

Food Safety, Animal Disease and Supply Chain Management in the European Meat Business

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Paper prepared for the **National Public Policy Education Conference** “*Consequences of the 21st Century Food Systems*”, Fayetteville, Arkansas, September 17-20, 2006.

1. Introduction

Consumer trust and food safety have become a central issue in the food chain (Grunert, 2005; Röhr, Lüddecke, Drusch et al., 2005; Verbeke, 2005). During the past two decades, food safety crises such as the mad cow disease throughout Europe, the dioxin crisis in Belgium, and outbreaks of foot-and-mouth disease in several countries led consumers to rethink their attitudes to and behavior towards meat consumption (Gellynck and Verbeke, 2001; Latouche, Rainelli, and Vermersch, 1998). Due to the increasing health and safety consciousness, both industry and the public authorities have developed quality and safety assurance systems (Hobbs, Bailey, Dickinson, and Haghiri, 2005; Schwägele, 2005; Theuvsen, 2003). Further, the crises induced a sharp and immediate drop in the demand for meat products, followed by a slow and often incomplete recovery (Böcker and Hanf, 2000; Verbeke, 2001).

Within the modern meat chain, consumers occupy a crucial position being situated at the end of the chain as the end user as well as at the start of the chain as inspiration for a consumer-driven or market oriented chain organization (Gellynck, Verbeke, and Viaene, 2004). The latter position makes consumer demand for safe and wholesome food in general and meat in particular the greatest driving force for the introduction of a variety of information systems such as labeling, traceability and quality assurance schemes (Gellynck and Verbeke, 2001; Leat, Marr, and Ritchie, 1998).

The objective of the paper is to investigate how consumers perceive information on food safety and quality aspects. It will be focused on the perception of information cues on meat labels as well as of traceability and quality information cues. Finally a future perspective of the development of integrated meat supply chains is given.

2. Trust and information

One of the main goals of food safety measures is to increase consumer trust in food and reduce uncertainty, and therefore information about meat quality and safety is provided to the consumer. Consumer trust in food products does not necessarily reflect the objective information that is communicated. The problem is depicted in Fig. 1.

Throughout the EU, both public and private initiatives such as new regulations and the introduction of voluntary quality assurance schemes are established to guarantee consumers that food is safe and wholesome. However, consumer trust will not be achieved unless there is increased effort to communicate risk (Frewer et al., 2005). To achieve this, the removal of information asymmetry through the provision of more information is often believed to be the most logic solution (Kola and Latvala, 2003; Yee, Yeung, and Morris, 2005). However, effective communication has to take into account differences among consumers' concerns. In this respect, authors distinguish differences in terms of purchasing motives and labelling preferences (Bernués et al., 2003) or risk perception (Frewer et al., 2005). Further, consumer concerns differ according to the type of food hazard (Miles and Frewer, 2001). This complexity in providing information is due to the fact that consumers are interested in very different properties of the food product (Theuvsen, 2003).

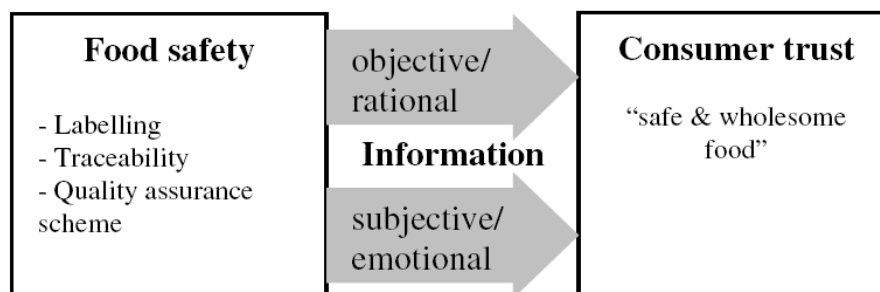


Figure 1: Influences of food safety information on consumer trust

Information from today's agriculture and food markets has to surpass several hurdles in order to be effective at the consumer level, e.g. building or strengthening consumer trust. A first hurdle relates to the availability and accessibility of information. Limited availability and accessibility to information yields potential market failures in the sense that consumers are hampered in making choices in line with their preferences (Caswell and Mojduszka, 1996; Teisl and Roe, 1998). However, even when information is made sufficiently available and accessible to consumers, only a limited amount of this information is attended to, i.e. attracting consumers' attention in an environment characterized by information overload and

raising interest for being processed. The explanation lies in the limited human cognitive capacity and willpower to process information on the one hand, and in high opportunity cost of processing information as compared to the expected marginal benefit of devoting time and effort to information processing on the other. Furthermore, there is a real potential danger of information overload. Increasing the amount of information, for instance on the product label, may overload the label or package, and make a given and desired amount of information harder to extract, or simply cause individuals without time or ability to process information to ignore it, hence yielding excess costs (Salaün and Flores, 2001). It may also yield boredom and impatience, as well as loss of confidence from non-understanding. Food labeling is an increasingly important route for delivering messages about the safety and wholesomeness of food to consumers. It has long been understood, however, that the presupposition that consumers want, will acquire and, having acquired, will adequately understand and use the information supplied on labels is invalid (Jacoby, Chestnut, and Silberman, 1977). Furthermore, labeling information is often inaccessible and useless to consumers (Hobbs et al., 2005; Salaün and Flores, 2001). It has yet been shown that consumers often misunderstand or misinterpret information, e.g. relating to quality or origin, which yields the formation of quality expectations that may not be confirmed by actual product performance upon consumption (Grunert, 2005). As a result, a particular challenge pertains to determining the optimum level of simplicity versus detail for any information to be provided, which is likely to differ depending on the individual and the product at hand.

3. Materials and methods

Consumer perception of meat quality and consumer interests in traceability and meat label information are explored in three consumer studies (Gellynck and Verbeke, 2001; Gellynck et al., 2005; Gellynck et al., 2006). To assess the consumer's perception of traceability in the meat chain the research framework presented in figure 2 is used (Gellynck and Verbeke, 2001).

The meat chain from producer to consumer constitutes the core of the framework. Tracking meat products within this chain focuses on two types of attributes, namely functional attributes such as organizational efficiency and meat chain monitoring on the one hand, and process attributes such as origin and production method on the other. Functional attributes are linked with the intrinsic opportunities of a traceability system, while the process attributes

deal with characteristics of the production process along which the tracking is organized. The tracking serves as a kind of peg for potential consumer benefits.

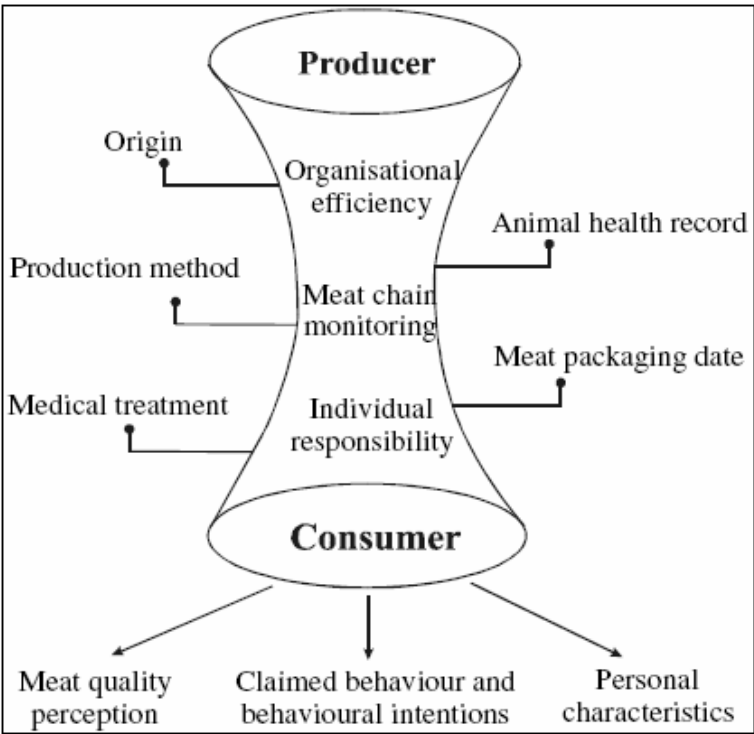


Figure 2: Framework for research on consumer perception of traceability

The consumer studies about perception of meat quality and consumer interests in traceability used a questionnaire to collect consumer data (170 meat consumers in Belgium in June 2001 and 155 meat consumers in November 2004). Respondents were selected based on non-probability convenience sampling, with the restriction that they were the main person responsible for buying meat in the household, which resulted in a gender distribution with two thirds of female respondents.

The third study about consumer interests in meat label information was performed in November 2005 in Belgium as well in form of a questionnaire. Respondents were also selected using convenience sampling, but no restriction for being main shoppers was applied. The sample (n = 127) included 49.6% males and 50.4% females with age ranging from 16 to 79 years (mean age = 38.13 years), of whom 56.7% were higher educated.

4. Consumer perception of food safety and quality information

Information about the food quality and safety is one of the most important criteria for consumers during the purchase process. Food manufacturers, especially in the meat sector, did a lot of effort to increase food safety, but failed to communicate (Röhr, Lüddecke, Drusch et al., 2005). In the following chapters the consumer's perception on quality and food safety are investigated.

4.1. Meat quality perception

A hierarchical cluster analysis (Ward's method –squared Euclidean distance), followed by a k-means clustering on the perception of quality of fresh meat now compared with 5 years ago, resulted in a three-cluster solutions in 2001 and a four-cluster solutions in 2004 (Table 1).

Table 1: Changes in perception of meat quality compared within 5 years, average attribute ratings on semantic differential from -3 to +3 (n= 160 in 2001, n=151 in 2004)

	Sample (n)		Safety		Healthiness		Animal welfare		Environmental friendly		Taste		Price	
	2001	2004	2001	2004	2001	2004	2001	2004	2001	2004	2001	2004	2001	2004
Enthusiasts	50	52	1.94 ^a	1.96 ^a	1.70 ^a	1.37 ^a	1.40 ^a	1.27 ^a	1.52 ^a	1.50 ^a	0.40 ^a	1.04 ^a	-1.30 ^a	-1.62 ^a
Cautious	66	43	0.97 ^b	1.00 ^b	0.30 ^b	0.40 ^b	0.91 ^b	0.37 ^b	0.18 ^b	0.67 ^b	-0.17 ^b	0.14 ^{b,d}	-0.15 ^b	-0.09 ^b
Pessimists	44	25	-0.95 ^c	-1.08 ^c	-1.09 ^c	-1.36 ^c	-0.70 ^c	-0.60 ^c	-0.34 ^c	-0.56 ^{c,d}	-0.70 ^c	-0.92 ^c	-1.50 ^a	-1.68 ^a
Green	--	31	--	0.81 ^b	--	0.52 ^b	--	-0.68 ^c	--	-0.87 ^d	--	-0.06 ^d	--	-1.55 ^a
Total	160	151	0.74	0.98	0.35	0.50	0.28	0.32	0.46	0.46	-0.14 [*]	0.25 [*]	-0.83 [*]	-1.19 [*]

The various superscripts indicate significant differences in the post-hoc Duncan test ($p < 0.05$).

* t-test with significant different means ($p < 0.05$)

Quality perception is assessed using six fresh meat attributes, based on a 7-point semantic differential scale ranging from -3 to +3. Fresh meat includes beef, pork, poultry and mixtures such as hamburgers and brochettes. Oneway ANOVA was carried out to illustrate the differences in quality perception between the clusters or consumer segments. The clusters are labeled based on an interpretation of their patterns of mean perception scores: enthusiasts, cautious and pessimists. In 2004, a new cluster can be identified and labeled as greens. The total sample scores above the middle scale position of the semantic differential for the attributes safety, healthiness, animal welfare and environmental friendliness, whereas there are negative average scores for taste and price in 2001. The negative score for taste turns into a positive one in 2004. All attributes except price obtain a better score in 2004. Compared with 2001, there is a clear increase in overall meat quality perception which is translated into

the enthusiasts becoming the most important segment with 34.4% of the respondents. The greens are a new segment representing 20.5% of the respondents and can be characterized as being positive related to safety and health, but negative towards the other attributes. The extremely low score for the environment is most striking.

4.2. Labeling

Labels function as a bridge between the food chain and the final consumer to inform the consumer about process and product attributes (Avermaete and Viaene, 2002). Labeling initiatives have a high potential direct impact on consumer's decision-making. Indications on labels perform a function as attribute or cue. During the consumer's decision-making process these indications can be attended, processed and evaluated by the consumer. Though the rational decision-making and utility maximization can be hampered by information which is imperfect, incomplete, inaccessible, asymmetrically distributed, non-standardized or costly to collect (Verbeke and Ward, 2003).

In a consumer survey in November 2003 in Belgium respondents were asked to express the importance and the frequency of use of 10 different information cues on meat labels on a 5-point scale (Gellynck et al., 2006). The most used ones are expiry date, meat type, weight and price. For these cues, a quite consistent picture between claimed importance and claimed use is obtained (Fig. 2), i.e. claimed use levels match relatively well with claimed importance levels. The other meat label cues are evaluated as significantly less important and much lower use levels are reported, particularly so for slaughter date, nutritional value, origin and brand. These findings are consistent with previous meat consumer studies in the sense that readily interpretable search information cues, such as expiry date and meat type, rank higher in terms of importance and use as compared to credence information cues, such as origin (Verbeke and Ward, 2006; Verbeke, Ward, and Avermaete, 2002).

The preference for certain information cues is significantly associated with education. The higher the education the more interest in informative cues on the label, like a website address or a traceability reference (Gellynck et al., 2006).

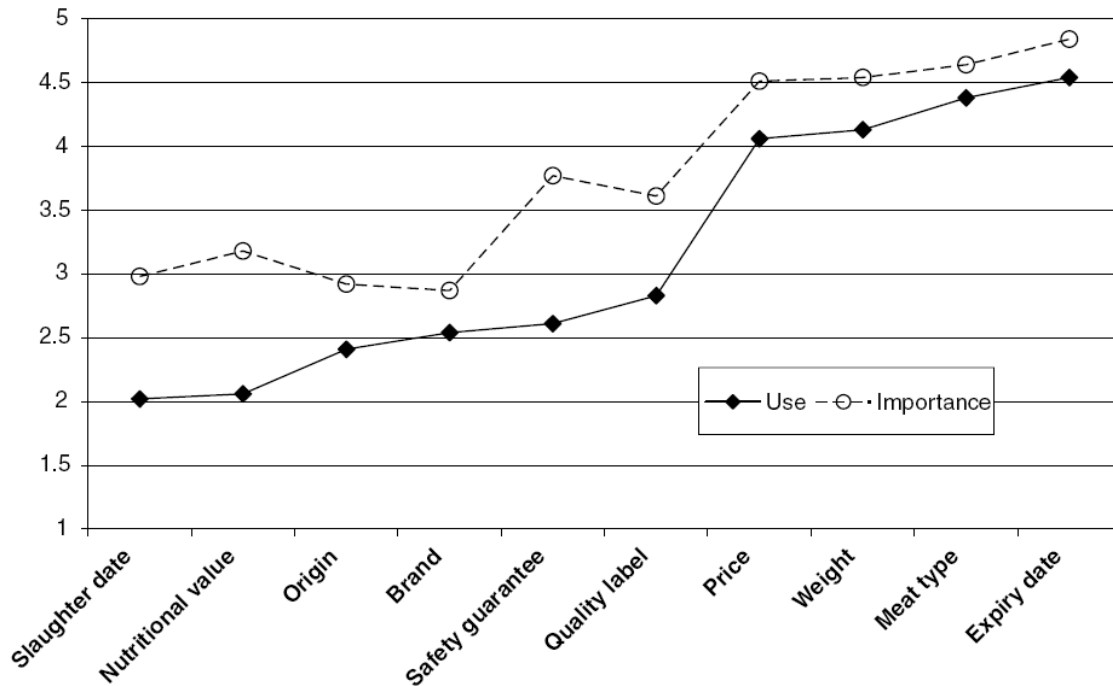


Figure 3: Claimed importance and use of information cues on meat labels, mean scores on 5-point scales (n=127); 2005

4.3. Traceability

Traceability systems are developed to assure food safety by increasing transparency, liability, recall efficiency and control of livestock epidemics (Meuwissen et al., 2003)

The perception of traceability of fresh meat is determined through the evaluation of eight statements on a 7-point scale (Table 2). Consumers were asked to express the degree of importance they attach to possible attributes of traceability systems in the meat chain (see research framework). The functional attributes obtain the highest scores in the overall sample. Most importance is attached to ‘individual responsibility’ and ‘meat chain monitoring’. Organizing the chain in a more efficient way is somewhat less important, but still more important than most of the process attributes. All the functional attributes score significantly higher than the process attributes in the t-test for paired comparison of means, except for ‘meat packaging date’. This statement was assumed to be somewhat misleading, consumers confusing ‘eat-by date’ for ‘meat packaging date’.

Table 2: Perception of traceability in the meat chain related to consumer segments, average scores on a 7-point scale (n=158 in 2001, n=150 in 2004)

	Enthusiasts		Cautions		Pessimists		Greens	Total	
	2001	2004	2001	2004	2001	2004	2004	2001	2004
<i>Process attributes</i>									
I have access to information regarding the medical treatment of the animal	3.57 ^a	4.13 ^a	3.94 ^a	4.35 ^{a,b}	4.56 ^b	4.68 ^b	5.10 ^b	3.99 [*]	4.48 [*]
I can check the animal production method	4.22 ^a	4.63 ^a	4.35 ^a	4.14 ^b	5.00 ^b	5.08 ^c	5.03 ^c	4.49	4.66
I can check the origin of the product (region, farm and slaughterhouse)	4.31 ^a	4.96 ^a	4.44 ^{a,b}	4.33 ^a	4.98 ^b	4.84 ^a	4.58 ^a	4.55	4.73
I can check the meat packaging date	5.53	5.49 ^a	5.47	5.19 ^b	5.84	5.96 ^a	5.77 ^a	5.59	5.57
I have access to information regarding the health record of the animal	3.95 ^a	4.71 ^a	4.14 ^a	4.65 ^a	4.81 ^b	5.16 ^b	4.90 ^{a,b}	4.27 [*]	4.81 [*]
<i>Functional attributes</i>									
Organizations responsible for monitoring public health can intervene in the event of a problem in the meat chain (e.g. dioxin scare: only contaminated products are removed from the shelves, not all products)	5.73	5.94	5.62	6.12	5.82	6.00	5.90	5.71	5.99
In the case of abuses, individuals responsible can be clearly identified and held accountable	5.83	5.90	5.86	5.74	6.11	5.58	5.71	5.92	5.77
The meat chain (from animal feed to the consumer's plate) can be organized more efficiently to further reduce costs	5.20	5.24	4.83	4.98	5.24	4.71	4.71	5.06	4.97

The various superscripts indicate significant differences in the post-hoc Duncan test ($p < 0.10$).

* t-test with significant different means ($p < 0.05$)

The importance consumers attach to the functional attributes does not differ significantly between segments. It can be concluded that organizing traceability and related marketing efforts around the functional attributes cannot be considered an efficient instrument for changing perceptions of meat quality, since it does not address concerns about safety, healthiness, environment and animal friendliness. It also shows that organizing traceability based on functional attributes will not meet consumer concerns or build consumer trust, as the retail sector often pretends. Contrary to the functional attributes, most of the process attribute perceptions differ significantly between the segments. The scores given by the pessimists and the greens are systematically higher than those of the other two segments in 2004, which shows that focusing on information about additional process attributes through traceability could at least meet the meat quality concerns of these consumers. However, it is important to remember that the pessimists and the greens constitute only a limited part of the sample (25% in 2001 and, respectively, 16% and 20% in 2004). It is therefore debatable whether it would be worthwhile organizing such a traceability system (including opportunities for consumers to personally check process attributes) for the entire meat chain, though individual chain participants or private initiatives might find it useful to address the specific concerns of the market segments we call pessimists and greens.

The questionnaire also focused on the perceived urgency of introducing a traceability system for the different meat types (Table 3). The system to be introduced was defined as one with the attributes considered important by the respondent. Consequently, respondents were asked to express the degree of urgency of introduction on a 7-point scale, ranging from 'not at all urgent' to 'extremely urgent'. The perceived need for a traceability system remains the highest in the case of meat mixtures compared with 2001. The differences in urgency between beef and poultry as well as between pork and poultry are not statistically significant. The top score for meat mixtures can be explained by the fact that evaluating mixture quality is perceived as more difficult than for the other meat types. Moreover, the risk of abuse is the highest in the case of mixtures. Table 3 shows differences in the perceived urgency of introducing traceability between the identified consumer segments. Pessimists express the strongest need for traceability systems, which for all meat types is more urgent than for the other segments, both in 2001 and 2004. This means that consumers who are more concerned about meat quality and eat meat less frequently indicate a more urgent need for the introduction of traceability systems. The scores for all meat types are still higher than the middle scale position, but show a clear decline in 2004 compared to 2001.

Table 3: Perception of traceability in the meat chain related to consumer segments, average scores on a 7-point scale (n=158 in 2001, n=150 in 2004)

	Beef		Pork		Poultry		Meat mixtures	
	2001	2004	2001	2004	2001	2004	2001	2004
Enthusiasts	5.02 ^a	4.65 ^a	4.75 ^a	4.75 ^a	4.88 ^a	4.96 ^a	5.25 ^a	5.04 ^a
Cautious	5.14 ^a	4.53 ^a	5.17 ^{a,b}	4.60 ^b	5.35 ^{a,b}	4.74 ^a	5.55 ^{a,b}	5.05 ^a
Pessimists	5.89 ^b	5.45 ^b	5.59 ^b	5.33 ^c	5.50 ^b	5.21 ^b	5.86 ^b	5.46 ^b
Green	--	4.79 ^a	--	4.67 ^b	--	5.28 ^b	--	4.93 ^a
Total	5.31 [*]	4.80 [*]	5.16	4.81	5.25	5.02	5.55 [*]	5.11 [*]

The various superscripts indicate significant differences in the post-hoc Duncan test ($p < 0.10$).

* t-test with significant different means ($p < 0.05$)

The awareness of traceability is significantly associated with education, but not with gender or age. The lower the education level the less is the awareness of traceability. Gellynck et al. (2006) show that the claimed awareness of traceability is not correlated with claimed importance or claimed use of information cues on meat labels. They also explored who should be responsible for traceability information from the consumer's point of view. Most consumers prefer the retailers or butchers to store all necessary information and to be able to

make it available only upon request. Also government should be able to provide traceability information upon request (Gellynck et al., 2006).

4.4. Quality Assurance Schemes

Developing quality assurance schemes and related labels is another way to inform consumers about the quality properties of food. Well-known examples in the EU are the French ‘label rouge’, the Dutch ‘IKB-label’, the German ‘Gütesiegel’ and the Belgian ‘Meritus’.

These quality assurance schemes are mainly based on the quality management principles of ISO 9000 and the HACCP-concept; some are also following the Good Agricultural Practice (Roosen, 2003). These basic quality standards provide improvement of process transparency, assistance to detect and avoid failures systematically and a better chance for traceability. The implementation of such concepts to the whole chain is motivated by internal and external factors, like improvement of productive efficiency as internal and market access as external factor (Roosen, 2003).

Benefits of implementation of quality assurance systems are, as listed in table easier access to new markets, trust in the product properties (liability), easier fulfillment of EU-regulations because of intersections of these regulations with demands of quality assurance systems, lower costs because of optimal process organization and less recalls (process and product quality) and finally traceability over the whole chain (Krieger and Schiefer, 2005).

Disadvantages or barriers for implementing even such basic quality standards are high administrative efforts, the costs of continually obligatory external certification and no refunding of these costs through higher prices (Weindlmaier and Dustmann, 2003). Especially on farm level these barriers plays an important role, but it is necessary to include them into an integrated chain quality control system to improve the safety and quality of food products.

Table 4: Benefits of implementing quality assurance systems, adapted from Krieger and Schiefer, 2005

- Market entry
- Product liability
- Cross compliance
- Process quality
- Product quality
- Traceability

The increasing consumer demand for higher-quality foods led to regulations on labeling as a means to shape consumer's knowledge and behavior, and manufacturers' product offerings and marketing practices (Caswell and Mojduszka, 1996).

Quality labeling is often related to food safety, but includes more than that. Food quality deals with a range of intrinsic and extrinsic attributes, which contribute to perceived quality by consumers (Luning and Marcelis, 2005). Quality labeling is a way to add value to the food product (Van Trijp and Steenkamp, 2005), serving as a tool for marketing, and holding benefits for both industry and the consumer (Verbeke and Viaene, 1999).

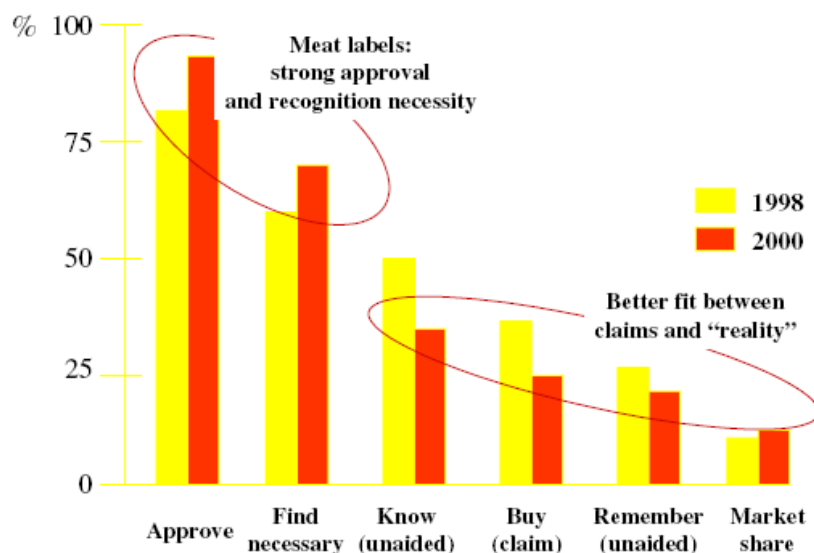


Figure 4: Perception of meat quality labels and actual reported market share

Despite this increased introduction of such quality labels, several studies argue that these labels do not function as quality cues at all (Alvensleben von and Gertken, 1993; Grunert, 2005; Van Trijp and Steenkamp, 2005) and consequently hardly add trust. Fig. 3 illustrates the limited knowledge and market share of meat quality labels. A repeated consumer survey conducted in 1998 and 2000 illustrates that consumers highly approve meat labels and recognize their necessity. However, knowledge, claimed and overt behavior are limited.

Consequently, one can wonder whether the introduction of these 'voluntary' quality assurance schemes highly supported by retailers is motivated by the search for procurement management efficiency rather than by food safety and public health concerns. Concentration in the retail sector continues to increase and necessitates more suppliers to obtain the volumes

for supplying the totality of the outlets. When suppliers present their products, the procurement manager has two main criteria to evaluate the products, namely the quality and the price. The most difficult to evaluate is the quality of the product since all suppliers argue that their product differs in quality from that of competitors. When a retailer manages to eliminate the discussion about quality and imposes the required quality attributes through quality assurance schemes, the job of the procurement manager becomes significantly simplified. Procurement management becomes limited to evaluating prices and verifying whether or not the specifications of the quality assurance scheme are respected. This could be the main reason explaining the success of quality assurance schemes. Other reasons relate to overall food safety concerns and the avoidance of product recall (Gellynck et al., 2006). The final goal of quality assurance systems is to generate a common vision and a coordinating scheme to deliver value added products which are better accepted by consumers (Ordóñez et al., 2004).

5. Future perspective of integrated meat supply chains

The recent developments of demand of quality assurance systems and the concentration in the retail sector will lead to a reorganization of the food industry. Food supply chains will undergo an increasing domination, integration and globalization led by mainly supermarket retailers (Wales et al., 2006). A precondition for competitiveness in food supply chains is the existence of an integrated chain quality control system. A lack of implementation of a quality management system in all stages of the food chain leads to disadvantages and non-competitiveness (Weindlmaier and Dustmann, 2003).

Integrated supply chains allow control of food safety and quality on all stages of the meat chain, from the feed supplier till the point of sale to the consumer (Weindlmaier and Dustmann, 2003). A successful integrated supply chain is managed by a so called chain director. This could be some firms of the supply chain who push for higher safety and quality efforts. A leadership can reduce market failure in the system and is benefited by regulatory interventions, like liability laws, or by the active participation of the supply chain members (Roosen, 2003). The integration of food safety and quality assurance schemes in all stages of the food supply chain has until now been accompanied with difficulties. Especially the integration of farmers is difficult, as they fear too much control on their business. For instance if the slaughterhouse is taken the position of a leader for this part of the chain (Meuwissen et al., 2003).

6. Conclusion

The overall perception of meat quality has increased within a 5-year period (from 2001 till 2004). This should be linked with the increased efforts related to quality assurance of food safety by both the private sector and public authorities.

Food safety can be communicated to the consumer through several information systems like labeling, traceability and quality assurance schemes. The most important information cues on meat labels required by the consumers are price, weight, meat type and expiry date. For these cues the required information match with the frequency of using these cues.

Other information cues on meat labels are information about traceability and quality assurance. Broadly supported by all consumers are functional attributes of the traceability information, such as meat chain monitoring or individual responsibility. Public policy plays an important role in guiding and monitoring this aspect of traceability. Extensions with respect to process attributes, such as production methods, are less relevant to the broad public and only interest specific market segments. These attributes are more suitable for private and voluntary initiatives of chain participants. These differences include opportunities for the meat chains to become more market oriented, i.e. to differentiate through the development of traceability based on process attributes. Such a market oriented approach should further enable companies to counterbalance increasing quality costs, create competitive advantage and consequently obtain better profitability in today's global markets.

Consumers are aware of the necessity of quality meat labels and highly approve them, but the knowledge and use are rather limited. So – it is questionable if the introduction of quality assurance schemes required by the retailers is only based on consumer's demand for higher-quality foods. It is assumed that the benefit of improving the efficiency of procurement management is the main reason why retailers support quality assurance schemes so strongly.

In the future meat supply chains will change to integrated supply chains, where food safety and quality can be guaranteed on all stages of the supply chain. Quality assurance systems provide an effective tool to manage and control the meat supply chain.

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