' 4= 'neither agree nor disagree' 7 = totally agree'	0.83
Confidence in beef	- How confident do you feel of the beef and beef products that you purchase?	1= 'not at all confident' 2= 'rather not confident' 3= 'neutral' 4= 'rather confident' 5= 'very confident'	
Regular beef consumption	- How often do you eat beef steak? - How often do you eat eef burger?	1 = 'never' 2= 'yearly or less often' 3= 'several times per year' 4= 'monthly' 5= 'several times per month' 6= 'weekly' 7= 'several times per week' 8= 'daily'	
Beef consumption frequency	- How many times have you been eating beef steak in the last 14 days? - How many times have you been eating beef burger in the last 14 days?	continuous scale from 0 to 14	

R = item reversed for analysis

Appendix V: Descriptions of safety-enhancing packaging technologies in Study 2

Descriptions of stage-specific intervention	Detailed process descriptions
Adjusting the packaging *"By changing some of the characteristics of the packaging, harmful organisms that can be present on beef can be prevented from growing or rendered harmless. By adapting the packaging, beef meat can become safer for human consumption and the risk of safety incidents can be lowered."*	a. Adding protective bacteria *"By adding protective bacteria to the beef package, harmful organisms that can be present on the beef can be prevented from growing or rendered harmless. This way, beef meat can become safer for human consumption."* b. Modified atmosphere packaging *"By modifying the composition of the internal atmosphere of the beef package, harmful organisms that can be present on the beef can be prevented from growing or rendered harmless. This way, beef meat can become safer for human consumption."* c. Vacuum packaging *"By vacuum packaging, harmful organisms that can be present on the beef can be prevented from growing or rendered harmless. This way, beef meat can become safer for human consumption."* d. Packaging releasing preservative food additives *"Preservative food additives released from the packaging material can protect beef against harmful organisms that can be present on the beef. This way, beef meat can become safer for human consumption."* e. Adding agents such as lactic acid *"By adding agents such as lactic acid (a natural substance always present in meat) to the beef packaging material, the beef can be protected against harmful organisms that can be present on the beef. This way, beef meat can become safer for human consumption."*

Appendix VI: National acceptance levels of the different packaging technologies (in % of the national samples) in Study 2

		France (n=504)	Germany (n=504)	Poland (n=504)	Spain (n=504)	UK (n=504)
Packaging (general)	Completely unacceptable	2,6	2,2	4,0	1,6	2,4
	Rather unacceptable	9,9	6,7	16,5	6,0	5,6
	Neutral	30,0	25,2	31,7	15,1	23,4
	Rather acceptable	43,5	36,5	34,1	45,2	40,9
	Completely acceptable	14,1	29,4	13,7	32,1	27,8
Vacuum packaging	Completely unacceptable	1,2	1,2	1,0	1,4	1,8
	Rather unacceptable	6,0	3,8	8,1	3,6	5,4
	Neutral	19,6	19,2	28,4	15,1	19,0
	Rather acceptable	43,8	43,5	33,7	40,5	38,7
	Completely acceptable	29,4	32,3	28,8	39,5	35,1
Modified atmosphere	Completely unacceptable	4,8	2,0	4,0	1,8	2,8
	Rather unacceptable	12,9	6,7	14,7	6,2	10,9
	Neutral	31,9	31,5	36,9	27,6	31,9
	Rather acceptable	40,1	41,9	34,7	47,4	37,3
	Completely acceptable	10,3	17,9	9,7	17,1	17,1
With natural agents	Completely unacceptable	7,5	5,4	3,2	4,6	7,7
	Rather unacceptable	23,0	15,3	19,2	11,3	18,7
	Neutral	35,7	42,3	45,0	40,7	37,9
	Rather acceptable	27,6	27,6	27,2	33,1	24,8
	Completely acceptable	6,2	9,5	5,4	10,3	10,9
With protective bacteria	Completely unacceptable	9,1	11,9	5,6	6,3	7,9
	Rather unacceptable	32,7	31,0	23,6	17,7	24,6
	Neutral	30,6	31,9	40,9	40,3	33,7
	Rather acceptable	23,2	18,7	24,4	29,0	24,2
	Completely acceptable	4,4	6,5	5,6	6,7	9,5
Releasing additives	Completely unacceptable	11,3	11,7	13,9	8,7	12,7
	Rather unacceptable	32,7	28,2	28,2	27,4	30,0
	Neutral	35,7	37,1	36,9	36,9	32,7
	Rather acceptable	16,3	17,9	17,1	20,6	17,3
	Completely acceptable	4,0	5,2	4,0	6,3	7,3

Appendix VII: Technology information used in Study 3

Basic information	Detailed information
Tenderloin / M. Psoas Major	
(none)	*"No technology has been applied to the beef meat you have before you"*
Muscle profiled M. Infraspinatus	
"The beef meat you have before you has been produced through use of muscle profiling, a technology which can ascertain the eating quality of a beef meat cut."	*"Specific parts of beef are selected to be sold in the shop as fresh meat cuts (such as steak). Not all muscles can be used as whole meat because of their structure or the characteristics of the muscle. Some muscles are so tough, that they can only be used in stew or minced meat. Through use of particular technologies, more muscles can be used as fresh whole meat.* *Muscle profiling is such a technology. Muscle profiling is the mapping of the characteristics of muscles, so that the muscles of good quality can be identified. This way, the consumer has more choice between various cuts of fresh beef in the shop.* *The beef meat you have before you has been produced using muscle profiling. This beef cut comes from a muscle that is part of the meat from the shoulder and is normally sold as meat for stew to be used in casseroles or local meat dishes.* (local equivalents)
Marinated M. Semitendinosus	
"The beef meat you have before you has been marinated, which can improve the eating quality of a beef cut."	*Specific muscles of beef are selected to be sold as fresh meat, such as steak. Not all muscles can be used as whole meat because of their structure or the characteristics of the muscle. Some muscles are so tough, that they can only be used in stew or minced meat. Through use of particular technologies, more meat cuts can be used as fresh whole meat.* *Marinating is such a technology. Marinating beef by injecting it with a solution containing kiwi extract will make muscles more tender and gives them more taste. This way, tough muscles can be consumed with a higher eating quality.* *The beef meat you have before you has been marinated by injection with a solution containing kiwi extract. This beef cut comes from a tougher muscle. By marinating it by injection, the eating quality of a beef cut can be improved.*

Summary

Over the past 20 years, a variety of developments have impacted the beef sector, such as food safety crises, increasing health concerns and sustainability issues. The contemporary European beef sector is confronted with increasingly demanding consumers that are urging the sector to produce beef and beef products that are divers, convenient, traceable, healthy, and of consistent eating quality. A commonly-used approach to improve various aspects of beef quality is the use of technologies. Although food technologies are often applied as a means to satisfy consumer demand, their use is most of the time not explicitly communicated to consumers. Knowledge about consumer attitudes towards beef and beef technologies can help the beef sector to advance into a competitive industry. For this reason, three consumer studies were conducted in different European countries: a qualitative focus group study (conducted in 2008 in France, Germany, Spain and the UK, n=65), a quantitative survey (conducted in 2010 in France, Germany, Poland, Spain, and the UK, n=2520), and a sensory study (conducted in 2011 in Belgium and Norway, n=218).

The first research objective was to explore consumer attitudes towards beef safety, healthiness and quality. The results of the qualitative focus group research suggested that consumers experienced difficulties in assessing beef safety. They adopted diverging uncertainty reduction strategies including the use of so called cues, easy decision rules that were used when purchasing beef. Both intrinsic (such as colour) and extrinsic cues (such as packaging) were identified. Beef was generally considered as a healthful food product, but also perceived negative effects of beef consumption were reported. These negative effects were mainly related to individual consumer choices with respect to consumption amount and preparation methods. Furthermore, consumers were asked about their perceptions on a specific extrinsic quality cue with the potential of signalling eating quality. The results indicated that the possibility to supply highly precise cuts of different guaranteed eating quality was considered appealing by consumers. However, they expressed some reserve related to the possible upgrading of lower value cuts, too much standardisation, and the fact that tenderness is to some extent subjective.

European consumers are often sceptical towards the application of food technologies. A second objective of this doctoral research was therefore to investigate consumer acceptance of technologies applied at different stages of the beef chain: primary production, slaughtering, processing and packaging. The focus group results indicated that consumer acceptance of processing technologies depend on a variety of factors. Invasive technologies were rejected, despite consumers' recognition of the possible benefits that these technologies might offer in terms of beef quality. Traditional and familiar processes were more easily accepted. 'Natural' beef was preferred over processed beef products, and excessive intervention in meat chains was criticised. The results of the quantitative survey confirmed that the processing stage was

not the consumers' favourite stage to intervene. Improving beef safety was acceptable for the large majority of consumers at slaughtering stage through hide decontamination, although not irrespective of the specific process that was applied for this aim. Enhancing beef safety at the packaging stage (especially by means of unfamiliar packaging technologies) was found to be not acceptable for a large group of consumers. Accepting beef-safety enhancing technologies seemed to be caused by diverging reasons: either because consumers were confident that what the industry will do (in terms of safety interventions) is the right thing to do, or because they felt that such safety interventions are heavily needed, which is fuelled by elevated safety concerns. Technology acceptance levels differed between consumer segments. Concerning technologies to improve beef safety at the primary production, slaughtering or processing stage, four segments were identified that differed in their beef consumption and attitudes: 'enthusiast' (11% of the sample), 'feeling OK' (36%), 'indifferent' (41%) and 'rejecting' consumers (11%), showing that only 11% of the participants are not in favour of these kinds of technologies. Concerning packaging technologies to improve beef safety four different groups could be indentified: 'enthusiast' (22% of the sample), 'cautious' (30%), 'conservative' (17%) and 'negative' consumers (31%). The large size of the negative consumer segment indicates that enhancing beef safety at the packaging stage is not straightforwardly acceptable.

The third research objective was to investigate the effect of information about beef technologies on consumer attitudes. The exploratory research participants already indicated that they preferred not to be fully informed about beef technologies. Information about the possible benefits of the technology appeared to have a positive impact on consumer acceptance. Informing consumers about a health benefit of a technology (such as adding omega-3 to beef products) seemed to result in a higher acceptance compared to a safety benefit (such as prolonged shelf life). The quantitative results showed that more detailed information about the applied process lowered consumer acceptance. Consumers reported higher acceptance levels of beef technologies when only the stage of application was mentioned, compared to when the process was explained. The results of the sensory study that was combined with an information experiment, illustrated that detailed information about beef technologies had an impact on consumer expectations and liking, but information transfer did not guarantee more positive attitudes.

Based on the research results, a number of recommendations are formulated. Public authorities and regulators are challenged to consider interests and concerns of consumers and citizens. The food industry can improve its competitiveness by avoiding food scares, establishing an integrated communication chain, and stimulating consumer-oriented product development.

Samenvatting

De voorbije 20 jaar hebben zich een aantal ontwikkelingen voorgedaan die de rundvleessector sterk beïnvloed hebben, onder meer crisissen inzake voedselveiligheid, een verhoogde bekommernis van de consument om zijn/haar gezondheid, en actuele duurzaamheids-vraagstukken. De Europese rundvleessector wordt vandaag geconfronteerd met veeleisende consumenten die aandringen op een grote variëteit aan producten die betaalbaar, gemakkelijk in gebruik, traceerbaar, gezond en van goede kwaliteit zijn. Een veelgebruikte aanpak om verschillende kwaliteitsaspecten van rundvlees te verbeteren is het gebruik van technologieën. Hoewel technologieën vaak worden toegepast om aan de vraag van de consument te voldoen, wordt het gebruik ervan niet altijd gecommuniceerd, terwijl er toch een toenemende consumenteninteresse bestaat naar hoe hun voedsel wordt geproduceerd. Kennis over de houding van consumenten ten opzichte van rundvlees en gerelateerde technologieën kan de competitiviteit van de sector ten goede komen. Daarom heeft dit doctoraatsonderzoek drie consumentenstudies uitgevoerd in verschillende Europese landen. In 2008 vond een verkennende kwalitatieve focusgroepstudie plaats in de hoofdsteden van Frankrijk, Duitsland, Spanje en het Verenigd Koninkrijk (n=65). Een kwantitatieve consumentenbevraging vond plaats in 2010 in dezelfde landen aangevuld met Polen (n=2520), waarna een sensorisch onderzoek gecombineerd met een informatie-experiment plaatsvond in België en Noorwegen (n=218) in 2011.

Een eerste doelstelling van dit onderzoek was om de houding van de consument ten aanzien van de veiligheid, gezondheid en kwaliteit van rundvlees te verkennen. De deelnemers aan de focusgroepen vermeldden dat ze moeilijkheden ervoeren om de veiligheid van rundvlees te beoordelen. Uiteenlopende strategieën om die onzekerheid te verminderen werden aangehaald, waaronder ook het gebruik van eenvoudige beslissingsregels die gebruikt worden bij de aankoop van vlees. Zowel intrinsieke signalen (zoals kleur) als extrinsieke signalen (zoals labels) werden geïdentificeerd. Rundvlees werd over het algemeen beschouwd als een gezond voedingsmiddel, hoewel ook vermeende nadelige gezondheidseffecten werden gerapporteerd. Deze werden voornamelijk gerelateerd aan de individuele keuzes van consumenten met betrekking tot de geconsumeerde hoeveelheid en de bereidingswijze. De deelnemers aan de focusgroepen werden ook gevraagd naar hun houding ten opzichte van een garantiesysteem voor de malsheid en kwaliteit van rundvlees. De mogelijkheid om rundvlees van een gegarandeerde en gedifferentieerde kwaliteit aan te kunnen bieden klonk voor hen aantrekkelijk. Toch formuleerden ze ook bedenkingen met betrekking tot het mogelijks opwaarderen van rundvlees van lage kwaliteit, een te hoge mate van standaardisering en de subjectieve kant van malsheid.

Europese consumenten staan vaak sceptisch tegenover het gebruik van technologieën bij het produceren en verwerken van voedsel. Een tweede doelstelling van dit onderzoek was om te

onderzoeken in welke mate consumenten technologieën aanvaarden die toegepast worden in verschillende fases van de rundvleesketen: tijdens de primaire productie, het slachten, het verwerken en het verpakken. De resultaten van de focusgroepstudie gaven aan dat de acceptatie door de consument van verwerkingstechnologieën afhankelijk was van verschillende factoren. Traditionele en vertrouwde processen werden gemakkelijker aanvaard. Invasieve technologieën werden verworpen, hoewel mogelijke voordelen werden erkend. 'Natuurlijk' rundvlees werd verkozen boven verwerkte vleesproducten en overmatige inmenging in de keten werd bekritiseerd. De kwantitatieve consumentenbevraging bevestigde dat de fase van rundvleesverwerking niet het favoriete stadium van de consument is om technologisch in te grijpen in de rundvleesketen. Voedselveiligheid van rundvlees verbeteren door het desinfecteren van de huid voor het slachten was aanvaardbaar voor de meeste consumenten, maar was wel afhankelijk van het proces dat hiervoor gebruikt werd. Voedselveiligheid van rundvlees verbeteren door technologieën tijdens het verpakken bleek onaanvaardbaar voor een grote groep consumenten, vooral wanneer het ging om onbekende verpakkingstechnologieën. Technologische interventies om de voedselveiligheid te verhogen leken te worden aanvaard om uiteenlopende redenen: ofwel omdat de consumenten erop vertrouwden dat de sector het nodige doet om voedselveiligheid te garanderen, ofwel omdat ze de noodzaak van deze interventies hoog achtten vanuit een grote bezorgdheid betreffende de veiligheid van rundvlees.

De mate waarin technologische interventies aanvaard werden, was verschillend tussen consumentengroepen. Met betrekking tot interventies tijdens de primaire productie, het slachten en het verwerken van rundvlees werden vier segmenten geïdentificeerd met elk hun eigen specifieke consumptie van en houding tegenover rundvlees: de 'enthousiaste' (11% van de steekproef), 'geruste' (36%), 'onverschillige' (41%) en 'afwijzende' consumenten (11%). Slechts 11% van de steekproef was sterk gekant tegen deze interventies. Met betrekking tot verpakkingstechnologieën konden opnieuw vier segmenten onderscheiden worden: de 'enthousiaste' (22% van de steekproef), 'voorzichtige' (30%), 'conservatieve' (17%) en 'negatieve' consumenten (31%). De omvang van dit laatste segment toont dat verpakkingstechnologieën niet zomaar aanvaard worden.

Een derde doelstelling van dit doctoraat was om het effect van informatie over rundvleestechnologieën op de houding van de consument te onderzoeken. Het verkennend onderzoek wees reeds uit dat consumenten liever niet alles weten over de gebruikte technologieën. Informatie over de mogelijke voordelen van een technologie bleek een positieve invloed te hebben op de acceptatie. Informatie over een gezondheidsvoordeel (zoals het toevoegen van omega-3) leek te resulteren in een hogere acceptatie vergeleken met een voordeel inzake voedselveiligheid (zoals een langere houdbaarheid). De kwantitatieve resultaten bevestigden dat gedetailleerde informatie kan leiden tot lagere acceptatie. Wanneer enkel informatie werd gegeven over de fase waarin de technologie werd toegepast, lagen de acceptatieniveaus hoger dan wanneer het toegepaste proces werd toegelicht. De resultaten van de sensorische studie toonden aan dat gedetailleerde informatie over rundvleestechnologieën

kan leiden tot een positievere houding bij de consument, maar dat louter informatie verschaffen hiervoor geen garantie is.

Op basis van de resultaten van dit onderzoek kunnen een aantal aanbevelingen worden geformuleerd. Overheden en beleidsmakers worden aangemoedigd om rekening te houden met de vragen en bekommernissen van consumenten. Sectoren uit de voedingsindustrie kunnen hun concurrentiepositie verstevigen door crisissen te vermijden, een geïntegreerde communicatieketen uit te bouwen en bij het ontwikkelen van nieuwe producten rekening te houden met de houding van de consument.

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Scientific Curriculum Vitae

Lynn Van Wezemael was born in Wilrijk on November 3, 1982. She completed her secondary education, option Latin-Mathematics at the Sint-Rita college in Kontich in 2000. The same year she started studying at the Faculty of Political and Social Sciences at the University of Antwerp. After obtaining a bachelor degree in Sociology, she continued her academic education at Ghent University, where she obtained a master degree in Political and Social Sciences, option Sociology with distinction in 2004, and a master degree in Economics, option International Economics with distinction in 2007.

In October 2007 she started working as a PhD student at the Department of Agricultural Economics at Ghent University. In the following years she was involved in research activities within the European Integrated Project ProSafeBeef, the Flanders' FOOD project Trends, and the French National Research Agency's project Medialog. She has supervised three master thesis students. In December 2009, she was hosted at the Chinese Academy for Social Sciences in Beijing as a guest researcher in the framework of the International Master of Rural Development Program – Action 3. In January 2011, she was hosted at the Norwegian Institute of Food, Fisheries and Aquaculture Research in Ås, for a training activity regarding sensory research. In 2011, she successfully completed the doctoral training program at the Doctoral Schools of BioScience Engineering at Ghent University. She has presented her research at national and international scientific conferences, and is author or co-author of six international peer-reviewed publications.

Publications A1

Van Wezemael, L., Verbeke, W., Kügler, J.O., de Barcellos, M.D. and Grunert, K.G. (2010). European consumers and beef safety: perceptions, expectations and uncertainty reduction strategies. *Food Control,* 21 (6), 835-844.

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Other publications

Verbeke, W., Van Wezemael, L., de Barcellos, M.D., Kügler, J.O., Chryssochoidis, G., Ueland, Ø. and Grunert, K.G. (2009). An exploratory study to assess European consumers' opinion about a beef quality guarantee system. 93-102 in Fritz, M., Rickert, U. and Schiefer, G. (eds.), System Dynamics and Innovation in Food Networks, Germany: Universität Bonn-ILB Press.

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Van Wezemael, L. and Verbeke, W. (2011). Consumer attitudes towards beef and beef technologies. Communications in Agricultural and Applied Biological Sciences, 76 (1), 85-88.

International conferences with oral or poster presentation

Verbeke, W., Van Wezemael, L., de Barcellos, M.D., Kügler, J.O., Chryssochoidis, G., Ueland, Ø. and Grunert, K.G. (2009). An exploratory study to assess European consumers' opinion about a beef quality guarantee system. Oral presentation at the 3rd International European Forum on System Dynamics and Innovation in Food Networks, 16-20 February in Austria, Igls/Innsbruck.

de Barcellos, M.D., Kügler, J.O., Grunert, K.G., Van Wezemael, L., Pothoulaki, M., Ueland, Ø. and Verbeke, W. (2009). European consumers' acceptance and rejection of novel beef technologies: a qualitative study. Oral presentation at the 3rd International European Forum on System Dynamics and Innovation in Food Networks, 16-20 February in Austria, Igls/Innsbruck. (presented by Marcia D. de Barcellos)

de Barcellos, M.D., Kügler, J.O., Van Wezemael, L., Ueland, Ø., Verbeke, W. and Grunert, K.G. (2009). Oral presentation at the 55th International Congress of Meat Science and Technology, 16-21 August in Denmark, Copenhagen. (presented by Marcia de Barcellos)

Van Wezemael, L.. and Verbeke, W. (2009). Consumer need for safety and health information and acceptability of novel processed beef products. Oral presentation at the ProSafeBeef Annual Meeting, 14-16 October in Greece, Athens.

Van Wezemael, L., Verbeke, W., Kügler, J.O., Scholderer, J. and Ueland, Ø. (2011). European consumers' acceptance of beef safety-improving interventions at different stages of the beef chain: primary production, slaughtering, processing and packaging. Oral presentation at the 3rd International European Forum on System Dynamics and Innovation in Food Networks, 14-18 February in Austria, Igls/Innsbruck.

Gellynck, X., Kühne, B., Van Wezemael, L.. and Verbeke, W. (2010). New product development: a decision tool for trend implementation. Paper presented at the 1st joint EAAE/AAEA seminar 'The Economics of Food, Food Choice and Health', 15-17 September in Germany, Freising/Munich. (presented by Bianka Kühne)

Van Wezemael, L., Verbeke, W., Kügler, J.O., Scholderer, J. (2010). European consumer acceptance of beef safety-improving interventions during primary production, slaughtering, processing and packaging. Oral presentation at the ProSafeBeef Annual Meeting, 5-7 October in UK, Aberystwyth.

Verbeke, W. and Van Wezemael, L. (2010). Highlights from the results from the consumer research in ProSafeBeef Pillar 5. Oral presentation at the ProSafeBeef Annual Meeting, 5-7 October in UK, Aberystwyth.

Van Wezemael, L., Verbeke, W., Kügler, J.O., Scholderer, J., de Barcellos, M.D., Ueland, Ø., Perez-Cueto, A., Hocquette, J.-F. and Grunert, K.G. (2010). Overview of exploratory insights from the ProSafeBeef qualitative consumer study. Poster presentation at the ProSafeBeef Annual Meeting, 5-7 October in UK, Aberystwyth.

Kügler, J.O., Scholderer, J., Van Wezemael, L., Verbeke, W. and Ueland, Ø. (2010). Consumer evaluation of fresh and minimally processed beef products. Oral presentation at the ProSafeBeef Annual Meeting, 5-7 October in UK, Aberystwyth. (presented by Jens Kügler)

National conferences with oral or poster presentation

Van Wezemael, L. and Verbeke, W. (2009). European consumers' perception of beef safety and healthiness. Poster presentation at the meeting of the Belgian Association of Meat Science and Technology, 8 October in Belgium, Ghent.

Van Wezemael, L. and Verbeke, W. (2009). European consumers' acceptance of novel beef production and processing technologies. Poster presentation at the workshop of the Belgian Association of Meat Science and Technology, 8 October in Belgium, Ghent.

Van Wezemael, L. and Verbeke, W. (2009). European consumers' perception of beef safety and healthiness. Poster presentation at the 15th PhD Symposium on Applied biological Sciences, 6 November in Belgium, Leuven.

Van Wezemael, L., Verbeke, W., Kügler, J.O., Scholderer, J., de Barcellos, M.D., Ueland, Ø., Perez-Cueto, A., Hocquette, J.-F. and Grunert, K.G. (2010). Exploratory insights from the ProSafeBeef qualitative consumer study. Poster presented at Workshop of the Belgian Association of Meat Science and Technology, 21 October in Belgium, Melle.

Van Wezemael, L. and Verbeke, W. (2010). Consumer attitudes towards beef and beef technologies. Oral presentation at the 16th Symposium on Applied Biological Sciences, 20 December in Belgium, Ghent.

Post Scriptum: Bedankt!

Na het uitpluizen van ellenlange uitgetypte teksten van groepsdiscussies, na het verwerken van de resultaten van onze enquêtes, na talloze verbeteringen aan het opzetten van studies en uitwerken van papers, na het beschrijven van mooie en minder mooie resultaten, etc. is mijn doctoraat dan echt af! Alvorens helemaal te genieten van de zomer en de vakantie, rest mij nog het schrijven van een gepast dankwoord. Aangezien dit ongetwijfeld het meest gelezen deel van dit boekje zal zijn, wil ik hier uitdrukkelijk de aandacht vestigen op een heleboel mensen die een invloed hebben gehad op het tot stand komen van dit doctoraat, en die mij van dichtbij of veraf hebben gevolgd tijdens de voorbije jaren.

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Het begon in het najaar van 2007. Groot was het enthousiasme van de dames van de studentenadministratie op de faculteit Economie toen ze hoorden dat ik zou beginnen doctoreren aan de vakgroep Landbouweconomie. “Daar zitten zoveel leuke mensen”, wisten ze me te vertellen, “veel leuker dan hier op de economie”. Hoewel dat waarschijnlijk meer zegt over hun collega’s dan over de mijne, kan ik niet anders dan hen volmondig gelijk geven. Kennis en kunde in onderzoek wordt hier even vlot uitgewisseld als huiselijke en sportieve ervaringen, net als interessante weetjes uit de wandelgangen. Dit zijn collega’s om U tegen te zeggen. “Fijne collega’s doen langer leven” titelde De Standaard onlangs. Dat belooft.

Noemenswaardig zijn zeker de collega’s van onze onderzoeksgroep, de bende van Wim: Christine, Filiep, Zuzanna, Armando en Pieter. Onze gesprekjes tussendoor hebben misschien niet altijd rechtstreeks geleid tot bruikbaar materiaal voor mijn doctoraat, maar zijn ongetwijfeld een meerwaarde voor mijn werk. Ik ben blij dat jullie in mijn team zitten! Christine, de grootste gemene deler van onze gesprekken is waarschijnlijk ‘de beste aanpak’: hoe die vraag best in een vragenlijst te formuleren, die ene noodzakelijke handtekening te pakken krijgen, of … dat ontsnapt schaap terug binnen zijn omheining te krijgen? De vele discussies over ons onderzoek hebben ertoe geleid dat we ons binnenkort allebei doctor mogen noemen. Alvast proficiat! Aan Filiep had ik een prima voorbeeld over hoe het indienen van een doctoraat zonder stress kan verlopen. Bedankt voor het wegwijs maken op de vakgroep en de treinritjes in de vroegte.

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Participating in a European research project such as ProSafeBeef offers the opportunity to meet and collaborate with scientists all over the world. The team of prof. Joachim Scholderer at MAPP/QUANTUS has been closely involved in our research. I am very grateful for the help of Joachim with the statistical analyses and his contribution to the consumer studies. My main co-worker within the project was Jens. Although struggling with two meat projects simultaneously, he has managed to take care of a lot of the practical work regarding the programming of questionnaires and the follow-up of the data collection. Jens, thank you for the nice collaboration, and the pleasant times in Aberystwyth, Athens, Copenhagen, Ghent, Girona, and Igls. I wish you all the best in finalizing your PhD. Marcia, thank you for giving food research an extra dimension. Our collaboration has been very successful from the start. The content analysis of the focus group discussions has been terribly time-consuming but oh-so-satisfying when finished. I'm looking forward to see you again in Europe.

"Oh, you are the doctoral student who will do the writing!" This is how I met Øydis in 2008. Now you hold the results of that writing. Øydis, your soft way of giving guidance and your appreciation of my work have stimulated me to do some extra efforts. I am really grateful for having the chance to collaborate with you and your research group, and to be introduced into sensory consumer science by experts. Bij de herhaling van de smaakproeven in België, waarvoor de nodige kilo's rundvlees voorzien werden door Stefaan DS (overigens een expert in Welsh Folk) bleken de zeer precieze instructies die ik uit Noorwegen had meegekregen voor het versnijden van deze spiermassa's echter niet zomaar toepasbaar op het Belgisch rundvlees. Gelukkig kwam spontaan de slager in Stefaan L. naar boven, die in de net iets te koude koelkamer vakkundig al het vlees voorbereidde en versneed. Bedankt!

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