Hans-Wilhelm Windhorst (Ed.)
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Product safety and quality assurance

Proceedings of Workshop 3 on Sustainable Animal Production, organized by the Institute for Spatial Analysis and Planning in Areas of Intensive Agriculture (ISPA), University of Vechta, held at Hannover, June 22, 2000

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Product Safety and Quality Assurance

edited by
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Workshop Series „Sustainable Animal Production", June - October 2000

Foreword to the Proceedings

How can agriculture provide a reliable source of food of animal origin for the world's population without compromising the basis of life of future generations? In view of the rising demand for food of animal origin in industrialized, emerging and developing countries, how can animal production on a global scale become sustainable?

These were among the key issues under scrutiny in a series of international workshops on sustainable animal production conducted during the world exposition EXPO 2000 by a consortium of scientists from four north German research institutions: the School of Veterinary Medicine Hannover (coordination), the Federal Research Institute for Agriculture (FAL), the Institute for Structural Analysis and Planning in Areas of Intensive Agriculture (ISPA) at the University of Vechta, and the Agricultural Faculty of the University of Göttingen.

A broad spectrum of current issues and problems in modern livestock production were covered: animal production and world food supply; globalization, production siting and competetiveness; product safety and quality assurance; the environmental impact of livestock farming; animal welfare and health; biotechnology and gene technology; animal genetic resources; animal nutrition: resources and new challenges; safeguarding animal health in global trade.

The individual workshops were organized by local coordinators and moderated by international discussion leaders. In all 142 scientists from 23 countries worldwide participated as speakers. The workshops produced a differentiated, inclusive and holistic vision of the future of global livestock farming without national bias and free of emotionally-tinged concepts or ideology. The results of the workshops were summarized and presented to the public in a final plenary session including a roundtable discussion with representatives of agricultural policy, public life and the media.

In addition to the publication of proceedings of the workshops as special issues of *Landbauforschung Völkenrode*, abstracts of the papers and summaries of the results are now documented in the Internet at www.agriculture.de, where a preparatory virtual conference was conducted from October 1999 until October 2000.

Volker Moennig
School of Veterinary Medicine Hannover

Workshopserie „Nachhaltige Tierproduktion", Juni – October 2000

Vorwort für die Tagungsbände

Wie kann die Landwirtschaft in Zukunft weltweit Menschen nachhaltig mit Lebensmitteln tierischer Herkunft versorgen, ohne die Lebensgrundlagen künftiger Generationen zu beeinträchtigen? Wie kann eine nachhaltige Tierproduktion global und angesichts wachsenden Bedarfs an Lebensmitteln tierischer Herkunft in Industrie-, Schwellen- und Entwicklungsländern aussehen?

Diese und ähnliche Fragen waren Anlass zur Organisation einer internationalen Workshopserie zum Thema „Nachhaltige Tierproduktion/Sustainable Animal Production" zur EXPO 2000. Veranstalter waren Wissenschaftler aus vier norddeutschen Forschungseinrichtungen: Die Tierärztliche Hochschule Hannover (federführend), die Bundesforschungsanstalt für Landwirtschaft (FAL), das Institut für Strukturforschung und Planungen in agrarischen Intensivgebieten der Hochschule Vechta (ISPA) sowie die Agrarwissenschaftliche Fakultät der Universität Göttingen.

Ein breites Spektrum von Themen, wie Tierproduktion und Welternährung, Globalisierung, Standortorientierung und Wettbewerbsfähigkeit, Umweltverträglichkeit der Tierproduktion, Tierschutz und Tiergesundheit, Produktsicherheit und Herkunftssicherung, Tierzucht und genetische Ressourcen, Sicherung der Tiergesundheit bei globalen Handelsströmen, Tierernährung: Ressourcen und neue Aufgaben, Bio- und Gentechnologie spiegeln die gesamte Bandbreite der modernen Tierhaltung und ihrer Probleme wider.

Die einzelnen Workshops wurden jeweils durch lokale Koordinatoren organisiert und von internationalen Diskussionsleiter moderiert. Insgesamt 142 Wissenschaftler und Wissenschaftlerinnen aus 23 Ländern weltweit haben als Referenten an der Serie teilgenommen. Die Workshops haben ein differenziertes und umfassendes, ganzheitliches Bild von der Tierhaltung der Zukunft ergeben, das frei von nationalen, teils emotional und ideologisch gefärbten Konzepten ist. In einem Abschlussworkshop wurden die Ergebnisse der Workshops mit Vertretern aus Politik, öffentlichem Leben und Presse diskutiert. Die jetzt vorliegenden Proceedings der Workshopserie in der *Landbauforschung Völkenrode* werden ergänzt und weltweit verfügbar gemacht durch die Veröffentlichung im Internet unter der Adresse www.agriculture.de. Unter derselben Internetadresse hatte vor den Workshops eine virtuelle Konferenz als Vorbereitung von Oktober 1999 bis Oktober 2000 stattgefunden.

Volker Moennig
Tierärztliche Hochschule Hannover

The importance of Quality Assurance and Food Safety in Modern Food Production Systems

T. Blaha

Abstract

The liberalization of the global trade, and the fact that the consumers in the industrialized countries are more and more demanding food to be not only economical, but also healthy, tasty, safe and sound in respect to animal welfare and the environment, are changing the so far quantity-oriented food production, guaranteeing the nutrient supply for a nation, into an international quality-oriented food market, where commodities, production areas, production chains and brands compete each other.

The competitiveness of food production will soon be more dependent on the reliability of the safety and the quality of the food and acceptability of the production procedures than on quantity and price.

In contrast to the quantity-oriented production that is often subsidized and producers can always sell everything they produce, since it is productivity-driven, quality-oriented production chains are market-driven.

Thus, apart from the steady increase of the national and international standards for food safety and public health, there is a growing influence of the consumer's demands (often completely ignorant of agriculture) on the animal production, its allied industries, advisers, consultants and food animal veterinarians.

All of this means that the agricultural supply of food production is facing remarkable changes in the years to come, which is both challenge and opportunity for food animal producers, packing plants and meat processors as well as for the veterinary profession.

The paper describes the foreseeable changes and their implications on livestock production and which on- and off-farm measures need to be developed and implemented in vertically coordinated supply chains rather than on single farms.

The need to improve food safety and to implement quality assurance from farm to table (The Example of Meat)

In countries that have implemented a consistent mandatory meat inspection, this classical harvest food safety procedure and the more and more stringent rules for post-harvest food safety measures improving the hygiene standards during slaughter, meat processing, storage and distribution have led to a remarkable decline of meat related-food-borne diseases in man. However, although meat inspection and food hygiene have been regarded as sufficient to guarantee safe meat over almost 100 years, new approaches to food safety and meat quality are becoming necessary. There are five major reasons for this need:

1.) Despite the generally recognized achievements in making food safer over the decades with the mandatory meat inspection and the principles of food hygiene being the most successful means in protecting the consumer against food-borne health risks, there are still deaths due to food-borne disease in man, e.g. 9000 deaths per year in the USA. Furthermore, the consumer's confidence in the safety of food is decreasing:

    It is true that meat has never been as safe as today, but the perception of the risks due to meat is that there are more risks to human health then ever. This general recognition is highly supported by the me dia. The urban consumer does not differentiate between commodities or diseases so that reports on BSE and E. coli O:157 H:7 do not only have an adverse impact on beef, but on meat in general. The concerns with food safety in meat focus mainly on pathogens, antimicrobial and chemical residues, and hormones.

2.) Modern agriculture is contributing to the increase of drug-resistant pathogens in humans, and, thus often being attacked by the medical society and consequently by the public:

    The latest and most serious attack is that of the Director General of the World Health Organization (WHO), who stated in his Word Health Report 1996: "....Making matters worse are modern types of food production. Antimicrobials are used in meat production to increase growth, but not usually in sufficient amounts to kill microbes. Drug-resistant bacteria are then passed through the food chain to the consumer".

3.) Food safety issues can easily become non-tariff trade barriers and are increasingly used as marketing tools, nationally and internationally:

    Nationally: Advertisements for meat use food safety concerns more and more often e.g. the grocery

chain "Whole Foods Market" in several major cities of the USA advertises: "....Our fresh meat and meat products come from animals raised naturally without hormones and antibiotics...." It is obvious that such statements create new consumer demands and increase the distrust in meat without any safety or high-quality "label". Internationally: Trade barriers that prevent national meat industries from getting access to international markets are more and more based on food safety concerns. The Danish salmonella control program throughout the Danish pork industry is successfully used to increase the pork export from Denmark.

4.) The consumer has the tendency to ask more and more for fresh and naturally raised (organic) products:
The tendency "back to the farmers' markets" results in the increasing consumption of food that is not or less processed than branded products with several processing procedures (cleaning, food additives such as preservatives, canning, packaging etc.) prior to marketing. The more fresh or organic the food is, the more is the consumer dependent on the absence of pathogens and contaminants in or on the raw material.

5.) The traditional mandatory meat inspection still is indispensable, but unable to control and prevent the emerging food-borne pathogens that nowadays pose risks to human health:
In the days of the so-called classical zoonoses, diseases such as tuberculosis and brucellosis caused both clinical diseases that could be recognized at farm level and lesions that could be recognized during meat inspection at slaughter. The emerging pathogens of today such as *Salmonella, Toxoplasma, Trichinella, Campylobacter* and *Yersinia* are only detectable through targeted monitoring systems, since they do neither cause clinical symptoms in affected animals nor lesions that could be helpful to recognize contaminated carcasses.

The "PRE-HARVEST" food safety and quality approach

As outlined above, the majority of the real and perceived reasons for the increased concerns with the safety and quality of meat apply to the pre-harvest area of the food production chain. Furthermore, it is true that the harvest food safety measures (inspection and removing carcasses unfit for human consumption from the food chain) is assuring the consumer's protection, but they do not prevent the major safety-related defects in the slaughter pig, i.e. they are only quality control at the end of the on-farm production phase.

Industries with long experiences in growing competition initially used quality control to cope with increasing quality standards. The needs to produce and sell high quality products and increase the efficiency of the production process, however, has led to the development of quality assurance systems along production chains. The difference between quality control and quality assurance can be explained as follows:

Quality control is the evaluation of a final product prior to its marketing, i.e. it is based on quality checks at the end of a production chain aiming at assigning the final product to quality categories such as "high quality", "regular quality", "low quality" and "non-marketable". Since, at the end of the production chain, there is no way to correct production failures or upgrade the quality of the final product, the low-quality products can only be sold at lower prices and the non-marketable products have to be discarded. Their production costs, however, had been as high as those of the high and regular quality products. Thus, quality control has only a limited potential to increase the quality and efficiency of a multi-step production procedure.

Quality Assurance, in contrast to quality control, is the implementation of quality checks and procedures to immediately correct any failure and mistake that is able to reduce the quality of the interim products at every production step. Thus, the desired high quality of the final product is planned and obtained by conducting:

Standard Operating Procedures (SOP's) that guarantee the desired quality of the interim products at every production step. If an entire production chain is following a written description (handbook) of all SOP's along the entire production chain, the demands for a

Good Manufacturing Practice (GMP) are met. The management approach to long-term success through customer satisfaction, based on the participation of all members of an organization (suppliers included) in improving processes, products, services and the working culture is called:

Total Quality Management (TQM).

Examples for quality control versus quality assurance in the area of food safety are:

- the testing of carcasses for residues is quality control, the implementation of residue avoiding production procedures at farm level is quality assurance;
- the testing of meat products for salmonella prior to their marketing and consumption is quality control, the implementation of on- and off-farm salmonella-

reducing measures as standard operating procedures is quality assurance.

In food production, where the safety of the produced food has the ultimate priority in the framework of quality, the **Hazard Analysis Critical Control Point (HACCP)** system is the internationally recognized system to help assure safe food production. HACCP emphasizes prevention in the avoidance of food safety problems. HACCP combines common sense with an evaluation of risks to identify the points along the food production chain, where possible hazards may occur, and then to strictly manage and monitor these points to make sure the process is in control. The HACCP system is made up of three parts:

1.) The identification of hazards, and the determination of the severity of the **hazard and risks**. These are risks associated with growing, harvesting, processing, distributing, preparing and/or using a raw material or food product. Hazard usually means the contamination, growth or survival of microorganisms related to food safety or spoilage. A hazard can also include dangerous chemical contaminants or foreign objects (glass or metal fragments). Risk is the estimate of how likely it is that the hazard will occur.
2.) The determination of critical control points (CCP) required to control the **hazard**. A critical control point is a location, practice, procedure or process which can be used to minimize or prevent unacceptable contamination, survival or growth of food-borne pathogens or spoilage organisms, or introduction of unwanted chemicals or foreign objects.
3.) Establishment and implementation of monitoring procedures to determine **that each CCP is under control**. Monitoring systems must be able to effectively determine if a CCP is under control. Corrective action must be defined to be used when a CCP monitoring point shows that the system is out of control.

Before developing an HACCP plan for a production procedure, the establishment of SOP's and GMP's is indispensable. Only the combination of these principles provides the possibility to have the correctness and the high standard verified. Verification is the procedure that provides the guarantee to any customer and to the public that the product in question is of the quality the producer is claiming, since it has been produced according to a production procedure that is based on specific GMP and HACCP principles that are documented in a handbook. If the verification is performed by independent agencies, bodies or companies that are accredited by nationally or internationally approved quality assurance organizations, the procedure becomes a **Certification** procedure. There are several systems, one of the leading internationally approved certification procedures is **DIN ISO 9000** (9001 - 9004).

All this means that the traditional mandatory meat inspection and the classical post-harvest food safety measures have a limited potential for further major improvements of the safety and quality of meat. Therefore, additional measures must be taken:

1.) Pre-harvest food safety programs implementing the rules of GMP and the HACCP concept at farm level from breeding to the slaughterhouse gate have to be added to the existing harvest and post-harvest HACCP programs. Quality assurance systems throughout the entire food production chain are the precondition for any certification procedure.
2.) Governmental food safety programs and market-driven food safety/quality programs must be coordinated.

It is obvious that the potential impact of pre-harvest food safety measures based on the HACCP concept is different depending on the nature of the addressed defect or pathogen. There are different areas in which the defect or pathogen enters the food production chain and the possibility to reduce the risk in question by proper handling and/or cooking prior to consumption are different. In the case of residues, on- and off-farm residue avoidance programs are the only opportunity of prevention, since there is no pre-consumption procedure that reduces the residue-associated risks to human health. In contrast, proper handling and freezing and/or cooking of the final product reduces the risks due to pathogens, but pre-harvest risk-reduction programs can either prevent the contamination of the carcass (*Trichinella* and *Toxoplasma*) or remarkably contribute to minimizing the pathogen-associated risks (*Salmonella, Campylobacter, Yersinia, Listeria*).

Therefore, the targets for intervention measures in the food chain should be prioritized as follows:

1.) On-farm residue avoidance programs with consistent record keeping, proper drug use, storage and extended withdrawal times. In general, an overall reduction of antimicrobial substances used in agriculture both for medical and production purposes is necessary. Off-farm residue programs via GMP and HACCP programs in the supplying feed mills aiming at the prevention of cross-contamination and proper labeling.
2.) On- and off-farm programs to develop *Trichinella*-and *Toxoplasma*-free herds, regions, areas and countries-with a well-coordinated cooperation between packers, producers, veterinary officers and practitioners, and epidemiologists.

3.) On-farm salmonella reduction programs with a statistically justified monitoring, either bacteriologically or serologically, of the salmonella load of the animals supplied for slaughter. Research is still needed to evaluate the risk factors for the introduction of salmonella into herds, to evaluate the feasibility and effectiveness of *Salmonella*-reducing measures. It is also still necessary to evaluate to which extend the recommended pre-harvest salmonella-reducing measures contribute to a measurable *Salmonella* reduction in the final product.
4.) On-farm programs to reduce the introduction of *Yersinia enterocolitica*, *Campylobacter jejuni* and *Listeria monocytogenes*. However, more research on the prevalence of these pathogens in swine herds and on the feasibility of control measures is needed.

To reliably decrease the food-borne health risks and to improve the consumer's confidence in food of animal origin, pre-harvest food safety programs should consist of three elements:

1.) Implementation of GMP and HACCP programs aiming at reducing food-borne risks to human health at farm level.
2.) Implementation of monitoring and surveillance programs at slaughter to determine the frequency of the introduction of food-borne health risks into the food chain identifying the farms of origin and mechanisms to develop incentives for the farming community to reduce these risks. This element is, as a rule, the "trigger" and "modulator" of any pre-harvest food safety program.
3.) Implementation of a certification procedure involving independent agencies and persons such as accredited veterinarians and quality consultants.

The implications of pre-harvest food safety and quality assurance

The role of the livestock producer is changing from just raising animals to being an indispensable part of the food production chain that supplies a product that is the basis for the production of a wholesome, safe and high quality food product. The food animal practitioner's former focusing at treating diseased animals, then at herd health and productivity will changeto focusing at supporting the livestock producer to provide slaughter animals with quality properties that meet the demands of slaughter-houses and meat processors, wholesalers, retailers and finally the consumer. Along with a consistent herd/flock health management, the food animal veterinarian will more and more be involved in on-farm pathogen control and on-farm residue avoidance programs, monitoring systems and verification procedures.

To take advantage of this development, it is necessary to introduce epidemiological methods for data collection, processing and analyzing into the daily work of the food animal veterinarian. The implementation of information feedback systems is needed to have the management tool at hand that combines data from the slaughter plant (disease-related lesions, quality deficiencies, and monitoring results) with on-farm data on animal health and residues (mortality, morbidity, pathogens, and drug use) and on the performance of the herds of origin.

Once such an information system has been implemented, it is quite easy to deal with any additional food safety/quality data set to address problems such as animal welfare improvement, e.g. the porcine stress syndrome and transport and/or environmental protection measures, e.g. data on antimicrobials in manure and the nutritional use of heavy metals.

Producing animals for the production of **certified high quality** and **safe** food products will make the livestock producer a competitive, publicly accepted and appreciated component of the food production chain. The food animal veterinarian will play an active role in the process of guiding animal production into becoming a transparent and high quality supply of food production chains.

The implementation of pre-harvest food safety programs using **information feedback systems** will be the major tool to prevent any negative impact of food safety problems on a country's export of food. First, the probability of food-borne risks to human health through meat produced from animals using a pre-harvest food safety approach is lower. Second, if food safety concerns are misused as non-tariff trade barriers, any food production chain using a science-based and transparent pre-harvest food safety program, is much more defensive than the traditional livestock production. Without consistent data on the entire production chain, it is almost impossible to deliver scientific evidence that the production in question is following the standards and guidelines of the FAO/WHO Codex Alimentarius Commission and the OFFICE INTERNATIONAL DES EPIZOOTIES (O.I.E.). However, if it can be proven that the production of the refused food is meeting the internationally approved standards, the "Agreement on the Application of Sanitary and Phytosanitary Measures" - appendix of the Marrakesh Agreement that established the World Trade Organization in April 1994 - will protect the exporting country against the unfair or un-

justified use of food safety concerns as non-tariff trade-barriers.

The major characteristics of modern food production systems that are organized as described above are:

1) vertically coordinated supply chains provide distinct market segments with defined (branded) food products;
2) any food product is traceable throughout the production chain up to the farm of origin; and
3) the use of pre-harvest food safety and quality assurance programs with third-party certification allows the livestock producer to offer shared liability in case of safety or quality deficiencies.

Food safety and quality assurance: Insights from the UK beef industry

A. Fearne

1. Introduction

The modern citizen, enjoying the benefits of modern science, tends to view 'safety' in general and 'food safety' in particular, as an absolute concept. In fact, although the food supply chains of today are very much safer than those of the past, most if not all human activity involves risks and one of the most important trade-offs all consumers face is the balancing of those risks against other 'costs' and 'benefits' (Swinbank, 1996).

Businesses operating in the food industry also face risks in the allocation of scarce resources to the production, distribution and sale of food products. The more firms invest in building consumer and customer loyalty the more likely they are to take actions, including the implementation of HACCP systems, to preserve that loyalty. Yet, such actions can prove costly and the incentives for cutting corners are relatively high in commodity markets, such as meat, in which margins are tight, product differentiation is, at best, very difficult to achieve, and the loyalty of customers and consumers is notoriously fickle. Moreover, the fundamental problem which all consumers and the majority of food businesses face is inadequate information upon which to make rational judgements, whether it be with respect to the safety of raw materials and the manufacturing process or the end product itself.

The food industry has a vested interest in supplying better information along the length of the supply chain (and avoiding trade with unscrupulous suppliers). Governments have both a duty and a vested interest in facilitating the process (and protecting consumers from unscrupulous businesses). In the extreme, the failure of markets to provide adequate information and to eradicate businesses who knowingly 'cut corners' with respect to food safety, results in Government intervention, not to facilitate but to regulate and enforce, to 'name and shame' and to deny consumers the freedom of choice which an efficient market should deliver. It is in everyone's interest to prevent such an extreme from becoming reality.

2. Public motives and private incentives for the provision of food safety

A basic premise is that, other things being equal, consumers prefer more rather than less food safety, whilst recognising that food safety is but one of a number of desirable attributes associated with food Swinbank (1993). The preference for food safety must be balanced against the other attributes of the product (i.e. a risk averse consumer may prefer a plain omelette to a gourmet dish of shellfish). Individuals will react in different ways and their preferences may change over time. Cost and income will also be important factors as safer food is likely to be, at the margin, more expensive than unsafe food. Thus, as incomes rise, the demand for food safety will rise.

A second premise is that food producers (farmers, food processors, food retailers) will supply food safety if it is profitable for them to do so. However, the provision of safer food will require the use of more resources (greater selectivity in choosing raw materials, more hygienic handling procedures, better chill-chain facilities, etc.). Thus, the marginal cost of producing additional units of food safety is likely to rise.

Thus, a market for food safety exists with an equilibrium where the marginal cost equals the marginal benefit. If any of the underlying conditions change then so will the equilibrium. Thus, if incomes rise, demand for food safety will increase and a new equilibrium will be reached at a higher price. However, this assumes a perfectly competitive market (many buyers/sellers, perfect information, and prices which truly reflect the costs and benefits to society). We all know that such a market does not exist.

Sellers are generally better informed than buyers, yet in most developed economies power is positively related to proximity to the final consumer, with small numbers of retailers doing battle with rather more, but relatively few, food manufacturers. Does this mean they care little about food safety? Not at all: Food retailing is a highly competi-

tive business and food retailers of whatever size or format only succeed by consistently satisfying the customer. The food chain is increasingly becoming a partnership, disciplined by competition and led by retailers as the interpreter of the customers' wishes. In satisfying the consumer, the retailer must ensure that the unwritten contract of trust which exists between the two is honoured. Thus, retailers are less concerned with the enforcement of regulation than with the application of good practice designed to lead to safe food handling and to assure safe food (Mathews, 1997).

The same holds for the manufacturers of branded food products. Building a brand is a costly business and constitutes an effective entry barrier. Thus, whilst the market may be characterised by oligopolistic sellers and imperfectly informed buyers, there is good reason to expect that the market will supply high quality in general and food safety in particular. The problem is that many of the products sold are not branded and may be supplied by small firms who have undertaken little investment and have little to 'defend'. For these firms, profit maximising behaviour might well involve selling 'sub-standard' products for as long as they can. A second problem is that there may be a time-lag between ingestion and effect. The longer the time lag the less likely it is that producers will take preventative action as the link between cause and effect will be hard to establish in a court of law.

It is also possible that the market will produce an excess supply of food safety. Unlike other quality attributes, safety is not easily measured by the buyer, (Caswell, 1994). In addition, consumers are not necessarily be good assessors of risk and may sometimes over-react to what they perceive as a 'dread' outcome (Henson & Traill, 1993). Furthermore, the supply of an unsafe product may not be intentional. The problem here is that the consumer has to judge not the intentions of the supplier but his quality assurance. In response to what may be severe market disciplines, suppliers are likely to go to extreme lengths to protect the good name of the brand.

So, just as with other products/markets, it is likely that for some food products the market will over-emphasize the food-borne disease risk and supply too high a level of food safety whereas in other instances it under-reacts and produces too low a level of food safety. In both cases the market is deemed to have 'failed' but we are concerned primarily with the latter case. One solution might be to simply provide the consumer with more/better information (McKechnie, 1997), but it has been argued (Henson & Trail, 1993) that it may not be a good thing to give consumers more information. Moreover, although sellers will always have more information than buyers even sellers may not be perfectly informed about the specific 'safeness' of certain elements of the food he produces. Information about food safety has many of the attributes of a public good – once produced it is available to all and its availability and validity are not diminished by its use. The resource costs of generating such information might be huge, but if the social benefits exceed those costs then there is a case for saying that government should ensure the information is generated.

Markets will certainly punish food businesses which are seen to have supplied unsafe food. However, if failures in safety are not detected or attributed to the right source, markets will not penalise the defaulter. Given the plurality of possible causes of stomach upsets, the source of relatively minor failures of food hygiene may not be identified. As a result, bad practice can continue unchecked. Where a serious failure is recognised, the response of markets may be disproportionate and misdirected (Marsh, 1997).

It is largely for this reason that in recent years attention has focussed on process standards rather than output controls – prevention rather than cure. HACCP is now internationally recognised as an effective process oriented approach to assuring food safety. It recognises that endpoint performance testing of each product is often impractical, especially if the significant hazards are distributed heterogeneously throughout the product. In use, HACCP is a multidisciplinary science based approach to the issue of food safety (Caswell & Hooker, 1996). The objective is to produce a safe product every time, to demonstrate that the process is safe (i.e. due diligence) and provide/promote confidence in the product. Moreover, it can feed into quality management systems, such as ISO9000.

However, HACCP implementation can be a costly exercise (Colatore & Caswell, 1998), necessary for the long term viability of the industry as a whole but posing a real threat to the viability of individual plants. Thus, it is no surprise that meat industry HACCP remains voluntary in the European Union (EU). Yet the fact that many food companies have chosen to implement HACCP is an indication that private incentives exist for the use of process standards. One recent study of the UK dairy industry (one of the few in which HACCP is a legal requirement), found that a number of firms had acted before the regulation and that customer requirements, pressure to conform to prevailing market standards of good practice, as well as the need to improve internal efficiency and product quality

were among the main reasons for implementing HACCP, in addition to the need to meet legal requirements (Henson, Holt & Northern, 1998). Even in the USA, where HACCP is mandatory in the meat industry, there is some evidence that firms identify benefits beyond regulatory compliance (e.g. identifying customer requirements and the need to reduce inspections) as a major incentive to implement HACCP (Colatore & Caswell, 1998).

Regulations which are seen to be effective in ensuring safety and detecting any lapses in standards, safeguard the industry as well as the consumer. Confidence in regulatory systems is essential but it is difficult to achieve and is easily undermined. (Marsh, 1997). Regulations that impose costs on businesses may also become an instrument of protection. By insisting that all operators invest in some costly piece of equipment, companies who have already equipped themselves and large organisations who can readily afford to do so, may deter newcomers and force small businesses out. Businesses may also argue that the same rules should be applied to producers in other countries or imports should be banned (Fearne & Garcia, 1999). Such regulations can prove effective non-tariff barriers, shielding high-cost domestic suppliers from competition.

In the final analysis, Governments might ban, or control the use of certain ingredients, particularlyadditives or raw materials contaminated with veterinary or pesticide residues, or the processing and handling procedures adopted. In practice this is what governments do. As a result, there is a cost to society over and above what would have been incurred in a free market, of determining, enforcing and complying with the regulations. These costs will be borne in part by taxpayers and in part by the participants in the supply chain and even by consumers in the form of higher prices. In addition, for some there could be a loss of consumer welfare – removal of products that would otherwise have been purchased and/or higher prices for unwanted levels of food safety. The benefits would embrace the reductions in lost production, medical expenses and longer life expectancy and improved quality of life consequent upon a reduction in food-borne disease (Swinbank, 1993).

3. Turning a crisis into an opportunity: insights from the UK beef industry

Regulations are a political activity. As such they have to be implemented via the political and legal institutions of each country. Most of these have been shaped by past history and it is understandable that those outside this 'establishment' should be critical of its operation and demand change. The UK approach to both politics and law tends to be confrontational rather than consensual (Marsh, 1997). At the regulatory level this translates into prescriptive rather than indicative rules for industry. Such arrangements make it possible to identify defaulters and to prosecute successfully those who have failed, but there is a danger of introducing undue rigidity.

The BSE crisis exposed the British meat industry in general and the British beef industry in particular to such detailed scrutiny that horror stories from one abattoir to another have became regular front-page news items. It also exposed a Government who chose to gamble with public health and failed. As a result it has had to go overboard in an attempt to convince the general public that the problem has been resolved. It set up the Meat Inspection Service in 1996 and gave it a mandate to raise health and safety standards in abattoirs and cutting plants. Mandatory inspections are now carried out every month by independent inspectors who assess each plant using an objective, risk-based assessment of health standards. The results of this Health Assessment Scheme (HAS) are published each month, so those who do not meet the standards are 'named and shamed' for all to see. Veterinary inspectors are now ever-present in abattoirs, yet the use of HACCP remains optional for meat processors in the UK and one which relatively few have embraced (MAFF, 1998). The sticks with which the Government have beaten the meat industry in recent years may well provide a solution to the problem of excess (and ageing) capacity, but they have done little to restore consumer confidence in British beef.

The meat industry continues to pay dearly for the mismanagement of the BSE crisis from the outset and the mood remains gloomy as compliance costs continue to weigh heavily on the balance sheets of the small and medium sized abattoirs and meat processors throughout the country. Market access is little comfort to those businesses already struggling to survive. What is needed is a change in emphasis, towards the benefits which can come directly from addressing consumer requirements for food safety and indirectly from the systems which have been put in place to deliver safe food. Ironically, the driving force for such benefits came initially from the Government, in the form of the 1990 Food Safety Act.

The 1990 Food Safety Act requires buyers to take all 'reasonable steps' to ensure that the food they receive from upstream suppliers is safe. It also means that upstream firms need to monitor more carefully their food handling to satisfy their downstream customers. The critical word in the definition of due diligence is 'reasonable'. This is suf-

ficiently vague that it has encouraged retailers to take extraordinary steps to ensure the safety of products reaching them from their suppliers. If their desire to develop own label products during the 1980s had encouraged them take a greater interest in what was happening upstream, the 1990 Food Safety Act compelled them to effectively take control, by instituting stringent quality assurance programs with their suppliers, with a particular emphasis on traceability (Fearne, 1998).

Retailers drew up codes of practice, covering all aspects of animal husbandry and issued them to their suppliers. The industry responded by developing generic farm assurance schemes. The first of these was Farm Assured Scotch Livestock (FASL), set up in 1990 and this was soon followed by Farm Assured Welsh Lamb (FAWL) and Farm Assured British Beef and Lamb (FABL). All of these schemes cover the same critical factors (traceability, feeding, animal health, animal welfare, transport and handling).

The BSE crisis served, amongst other things, to raise the stakes for those whose living depends on a buoyant domestic beef market and the restoration of consumer confidence in British beef. Quality assurance and traceability are now top of the list as far as retailers are concerned - all of the major supermarkets now require **all** livestock to come from suppliers who are members of a recognised farm assurance scheme and the race is on to develop a system to provide full traceability from breeder through to individual retail cuts of meat. Retailers and meat processors have been under pressure to remain price competitive but these assurance schemes provide an alternative source of competitive advantage, based on animal welfare and product quality, over and above the assurance of safety for which they were originally designed (Fearne, 1998).

More recently, these schemes have been extended to the abattoirs and cutting plants, providing an integrated system of quality assurance from farm through to retail store. Assured British Meats (ABM), is an independent organisation with representation from within and outside of the meat industry. ABM has the sole aim of restoring consumer confidence in British meat through an industry-wide assurance scheme which is designed to establish minimum safety standards on which retailers will be free to 'bolt on' their own quality assurance schemes (ABM, 1998). The scheme is voluntary but ABM hope to attract 80% of British meat into the scheme by 2001.

The ABM initiative seeks to remove meat safety as a source of competitive advantage, yet the first retailer/processor/producer who can deliver full traceability **will** gain some 'first mover' advantage. The government has supported the establishment of a fully computerised cattle passport system, equipped to trace over 24 million animal movements per annum. However, this system is only concerned with the movement of animals and is unable to accommodate information about husbandry practices, origin of feed or veterinary treatments on the farm.

Significantly, the major multiples and the largest abattoirs have yet to find an effective system for tracing products from the breeder through the cutting plant to the retailer on a commercial scale. This has provided the smaller players with an opportunity to gain competitive advantage. One such player is Les Fearn, a beef farmer from the South West of England, who is also the Managing Director of 'Tracesafe, a farmer owned company which operates a unique cattle traceability and quality assurance scheme that has been in development since 1993 and operational since January 1996.

The Tracesafe Cattle Management System is the first of its kind to receive the internationally recognised ISO 90012 quality assurance accreditation, covering parent selection and all stages of rearing and production through to receipt of carcass by the processor or butcher. Systems are in place to allow the history of individual cuts of meat to be traced back to the animal of origin. Tracesafe beef is targeted at specialist retail outlets and high quality restaurants, where consumers are willing to pay a premium for the assurance of guaranteed traceability. There are currently 130 members, including breeders, breeder/finishers and finishers. Calves of any breed are supplied at 100kg, from units which comply with MAFF welfare standards. All animals are reared on natural feed. On-farm feed mixing is encouraged and all grain is supplied from a network of mills contracted to provide specially prepared rations (free from hormones, growth promoters or fishmeal) into breeding and rearing units, where independent auditing is carried out under the ISO 9002 accreditation requirements. Tracesafe has a unique computer-controlled Birth Card system, which records the dam and sire of every calf and allows the animal to be monitored through every stage of the rearing and meat processing chain. Complete details of an animal's life, including the individual details, parentage, medication administered, the feeding of the animal and any movements are fully documented. The BSE and TB risk is eliminated as far as possible with cattle being supplied from parentage that can have either one, two or three generations free of BSE and TB, as required. The system allows joints of meat sold to be traced back to the farm where the calf was born, and account for all activities throughout the animal's life. The brand name, Trace-

safe, serves as the quality assurance stamp, to be used on all accredited carcasses. This helps to prevent fraud and acts as an endorsement of Traceability.

At the other end of the supply chain, Marks and Spencer (M&S) are probably the closest to having a system similar to that developed by Les Fearn. What distinguishes M&S from the other major food retailers is their direct link with their suppliers, something which the larger food retailers tend to leave to the abattoir. Moreover, what distinguishes M&S' Select Beef scheme from the Tracesafe initiative is the extent to which M&S use a system which was originally designed to deliver traceability to improve product quality.

M&S' Select Beef Scheme claims to deliver **c**onsistent high meat eating quality, backed up by frequent taste panel tests. M&S run extensive taste panels which, using a detailed producer database, can be related directly back to the individual farm. Every producer who applies for approval submits information covering housing, breeds, feed use and stockmanship. M&S claim their code of practice is superior to generic assurance schemes, such as FABL. They use the privatised Agricultural Development and Advisory Service (ADAS) to carry out random inspections, but initial inspections of applicants are carried out by the farm assurance officer of the local abattoir approved to process meat for the scheme. Information is then stored on a database and taste panel tests carried out to check meat quality and consistency. Results are used to compare beef produced under different regimes, enabling technical staff to recommend changes to a ration or husbandry to further ensure that beef produced has a consistent eating quality. Every six months producers are asked to complete a feed declaration and details are entered on the database. Any changes that are made are then highlighted. When buying in feed, producers must have a breakdown of all ingredients to show that only approved ingredients are used.

These two examples demonstrate an important change in the nature of contractual relationships in the British meat industry. Agency theory provides a useful framework for the analysis of contractual relationships in the supply chain and the extent to which the (ex-poste) costs of non-compliance with food safety legislation may be reduced through an ex-ante alignment of incentives (Bergen, Dutta & Walker, 1992), subject to the risk preferences of trading partners, outcome uncertainty and information systems (Eisenhardt, 1989).

Prior to 1990, contracts at each point in the meat supply chain were primarily outcome-based: abattoirs purchased live animals from auction markets and supermarkets purchased 'standard' products according to specifications. The balance of risk in such contracts generally falls on the agent (who may not be adequately rewarded for his efforts), yet farmers were willing to assume this risk as the information system used to determine quality (inspection of live animals at the auction market) is inadequate for the assessment of carcass quality. Retrospective discounts for carcass quality were only possible with deadweight contracts and abattoirs were so pre-occupied with throughput that volume was given priority over carcass quality. In the absence of consumer concerns about animal welfare, nutritional composition and food safety, the standard meat products purchased by retailers were easily measured and the 'manufacturing' processes highly programmable, so the risk of default on the part of the processor was minimal. The 1990 Food Safety Act changed this virtually overnight – the origin of products and the 'manufacturing' process mattered even if the quality did not – and the 1990s has seen a rapid move towards behaviour-based contracts, in which agents are notionally rewarded for theirefforts and the risk notionally switches to the Principal.

To reduce the risk of suppliers' behaviour failing to deliver products according to (revised) specifications, principals (notably retailers) have sought improved information regarding the activities of their suppliers. This has taken the form of a steady shift away from liveweight auctions, towards deadweight sales, where quality of the raw material (i.e. carcass) can be more accurately determined, and an increase in inspection activities throughout the meat supply chain. Initially this increased inspection activity was undertaken by retailers (driven by due diligence considerations and a heightened aversion to risk), but generic assurance schemes and private initiatives (including ISO registration), as well as public intervention through mandatory meat inspections, has enabled retailers to shift the cost of monitoring back to the agent (i.e. farmers being required to join assurance scheme, and pay for the inspection costs, and processors gaining ISO900 registration as a means of securing preferred supplier status in a time of extreme uncertainty). Moreover, these costs have not been offset by increased returns, which is a constant source of conflict within the industry. The secret would appear to be in the re-casting of 'ex-poste agency costs (inversely related to the quality and availability of information) as ex-ante incentives (positively related to the quality and availability of information), where financial rewards can be identified.

The Tracesafe system provides detailed information on the safety attributes of prime steaks entering niche retail outlets and high class restaurants. M&S' Select beef

system provides a direct link between behaviour and outcome, which in turn can be used to extract maximum benefit for both principal and agent. The information provided in both systems effectively reduces the risk of agents not being adequately compensated for their efforts and the risk of principals falling to deliver products to the highest specification. Thus, the information provided reduces ex-poste agency costs and facilitates the alignment of ex-ante incentives.

Conclusions

Clearly, if food safety is treated as a public good then Governments will need (and be expected) to intervene to protect the vulnerable from unscrupulous traders and regulate those industries (of which meat is an example) ill-equipped to meet minimum food safety standards. However, enforcement carries a cost and prevention is generally more effective than cure.

The recent trend towards increased government regulation of food safety stands contrasts the trend towards greater reliance on voluntary approaches in other areas of government involvement in the private sector, such as environmental protection (Segerson, 1998). In the context of food safety, there is a greater potential for the market to provide adoption incentives when consumers and producers are aware of the safety characteristics of individual products and when product liability extends upstream, beyond the manufacturer.

Information is the key and it is here that Government has an important facilitative role to play, providing objective scientific information to help improve production systems, and communicating that information to the consumer. While we wait for a technological solution to the collection and dissemination of accurate and detailed information on **all** product attributes (including ingredients and production processes) opportunities exist for firms to exploit the risk-averse preferences of heterogeneous meat consumers. Such opportunities warrant greater attention in the current climate of gloom and doom.

References

Assured British Meats (ABM), 1998. Meat Industry Sets New Standards with Consumer Assurance Body, Press Release, ABM, Milton Keynes

Caswell, J. 1994. The policy environment for food safety and nutrition: regulating quality and quality signalling, in Padberg, D. (Ed), 1994. Re-engineering marketing policies for food and agriculture, Texas A&M University.

Caswell, J. & Hooker, N. 1996. HACCP as an International Trade Standard, American Journal of Agricultural Economics, Vol.78, August 1996.

Colatore, C. & Caswell, J. 1998. The cost of HACCP implementation in the seafood industry: a case study of breaded fish, paper presented at the Economics of HACCP: New Studies of costs and benefits conference, Washington, June 16-18, 1998.

Bergen, M., Dutta, S. & Walker, O. 1992. Agency relationships in marketing: a review of the implications and applications of agency and related theories, Journal of Marketing, Vol.56, July 1992.

Eisenhardt, K. 1989. Agency theory: an assessment and review, Academy of Management Review, Vol.14, No.1.

Fearne, A. & Garcia, M. 1999. The Assured Combinable Crop Scheme in England and Wales: Carrot or Stick?, Farm Management Journal, Vol.10, No.5

Fearne, A. 1998. The evolution of partnerships in the meat supply chain: insights from the British beef industry, International Journal of Supupply Chain Management, vol. 3, No. 4.

Henson, S. & Traill, B. 1993. The demand for food safety: market imperfections and the role of government, Food Policy, Vol.18, No.2.

Henson, S, Holt, G. & Northern, J.1998. Costs and benefits of implementing HACCP in the UK dairy processing industry, paper presented at the Economics of HACCP: New Studies of costs and benefits conference, Washington, June 16-18, 1998.

MAFF, 1998. Government/Industry Working Group on Meat Hygiene: Review of Progress June– October, 1998 (Report No.2).

Marsh, J. 1997. Making and enforcing food chain regulations – the factors that determine when, by whom and how, in Marshall, B. & Miller, F. (Eds), Management of regulation in the food chain – balancing costs, benefits and effects, Centre for Agricultural Strategy Paper 36, University of Reading.

Mathews, N. 1997. Food regulation and the retail sector, in Marshall, B. & Miller, F. (Eds), Management of regulation in the food chain – balancing costs, benefits and effects, Centre for Agricultural Strategy Paper 36, University of Reading.

McKechnie, S. 1997. Food regulation – the consumer agenda, in Marshall, B. & Miller, F. (Eds), Management of regulation in the food chain – balancing costs, benefits and effects, Centre for Agricultural Strategy Paper 36, University of Reading.

Segerson, K. 1998. Mandatory versus voluntary approaches to food safety, Food Marketing Policy Center Research Report No.36, University of Connecticut.

Swinbank, A. 1996. The economics of food safety, Food Policy, Vol.18, No.2.

Implications of changing general market conditions on product quality and quality assurance in the german pork production

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Abstract

The purpose of this paper is to derive suggestions for product quality and quality assurance in German pig production from general market conditions. It is argued that developments in trade, the EU agricultural policy and legislation increase the already existing disadvantages in competitiveness of German pork producers. The German consumers, food retailers, meat processors, and large-scale consumers mainly demand low priced pork and special hygienic quality whereas process quality characteristics such as regional production or animal welfare are of lower importance. Against this background, low priced meat and special hygienic quality must be the quality characteristics to be assured. In order to achieve a sustainable animal production in Germany, a closer co-operation between the participants of the food production chain and the increase in average pig stock size to gain profit from cost degressions is required.

1 Introduction

The production value of DM 7 billion in the financial year 1998/99 underlines the importance of the German pig production for the agricultural sector.[1] However, the German pork producing sector has lost market share in the EU. It is regarded as not being prepared for the increasing competition mainly because of the following reasons:

- High production costs. The main competitors on the European market profit by lower production costs due to advantages in farm structure and the organisational degree of production and marketing.[2]
- Low product and process quality. By now, warranted elements of the Danish national quality assurance system are traceability and assurance of origin. Germany is still occupied with establishing the basic conditions.[3]

Lack of organisation in production and marketing. The atomistic supply structure of the German agriculture is confronted with the market power of highly concentrated retailers. Higher degree of integration among the participants of the production chain are necessary for the coordination and the implementation of new standards.

These disadvantages have to be overcome. Therefore, the aim of this study is to derive suggestions for product quality and quality assurance in German pig production

from general market conditions. The following questions have to be answered:

1. How will German pig and pork production be influ enced by EU legislation in the future?
2. What kind of product characteristics are demanded by German consumers, retailers and the meat processors?
3. Which measures are capable to improve the standards of a sustainable animal production according to product quality and quality assurance in Germany with special regard to the economic impact?

2 Implications of changes in the general frame work of the German pork market

Changes in legal market conditions comprise developments of agricultural policy in international trade and within the European Union as well as aspects of food safety and animal welfare. They influence the competitiveness of the German pork production sector.

2.1 Changes in trade regulations, EU agricultural policy and EU enlargement

The following factors will increase the excess supply of pork in the EU and lead to price pressure:

- Cutback of subsidised exports. In the range of the ongoing WTO- negotiations, the EU already conceded a cutback of subsidised exports. However, this restriction becomes less binding in the face of the support price reduction for cereals which lowers the feed costs and increases the competitiveness of pork on the world markets.
- Increase of minimum market access.
- A reduction of pork consumption. Although the Agenda 2000 does not imply changes in the market organisation for pork, the reduction of the market support price for beef results in a shift form pork to beef consumption, especially in the processing industry.

[1] BMELF (2000).

[2] E.g., feed costs and expenditures for buildings in the Netherlands and Denmark are lower than those in Germany. Compare: Brill (1996). - N.N.$_A$ (1999), p.1 – Schulze (1995). - USDA (1999), p. 34. - Wolffram (1998), p. 39.

[3] Danske Slagterier, p. 2. - N.N.$_E$ (1998), p. 29 – N.N.$_B$ (1999), p. 15.

[4] Windhorst (1999), p. 80.

A decrease in supply of pigs and pork in the present EU countries owing to the EU enlargement is not expected in the short- or medium-term.[4]

The changes of these general market conditions can be summarised as follows. The changes in trade regulations, EU agricultural policy and the EU enlargement will have significant impact on the German pork market. Additional supply weakens the competitiveness of European exports on the world export markets[5] and leads to increasing price pressure on the EU market. Marginal suppliers will be forced out of production. This especially affects structurally weak regions in Germany where cost disadvantages already exist.

2.2 Food Safety

The following product damages are related to the production of meat:

- Contamination with micro-organisms. It is estimated that about 20 % of human cases of salmonellosis are caused by consumption of pork.[6]
- Other contaminants and residues.
- Foreign bodies, e.g. broken injection needles.

The EU's goal is to protect the consumers' health by increasing the standards of food safety to the highest level possible. This shall be achieved mainly through[7]

- control of food in every step of production. The planned General Food Law requires the implementation of elements of hazard analysis control principles, and the observance of hygiene rules in the whole food production chain. The adaptation to the pig farmers' situation is put up for discussion. The proposal contains explicit principles for good practice in agriculture.
- traceability. To improve traceability also for disease prevention and assurance of origin, each EU country has to implement a central database where every pig movement has to be registered. The database requires electronic labelling and identification systems that do not exist in Germany by now.
- including the agricultural production into the product liability.[8] In the past, it has been difficult to trace back product deficiencies to the farmers because it was not possible to differentiate between the single products. Agricultural products are often mixed up in the process of united storage, transportation, cleansing, processing, and marketing. Additionally, agricultural products are usually distributed without any individualising packaging and labelling.

The German Ministry of Agriculture objects to the establishment of a database because of difficulties in realisation and already sufficient existing rules.[9] German measures to improve product safety support the reduction of pig transports and of mixing up different origins as an indirect prevention. The fees for pest insurance, e.g. in North Rhine-Westphalia, are lowered when fatteners receive piglets from only up to 3 farms.[10] In addition, the German government started a national eradication and disease control programme against salmonellosis in pork where participation was voluntary. It was abandoned by the end of last year because of a lack of interest. At the moment, the ministry plans to introduce a directive. Fatteners will be legally forced to control the slaughter pigs concerning salmonella. Samples have to be taken and controlled at the slaughterhouse.[11]

It is obvious that the German pork sector only follows the EU legislation without own initiative. The implementation of higher standards in food safety causes additional expenses but this is valid for all producers in the EU. As quality assuring measures are subject to cost degression, the competitiveness of large scale producers increases even more. Marginal producers will be forced out of production.

2.3 Animal Welfare

Animal welfare is supported because of ethical aspects and concerns about product quality. It is directly connected with performance measurements and with the application of veterinary medicine. It also affects the quality of meat. Proper animal keeping reduces the susceptibility for diseases. The two main tendencies are

- the EU wide prohibition of (fully) slatted floors. Slatted floors are widespread in the EU and also in Germany because of advantages in labour productivity.[12]
- intensification of the German animal welfare legislation. The Federal Constitutional Court is likely to check the conformity of the German regulations of pig housing with the German law about animal protection as it was the case with laying hens. If it is found not to be conform, the German legislation may be forced to improve the pig welfare standards to a level above those of the EU. This unilaterally increases the production costs with the consequence of reduction in German production.[13]

Although the standards for pig keeping are raised in the EU in general, especially German producers suffer from additional production costs because measures in animal welfare are also subject to cost degression. The marginal producers in Germany will have to give up production.

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[5] Different studies emphasise that the production costs, e.g. in Canada and the USA, are overall lower than in the EU. Compare: Brewer, Kliebenstein, Hayenga (1998). - Hayenga et al. (1998). - ABN AMRO-BANK N.V. (1997).

[6] Steinbach, Hartung (1999), p. 299.

[7] Commission of European Communities (2000).

[8] Directive 1999/34/EC.

[9] Ingwersen (2000), p. 8. - Council Directive 97/12/EC. - Verordnung zum Schutz gegen die Verschleppung von Tierseuchen im Viehverkehr (Viehverkehrsverordnung).

[10] Bowinkelmann (1999), p. 30.

[11] BMELF (1998). - N.N.$_C$ (2000), p. 20.

[12] ZDS (1999), p. 7. - Ratschow (1999). - Franke (1999). - ZDS (1998), p. 140. – Scientific Veterinary Committee (1997), p. 137.

[13] Tierschutzgesetz. - Bundesverfassungsgericht (1999). - Verordnung zum Schutz von Schweinen bei Stallhaltung (Schweinehaltungsverordnung). - Council Directive 91/630/EEC.

[14] v. Alvensleben (1999). - Becker, Glitsch, Holzapfel (1995). - Overhoff. - Wirz (1996).

3 Requirements of the demand side for pork

The demand side consists of consumers, retailers, meat processors, large-scale consumers, gastronomy and catering. These groups request different quality items according to their goals.

3.1 German consumers

When asked to rank quality characteristics of meat according to the importance in buying decisions, the consumers mention elements of product quality, measurable at the product itself, and of process quality not measurable at the product.[14]

- Product quality comprises flavour and taste, appearance, health aspects (e.g., low fat), packaging, juiciness, and frying characteristics.
- Process quality includes elements of animal welfare, product safety, regional origin, ecology, and labelling.

Since consumers more and more buy cheap offers, their behaviour is inconsistent with their statements. Although items like animal welfare, traceability and assurance of origin are discussed in public, the main criterion in meat purchasing remains the price.[15]

At least, two facts indicate that the price is the main buying criterion for the consumer:

- The growing importance of discounters.[16]
- The small market share of pork produced under special regulations.[17]

Only few and limited market segments are left for products with special process quality items.

General trends in pork consumption are[18]

- the rise in demand for processed meat. At present (1999), pork consumption is at 57.5 kg again, with 41 kg of human consumption. Generally, the human consumption of meat consists of 50 % fresh meat and 50 % meat products. From 1980 to 1998, a steady decline in fresh meat consumption can be observed. It was replaced mainly by sausages, the most important meat products.
- more pre-packed meat. The still growing share of pre-packed meat and meat products including sausages accounted for nearly 40% (1998/99) of the private purchases.
- the increase in out-of-home consumption. The number of meals taken outside is steadily increasing. About one third of those meals contains meat.

Furthermore, processed meat, pre-packed meat and consumption out-of-home belong to the overall convenience trend.

3.2 Food retailers

The following trends emphasise the requirements of the food retailers:

- The food market is highly concentrated. In 1998, the top 5 in German food retail had a 64 % share in total sales volume. Most of the meat and meat products are sold through food retailers. A steady increase in price competition which is caused by the consumers' demand also affects the meat prices. Additionally, meat is often used as a special offer. The consumer prices for pork have been declining in 1998 and the first half of 1999 with a trend to stabilise in the second half.[29]
- Retailers stated their expectations towards their suppliers in the so-called "Frankfurter Deklaration". They demand, among other things, ISO certificates, a special status of hygiene, a HACCP concept, proper keeping and transportation of the animals, and a certificate of origin.[20] Although products produced under these regulations would be available, the retailers follow the consumers wish of low prices.
- Butchers lose market share. They concentrate on the high quality segment combined with consumer confidence and consumer orientation. Sensorial characteristics (tenderness, juiciness, taste/flavour, smell), hygienic factors and other features (German origin, produced by taking care of the environment, freshness) are important buying criteria for the butchers. The price is of lower importance. The microbiological guarantees and certificates lose significance because the consumers heat and cook most of the meat from the butcher's shop and thereby destroy pathogens. The consumers rely more upon a personal relationship, e.g. with a butcher, than on a quality label.[21]

3.3 Meat processors

The meat processing industry is interested more explicitly in special quality characteristics because some elements directly influence the processing. Therefore, the meat processors demand

- a technological applicability determined by a defined protein, fat and water content, and a defined pH value.[22]
- good microbiological condition. High demands towards the hygienic level result from the fact that many meat products such as raw salted meat, raw sausages, minced meat (contributing to more than one third of the consumption of meat products) are not cooked at all, neither in processing nor in the household and bear the risk of containing not destroyed infectious pathogens.

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[16] Compare: Problem of social desirability at consumer interviews. Bortz, Döring (1995), p. 212.
[17] DFV.
[18] E.g., the market share of "Prüfsiegel" labelled pork, produced under guidelines of the CMA, was only 5 %. The Danish initiative to label a guaranteed proper pig keeping has failed up to now because of the consumers' unwillingness to pay a higher price for it. - CMA (1999). - ZMP. - N.N.$_D$ (2000), p. 28. – Verseput (2000).
[19] DFV. - ZMP (1999).
[20] M+M EUROdATA (2000). - DFV. - ZMP.
[21] Peters (1996), p. 59.
[22] DFV. - Peters (1996), p. 74. - Wirz (1996), p. 57. - v. Alvensleben (1995), p. [illegible]
[23] Schmalhofer (1999), p. 51. - Timm, Herrmann (1996), p. 112.
[24] DFV.
[25] Vogelsang (1997). - Schmalhofer (1999), p. 45.
[26] Pottebaum (1996), p. 120. - Vogelsang (1997).

Additionally, there are meat products only heated in processing, such as cooked salted meat, boiled sausages, cooked sausages, and aspic products. They also account for more than one third of the meat products' consumption.[23] In addition to the health risk for the consumers, undesirable micro-organisms can disturb the processing.

- no residues. The products have to be free from residues such as environmental chemicals, veterinary medicine, growth promoters and foreign bodies,[24] because they also can negatively influence the production process.
- uniformity of the supply. Meat processors demand uniform supply and a standardisation of raw material[25] in order to better control the production process.

Other features concerning the agricultural production are of less importance. Instead of labelling the origin of the raw materials, the regional specialities in processing should be stressed. In addition, the brand of the processor is more important than the labelling of the region.[26] The regional origin might be interesting for special segments but the processing industry that distributes nationally would need a great amount of meat which is not available in one region.

Although not explicitly mentioned, the price is also of importance for meat processors because of the consumers' wish to buy cheap products. Additional value cannot be conveyed for most of the products by the meat processor. This is caused by the distance to the animal and the fact that meat often only remains a small part in a composed end product.

3.4 Large-scale consumers, gastronomy, and cate ring

The increasing importance of large-scale consumers, the gastronomy and catering is closely related to a reduction in household size, the greying population and the convenience trend. Just as meat processors, this group has difficulties to convey additional process qualities to their customers. Especially large-scale consumers are forced to buy cheap meat because of a limited budget. Additionally, gastronomy and catering services depend on good taste but less on process quality.

3.5 Conclusions

The demand side mainly concentrates on low prices and the hygienic quality. The consumer is not willing to pay more for further quality elements. The segments with special guarantees for process quality characteristics are small.

4 Implications

The development of strategies for adequate quality assurance and product safety requires the consideration of legal aspects and demand of consumers. The mentioned aspects show that quality is defined differently by every market participant but still the main criterion remains the low price, followed by hygienic aspects and a sufficient amount of standardised meat. To participate in the different market segments, the German producers have to fulfil certain requirements. Those are described for the following demanded product and process qualities:

- Low prices. In general, the German producers are badly prepared to meet this issue because of already existing disadvantages in production costs. Developments in trade, the EU agricultural policy and legislation in addition to the consumers' demand will increase the disadvantages. Furthermore, the importance of the price for buying decisions is heightened because the possibilities of quality differentiation are reduced by the intensification of legal requirements. Increasing price pressure implies the reduction of production volume especially in structurally weak regions. Other countries such as Denmark or Spain are going to fill the gap until they are forced to stop their expansion in production. The German producers must lower their production costs mainly through improvements in structure to gain profits from in economies of scale.
- Hygienic quality. This issue is mainly fostered through legislation. In addition, the market segment of meat and meat products which are hygienically sensitive is growing in importance. Again, the German producers are badly prepared to fulfil the requirements in comparison to their main competitors because of the low organisational degree in German production. The industry hardly benefits from existing relationships. It forces the pig producers to become part of an uninterrupted system to trace back products from the store to the farm in case of product deviations. Another advantage would be an improved adaptability of the pork sector on changing general market conditions. The starting point has to be the protection of animal health. Therefore, basic elements have to be a standardised registration process, which starts with the registration of all animals and animal movements on every farm and obligatory regular veterinary care and advice. Due to the large variety of specific operational characteristics, a general framework has to be built up with concepts adjustable to every farm's situation. It has to be considered that means of quality assurance are subject to degression of costs.[27] Due to already existing disadvantages, the efforts of German producers should be

[26] Pottebaum (1996), p. 39.

[27] Simons (1999).

restricted to fulfil the legal requirements. Additional measures to take are improvements in structure, namely the increase in the average stock size, and a higher organisational degree.

- Large uniform pork cuts. Prerequisites for large uniform pork cuts standardised according to customers requirements are the production on large-scale farms or the co-ordinated production in organisations using the same genetics and production methods and combining the animals to larger units. Due to the special situation in Germany with mainly small scale farms and unorganised production, an intensified co-operation and increases in the average pig stock size are necessary to achieve the goal. Firstly, regional co-ordination should take precedence of national co-ordination due to regional characteristics. When established, national measures can more easily be implemented, respectively the pooling of desired qualities and co-ordination of the sales-volume.
- Process quality characteristics. Only a small market segment values process quality characteristics, such as regional production and animal welfare. Additional supply would lower the price and displace the marginal suppliers. Although consumers express their willingness to pay higher prices for food from the region or for animal welfare, these higher prices cannot be achieved because the supply with qualitatively equal products is bigger than the demand for higher priced products.[28] So, it does not make sense for most of the producers to invest in these market segments. Animal welfare has to be improved mainly in accordance with increasing standards in the hygienic quality. Controls of housing systems have to be adjusted and tailored to individual operational conditions and special forms of housing. In order to prevent product damages caused by exhausting transportation, a regional co-ordination is required through a well-balanced relation between places for sows and fattening pigs. Again, larger farms profit from cost degression effects so that German producers should increase their stock size.

In order to achieve a sustainable pig production in Germany, the main qualities that have to be assured are a low pork price and a high hygienic quality based on legal requirements. This goal must be supported by reductions in production costs mainly through increases in the average pig stock size and a higher organisational degree.

[28] Wolffram (1997), p. 89.

References:

ABN AMRO-BANK N.V. (1997): De Varkenshouderij in de Europese Unie vergeleken met Noord-Amerika. Amsterdam.

v. Alvensleben, R. (1995): Den Imageverlust von Fleisch bremsen. DLG-Mitteilungen, No. 3, pp. 55-57.

v. Alvensleben, R. (1999): Verbraucherpräferenzen für regionale Produkte: Konsumtheoretische Grundlagen. Lecture/ Vortrag auf der Wissenschaftlichen Arbeitstagung "Regionale Vermarktungssysteme in der Land-, Ernährungs- und Forstwirtschaft - Chancen, Probleme und Bewertung" des Dachverbandes wissenschaftlicher Gesellschaften der Agrar-, Forst-, Ernährungs-, Veterinär- und Umweltforschung e.V. am 25./26.11.1999 in Bonn.

Becker, T., Glitsch, K., Holzapfel, R. (1995): Neue Organisationsformen der Qualitätssicherung bei Fleisch und Fleischprodukten. Schriftenreihe der Landwirtschaftlichen Rentenbank, Vol. 9. Frankfurt am Main, pp. 113-164.

BMELF (1998): Bekanntmachung der Leitlinien für ein Programm zur Reduzierung des Eintrags von Salmonellen durch Schlachtschweine in der Fleischgewinnung. Bundesanzeiger No. 44/98, 5.3.98, p. 2905.

BMELF (2000): Agrarbericht der Bundesregierung 2000. http://www.bml.de/landwirtschaft/ab-2000/ab00/material/tab009.htm (29.03.00).

Bortz, J., Döring, N. (1995): Forschungsmethoden und Evaluation. 2., vollst. überarb. und aktualisierte Auflage, Berlin, Heidelberg.

Bowinkelmann, H. (1999): Was die Tierseuchenkasse 2000 kassiert. Landwirtschaftliches Wochenblatt Westfalen-Lippe, No. 48, pp. 30-31.

Brewer, C., Kliebenstein, J., Hayenga, M. (1998): Pork Production Costs: A Comparison of Major Pork Exporting Countries. Department of Economics, Iowa State University (ed.), Staff Paper Series, No. 302, Ames.

Brill, M. (1996): Der Einfluß der vertikalen Integration auf die regionale Wettbewerbsstellung der Schlachtschweineproduktion und -vermarktung. Diss., Bonn.

Bundesverfassungsgericht (1999): Entscheidung des Bundesverfassungsgerichts zur Hennenhaltungsverordnung vom 12.8.1999 (Az. 2 BvF 3/90). BGBL. I, Nr. 45 vom 13.9.1999.

CMA (1999): Charts aus der Präsentation. http://www.cma.de/d/a/pruefsiegel/stat_charts.asp (23.04.99).

Commission of the European Communities (2000): White Paper on Food Safety. Brussels, 12.01.2000. http://europa.eu.int/comm/dg24/library/pub/pub06_en.pdf (13.01.00).

Council Directive 97/12/EC of 17 March 1997 amending and updating Directive 64/432/EEC on health problems affecting intra-Community trade in bovine animals and swine. Official Journal L 109, 25/01/1999 pp.0001-0037.

Council Directive 91/630/EEC of 19 November 1991 laying down minimum standards for the protection of pigs.

Danske Slagterier: Rückverfolgbarkeit und Herkunft in der dänischen Schweineproduktion. Kopenhagen.

DFV: Geschäftsberichte. Frankfurt/Main, various years.

Directive 1999/34/EC of the European Parliament and of the Council of 10 May 1999 amending Council Directive 85/374/EEC on the approximation of the laws, regulations and administrative provisions

of the Member States concerning liability for defective products. Official Journal L141, 04.06.99.

Franke, W. (1999): Moderne Haltungsverfahren zur Verbesserung der Tiergerechtheit und Akzeptanz. Vortrag auf der DLG-Fachtagung "Schweineproduktion unter neuen Rahmenbedingungen" am 27.10.1999 in Güstrow-Bockhorst.

Hayenga, M. et al. (1998): Global Competitiveness of the U.S. Pork Sector. Department of Economics, Iowa State University (ed.), Staff Paper Series, No. 301, Ames.

Ingwersen, J. (2000): Mit zunehmender Gesetzesdichte ins neue Jahrtausend. SUS, No. 1, pp. 6-9.

M+M EUROdATA (2000): Konzentration im deutschen Lebensmittelhandel. http://mm-eurodata.de/presse/99112301.htm (18.02.00).

N.N.$_{A}$ (1999): Anhaltender Trend zu größeren Viehbeständen. Agra-Europe, No. 35, Markt + Meinung, pp. 1-7.

N.N.$_{B}$ (1999): Auf die Veredlungs- folgt die Qualitätsoffensive. Agra-Europe, No. 6, Länderbrichte, p. 15.

N.N.$_{C}$ (2000): Behörden nehmen Listerien ins Visier, Lebensmittelszeitung, No. 11, p. 20.

N.N.$_{D}$ (2000): Qualitätsoffensive für Schweinefleisch. Agra-Europe, No. 12, Länderberichte, pp. 28-29.

N.N.$_{E}$ (1998): Zentrale Datenbank für die Schweineproduktion praxisreif. Agra-Europe, No. 43, Länderberichte.

Overhoff, C.: Die Nachfrage nach Wurstwaren in der BRD - Marketingkonzept für Putenwurst der Firma Bernard Matthews Oldenburg. Diplomarbeit, Bonn, forthcoming.

Peters, W. (1996): Wie wichtig sind ISO-Zertifizierungen für den Handel? DLG (ed.), Reicht die ISO-Zertifizierung?. Frankfurt am Main, pp. 55-77.

Pottebaum, P. (1996): Die künftigen Marktchancen der nordrhein-westfälischen Landwirtschaft. Münster, Gutachten im Auftrag der Stiftung Westfälische Landschaft in Münster.

Ratschow, J.-P. (1999): Umweltschonende Tierproduktion. Leiter des Referates Tierhaltung, Bauen und Technik an der Landwirtschaftskammer Westfalen-Lippe in Münster. Lecture/ Vortrag am 15.12.1999 im Rahmen des Tierzüchterischen Kolloquiums an der Uni Bonn.

Schmalhofer, O. (1999): Wachsende Ansprüche der Industrie an die Rohware. Deutscher Raiffeisenverband e.V. (ed.), Lahnsteiner Tagung, Zwölfte Fachtagung für bäuerliche Führungskräfte aus dem genossenschaftlichen Vieh- und Fleischbereich am 15./16. Nov. 1999, Bonn, p. 51.

Schulze, U. (1995): Analyse der Wettbewerbsfähigkeit der Schweineproduktion in Niedersachsen, den Niederlanden und Dänemark und Vorschläge zu ihrer Verbesserung. Bonn.

Scientific Veterinary Committee (1997): The welfare of intensively kept pigs. Brussels 1997.

Simons, J. (1999): Ökonomische Bewertung regionaler Vermarktungssysteme bei Fleisch. Lecture/ Vortrag auf der Wissenschaftlichen Arbeitstagung "Regionale Vermarktungssysteme in der Land-, Ernährungs- und Forstwirtschaft - Chancen, Probleme und Bewertung" des Dachverbandes wissenschaftlicher Gesellschaften der Agrar-, Forst-, Ernährungs-, Veterinär- und Umweltforschung e.V. am 25./26.11.1999 in Bonn.

Steinbach, G., Hartung, M. (1999): Versuch einer Schätzung des Anteils menschlicher Salmonellaerkrankungen, die auf vom Schwein stammende Salmonellen zurückzuführen sind. Berl. Münch. Tierärztl. Wschr., No. 112, pp. 296-300.

Tierschutzgesetz vom 25.5.1998. BGBl. I, S. 1105.

Timm, F., Herrmann, K. (1996): Tiefgefrorene Lebensmittel. 2., völlig neu bearbeitete Auflage, Berlin.

USDA (1999): 1997 Census of Agriculture. United States Summary and State Data. Washington 1999, Volume 1, Geographic Area Series Part 51, AC97-A-51.

Verordnung zum Schutz gegen die Verschleppung von Tierseuchen im Viehverkehr (Viehverkehrsverordnung) vom 9.6.1998. BGBl. I, No. 32, p. 1194.

Verordnung zum Schutz von Schweinen bei Stallhaltung (Schweinehaltungsverordnung) in der Fassung der Bekanntmachung vom 18. Februar 1994 (BGBL. I, S.311), geändert durch die Verordnung vom 2. August 1995 (BGBl. I S. 1016).

Verseput, W. (2000): Dänische Initiative für Fleischlogo scheitert am Preis. Ernährungsdienst, Agrarzeitung, Forum Vermarktung, p. III.

Vogelsang, T. (1997): Industrieller Fleischeinkauf im Wandel. Danske Slagterier (ed.), Qualität einkaufen - mit System/ Handbuch des Einkaufs von Verarbeitungsfleisch, Kopenhagen.

Windhorst, H.-W. (1999): Ein neues Leitbild für die Fleischproduktion. DLG (ed.), Landwirtschaft 2010, Frankfurt a.M., pp. 75-89.

Wirz, S. (1996): Imageanalyse für deutsches Schweinefleisch. Diplomarbeit, Bonn.

Wolffram, R. (1997): Konzepte zum Aufbau regionaler Vermarktungsstrukturen in Nordrhein-Westfalen. Landwirtschaftliche Fakultät der Rheinischen Friedrich-Wilhelms-Universität Bonn (ed.), Vorträge der 49. Hochschultagung, Münster, pp. 85-104.

Wolffram, R. (1998): Zukunft des Veredelungsstandortes Nordrhein-Westfalen. Landwirtschaftliche Fakultät der Rheinischen Friedrich-Wilhelms-Universität Bonn (ed.), Vorträge der 50. Hochschultagung, Münster, pp. 23-46.

ZDS (1999): Mitgliederrundschreiben (MR) 7/99. Bonn.

ZDS (1998): Schweineproduzenten in Deutschland 1997. Bonn.

ZMP (1999): Nachrichten von den Agrarmärkten Online, No. 97 vom 07.12.1999. http://www.zmp.de/presse/nachrichten/zmpnac97.htm (23.12.99).

ZMP (ed.): ZMP-Bilanz Vieh und Fleisch. Bonn, various years.

Risk management strategies in relation to food safety: who benefits and who pays?

S. Horst

Abstract

Food safety is an issue of increasing importance. Safe food starts with safe 'ground material',i.e., healthy animals. Incentives for the producers (farmers, slaughter plants) to apply risk management strategies are divers. In absence of a perfect (transparent) market, consumer behaviour is not enough. Additional incentives can be provided via laws or regulations that force the agricultural sector to develop and apply risk reduction programs. Dutch case studies on *Salmonella* in poultry and paratuberculosis in dairy cattle show that the distribution of costs and benefits from such programs may influence the motivation of farmers to join. More insight into this aspect may help to develop more efficient programs.

Introduction

Efforts to apply risk management strategies and increase food safety are usually motivated by pointing out the enormous costs that are involved with food-borne diseases. Buzby et al. (1996) report that microbial pathogens in food cause an estimated 6.3-33 million cases of human illness and up to 9,000 deaths in the United States each year. These authors estimated that the four most common bacterial pathogens, *Salmonella, Campylobacter jejuni, Escheria coli O157:H7,* and *Listeria monocytogenes,* account for $1.1-$4.1 billion in human illness costs in the United States each year. The authors used the so-called Cost-Of-Illness (COI) method, which measures the sum of medical expenses, forgone earnings of affected individuals, and productivity losses to employers of affected individuals on paid sick leave.

Benefits of risk management leading to increased food safety are often estimated as a reduction of the COI. For example, USDA's Economic Research Service (ESR) estimates the twenty-year public health benefits of a 90% reduction in illness and death from the above mentioned four pathogens to be $7.13-$26.59 billion. Some authors, for example Roberts (1991) argue that COI is the lower-bound estimate of the benefits, because consumers would be willing to pay to reduce the risk of food-borne illness, even if they don't actually become ill. COI benefit calculations usually only incorporate the reduction of human cases of illness and death. Which is fairly correct, because the damage of pathogens such as *Salmonella* and *Campylobacter* on the health of the animals that are the source of the meat products, is almost negligible. Therefore, reduction of animal health costs is almost never an incentive for farmers to invest in risk management strategies related to these pathogens.

In this paper we will address the issue of the distribution of benefits and costs on the farm level, in order to obtain more insight into what incentives are currently expected to motivate farmers to apply certain risk management strategies. We will first give a general overview of possible incentives and then discuss two case studies that were recently carried out in the Netherlands.

Incentives to apply risk management strategies

Consumer behaviour is perhaps the most logical incentive to apply risk management strategies. Generally speaking, consumers could respond to food hazards in four ways (Weaver, 1995): 1) product avoidance, 2) brand switching, 3) averting, and 4) mitigating actions. Product avoidance and brand switching may directly influence the market price and market share of a specific product and therefore be a strong incentive. Averting actions such as cleaning or cooking the product and mitigating actions such as treatment of illness are not direct economic incentives to the producers of the specific product.

One might argue that in a perfect market, consumer behaviour could be the only incentive necessary to increase food safety to a level desired by the consumers. Only a small group of consumers would buy the 'unsafe' products, resulting in a low price and small market share for these products. Most consumers are risk averse and only interested in the 'safe' products. The higher demand would them result in a higher price for these safe products, which will cover the extra costs made by the producers to produce the higher safety level (costs of risk management). But, as argued by Unnevehr (1996) and many other authors, this perfect market seems to be non-existing, due to the lack (or the cost) of information about food safety available to the consumer.

Other, and perhaps more important incentives for application of risk management, are lawsand regulations. The high number of cases and the high societal costs involved might be the reason that in many countries the government takes the responsibility for food safety. The food safety regulation applied can either be process based or performance based. Performance based regulation might be viewed as the more 'liberal' form of regulation, because it sets a certain standard, for example a maximum number of pathogens to be found in a certain product, and leaves it to the producers how to adhere to that standard. However, this type of regulation might be infeasible because of very high information costs. An example of process based regulation can be found in the US, where, since 1996, meat and poultry plants are required to develop Hazard Analysis and Critical Control Point (HACCP) plans, subject to state (FSIS) approval and verification.

Case study: *Salmonella* in poultry meat

Within the Netherlands, *Salmonella*-infection, is one of the most important foodborne infections, with an estimated number of 100,000 cases per year (De Wit et al., 1996). In about 75% of the cases, poultry are thought to be the source of the infection. This caused the Dutch government require the poultry industry to develop a program that will reduce the percentage of *Salmonella*-infected flocks (batches) at the slaughter plants, to a maximum of 10%. In 1996, about between 50 and 75% of the flocks at the slaughterhouses were found to be infected with *Salmonella*.

Since May 1997, the Dutch poultry sector applies a *Salmonella*-reduction program including measures such as feeding of *Salmonella*-free feed, hygienic measures (cleansing and disinfecting), treating or eradicating infected flocks, and logistic measures (separation of infected and not infected flocks or batches, i.e., in the hatcheries). Also an extensive monitoring system was started in 1997, including entrance and exit checks for all parts of the production chain. It is not expected that *Salmonella* reduction will lead to a significantly higher market price for the Dutch poultry products. The Netherlands produces for the international market, and thus has to compete with countries such as Sweden, which claims to be free of *Salmonella.* The incentive to reduce *Salmonella* prevalence thus comes from legislation, and, perhaps in the longer term, the fear of losing export markets or market shares.

The yearly costs of the *Salmonella*-program depend on the efficacy of the measures, i.e., higher efficacy results in less flocks to be treated or eradicated. Therefore the economic calculations were based on the *Salmonella*-transmission model developed by Nauta et al. (1998). Table 1 shows the costs of the program (including monitoring) for each part of the production chain. The table shows that the total costs for *Salmonella* monitoring and control are not evenly distributed among the various parts of the production chain (1998 estimates).

Part of the chain	Costs monitoring	Costs reduction program	Total costs	Cost per operation
Breeding companies	75,000	138,000	213,000	35,500
Rearing farms	165,000	320,000	485,000	3,000
Parent stock farms	75,000	1,125,000	1,200,000	2,500
Hatcheries	440,000	2,193,000	2,633,000	105,000
Broiler farms	860,000	650,000	1,510,000	1,200
Slaughterhouses	1,480,000	2,000,000	3,480,000	158,000
Total	*3,095,000*	*6,426,000*	*9,521,000*	

Table 1: Cost of *Salmonella*-monitoring program and *Salmonella*-reduction program in the Netherlands, based on 1998 statistics, in US dollars

For better insight, the table also provides the costs per operation, i.e., per farm, hatchery, slaughterhouse, etc. We then see that the breeding companies, the hatcheries and the slaughterhouses have the highest costs. But does this mean that these operations 'suffer' more from the program than the other parts of the production chain? That's a difficult question to answer. Fact is that Dutch broiler farms and multiplier farms are usually single-handed or family operated whereas most slaughterhouses, hatcheries and breeding farms in the Netherlands are much bigger. A calculation of the cost per labour equivalent might therefore change the picture. Other insight-enhancing calculations might be the calculation of the relative impact of the measures on the net profit, per animal or per operation. Research is underway to do so.

However, perhaps more important than knowing where the costs are made is knowing where they are paid. Table 1 shows that the program includes costs for the hatcheries of 2,633,000 US dollars. Per egg hatched this is a

cost of about 0.5 dollar cent (500 million eggs per year). But hatcheries increased the price of their products (one-day old chickens) by 0.75 to 1.0 dollar cent. The costs for the program are thus transferred to the next part of the production chain, the broiler farms. Broiler farmers have a much weaker position than the hatcheries; they are smaller, with a higher number, and less well organised. In consequence it is difficult for them to transfer their costs to the next part of the chain, the slaughterhouses. A growing percentage (currently 10-15%) of the broiler farmers produce within cooperatives. In many cases the cooperative consists of a combination of a feed company and a slaughter company, it sometimes also includes a hatchery. The cooperative often owns the chickens and pays the farmer for his labour. Within such a structure costs for health care programs can be reshuffled.

In May 1999 monitoring results showed that the *Salmonella*-program had reduced the prevalence at the slaughterhouse to 36%, which was still far more than the targeted 10% to be reached in 2000. Many of the measures included in the program will only be successful if farmers are highly motivated (especially the hygiene measures). Part of the lower than expected efficacy of the program is thought to come from incomplete co-operation of the farmers. This might be explained by lack of motivation due to unease about the distribution (and height) of the costs. But it is also thought that the measures at such are not able to reduce the prevalence enough. Therefore, a stricter program will be applied in the near future, including logistic measures at the slaughterhouse, i.e., separate slaughter of affected and unaffected flocks. It is yet to be seen who will bear the costs of this highly expensive measure. One might argue that if the slaughter plants transfer these costs to the preceding parts of the chain (in effect: lower meat prices), this will reduce the motivation to adhere to the reduction program.

Case study: Paratuberculosis (Johne's disease) in dairy cattle

Paratuberculosis or Johne's disease has been implicated as a possible cause, or complicating infection, in people with Crohn's disease. There is evidence both for and against this theory, reviewed by, amongst others, Chiodini (1989) and Thompson (1994). Humans can become contaminated with the pathogen causing paratuberculosis (*mycobacterium bovis*) due to the consumption of raw milk or meat from infectious animals (animals shedding the bacterium). The zoonotic potential of paratuberculosis is not proven and simple treatment (pasteurisation, cooking, etc.) is enough to kill the bacterium. Still, the Dutch veterinary services and farmers organisations fear loss of consumers' trust in cattle products when consumers become aware of the fact that many Dutch farms house a (usually very low) number of cattle with paratuberculosis. This fear for consumer distrust, and thus potential price falls and loss of marketshares, was the main motive to study the possibilities for a compulsory eradication program. A submotive was the fact that clinical and subclinical forms of paratuberculosis lead to losses for the farmers because of diarrhoea, decreased milk production, weight loss and premature disposal of the animals.

To provide insight into the epidemiological and economic impact of various eradication strategies, we developed a Monte Carlo simulation model. The model mimics the spread of paratuberculosis on the farm and sector level in situations with and without application of a certain eradication/prevention strategy. Strategies included combinations of testing (testing with ELISA or faecal test, culling the positive animals) and management measures. Cows can only become infected with paratuberculosis at a young age (up to 1 year), so management measures were focussed on reducing the contacts between older cows (potential shedders of the pathogen) and calves by measures such as: improved hygiene, feeding of milk replacer, and separate housing of young stock. The results showed clearly that testing alone (including culling the positive animals) is not sufficient to reduce the prevalence of paratuberculosis. The main reason for this is that the tests are almost unable to detect the latently infected animals and that they also miss 40 to 80% of the clinical and subclinical animals. Only strategies including severe management measures, such as separate housing of the calves, succeed in reducing the prevalence. For the economic evaluation only the benefits resulting from a reduction in the losses due to paratuberculosis were incorporated, hence possible consumers' distrust (lower milk and meat prices) was not included. It was not expected that paratuberculosis or freedom from paratuberculosis would influence milk or meat prices. The results showed that for about 5 to 10% of the farms (the larger and highly infected farms) eradication was attractive. But for the average Dutch farm (including both infected and non-infected farms) the benefit cost ratio's were between 0.2 and 0.72, on a planning horizon of 20 years. This indicates that non of the proposed eradication programs was economically attractive, at least not for the 'average dairy farm', which is mainly caused by the high costs of separate housing of the calves

The results were discussed with farmers' representatives and it was concluded that the unfavourable benefit cost ratio's would make it impossible to motivate farmers to

accept an eradication program forced upon them by their 'own' organisations (veterinary services, Dutch farmers organisation). The potential thread of failing consumer demands was not thought to be large enough to overcome the low benefit cost ratios. Also on governmental level (Dutch government or European Union) no actions were expected. Therefore, it was decided to stop the development of a compulsory eradication program. Instead, the veterinary services and the Dutch farmers organisation are currently developing a voluntary program, joint by an extensive information and promotion campaign.

Conclusion and discussion

Food safety is an issue of increasing importance. Providing safe food starts with safe 'ground material'. This means that one can expect that in future farmers will be confronted more and more with requests to implement risk management strategies. Currently many researchers focus on the technical side of this issue, i.e., what are effective strategies. We argue that more attention should be given to the presence or non-presence of incentives, i.e., to the motivation of the farmers to apply the strategies or adhere to the rules. As in most programs the success is very much dependent on factors that are difficult to monitor, such as discipline with hygiene measures, programs will never be successful if the participants are not motivated. Often, motivation will be linked closely with the distribution of the costs and benefits of the strategies. In most cases, risk management programs will be applied in order to comply with laws or regulations or in order to avoid price falls or loss of market shares. Profits such as higher prices or market shares are often not expected to occur. This means that costs of the programs will directly influence the net profits of the farmers. A better insight into this matter might help to understand why certain food risks are difficult to reduce and might also help in the development of more successful programs.

References

Buzby, J.C., Roberts, T., Jordan Lin, C.-T, and MacDonald, J.M. (1996). Bacterial Foodborne Diseases:Medical Costs and Productivity Losses. USDA, ESR report no 741, 81 pp.

Chiodini, R.J. (1989). Crohn's disease, sulfasalazine, and mycobacteria. J. Lab. Clin. Med. 114: 63-65.

De Wit, M.A.S., Hoogeboom-Vergedaal, A.M.M., Goosen, E.S.M., Sprenger, M.J.W., Borgdorff, M.W., 1996. Een bevolkingsonderzoek in vier regio's in Nederland naar de incidentie en ziektelast van gastro-enteritis en van Campylobacter- en Salmonella-infectie. (in Dutch). Bilthoven, RIVM report no 149101014.

Nauta, M.J. (1998). Modelling the transmission of *Salmonella* via poultry meat, from farm to consumer; state of the art. (in Dutch). RIVM, report nr 257851001, 52 pp.

Roberts, T., 1991. A survey of estimated risks of human illness and costs of microbial foodborne disease. Agribus. 9: 5-23.

Thompson, D.E. (1994). The role of mycobacteria in Crohn's disease. J. Med. Microbiol., 41: 74-94.

Weaver, R.D., 1995. Mitigation, product substitution, and consumer valuation of undesirable food borne effects. in: Valuing food safety and nutrition, J. Caswell (ed.), Boulder CO, Westview Press.

Control strategies in the production of pork in Styria

J. Köfer

Abstract:

European consumers are becoming increasingly critical as far as food is concerned with regard to safety and animal welfare. They want to know more about breeding methods, fattening procedures and animal husbandry, prevention and eradication of severe animal diseases and meat inspection. Modern control systems in the production of food of animal origin include the entire food chain, shift the control focus from the final product to process and system monitoring, demand increased personal responsibility through the establishment of self-assessment measures and assign new tasks to food control. Consistent control measures from "farm to table" are also of top priority in the European Union as can be seen from the White Papers on food safety.

Keywords: Quality assurance, integrated control systems, public health.

Introduction:

In a concept of integrated quality assurance ("from conception to consumption") traditional organoleptic postmortem meat inspection must be supplemented by effective system controls (BERENDS et al., 1993). Traditional meat inspection provides information on the status of animal health at the time of slaughtering and has an important function in the exclusion of epidemic diseases. But it yields only limited information about residues in meat. Effective system control provides essential information about the spread of zoonotic pathogens, animal health, epizootic situation, proper drug use, residue contamination or the spread of resistance to antibiotics.

Arguments have been raised that traditional agricultural countries with a low degree of integration (small agricultural and meat processing establishments) would not be able to keep to such "integrated quality assurance standards" or provide the required organisational or administrative infrastructure. The Austrian market share in the European Union comes up to only 3 % in milk and beef, 3 % in pork and 2 % in poultry and egg production. Since prevention of mistakes is more cost-efficient than detection of mistakes, the DVA in Styria has created methods for quality assurance concerning pork production with the purpose of monitoring complex systems. It includes taking measures in livestock control (origin of the animals and the fodder, residues in feed and animals, animal welfare), examining of slaughterhouses (slaughtering, hygiene, cold store, residues in muscle and kidney, traceability) and of meat processing plants. The efforts of the Styrian

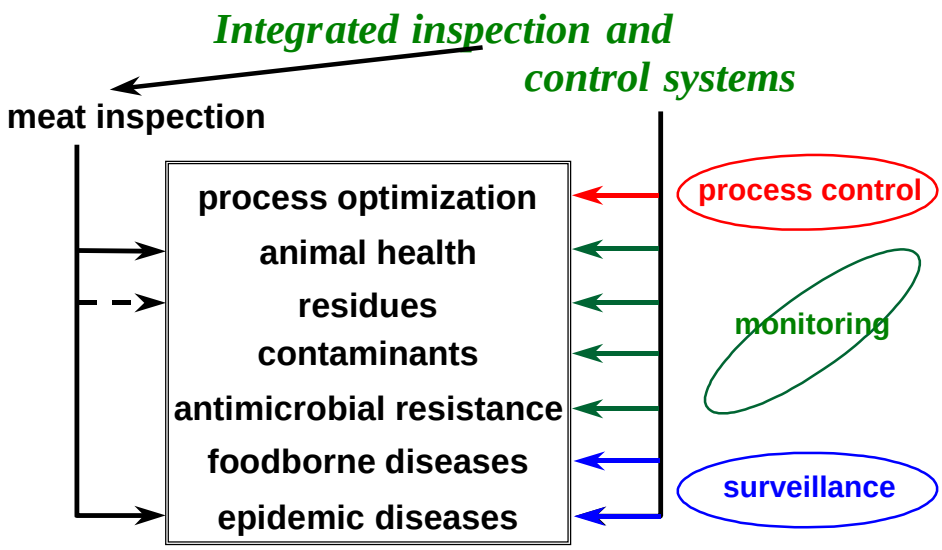

Fig. 1: Integrated inspection and control systems

Veterinary Administration to establish integrated control systems in meat production are illustrated by selected examples (KÖFER and FUCHS, 1999).

Control systems are based on a cycle mechanism, starting from data acquisition and data analysis using appropriate analytical and epidemiological/statistical methods, ranging to the interpretation of results, feedback to the persons in charge of intervention strategies and finally to the intervention programme itself, which in its turn directly influences the sampling system. Data acquisition usually requires the sample size and corresponding sample design (e.g. simple random sample, PPS method, etc.) to be tailored to the aim of the respective programme (estimated prevalence and incidence, comparison of different regions, or estimation of temporal trends). In the case of spatial/temporal interactions the sample design must always take the following components into account: "when" (temporal component) and "where" (spatial component) must "how many" samples (sample size in relation to space and time) be taken.

Process control:

Process control means prevention, monitoring and corrective actions while performing a process with the aim of fulfilling quality requirements. Online methods of process control allow direct intervention into the production process (= control). They include all methods of statistical process control, such as process capability indices, quality control charts or monitoring plans within the framework of the HACCP system. So-called offline methods do not allow direct intervention into the process (= control) and aim at the detection of weak points, their causes, effects and possible elimination. In this way, error detection should occur earlier in the process chain, with the aim of avoiding faulty units in the first place.

The regular farm visit by the veterinarian within the Swine Health Service plays a key role in the process of pork production. Farmers and veterinarians cooperate in order to increase the productivity of the farms to improve the quality of pork and to establish a quality assurance system (KÖFER, 1995).

Surveys of process analysis were conducted in slaughterhouses throughout the Province, comprising the establishment of feedback and supplier assessment systems in pig slaughtering (SCHUH et al., 2000), process control measures at the slaughter line in order to reduce microbial contamination of pig carcass surfaces (PLESS and KÖFER, 1999) and recent investigations on animal protection in the slaughtering process. Animal welfare in slaughterhouses is a very sensitive subject. In cooperation with "bsi", D-21487 Schwarzenbek, we started a welfare monitoring programme at slaughter plants in Styria in 1998 (WENZLAWOWICZ et al., 1999). The aim of this study (3 years) was to obtain a general view of the welfare standard of the plants, to assess the enforcement of the European Community welfare regulations for the slaughter process (Council Directive 93/119) and to advise the individual companies on how to improve constructional arrangements, devices and animal handling. Increased hygienic standards for fresh meat require strict compliance with process, operational and personal hygiene along the entire

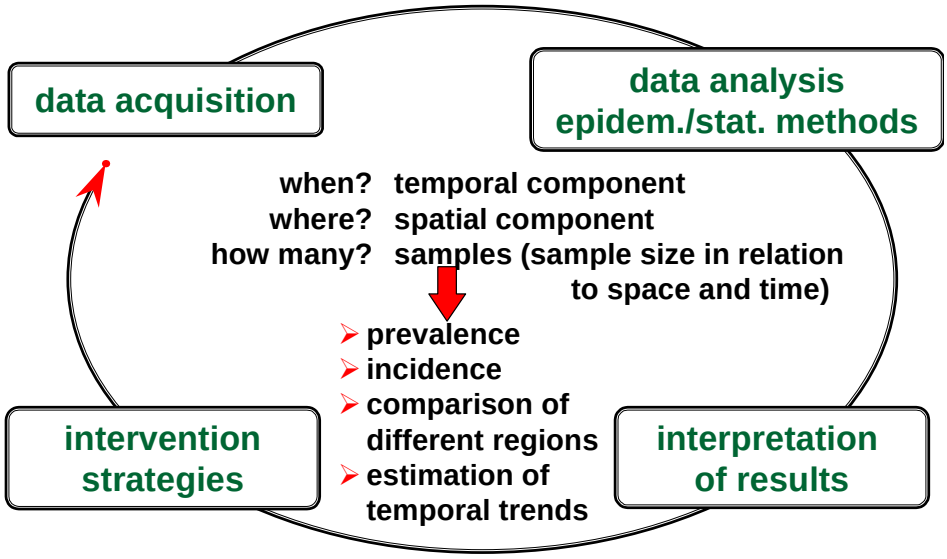

Fig. 2: Biometrical control systems

production chain in order to prevent the transmission of pathogens and to extend the shelf life of meat. The microbial load on the surface of the carcass is an essential quality parameter. The average microbial load of pig carcasses after slaughtering was assessed at ten Styrian slaughter plants licensed for intra-Community trade. The assessment of slaughtering hygiene in Styrian slaughterhouses showed that more than half of the plants investigated did not comply with the high quality standards required. The lack of process hygiene is primarily the result of the constant increase in line speeds combined with insufficient adaptation of the technical equipment. The aim of this project was to support slaughter plants, where carcasses significantly exceeded the microbiological guideline values, in their effort to reduce the microbial load on the carcass surface. Based on the examination results most slaughterhouses decided to take measures to implement both structural and technical improvements and to raise the standard of operational and personal hygiene.

Monitoring systems:

Monitoring includes routine observations on health, productivity and environmental factors and the recording and transmission of the results with the aim of early detection of changes in prevalence. Food quality monitoring is designed to protect the consumer from potentially harmful food. The regular analysis for chemical residues in food of animal origin plays a vital role in this respect. The controls were gradually developed into monitoring systems, which not only serve to identify the current situation but also allow conclusions to be drawn concerning the cause of the residues. The Styrian residue monitoring programme, which is based on the BAYES model and includes information from previous surveys, has proved extremely successful (KÖFER and FUCHS, 1993). Residues may be caused by environmental contaminants and other substances such as veterinary drugs, hormones, food additives or antibiotics. Contrary to foodborne infections and intoxications caused by micro-organisms, chemical residues in food of animal origin seldom lead to acute poisoning. Their hazard potential lies rather in their ability to cause chronic diseases, which can be triggered by minute amounts of these substances. The current results are compiled in the veterinary reports of the Department of Veterinary Administration and in a survey drawn up by DIEBER et al. (1999). The programme is supplemented by current investigations on the detection of ochratoxin A in the serum of Styrian slaughter pigs and environmental pollutants like PCB and PCDD/DF in pig fats.

In 1998 the province of Styria launched an animal health monitoring scheme based on organ inspection in selected slaughterhouses. The recording of pathological findings in the course of meat inspection at the slaughterhouse is an essential step in the establishment of integrated quality management systems. The pathological-anatomical organic changes determined at post-mortem inspection are an objective indication of the diseases that have affected the living animals. Repeated examinations and biometric evaluations of results from organ inspections on randomly selected carcasses representative of the entire pig population are designed to reduce the prevalence of pathological-anatomical organic changes by taking suitable measures in the herd.

Based on the present surveys of the resistance to antibiotics in pig, cattle and poultry farms, which have been performed over a period of several years (DEUTZ and KÖFER, 1998), the Styrian authorities intend to introduce a resistance monitoring programme similar to the "Danish Integrated Antimicrobial Resistance Monitoring and Research Programme" - DANMAP (BAGER and EMBORG, 1999).

Surveillance programmes:

According to WHO, surveillance programmes are presently the most important concepts in controlling foodborne diseases or combating notifiable epizootic diseases (e.g., BSE, tuberculosis, or rabies).

Successful surveillance schemes are increasingly focussed on diagnostic measures for the early detection of notifiable epizootics. A typical example of this development is the Styrian serological control programme required for the maintenance of additional guarantees concerning Aujeszky's disease under Article 10 of Directive 64/432/EEC. In addition to the blood samples taken in the animal herd, veterinarians are also commissioned to take blood samples from boars and sows prior to slaughter and analyse them for the presence of antibodies.

Geographical information systems can be used for zoonosis monitoring and for the risk assessment and cost-profit analysis of zoonosis control strategies. The space-time analysis of existing data provides the basis for the detection of spreading tendencies and allows targeted examination and control measures to be launched earlier. In 1999 Styria set up a geographical information system, which includes all farms with the exact number of ani-

mals, all slaughterhouses and alpine pastures of the entire province. Some efforts have been made to use GIS in the strategy of eradication or control of notifiable epizootic diseases under practical conditions. In addition, computer simulation programmes are available with which GIS data can be analysed in combination with the costs of various control strategies.

The implementation of Directive 92/117/EEC ("Zoonoses Directive"), which requires measures to be taken for the control of "foodborne diseases", resulted in the setting up of a Salmonella surveillance programme, which has also been introduced in pork production (KÖFER et al., 2000).

They are an essential part in the establishment of integrated control systems and provide the basis for efficient consumer protection. The Styrian system in pork production is similar to the "Danish Salmonella surveillance and control programme" (MOUSING et al., 1997) and includes breeding and fattening farms, slaughterhouses and meat processing plants. After bacteriological Salmonella screening, comprising determination of serovars and resistance patterns, a serological monitoring programme was established.

Intervention programmes:

Exploratory and descriptive statistical methods are applied to generate hypotheses from the data obtained, which are then tested using methods of statistical inference. In this process the entire range of epidemiological tools may be applied. The results of these statistical/epidemiological investigations provide the basis for the intervention programme, which specifies the particular actions to be taken, e.g. in the case of an increase in incidence, the occurrence of regional clusters etc. Practical examples are the surveillance measures for additional guarantees under Directive 64/432/EEC concerning Aujeszky's disease in pigs, the introduction of measures following the detection of drug residues, or epidemiological investigations in animal herds testing positive for *Salmonella*. All intervention programmes are aimed at an effective correction of observed system deviations. This results in a closed cycle since the outcome of the effectiveness test directly influences the sampling system.

References:

BAGER, F., EMBORG, H.D. (1999): DANMAP 98 - Consumption of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from food animals, food and humans in Denmark. In: DANMAP 98, Danish Veterinary Laboratory, ISSN 1397-1409.

BERENDS, B.R., SNIJDERS, J.M.A., Van LOGTESTIJN, J.G. (1993): Efficacy of current EC meat inspection procedures and some proposed revisions with respect to microbiological safety: a critical review. Vet. Rec., **133**, 411-415.

DEUTZ, A., KÖFER, J. (1998): Situation and development of antibiotic resistance in swine, cattle and poultry. In: Proc. 4th World Congress Foodborne Infections and Intoxications, Vol. II, 7. - 12. June, p. 715-720.

DIEBER, F., KÖFER, J., PLESS, P. (1999): Current results of Styrian residue monitoring. In: Proc. 45th ICOMST, 1. - 6. August, Yokohama, p. 628-629.

KÖFER, J., (1995): Tiergesundheitsdienst - das steirische Modell. Wien. Tierärztl. Mschr. **82**, 110-116.

KÖFER, J., FUCHS, K. (1993): Rückstandsmonitoring bei Fleisch. 1. Mitteilung: Modellansätze, Stichprobenpläne und gesetzliche Grundlagen. Wien. Tierärztl. Mschr. **80**, 2-9.

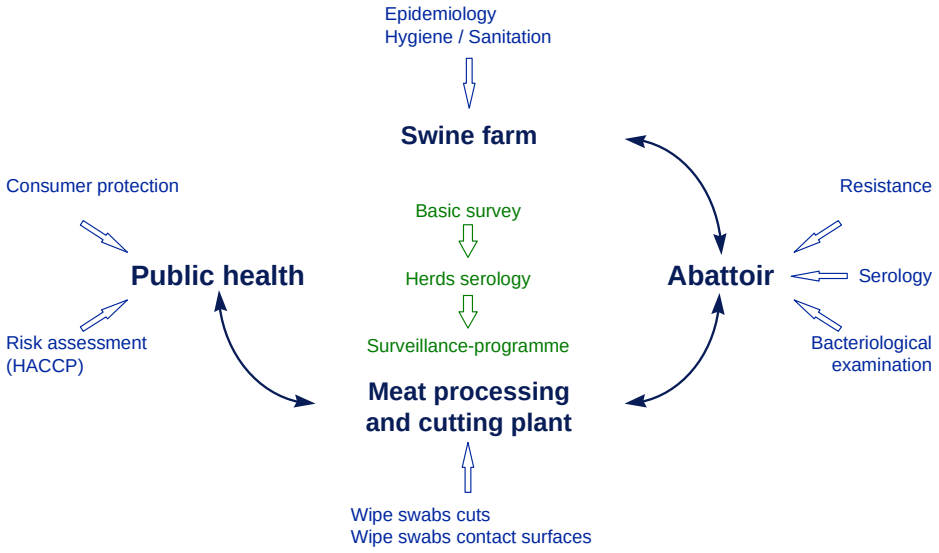

Fig. 3: *Salmonella* surveillance programme - pigs

KÖFER, J., FUCHS, K. (1999): Endprodukt - vs Systemkontrolle?. 40. Arbeitstag. des Arbeitsgebietes Lebensmittelhygiene der DVG, 29. September - 1. Oktober, Garmisch-Partenkirchen, S. 104-108.

KÖFER, J., PLESS, P., FUCHS, K., THIEL, W. (2000): Aufbau eines *Salmonella*-Überwachungsprogrammes für die steirische Schweinefleischerzeugung. Wien. Tierärztl. Mschr. **87**, 14-20.

MOUSING, J., JENSEN, P.T., HOLGAARD, C., BAGER, F., FELD, N., NIELSEN, J.P., BECK-NIELSEN, S. (1997): Nationwide *Salmonella* enterica surveillance and control in Danish slaughter swine herds. Prev. Vet. Med. 29, 247-261.

PLESS, P., KÖFER, J. (1999): Process control on the slaughter line for reducing the microbial load on the surface of pig carcasses. In: Proc. 45th ICOMST, 1. - 6. August, Yokohama, p. 566-567.

SCHUH, M., KÖFER, J., FUCHS, K. (2000): Errichtung eines Rückmeldesystems zur Kontrolle der Tiergesundheit. Wien. Tierärztl. Mschr. **87**, 40-48.

Von WENZLAWOWICZ, M., Von HOLLEBEN, K., KÖFER, J., BOSTELMANN, N. (1999): Welfare monitoring at slaughter plants in Styria (Austria). In: Proc. 45th ICOMST, 1. - 6. August, Yokohama, p. 64-65.

AMTSBLATT DER EUROPÄISCHEN GEMEINSCHAFT (1964): Richtlinie 64/432/EWG des Rates zur Regelung viehseuchenrechtlicher Fragen beim innergemeinschaftlichen Handelsverkehr mit Rindern und Schweinen. ABL Nr. 121 v. 29.7.1964.

AMTSBLATT DER EUROPÄISCHEN GEMEINSCHAFT (1992): Richtlinie 92/117/EWG des Rates über Maßnahmen zum Schutz gegen bestimmte Zoonosen bzw. ihre Erreger bei Tieren und Erzeugnissen tierischen Ursprungs zur Verhütung lebensmittelbedingter Infektionen und Vergiftungen. ABL Nr. L 62/38 v. 15.3.1993.

AMTSBLATT DER EUROPÄISCHEN GEMEINSCHAFT (1993): Richtlinie 93/119/EG des Rates über den Schutz von Tieren zum Zeitpunkt der Schlachtung oder Tötung. ABL Nr. L 340 v. 31.12.1993.

On-farm Veterinary Management for the Production of Certified Pig Meat

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Summary

The unconditional use of animal by-products in the nutrition of pigs during the last decades, combined with management improvements and the use of chemicals, hormones and antibacterials as growth promoters, resulted in a tremendous increase of pig production. However, the use of these "enhancing factors" in the feeds is not totally "innocent" both for consumer and porcine, since they may cause a series of harmful food-borne conditions, either directly or indirectly. In order to efficiently protect consumer's health, it is necessary that measures starting at the farm level, or even earlier at the land stage will be practiced.

The protection of animal health and welfare, as well as of human and environment from potential risks caused by animals, are all primary tasks of the veterinary practitioner, and should be mainly focused on preventive measures such as a) the control of animal feed and water for the detection of pathogens and toxic compounds, b) the application of the essential rules to ensure the good health of animals, meeting their needs in feed, housing, transport and microenvironment, c) the prevention of major diseases and rapid response to them by applying efficient programmes of vaccination, metaphylaxis, disinfection, rodent and insect control, d) the reduction of the antimicrobial drug use to a minimum and only for therapeutic purposes, e) the selective promotion of healthy slaughter animals, f) the protection of the environment by properly processing farm's waste and g) the application of certain policies within the farm aiming to protect stockmen's health.

All these measures, which have to be based on HACCP (Hazard Analysis Critical Control Points) procedure, are included in the presently proposed on-farm Veterinary Management (V.M.) programme for industrial pig enterprises. The cornerstone and guard of such a programme will be the authorized veterinarian of the participant farm who will be responsible for its correct planning, coordination and supervision.

A pilot version of such a V.M. programme has been successfully operated in a Greek farm under the guidance of the Clinics of Faculty of Veterinary Medicine, University of Thessaloniki, resulting to an ISO 9002 certification by Lloyds.

Introduction

The continuous demand of the consumers for low cost pork during the last decades resulted in the intensification of pig production methods and in the dominance of industrial type of farms. Up to now, the industrial farming was mainly -if not exclusively- targeted on the reduction of the cost of the final product, placing consumers' health at a second order (Nielsen and Wegener, 1997).

The continuous genetic improvements have created high performance commercial pig hybrids but sensitive to many pathological conditions. Animal confinement in "cement boxes" or individually in stalls resulted in the appearance of several pathological conditions, known as "man made diseases", together with the emergence of public feelings about animal welfare. Furthermore, the concentration of large numbers of animals in a single building facilitated the high transmissibility of many infectious and parasitic agents, inevitably increasing the use of pharmaceutical substances, particularly antibiotics, and in most cases without prescription. This uncontrollable use of antibiotics created further questions on the presence of drug residues in edible animal products, as well as on the transfer of antibiotic resistance to human pathogens (Blaha, 1997).

Feeding by-products of questionable hygienic status to an animal is not only risky for the animal itself, but also indirectly for the person who consumes the animal products (Blaha, 1997; Pepin et al., 1997). Recently arisen feed-related problems, such as dioxines and salmonellae contamination of poultry meat, the zoonotic potential of bovine spongiform encephalitis (BSE) and ovine scrapie, the detection of toxins, pesticides or other foreign com-

pounds in food products of animal origin, and the recent use of genetically modified plant products in animal feeds, all represent potential hazards for both animals and human. As additional hazards can be considered the environmental pollution by pigs' waste and the "aggravated" microenvironment within the farms (Blaha, 1997; Pepin et al., 1997; WHO 2000).

All the previously mentioned problems, that are related with the protection of animal health, as well as of human and environment from potential risks caused by animals, can be attributed to the absence of appropriate veterinary hygienic control and the lack of security mechanisms in different steps of animal raising and feed manufacturing. Therefore, a Veterinary Management (V.M.) programme based on the HACCP (Hazard Analysis Critical Control Points) rules is mandatory to be practiced at the farm level (Blaha, 2000; Blaha and Carlson, 2000; Vesseur et al., 2000).

Principles of veterinary management Programme

I. Organisational and legislative frame for the function of accredited pig enterprises

The accredited farms will possess special licence for their establishments and function, in which the number of sows being under full reproduction has to be mentioned (Annex III, 1804/1999 Directive of the Council of E.C.). A special licence from the appropriate authorities will be required in case the farm owns a mill for preparing swine feed, and an additional licence will be necessary by the local Organisation for Veterinary Products, in case that medicated premixes are buyed and used in the farm. The latter organisation will also be responsible for the frequent control of proper mixing capacity of the farm mill. Concentrates, premixes or final feed (meal, pellets, etc.) to be used, should be supplied only from factories possessing relative production licence. If these factories produce medicated concentrates or feeds, an additional licence will be required.

The V.M. programme, will be designed, coordinated and supervised by the private authorized veterinarian of the farm, whose responsibilities will be accredited and approved by the Veterinary Headquarters of the local Prefecture. The authorised veterinary specialist will necessarily be (a) university graduate of a recognised Veterinary Faculty and (b) member of the official Veterinary Association of the country. It is compulsory for every farm to officially employ a veterinary practitioner, who will be independent and will have no commercial, financial or family bonds with the owner (Directive 97/12/E.C.). The contract or the legal proof of this agreement will be deposited at the Veterinary Headquarters of the local Prefecture. The veterinary practitioner will work either on a full-time or on a part-time basis.

Any medicinal preparate, feed additive, disinfectant, insecticide, rodenticide, and chemical substance to be used in the farm must be approved by one of the local official authorities and its use will follow the instructions included in the data sheets kept in a special archive. All these substances are allowed for use in animals only after prescription by the authorised veterinarian (Annex III, 1804/1999 Directive of the Council of E.C.). Only pig farms employing full-time veterinarian are legalised to retain veterinary pharmacy within its premises for own use.

II. Welfare rules for proper pig raising

During all stages of pig life, V.M. should be consistent to welfare rules (Leyton and Bonney, 1998; Commission of the European Communities, 2000; Madec and Meunier-Salaün, 2000). Indicatively, in Great Britain, the cost of pig welfare measures was recently estimated to 4 £ per fattening pig. In general, circumvention of basic welfare rules may cause continuous stress, leading to the release of corticosteroids and the subsequent reduction of immune response to infectious and parasitic diseases. Thus, compliance with welfare rules will result in the drastic reduction of medicines. Less medicines mean less residues in pork products, and reduced likelihood for the development of antibiotic-resistance by bacteria potentially harmful for animals and, especially, man (Blaha, 1997).

The effect of stress is often reflected on the behaviour and the feeding habits of the pigs. For instance, "wasting pig syndrome" and "thin sow syndrome", both characterised by inappetence and wasting, are attributed to the intensified stressy conditions of pig production (Kyriakis, 1989; Kyriakis and Andersson, 1989; Kyriakis et al., 1990).

To fulfil the basic requirements for welfare, certain measures should be taken during pig raising such as (Annex I, 1804/1999 Directive of the Council of E.C.):

- Proper identification of pigs by the most painless and safe way, facilitating the fast access to farm records.
- Easy access of the animals in adequate quantities of feed and water, according to the requirements described by Muirhead and Alexander (1997).
- Adequate supply of space for each animal. If possible, the pigs should have access outside for exercise (An-

nexes VII and VIII, 1804/1999 Directive of the Council of E.C.).

- Good construction of the pens and the buildings of the pig enterprise, so that the risk of injuries to be minimised. The floor should not be fully slatted for piglets and fatteners, and part of the pen shall be covered solid.
- Proper microenvironmental conditions within the buildings (ventilation, light, temperature, humidity) so that dust and noxious gases (NH_3, H_2S, CO_2) are kept at the lowest levels. A sprinkler cooling system during summer should be provided. Room temperature should be at levels recommended Muirhead and Alexander (1997).
- Thorough removal of solid and liquid manure from the buildings.
- Optimal treatment of the live animals for creating less, if at all, pain, stress or injuries. Prohibition of sow tethering and of enclosement of individuals in stalls, housing of pregnant females on groups, no use of violence during transport. Tail docking should not be practiced. Castration may be allowed for keeping the quality of pork products increased. Teeth clipping should be permitted in order to minimise mastitis problems in sows or infections arising from fighting (Annex I, 1804/1999 Directive of the Council of E.C.).
- Optimal treatment of animals-to-die (sick pigs) by avoiding creating pain, anxiety, or discomfort.
- Where euthanasia is necessary, all rules recommended for its application have to be followed.

The transportation of the pigs will be performed according to the national and the E.U. laws (Council Regulation, EC 1804/1999) and to the welfare rules (Human Slaughter Association, 2000). During the transport, stress and injuries should be avoided, whilst in cases of long trips, pigs should be regularly supplied with feed and water. More specifically, animals should be supplied with drinking water every 3 hours, and should get rest and feed if the trip is longer than 8 hours. Careful loading and unloading of the animals with no use of force should be practiced. No tranquilisers or other medicines will be given for reducing transport stress (Council Regulation, EC 1804/1999). Stress during these manipulations may result in scouring of the animals, increasing this way the excretion and spread of several enteric pathogens. It also may cause meat devaluation due to Pale, Soft, Exudative (PSE) muscle, or to Back Muscle Necrosis, or even deaths due to Porcine Stress Syndrome (PSS) (Muirhead and Alexander, 1997).

Transport vehicles will be targeted exclusively for this purpose and will be thoroughly cleaned and disinfected. They will provide the minimum required floor space (Danske Slagterier, 1998). These vehicles should protect them from adverse weather conditions. Animal transportation will take place at suitable periods of the day (e.g. early morning during summer, so as to avoid heatstroke or deaths from cardiac arrest). The floor will be non-slippery and will be covered by straw for the absorption of liquid waste.

Slaughter pigs should preferably be transported to neighbouring abattoirs that fulfil national and E.U. regulations (Human Slaughter Association, 2000). Carcasses will be sold either in the local market or abroad, dependent on the type of licence of the abattoir.

The authorised veterinarian of the farm will examine the animals for slaughterhouse or for transport the last 24 hours prior their departure and will issue the accompanying health certificate (Directive 97/12/E.C.). This will include individual animal's identification, history during every productive stage (nutrition, health status, vaccinations, therapeutic schemes, etc) and destination. In case of transporting breeding animals, all legal health provisions should be followed.

The manipulations following the arrival of the animals at the slaughterhouse (waiting compartment, final health control, moving to the slaughtering compartment) and during the slaughtering process (stunning, bleeding, carcass preparation until its entrance in the cooling room) are of major importance for the high hygienic quality of the meat and will be in accordance with all welfare and euthanasia rules (Human Slaughter Association, 1999). Together with the subsequent meat inspection, the control of the previous manipulations is performed by the veterinary inspector of the abattoir officially assigned by the Veterinary Headquarters. The veterinary inspector will also be liable to receive and check the health certificate of the animals to-be-slaughtered, issued by the authorised veterinarian of each farm.

In case that deviations from the rules imposed by the laws and by the V.M. programme are observed, the carcass should not be certified for its hygienic quality.

III. Pig nutrition

1. Hygienic quality of animal feeds

In every production stage, all the nutritional needs of pigs should be satisfied (Council Regulation, EC 1804/1999). A list of all hygienically appropriate raw materials,

as provided by the relative national and E.U. laws, should be considered prior any preparation of feed ration (Annex II, 1804/1999 Directive of the Council of E.C.). It is best that the plants used in animal feeds originate from biological crops. However, this is not always feasible, particularly during the initial phase of transforming a conventional farm to an organic one.

The transmission of certain pathogens (various Salmonella species, prions related to BSE and ovine scrapie) to human and to animals has been recently related to the consumption of contaminated feeds of animal origins (MacDiarmid and Thompson, 1997; Pepin et al.,1997; Troutt and Osburn, 1997). Toxic products such as mycotoxins, peroxides, pesticides, heavy metals or other chemicals dangerous for both humans and animals may also be detected in unchecked raw materials of plant or animal origin. Furthermore, the "innocence" of genetically-modified plants is still questioned by the consumers (Harland 2000). Thus, it is essential that the authorised veterinarian of the farm will check all the necessary documents issued by appropriate veterinarians or agronomists, certifying that the raw materials and feeds are free of all previously mentioned harmful substances. She/he will be free to guide any additional laboratory examination that will help her/him to protect swine and human health. Only a limited number of animal origin proteins (dairy and marine origin) and no genetically modified plants should be used for producing the feeds (Annex II, 1804/1999 Directive of the Council of E.C.). In case that this is not applied, the consumer should be able to make his/her own decision, simply by looking at the product labelling. Label will show the origin of the animal and whether the pig was fed with genetically modified plant proteins, with animal proteins, or otherwise (all information derived by the records of the authorised veterinarian).

2. Hygienic quality of water

All animals of the farm will have free access to drinking water. Water supply system will be in good condition and will satisfy the needs of animals according to their number, production stage and feeding system (Turner and Edwards,1999). Regular water controls may include total bacteria count, coliform count and the concentration of total dissolved solids, nitrates and nitrites. The water should be free of toxic compounds or pathogens (Muirhead and Alexander, 1997). The easiest way for the reduction of microorganisms is water chlorination (Fraser et al., 1993). Total dissolved solids should not exceed 7000 ppm (best concentrations <1000 ppm) (National Research Council, 1974), since high levels are incriminated to delay animal growth and to cause scours (Fraser et al., 1993). Similarly, high levels of nitrates/ nitrites may cause retardation of animal growth and high incidence of stillborn piglets (Wood et al., 1967).

IV. Control and prevention of pathological conditions - Animal health care

Balanced nutrition, correct application of welfare rules and selection of appropriate pig breeds with increased resistance against stress or diseases are necessary for the prevention of any pathological condition. For resistance against diseases, the use of native races in the breeding schemes of the pigs should be considered.

The basis of any prophylactic programme, however, is the strict control of pig movements in, through and out of the farm, together with a well-designed scheme of vaccinations, metaphylaxis and parasite control. In addition, disinfections and rodent-insect control will complete prophylaxis.

The newly-purchased breeding animals will be accompanied by certificate showing their origin and their health history. They preferably should come from organic farms or from farms being under strict veterinary surveillance as proved by the appropriate veterinary documents. The pigs should be free of major infectious and parasitic diseases, and will be transported under all welfare rules with disinfected vehicles. Following their arrival in the new facilities, the animals will be kept in quarantine for sufficient period, so as to get gradually used to their new enviroment and the new pathogens, and to be submitted to the reception protocol of the new farm (blood sampling, vaccinations, contact with other animals of the new farm, etc). Quarantine procedure and reception protocol will be designed, applied and supervised by the authorised veterinarian of the farm, so that receptor farm will be secured against newly introduced pathogens (Heuser, 1999; Batista, 2000).

"All-in, all-out" operation system is essential to be practiced within the farm since it facilitates pathogen transfer and disinfections, keeping this way microorganisms at low levels. A segregated production scheme (e.g. sows in one place, piglets in another place and possibly slaughter pigs in a third place) should be considered whenever feasible.

Control of different pig diseases is an exclusive task of the authorised veterinarian of the farm. She/he will also be responsible for the receipt, the usage and storing of medicines, and for keeping individual records (preferably in electronic form) with every medicinal treatment app-

lied on the animals (diagnosis, type and quantity of the drug, date and duration of treatment, withdrawal periods) (Annex III, 1804/1999 Directive of the Council of E.C.).

The use of feed additives or growth promoters should be prohibited in order to prevent the deposition of drug residues in the meat and the development of antibiotic resistance by certain bacteria potentially hazardous for human (Inborr, 2000). In order to compensate the beneficial effects of antibiotics, drastic upgrading of all the measures of farm hygiene and careful planning and application of effective vaccination and metaphylaxis schemes will be practiced (Federation of Veterinarians of Europe, 2000).

Vaccinations represent the most economical way of protecting the health in animal populations (Whalen 1996). However, for an efficient vaccination scheme, a wide spectrum of serological, microbiological, or/and pathological examinations are necessary in order to check current and previous health status of the pigs. Epizootiological information of the neighbouring area will also accordingly coevaluated. The vaccines to-be-used should be approved as safe and efficacious.

Schemes for metaphylaxis employing approved antibiotics/ antibacterials will be applied in young pigs, being no older than 12 weeks of age. Only in this way, the animals can be protected from certain pathogens endemic in the farm, in combination with the minimal use of antibiotics during the critical stages of their life. The protection of the health of the older animals will be based on the strict application of vaccination schemes and hygienic rules (disinfections, elimination of rodents and insects etc) in the farm. In case that a therapeutic scheme is necessary for an animal, withdrawal times should be strictly considered and the individual records of the specific animal will be informed, so that its carcass will be later characterised as "conventional".

The use of alternative prophylactic or control schemes such as the use of probiotics, acidifiers, homeopathic drugs or natural substances etc. should also be evaluated and practiced accordingly (Lyons, 1987; Tsiloyiannis et al., 1998a,b; Kyriakis et al., 1999; Best, 2000; Witte et al., 2000; Council Regulation, EC 1804/1999).

Parasite control should be performed by appropriate schemes applied on breeding and on fattening animals (Cunningham and Myers, 2000; Smets and Vercruysse, 2000). The authorised veterinarian is responsible for evaluating the efficacy of such schemes by using the findings of abattoir, meat inpection and regular laboratory examinations.

V. Hygiene in farm establishments

Cleaning and disinfection of the establishments aim at the reduction of harmful microbial load in the farm (Waddilove and Blackwell, 1997). A fence for separating the farm from outsiders will effectively prevent outsiders from entering.

Lorries carrying animals or feed may transfer pathogens from one farm to another. Vehicles entering the farm should be clean and disinfected, not only on the carrier compartment, but also in the driver's cabin. The driver should always be considered as a potential hazard and not allowed to get off the truck, even for helping during animal loading. Some construction tips may be crucial to minimise the entrance of trucks in the farm. A loading ramp extending out of the farm's fence may prove ideal for safe loading and unloading of the animals, keeping out the trucks. Similarly, a feed pipe for filling up the feed bins, or alternately, feed bins sited out of the farm will prevent the entrance of feed lorries in the farm (Muirhead and Alexander, 1997). No entrance of visitors should be allowed in the farm without the approval of the authorised veterinary specialist and without the appropriate clothing provided by the farm. Disinfectant dips for vehicles, at the entrance of the farm, and for individuals, at the entrance of each building, are essential for the prevention of incoming pathogens (Blaha, 1997).

For washing and disinfecting farm establishments and equipments, only approved chemicals will be used, preferably those with the least residual capacity (Annex II, 1804/1999 Directive of the Council of E.C.). For instance, mild organic acids sprayed in populated buildings appear to reduce dust, ammonia and pathogens in the air space without the appearance of chemical residues in the pork meat and the environment (Kritas and Kyriakis, unpublished data). It should always be remembered that previous washing is essential for an efficient disinfection (Waddilove and Blackwell, 1997).

The effectiveness of disinfection procedure will be continuously evaluated e.g. by observing the incidence of some common diseases in the farm (exudative epidermitis, arthritis etc.) or/and by regular sampling of concrete surfaces and measuring bacterial load (Amass and Clarck, 1999). Appropriate microbiological examinations for detecting potential human pathogens that may also be found

in the pork meat (e.g. *Salmonella* spp., *Campylobacter coli, E. coli 0157, Yersinia enterocolitica, Listeria monocytogenes*) will be practiced at the farm level and particularly at "risky areas" of the production (Wells et al., 1999; European Commission, 2000). In USA, 5,000,000 cases of food poisoning and 4,000 deaths are annually observed in human related to the consumption of pork and poultry meat (USDA / FSIS, 1996; Horst, 2000).

The control of rodents and insects is a main task in the farm. Rodents are incriminated for the transmission of more than 25 different infectious diseases in human and pigs. Insects such as flies, mosquito's etc. may also be responsible for the spread of several diseases (Amass and Clarck, 1999). Their control, particularly during summer, is therefore necessary. Frequent washing of establishments by organic materials (feeds and manure), proper storing conditions of feeds, right management of wastes, and the use of approved rodenticides and insecticides are important control measures (Newman, 1997; Holscher, 1997; Henzler, 1997; Annex II, 1804/1999 Directive of the Council of E.C.). The authorised veterinary specialist of the farm is responsible for planning, coordinating, supervising and recording such procedures.

VI. Protecting stockmen's health in the pig farms

Dust and noxious gases represent, nowadays, a serious problem in confined farm buildings not only for pigs, but for workers as well. Reduced respiratory capacity of the lungs, chronic inflammation of the airways, and syndromes such as "mucosa irritation syndrome" and "organic dust toxic syndrome" have been observed in stockmen. Ammonia is one of the commonest harmful gas that negatively affect pulmonary function (Donham et al., 1995).

Zoonoses as for instance leptospirosis, brucellosis, anthrax, *Mycobacterium avium* and Chlamydia spp. may cause problems in humans, mostly those being immunodeficient (WHO 2000). Also, influenza still may be considered as one of the most important diseases potentially transmitable from pig to human and the other way round (Wood and Robertson, 1996). A proper V.M. programme should include a periodic control of stockmen's health for zoonoses. Vaccination of both pigs and stockmen against influenza may be of some help since it can provide some level of cross-protection.

The authorised veterinarian of the farm is responsible for protecting animals' and personnel's health by controlling air quality in the buildings (measuring ammonia, endotoxins, dust, air-circulation, etc) and by interfering correctively in case of deviation out of the acceptable levels. He will also be in a continuous alert for a zoonosis that may emerge in an individual.

VII. Manure management and protection of the environment

Liquid or solid manure processing (collection, storing, processing, distribution) will be subjected to current legislative and health provisions, and will require licence from the local prefectural authorities with regard to the maximum discharge of nitrogen content per hectare (Annex I, 1804/1999 Directive of the Council of E.C.). A minimum 9-month wasting storage capacity of the farm should be required.

The most popular method for pig farms is manure collection and processing in lagoons that function under natural or artificial ventilation, or under anaerobic conditions. Air pollution from anaerobically-produced maladorous gases (CH_4, H_2S, NH_3) is controlled by combustion, whilst solid residues will be regularly discarded, or dispersed as land fertilizers according to the instructions of the appropriate Authorities. Only this way, pollution of deep water by nitrates and eutrophism of superficial water will be prevented.

Amongst the duties of the authorised veterinarian is:

- to regularly evaluate the effectiveness of manure processing system of the farm by controlling several parameters such as $B.O.D_5$, C.O.D., $??_3$, nitrates, phosphates, pH, microbial load etc.
- to include non-starch polysaccharites, urine acidifiers or natural zeolites in the feeds in order to reduce the excretion of nitrogen and ammonia by the animals (Monteny, 1994; Andre et al., 1999; Kyriakis et al., 2000).

VIII. On-farm application of Hazard Analysis Critical Control Points (HACCP)

The effectiveness of a V.M. programme is highly dependent on the correct application of HACCP principles shown below :

1. Identification of the risks and of their importance
2. Identification of the Critical Control Points (CCP) in the production, that are necessary to eliminate these risks
3. Definition of the acceptable ranges of CCP
4. Establishment of methods for following /measuring CCP
5. Creating a restoration plan that will be applied in case of deviation from the CCP's acceptable ranges

6. Creating a programme to control the efficacy of the system
7. Creating a record system for all the data

These principles provide a systemic approach of the risks relative to the pork meat, and the identification of the preventive measures necessary for the control of these risks (Newman, 1997). The application of HACCP system at farm level should be mandatory, so that all requirements necessary for the production of certified pork meat in V.M. controlled farms are fulfilled. During the phase of primary production, any step, stage or procedure that can be disarranged and may cause this way disturbances in animals' and human's health, and in the environment can be considered as CCP (Table 1). The function of the operation and the possible deviation from CCP ranges should be controlled, whenever feasible, by the assistance of appropriate automatic systems, including alarms and restorations (for instance, electrical failure should automatically generate the auxilliary power supply of the farm, as well as a reserve system for drinking water supply has to be provided). It is obvious that the control of the HACCP system is much more easy, reliable and applicable in small than in large farms, and such farms are suggested as more suitable for participating in a V.M. programme. To follow CCPs, accredited, fully-equipped laboratories being able to perform a wide range of chemical, toxicological and microbiological examinations are necessary. The task of the authorised veterinarian is to evaluate the results from these examinations, to determine the problem and to correct deviations from CCPs ranges. All these actions should be recorded for future reviewing and be ready-for-control by the official Authorities.

The education of all people involved in the programme is a prerequisite for its successful outcome. Veterinarians, farm owners and personnel should learn and get acquainted with what is meant by welfare, hygiene and quality of produced pork meat, preventive measures against stockmen's health, and generally all the "philosophy" and the value of success of a V.M. programme.

Pilot application of a V.M. programme in Greece

Based on the previously described principles, a pilot V.M. programme has been designed in a Greek farrow-to-finish pig farm with a capacity of 2,000 sows in Rethymno, Crete, Greece under the guidance of the Clinics of Faculty of Veterinary Medicine, University of Thessaloniki.

Starting at the level of feed preparation, all animal origin raw materials have been excluded and high quality plant origin feeds, as well as naïve bioregulators (eg. acidfiers, probiotics) have been used. Strict protocols of disinfections, vaccinations and metaphylaxis have been applied on a standard basis and no antibiotics were used after the age of 8 weeks. Special attention was paid on welfare, worker's safety and environmental respect.

All these tasks, part of a HAACP based Veterinary Management scheme, were coordinated by authorised veterinarians of the farm and further checked and approved by Lloyds this way providing an ISO 9002 certificate. As far as we know, it is the only case reported at both EU and worldwide, that an ISO 9002 certificate was provided to a farm.

Table 1. The main critical control points of the proposed V.M. and essential requirements for the application of HACCP at the farm level

1. Control of appropriate certificates accrediting the safety of purchased raw materials or feeds (issued by agronomist or /and veterinarian)
2. Control of feeds' quality in case of long-term storing in the farm
3. Control of health veterinary certificates of incoming and outcoming animals
4. Health records of every animal in the farm up to 24 months after its removal
5. Practice of all welfare rules during raising and transport of animals
6. Control of the availability of drinking water by laboratory examinations
7. Planning and proper application of appropriate vaccination and metaphylaxis schemes
8. Compliance with the instructions of data sheets of all pharmaceutical products
9. Planning and proper implementation of "all in-all out" system, disinfections and schemes for the control of rodents and insects. Also control of air quality in the compartments of the farm
10. Measures for the proper protection of stockmen's health and continuous medical care
11. Control of the correct function of waste processing system of the farm and the compliance with all the rules regulating their discard 12. Warning in case of mechanical and electrical malfunctions in the farm by appropriate alarm systems

13. Application of regular sampling and controls in the farm in all production stages
14. Proper record keeping of all findings at slaughterhouse relative to the health of fattening and breeding animals culled
15. Proper record keeping for all problems relative to the final pork products preferably at the level of retailer and consumer

Essential requirements for the application of HACCP at the farm level

I. All breeding animals, and feed raw materials will originate from companies possessing appropriate quality certificate (ISO, GMP, GLP, IQC, HACCP etc)
II. All laboratories involved in the V.M. programme of the farm will be certified (ISO, GMP, GLP, IQC, HACCP etc)
III. Complete computerised recording of all previous parameters, and care for solid credibility of the chosen V.M. programme

References

Amass SF, Clarck LK. (1999) Biosecurity consideration for pork production units. Swine Health and Production, 7 (5): 217-228.

Andre JA, Aarnink JA, Cahn TT. (1999) Ammonia emission from pig houses as affected by dietary composition. Feed Mix, 7 (3): 23–27.

Batista L. (2000) Gilt acclimation: your insurance for health and production at the farm. Proceedings of the American Association of Swine Practitioners: 289-291.

Best P. (2000) How do acids work as growth promoters? Feed International, 21 (5): 23 - 24.

Blaha T. (1997) Public health and pork: pre-harvest food safety and slaughter perspectives. O.I.E. Contamination of animal products: prevention and risks for animal health, Scientific and Technical Review, 16 (2) - August 1997.

Blaha T. (2000). "Minnesota certified" (MnCERT): The potential role of veterinarians in quality assurance and certification. 16th International Pig Veterinary Society Congress, Melbourne, Australia, 17-20 September 2000, p. 378

Blaha T. and Carlson A (2000). "Minnesota certified" (MnCERT): A pork producer co-op based on standardization, auditing and certification. 16th International Pig Veterinary Society Congress, Melbourne, Australia, 17-20 September 2000, p. 313

Commission of the European Communities. (2000) White Paper on Food Safety. COM 1999, 719 final, Brussels.

Council Directive No 93/119/EC of 22 December 1993 on the protection of animals at the time of slauhgter or killing. Official Journal 31/12/1993, L340: 0021 - 0034.

Council Directive No 97/12/EC of 17 March 1997 amending and updating Directive 64/432/EEC on health problems affecting intra-Community trade in bovine animals and swine. Official Journal 25/04/1997, L109: 0001 - 0037.

Council Regulation (EC) No 1804/1999 of 18 July 1999 supplementing Regulation (EEC) No 2092/91 on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs to include livestock production. Official Journal 1999, L222: 0001 - 0028.

Cunningham FL, Myers GH. (2000) A comparison of deworming protocols for replacement gilts. Proceedings of 31st annual meeting of American Association of Swine Practitioners, Indianapolis, Indiana: 145 - 146.

Danske Slagterier. (1998) Brochure. Wohlergehen der Tiere in der dänishen Schweinenproduktion.

Donham KJ, Reynolds SJ, Whitten P, Merchant JA, Burmeister L, Popendorf WJ. (1995) Respiratory dysfunction in swine production facility workers: Dose-response relationships of environmental exposures and pulmonary function. Am. J. Indust. Med., 27: 405-418.

European Commission. (2000) Opinion of the Scientific Committee on Veterinary Measures relating to Public Health on food-borne pathogens, 12 April.

Federation of Veterinarians of Europe. (2000) Antibiotic Resistance and Prudent use of Antibiotics in Veterinary Medicine. Website: http://www.fve.org.

Fraser D, Patience JF, Phillips PA, McLeese JM. (1993) Water for piglets and lactating sows: Quantity, quality and quandraries. In: Coles DJ, Haresign W, Garnsworthy PC, (eds), Recent Developments in Pig Nutrition. 1st ed, University Press, Nottingham: 200 - 224.

Harland J. (2000). What is "GMO-free"?. Feed International, 21 (7): 6-8.

Henzler DJ. (1997) Rodent control and pathogen reduction: Best Management Practices (BMP) for rodent control on swine premises. Proceedings of the 5th Annual Swine Disease Conference for Swine Practitioners. College of Veterinary Medicine, Iowa State University, Ames, Iowa:39 – 44.

Heuser W. (1999) Gilt pool management acclimatization and verification. Proceedings of the American Association of Swine Practitioners: 469 - 471.

Holscher K. (1997) Successful insect control procedures in swine units. Proceedings of the 5th Annual Swine Disease Conference for Swine Practitioners. College of Veterinary Medicine, Iowa State University, Ames, Iowa: 45 - 53.

Human Slaughter Association. (1999) Annual Report 1998 - 99.

Human Slaughter Association. (2000) Newsletter, 22.

Inborr J. (2000) Animal production by "the Swedish model". Feed International, 21 (5): 6.

Kyriakis SC, Andersson G. (1989) Wasting Pig Syndrome (WPS) in weaners – treatment with amperozide. Journal of Vet. Pharmacol. Therap., 12: 232-236.

Kyriakis SC. (1989) New aspects of the prevention and/or treatment of the major stress induced diseases of the early weaned piglet. Pig News and Information, 10 (2):177-181.

Kyriakis SC, Martinsson K, Olsson NG, Bjork A. (1990) Thin Sow Syndrome (TSS): The effect of amperozide. Br. Vet. Journal, 146:463-467.

Kyriakis SC, Tsiloyiannis VK, Vlemmas J, Sarris K, Tsinas AC, Alexopoulos C, Jansegers L. (1999) The effect of probiotic LSP 122 on the control of post-weaning diarrhoea syndrome of piglets. Research in Veterinary Science, 67: 223 - 228.

Kyriakis SC, Alexopoulos C, Saoulidis K, Papaioannou D, Balkamos G. (2000) An experimental study on the effect of in-feed inclusion of a natural zeolite (clinoptilolite) on health status and performance of weaned, growing and finishing pigs. 16th International Pig Veterinary Society Congress, Melbourne (accepted).

Leyton R, Bonney RJ. (1998) Pig welfare - The issues? The Pig

Journal, 42: 66 - 73.

Lyons TP. (1987) Probiotics: an alternative to antibiotics. Pig News and Information, 8 (2): 157 - 164.

MacDiarmid S.C., Thompson EJ. (1997) The potential risks to animal health from imposed sheep and goat meat. O.I.E. Contamination of animal products: prevention and risks for animal health, Scientific and Technical Review, 16 (1) - April 1997.

Madec F, Meunier-Salaün MC. (2000) From welfare for pigs to adversity for pig farmers. Pig News and Information, 21 (1):33 - 38.

Monteny GJ. (1994) Reduction of ammonia emission from Dutch agriculture: Technical solutions. In: Dewi IA, Axford RFE, Marai IFM, Omed H, (eds), Pollution in Livestock Production Systems. CAB International, Wallingford: 429 - 441.

Muirhead MR, Alexander TJL. (1997) Managing pig health and the treatment of disease. 1st ed, 5M Enterprises Ltd, Sheffield.

National Research Council. (1974) Nutrient and Toxic Substances in Water for Livestock and Poultry. National Academy Press, Washington DC.

Newman MC. (1997) Pathogen control in the human food chain and the necessity for HACCP programs beginning at the farm. In: Lyons TP, Jacques KA, (eds) Biotechnology in the feed industry, Proceedings of Altech's 13th annual symposium. 1st ed, Nottingham University Press, Nottingham: 305 - 312.

Nielsen B, Wegener HC. (1997) Public health and pork products: regional perspectives of Denmark. O.I.E. Contamination of animal products: prevention and risks for animal health, Scientific and Technical Review, 16 (2) - August 1997.

Pepin M, Russo P, Osburn BI. (1997) Public health hazards from small ruminant meat products in Europe. O.I.E. Contamination of animal products: prevention and risks for animal health, Scientific and Technical Review, 16 (2) - August 1997.

Smets K, Vercruysse J. (2000) The control of scabies in pigs on a fattening farm. Proceedings of 31st annual meeting of American Association of Swine Practitioners, Indianapolis, Indiana: 153 - 155.

Troutt HF, Osburn BI. (1997) Meat from dairy cows: possible microbiological hazards and risks. O.I.E. Contamination of animal products: prevention and risks for animal health, Scientific and Technical Review, 16 (2) - August 1997.

Tsiloyiannis VK, Kyriakis SC, Vlemmas J, Sarris K. (1998a) The effect of organic acids on the control of post weaning diarrhoea syndrome of piglets. Proceedings of 15th International Pig Veterinary Society Congress, Birmingham, Vol 3: 151.

Tsiloyiannis VK, Kyriakis SC, Vlemmas J, Sarris K. (1998b) The effect of organic acids on the control of post weaning oedema disease of piglets. Proceedings of 15th International Pig Veterinary Society Congress, Birmingham, Vol 3: 152.

Turner S, Edwards S. (1999) Do pigs gain sufficient access to nipple drinkers? Pig Progress, 15 (2): 20 - 21.

USDA/FSIS. (1996) Federal Register of July 1996, 9CFR Part 304.

Vesseur PC, Voermans JJM, Bokma-Bakker MH, Verheijden JHM. (2000). Certification in the Dutch pig production sector. 16th International Pig Veterinary Society Congress, Melbourne, Australia, 17-20 September 2000, p. 295-299

Waddilove J, Blackwell M. (1997) Disinfection of pig units. The Pig Journal, 40: 28 - 37.

Wells SJ, Bush EJ, Blaha T. (1999) What do we know about foodborne pathogens in pigs and slaughterhouses? Allen D. Leman Swine Conference, University of Minnesota: 228 - 230.

Whalen RG: DNA vaccines, cyberspace and self-help programs. Intervirology 1996, 39: 120-125.

Witte W, Jorsal SE, Roth FX, Kirchgessner M, Göransson L, Lange S, Pedersen KB. (2000) Future strategies with regard to the use of feed without antibiotic additives in pig production. Pig News and Information, 21 (1): 27-32.

Wood JM, Robertson JS. (1996) Human influenza viruses and vaccines. The Pig Journal Proceedings, 37: 95-104.

Wood RD, Chaney DG, Waddill DG, Garrison GW. (1967) Effect of adding nitrate or nitrite to drinking water on the utilization of carotene by growing swine. Journal of Animal Science, 26: 510 - 513.

World Health Organization. (2000). The impact of food and nutrition on public health. The case for a food and nutrition policy and action plan for the European region of WHO 2000-2005.

Meat Production and Distribution: Criteria for the Future

H. Schweer

Abstract:

Meat Production and Distribution: Criteria for the Futur Consumer demands have radically changed in recent years. More and more people want to buy meat which is not only tender, delicious, hygienic, and - most importantly! - free of antibiotics and hormones, but which was also produced in compliance with animal welfare needs with no adverse effects on the environment. The production of tender pork and beef requires clearly-defined breeding programmes driven by marketing strategies that will enable farmers to deliver the products the market demands at a profit. At the same time, a permanent and reliable supply and delivery system is needed between the various stages of production involved in breeding and fattening, and between farmers, their suppliers, and the slaughter houses, thus creating a vertical communication network. For this is the only way to improve health and hygiene, reduce infectious disease and increase profitability at all stages of the production and distribution system.

This interdependence has been amply documented in scientific studies and demonstrated in practice in other countries. It has been widely publicised in Germany for years, so that most farmers are aware of this. Nevertheless many German farmers, unlike their counterparts in other European countries, have been unwilling to commit themselves to such a vertical network. Traditional attitudes and working methods, and a not inconsiderable excess slaughter capacity, have made it easy for farmers to "gamble" week by week in hopes of finding what appears to be the best daily price for their slaughter animals, and switching buyers frequently.

Premium-Fleisch AG, a consortium of over 4000 participating farmers, has demonstrated without a doubt that what matters most is not the highest daily price, but the marginal return per pig. And this is a factor that varies by as much as 40 DM per pig between enterprises with healthy animals and those with problematic ones. This is what has convinced all participating farmers in our Premium-Fleisch AG consortium that there is a close relationship between animal welfare, animal health, slaughterhouse meat inspection findings, expert advice and optimal breeding and sales results, and that all these factors play a role in securing long-term success at all levels of the system.

At present more than half of our total of 1.5 million slaughter pigs are produced in accordance with the guidelines of only two breeding programmes (BHZP and PIG), which fulfil the criteria of the CMA seal guaranteeing „German Meat of Proven Quality from Controlled Production". All participating producers are also shareholders in Premium-Fleisch AG. Despite the additional costs of the programme, their marginal return is better by 5 DM per animal than for comparable, non-participating farms. Weaner producers have also profited from higher prices. And Premium-Fleisch AG has benefited, as well, and has been in the black for the last four years.

This experience has clearly shown that agricultural animal production infrastructures cannot be separated from the slaughter and processing industries. Only where centres of meat production and distribution join with farmers to develop regional cooperative systems can consumer demand for meat of guaranteed quality, safety and source be met reliably and on a long-term basis, thus establishing and maintaining competitiveness at the regional level. For in the European market of the future, only the best producer/distributor systems will be able to compete for the business of large food distribution enterprises. To meet this challenge we need a legal structure that can account for ca. 1 to 1.5 million slaughter pigs and ca. 50,000 head of cattle, and which allows direct participation by farmers, who must also be able to identify with the system. Clearly, size is essential to survival in the meat market, but this must be the result of the sum total of highly-productive, compatible regional organisations cooperating under the auspices of a consortium. Such an umbrella organisation, however, cannot be forced on farmers. It is therefore extremely important that all members of such a consortium support and identify with its goals, for this the key to con-

sumer trust in the value of their products. This is the only way to safeguard the future of farming enterprises and to maintain the competitiveness of centres of meat production in the long run.

Der deutsche Verbraucher ist verunsichert. Ständige Medienmeldungen über Schweinepest, BSE, EHEC, Hormone, lange Tiertransporte, illegal importiertes Fleisch, und so weiter - verderben immer mehr Verbrauchern den Appetit auf Fleisch. Der Verzehr sinkt und was auf Dauer noch schwerer wiegt, das Sozialprestige von Fleisch sinkt, da das Image angeschlagen ist. Insbesondere die junge Generation wendet sich vom Fleisch zunehmend ab. Es gibt schließlich genügend Alternativen. Pasta-Gerichte sind “ in “ - leider nur mit kleinen Fleischeinwaagen.

Umgerechnet 20 Millionen Deutsche werden mit Schweinefleisch von unseren europäischen Nachbarn versorgt - mit steigender Tendenz -, denn unser Selbstversorgungsgrad bei Schweinefleisch sinkt auf unter 80 %.

In den europäischen Nachbarregionen Dänemark, Frankreich und Spanien wird die Schweineproduktion deutlich ausgedehnt. In den Niederlanden sinkt die Produktion. Die wirtschaftlichen Schäden der Schweinepest waren so gravierend, dass die holländische Regierung gesetzliche Regelungen zur Produktionseinschränkung erlassen hat.

Auf die grundlegende Frage, weshalb es den inländischen Produzenten nicht gelingt, auf einem unterversorgten deutschen Markt erfolgreich zu agieren, lassen sich folgende erste Antworten geben:

1. Die deutsche Schweinehaltung weist gegenüber den Hauptkonkurrenten, sieht man einmal von den Hochburgen ab, deutliche Strukturnachteile auf. Dies bezieht sich sowohl auf die vorliegenden Bestandsgrößen als auch auf die Erfassung der Tiere und die Abstimmung der Produktionsschritte. Aus den Strukturnachteilen erwachsen zu hohe Kosten bereits in der ersten Stufe der Produktion.
2. Die installierten Schlachtkapazitäten sind nur etwa zu zwei Dritteln ausgelastet. Hieraus resultieren zu hohe Stückkosten. Außerdem sind die Nebenkosten, zum Beispiel amtliche Hygieneüberwachung, Schlachttier- und Fleischuntersuchung im Vergleich zu ausländischen Produktionsgebieten zumeist deutlich höher, woraus weitere Kostennachteile erwachsen.
3. Im Gegensatz zur Geflügelwirtschaft ist es bei der Erzeugung von Schweine- und Rindfleisch erst ansatzweise gelungen, integrierte Produktionssysteme aufzubauen, die eine Qualitätsgarantie und eine Dokumentation der Herkunft zulassen. Auch in den Zentren der Schweinemast ist bis in die Gegenwart vielfach eine ablehnende Haltung gegenüber der vertraglichen Einbindung in Produktionssysteme festzustellen.

Untersuchen wir die europäischen Nachbarregionen dahingehend, wo das Geheimnis ihres Wachstums liegt, so kristallisiert sich im Wesentlichen ein Strukturvorteil heraus:

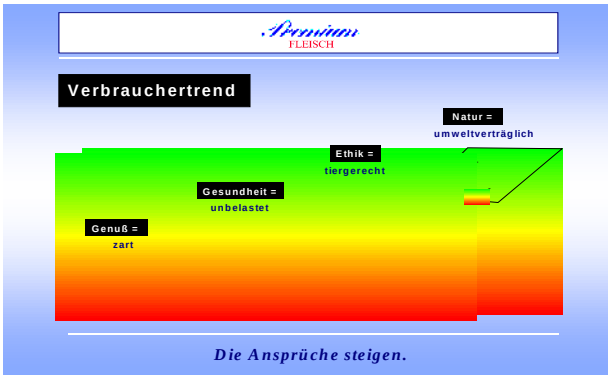
Wer in der Veredelungsproduktion sicher in das zweite Jahrtausend wachsen will, muss Verbundsysteme aufbauen, muss ein in sich geschlossenes integriertes System von der Zucht bis zum Teilstück beziehungsweise SB-Artikel haben. Integrierte Verbundsysteme, so die Erfahrung der Wachstumsregionen, sind nicht **ein** Weg, sondern der ausschließliche Weg, den Verbraucherwünschen gerecht zu werden und die eigene Wettbewerbsfähigkeit zu erhalten.

Warum das so ist, wird aus der Sicht der Verbraucher und zum Vorteil der Landwirte und Vermarktungsunternehmen nachstehend erläutert.

Die Verbraucheransprüche steigen. Wenn wir aus den Schlagzeilen kommen wollen, müssen wir unseren Verbrauchern ein zartes Stück Fleisch bieten, das gesundheitlich unbelastet ist, aus tiergerechter Haltung stammt und umweltverträglich produziert wird (Abb. 1). Eine solche Produktion und Vermarktung brauchen wir nicht als Nische, sondern im großen Stil und zwar aus folgenden Gründen:

1. Zartes Schweinefleisch setzt klare Zuchtprogramme voraus, die von der Vermarktungsseite gesteuert werden und für den Landwirt eine marktgerechte und rentable

Abbildung 1: Verbrauchertrend



Produktion ermöglichen. Zwei bis drei ähnlich strukturierte Zuchtprogramme reichen zum Beispiel in ganz Nord-West-Deutschland aus.

Sie reichen auch aus, um die finanziell notwendigen Mittel für die Zuchtforschung zu bündeln. Aktuell geht es darum, die Fleischqualität und den Genusswert zu steigern. Zusammen mit dem Institut für Tierzucht der Universität Göttingen haben wir, der Verbund Premium-Fleisch AG / VzF / BauernSiegel, mit Unterstützung des niedersächsischen Landwirtschaftsministeriums ein Forschungsprojekt zur weiteren Verbesserung der Fleischqualität im Bundeshybridzuchtprogramm (BHZP) auf den Weg gebracht.

In einem großangelegten Feldversuch über zwei Jahre wurde durch den Einsatz H-stressresistenter Vaterlinien im BHZP die Frage beantwortet, dass wir ohne stressanfällige Rassen auskommen können. Gleichzeitig wurde geprüft, die Schmackhaftigkeit des Fleisches durch eine Erhöhung des intramuskulären Fettgehaltes und eine Änderung des Fettsäuremusters zu beeinflussen.

2. Um den Wunsch der Verbraucher nach gesundheitlich unbedenklich produziertem Fleisch zu erfüllen, dürfen weder die Themen Schweinepest, noch Salmonellen, noch lange Tiertransporte weiter die Schlagzeilen der Gazetten zieren. Gegen eine Schweinepestansteckung mag sich vielleicht ein einzelner Landwirt nicht immer schützen können, wohl aber gegen die Verbreitung über ganz Deutschland.

Die Degenerierung mancher Erzeugergemeinschaften, Genossenschaften oder Viehhandelsunternehmen zu Schweinetourismus-Büros sind Ausdruck struktureller Schwäche und Mitursache für die Ausdehnung von Seuchenzügen. Nur der direkte Tierverkehr in geschlossenen regionalen Produktionssystemen wird auf Dauer Abhilfe schaffen. Die jüngsten Vorschläge der holländischen Regierung zur Neustrukturierung der holländischen Veredelungsproduktion infolge des massiven wirtschaftlichen Schadens von über DM 3,5 Milliarden Gulden in einem Jahr zeigen genau in diese Richtung.

3. Wenn wir das aktuelle Thema Salmonellen erst gar nicht zu einem Thema wer- den lassen wollen, benötigen wir dauerhaft immer wiederkehrende Liefer- und Abnahmebeziehungen zwischen den Landwirten und zwischen den Landwirten und den Schlachtunternehmen.

Ständig wechselnde Schlachtstellen als Abnehmer der Schweine geben den neuen Leitlinien der Bundesregierung zur Minimierung der Salmonellen bei Schweinen keine Chance der Durchsetzung. Für die Fleischwarenindustrie wird die Salmonellenminimierung künftig einen noch höheren Stellenwert einnehmen, da die mikrobiologischen Kontrollen bei den rohen Waren, wie Hackfleisch und frischen Rohwürsten eine wachsende Rolle spielen werden.

Die Fleischwarenindustrie fordert daher organisatorische Änderungen in der Schweineproduktion. “ Stark ausgeprägter Schweinetourismus und Sammeltransporte“, so Professor Gareis und Professor Blaha, erschweren jede Rückverfolgbarkeit der Herkunftsbetriebe, denn “einige wenige Salmonellen positive Bestände, die ihre Tiere diskontinuierlich liefern, sind in der Lage die gesamte Produktionslinie eines Schlachtbetriebes zu kontaminieren“.

Die Tatsache, dass in Dänemark seit 1995 ein systematisches Programm zur konsequenten Senkung des Salmonellenrisikos durch Schweinefleisch mit erheblichem Werbeaufwand durchgeführt wird und dass die seit 01. Januar 1995 zur EU gehörenden Länder Finnland und Schweden bei jedem Fleischimport eine Salmonellen-Freiheitsbescheinigung fordern, hat zur Folge, dass sich auch die deutsche Fleischproduktion verstärkt der Salmonellenfrage annehmen muss, wobei es in erster Linie um Aktivitäten in den landwirtschaftlichen Betrieben geht.

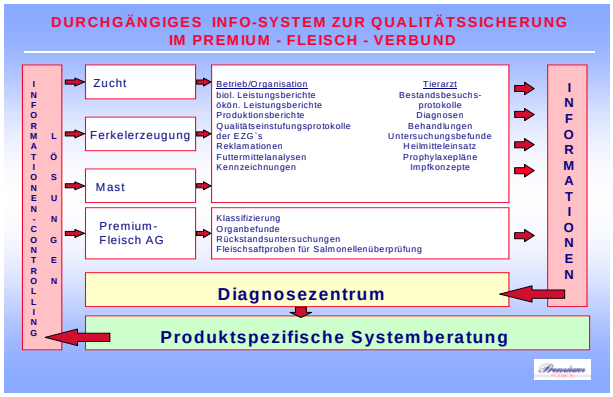
Wenn wir als Vermarktungsunternehmen, Premium-Fleisch AG, zusammen mit dem VzF- und Emsland-Verbund, das Thema angehen, wenn wir auf der Absatzseite für unsere Kunden eine Aussage treffen wollen, die Salmonellen bis auf ein Restrisiko minimiert zu haben, dann geht das nur, wenn wir ausschließlich von Salmonellen-überprüften landwirtschaftlichen Betrieben beliefert werden. Nur dann können sich unsere Kunden darauf verlassen, dass die Salmonellenkontamination auf ein Restrisiko minimiert ist. Sobald aber in das Belieferungssystem Schweinetouristen zugelassen sind, die nicht Salmonellen überprüft sind, dann sind Kontaminationen nicht ausgeschlossen, ist eine glaubwürdige Aussage auf der Absatzseite nicht zu geben.

Das heißt: Sinnvoll ist das Engagement zur Reduzierung der Salmonellen nur für die Unternehmen, die ausschließlich Salmonellen überprüfte landwirtschaftliche Betriebe als Lieferanten haben.

4. Dem Verbraucheranspruch nach tiergerechter Haltung und umweltverträglicher Produktion wird an dieser Stelle nicht tiefergehend behandelt, sondern einige grundsätzliche Bemerkungen genannt.

Grundvoraussetzung für die tiergerechte Aufzucht von Schweinen ist die Gesunderhaltung unserer Bestände. Ein Indikator für die Gesundheit unserer Schweine ist die systematische Erfassung von Organbefunden wie Lungen, Leber und äußere Schäden am Schlachtband. Wenn zum Beispiel eine Gruppe von Betrieben über das ganze Jahr weit über 20 % der Schweine mit Lungenentzündungen aufweist, festgestellt an den Organen bei der Befunderfassung im Schlachthof, dann sind diese Tiere nicht gesund aufgewachsen und der Nachweis über eine tiergerechte Aufzucht fällt schwer. Gleichzeitig haben diese Betriebe - so unsere Auswertung in Kopplung mit den biologischen und ökonomischen Daten unserer Beratungsorganisation VzF-nennenswerte Leistungseinbußen, die einen wirtschaftlichen Erfolg in Frage stellen. Deckungsbeitragsunterschiede von DM 40,—/Schwein zwischen den Betrieben mit gesunden Beständen und den Betrieben mit massiven Problemen sprechen für sich. Deutlicher als mit einem Schlachtbefundprogramm in Kopplung mit den wirtschaftlichen Daten kann der Zusammenhang zwischen tiergerechter Haltung, Tiergesundheit und wirtschaftlichen Erfolg des Landwirts nicht aufgezeigt werden. Um die Ziele zu erreichen, Sicherheit für den Verbraucher, Gesundheit der Tiere, tiergerechte Haltung und wirtschaftlichen Erfolg für den Landwirt brauchen wir durchgängige Verbundsystemberatungsorganisationen, wie wir das mit dem VzF von der Zucht bis zum Schlachthof aufgebaut haben (Abb. 2). Zentral gesteuert, dezentral gehandhabt, aber aus einem Guss und nicht wie mancherorts in jedem Dorf mit einem Beratungsringleiter, der wiederum völlig andere Vorstellungen hat, als sein Kollege im Nachbardorf.

Abbildung 2: Info-System zur Qualitätssicherung



Nur auf der Grundlage ständig erhobener biologischer und ökonomischer Daten lässt sich dauerhaft ein Verbundsystem ergebnismäßig steuern. Wir müssen auf jeder Produktionsstufe, nicht nur für den einzelnen Landwirt, sondern für ganze Gruppen horizontal und vertikal wirtschaftlich erkennen können, ob sich beispielsweise vom Markt eingeleitete Maßnahmen für die Landwirte rechnen und wie die Verteilung zwischen den Gruppen Zucht-, Ferkelerzeugung, Mast und Schlachthof sein könnte. Erfolgsmaßstab für die angestrebte Produktions- und Vermarktungsrichtung ist dabei nicht allein der Preis, sondern ausschließlich der Deckungsbeitrag unter dem Strich für alle Beteiligten.

Auf der Grundlage der Erfüllung dieser Kriterien in der Zucht und der Kriterien zur Gesunderhaltung der Bestände sowie der Organisation im geschlossenen vertikalen Verbund zur Qualitätssicherung lassen sich Fleisch-Markenprogramme für den Bedienungs- wie für den SB-Bereich aufbauen. Das CMA-Prüfsiegel “ Deutsches Qualitätsfleisch aus kontrollierter Aufzucht “ gibt in Deutschland die Standards in Form von Qualitäts- und Prozesskriterien vor. Kontrollen der Futtelmittel auf Leistungsförderer, Medikamente und Schadstoffe sowie Urinproben, jeweils durchgeführt von neutralen Instituten, tragen dazu bei, das Sicherheitsnetz sehr engmaschig zu ziehen.

Aufgeschreckt durch den Dioxinskandal in Belgien im Sommer 1999 hat inzwischen auch die deutsche Fleischwarenindustrie im “ Hertener Aufruf “, vorgetragen durch namhafte Markenartikler wie Herta, Unilever und Stockmeyer, Anfang des Jahres 2000 die Anforderungen an die Rohstofflieferanten formuliert. Diese Qualitätskriterien sind identisch mit den Kriterien des CMA-Prüfsiegels, ergänzt um ein Salmonellenmonitoring, den Nachweis der Organbefunde und als wichtigstes Herkunftskriterium die Chargenrückverfolgung. Hintergrund des engagierten Auftretens dieser namhaften Wurst-Markenartikler ist die Befürchtung, durch Rückstände und Kontamination im Rohstoff etablierte Marken in Misskredit zu bringen, die Werbeaufwendungen in Millionenhöhe auf eine Schlag zunichte machen.

Im Folgenden sind die Risiken für die unterschiedlichen Zielgruppen der Verbraucher für Rohwurst und schwach erhitzte Produkte näher spezifiziert (Abb. 3).

Abbildung 3: Risiken für Verbraucher von Rohwurst

Produkt:	**BiFi**
Kriterium 1:	nicht erhitztes Produkt
Kriterium 2:	Zielgruppe Kinder
Kriterium 3:	hoher Marktwert
Risiko:	**Salmonellen**

Produkt:	**BECEL - Teewurst**
Kriterium 1:	nicht erhitztes Produkt
Kriterium 2:	Zielgruppe alte Menschen
Risiko 1:	**Salmonellen**
Risiko 2:	**EHEC**

Produkt:	**Du Darfst**	**- Salami** **- Cervelatwurst** **- Teewurst**
Kriterium 1:	nicht erhitztes Produkt	
Kriterium 2:	Zielgruppe junge Frauen	
Kriterium 3:	hoher Marktwert	
Risiko 1:	**Listerien führen zu Abortus**	
Risiko 2:	**Salmonellen**	
Risiko 3:	**EHEC**	

Fazit:

Offensives Marketing für Frischfleisch und Wurstwaren in Form von Markenprogrammen und Markenartikeln brauchen als Hintergrund Qualitätskriterien, die ein Höchstmaß an Produktsicherheit bieten und vertikale Prozessabläufe von der Zucht bis zum Verkaufspunkt in geschlossenen, hygienisch gesicherten Ketten voraussetzen.

Die im CMA-Prüfsiegel festgelegten Qualitäts- und Prozesskriterien sowie die im "Hertener Aufruf" für die Fleischwarenindustrie spezifizierten Qualitätskriterien (Abb. 4) werden in Deutschland nachweisbar und dokumentierbar erst mit 5 – 10 % der produzierten Schweine erfüllt. Dabei ist das Salmonellen-Monitoring noch außen vor, das in Deutschland erst von wenigen Unternehmen,

Abbildung 4: Qualitätskriterien

wie zum Beispiel von der Premium-Fleisch AG, umgesetzt wird. In Dänemark gilt die Einhaltung dieser Qualitätskriterien einschließlich des Salmonellen-Monitorings für alle, das heißt für 22 Millionen produzierte Schweine. Der Verzicht auf den Einsatz von Tiermehl im Schweinemastfutter, übrigens eine Forderung im " Hertener Aufruf", wird bisher nur von einigen wenigen Unternehmen erfüllt.

Die Schlussfolgerung im Vergleich der Kriterien zwischen den Anforderungen Dänemarks, des CMA-Prüfsiegels Premium-Programms lautet:

Die Erfüllung der dänischen Kriterien und damit auch des CMA-Prüfsiegels ist europäischer Benchmark, Maßstab für die europäische Wettbewerbsfähigkeit und Voraussetzung für die internationale Wettbewerbsfähigkeit auf den Wachstumsmärkten Südostasiens. In Deutschland müssen durch den Aufbau von Verbundsystemen sehr schnell die strukturellen Voraussetzungen geschaffen werden, diese Qualitätskriterien zu erfüllen, um die heimischen wie auch die Exportmärkte nicht leistungsfähigen Verbundsystemen der Nachbarländer zu überlassen.

The Strategy of the Danish Pig Meat Sector

Per E. Sørensen

Slide 1

Slide 2
Danish

Ladies and Gentlemen,

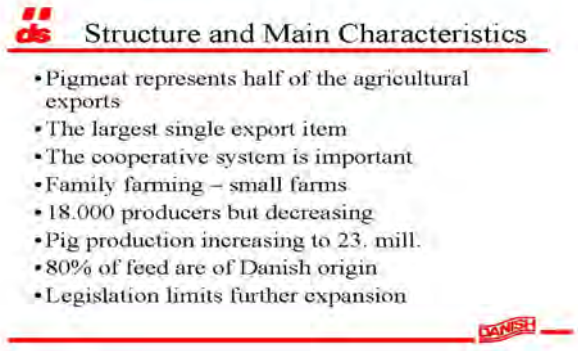
First of all I would like to take this opportunity to thank you for inviting me to speak at this workshop today. I expect to have an interesting discussion with the other participants who are present today and tomorrow.

I have been asked to cover subjects as how the Danish pork industry deals with issues related to product quality and safety assurance, which of course is closely related to how we respond to existing and future consumer concerns.

There is no doubt that food safety is a very hot topic these days, and I am sure that this will also be the case in the future. A lot of decisions and proposals are being made both on national and on international levels, which already today have an impact in the way we produce and market our products.

I would like to begin my speech today with a short presentation of the Danish pork industry because this is a recondition for understanding our possibilities to deal with the current and future challenges on product quality an safety assurance.

Slide 3
Structure and Main Characteristics



As you know, agriculture is of vital importance to the Danish economy. Pigmeat exports represent almost half of the agricultural exports with a value of 22.5 billion Danish crowns last year. Pigmeat is the largest single item on the list of Danish exports.

The cooperative system plays a significant role in Danish agriculture and especially in the Danish pigmeat sector.

The cooperative system was introduced in Denmark more than hundred years ago, and is the main reason for the current strength of the Danish agricultural sector. Nowhere is this more apparent than within the Danish pigmeat sector. I think that this is what is often regarded as the "Danish Model" by our competitors.

Pig production in Denmark is based on family farming, and less than 100 pig producers supply more than 10.000 pigs a year. 84% of the production stems from less than 6.000 (29%) of the producers, each delivering more than 1.000 pigs per year.

The number of pig producers in Denmark has fallen drastically over the last 25 years. It has now dropped further to about 18.000, and 10% is going out of business each year.

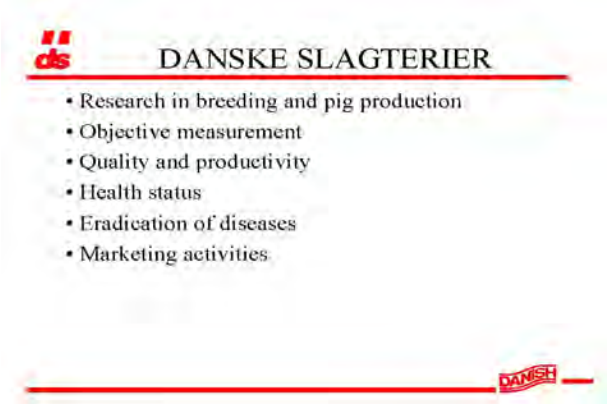
The number of slaughter pigs produced has increased considerably over the years. From a production of 9 million pigs in 1975, production has increased to the present level of 23 million pigs.

With regard to feedstuffs, you might be interested to learn that around two thirds of the feed used by Danish pig producers are grown on their own land. The basic source of this feed is barley and wheat, but soy, soy cake and other supplements are also added. Approx. 80 per cent of all the feed used by Danish pig producers is of Danish origin.

Environmental laws in Denmark state that a certain amount of farmland is required for every animal unit produced. These regulations, which have been in force since 1986, also require that farmers have sufficient storage capacity for manure. The regulations also include a number of other specific requirements, aimed at limiting the environmental impact of pig production. These regulations, together with other agricultural regulations, put a strict limit on the further development of production, structure and size.

All elements associated with pigmeat production in Denmark are controlled and managed by the cooperative companies. The existence of a central organisation, DANSKE SLAGTERIER (The Danish Bacon & Meat Council), that links together the cooperative companies, ensures that joint strategies and actions can be followed.

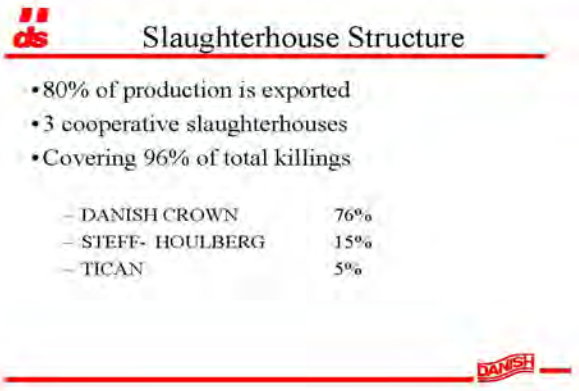
Slide 4
DANSKE SLAGTERIER



The cooperation taking place between the Danish slaughterhouses has led to joint activities in the following areas:

- research and development in breeding and pig production
- development of methods and equipment for the objective measurement of meat percentage and weight
- research and development with respect to quality and productivity
- projects to protect the high health status
- projects to eradicate diseases which can affect production economy and also diseases contagious to humans, such as salmonella
- marketing activities and marketing research
- and finally, joint projects to improve animal welfare

Slide 5
Slaughterhouse Structure



Today, there are three cooperative slaughterhouses, and although they cooperate in all these areas, they compete fiercely on the various markets inside and outside the EU.

Approx. 80 per cent of production is exported, and this makes Denmark the largest exporter of pigmeat in the world.

The three Danish cooperative slaughterhouses and exporters, Danish Crown, Steff-Houlberg and Tican, are responsible for 96 per cent of total slaughterings.

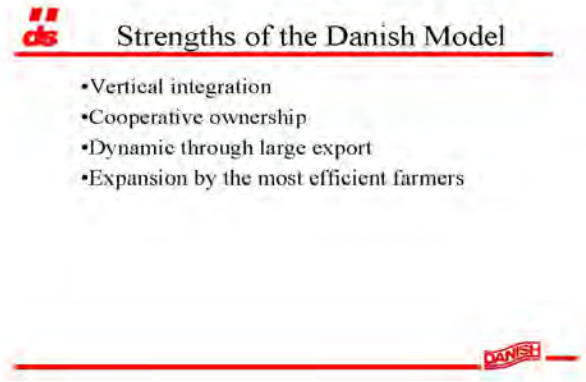
Danish Crown is the largest company with a share of 76 per cent of the killings, followed by Steff-Houlberg with a share of 15 per cent while Tican, the smallest company, is responsible for 5 per cent of the total pig killings in Denmark. The three slaughterhouse companies own 22 slaughtering plants and a number of processing plants of various kinds.

Slide 6
Export 1999

In 1999 we exported 1.474 mio. tonnes of which 890.000 was exported to other EU-countries and the remaining 584.000 tonnes to the rest of the world.

The most important countries receiving our products in the EU are Germany, UK, Italy and France, and outside the EU, Japan, United States, Russia and Korea are the most important markets. The main product category is fresh or frozen customized cuts and furthermore bacon and processed products.

Slide 7
Strengths of the Danish Model



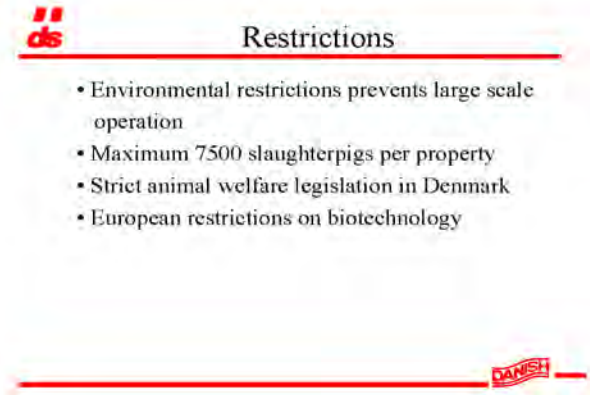
I think that the "Danish Model" is one of the reasons why the Danish pig producers in general have been able to survive the crisis we have faced in the pigmeat sector the last couple of years and which we have yet to overcome.

Firstly pig prices in Denmark do not fluctuate as much as in other pig producing countries. Due to the cooperative system the pig producer and the slaughterhouse have the same and only interest namely to optimise the price to the benefit of both parties. The profit of the slaughterhouse has to be given back to the owners - i.e. the pig producers - so the slaughterhouse can not take advantage of a big supply and make profit at the expense of the pig producer.

Secondly we are not as many other pig producing countries dependent on a domestic market taking the majority of the production. As mentioned 80-85% of our production is exported to a lot of different markets. This mix of markets makes prices more stable.

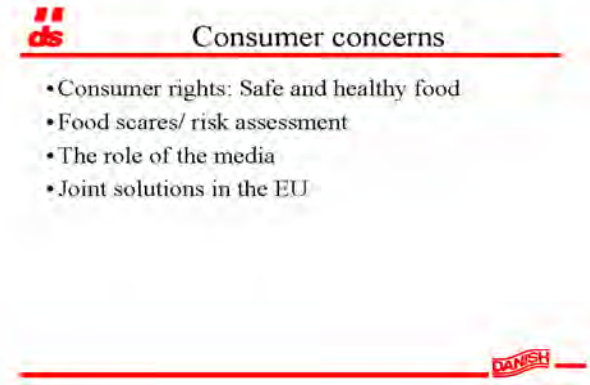
Another reason for the actual survival of the Danish pigmeat industry is that the pig producers which are really expanding are the 20-25% most efficient ones.

Slide 8
Restrictions



But we must also face a number of restrictions, for instance regarding the environment. Also concerning animal welfare the national legislation is getting tougher and tougher. On biotechnology the EU have also made restrictions and thereby stopping or at least postponing the breakthrough for GMO's.

Slide 9
Consumer concerns



Response to consumer concerns on food safety issues

Coming now to the next part of my speech namely our response to existing and future consumer concerns on product quality and safety assurance I will start by saying that never have food safety in general been discussed more than it is now. This goes for health, safety, how we produce the products, origin, transportation, etc. in other words from stable to table.

However I think it is important to reflect on the definition of food safety, in other words you could ask the question what is food safety? A simple answer could be food, which is safe to eat. In order to make this guarantee, I believe it is extremely important to look at every single step in the food chain, not only from producer to supermarkets but also the way people handle food products privately in their kitchens.

Consumers and consumer related organisations are becoming more and more important, as to how food is produced, and we believe that consumers have the right to be guaranteed safe products.

In the last decade we have been confronted with a lot of food scares and scandals such as BSE, other animal diseases, dioxin-crisis etc. Furthermore the introduction of new technologies such as the use of GMO's, have added to uncertainty among consumers. However it also seems to me that a significant part of the uncertainty among consumers is caused by the lack of transparency in legislation related to all the chains in food production. Also misunderstandings related to the risk assessments caused by the media mixing up things. During the dioxin-crisis in 1999, the Danish food safety system proved it's effectiveness, since it took us less than two weeks to prove that no Danish feeding stuff was contaminated. The ability to act quickly on traceability is in my opinion extremely important in order to restore consumer and client confidence.

The ever increasing trade cross boarders, means that food safety cannot only be solved on national level. Today most of the European market for food is covered by EU-legislation and rules in United Nation's Codex Alimentarius.

International cooperation is essential in order to improve consumer confidence cross boarders but also to avoid lack of coordination and action when food scares hits cross boarders.

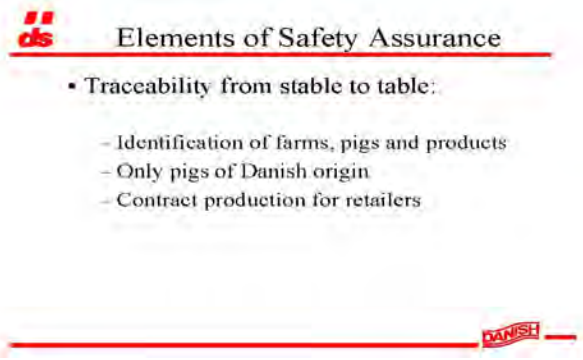
As you are aware the European Commission has as a response proposed in the so-called White Paper on food safety the establishment of an independent European Food Authority in order to be able to react faster and more streamlined to different issues related to food safety in the future.

The principal objective- as defined in the White Paper - of a European Food Authority will be to contribute to a high level of consumer health protection in the area of food safety, thorough which consumer confidence can be restored and maintained.

In general we support this initiative from the Commission, and it seems to me that most of the subjects mentioned in the White Paper, are very much in line with the priorities we have had in Denmark for years. However we believe it is essential that all members of the European Union support it actively, and only if the member states show real interest in involving this new Authority in their work, it will be successful.

In the EU, the discussion of full traceability is becoming more and more intensified, especially for beef.

Slide 10
Elements of safety Assurance



Traceability from stable to table

Because of the vertical integration in Denmark we are able to deliver traceability from stable to table and back again. The key elements are that we only use pigs of known, Danish origin and we have a central holding register covering all farms. We identify pigs when they are moved, either between farms or when delivering to the abattoir. We have no open markets in between. On the abattoir the traceability is maintained through a system of codes.

We have introduced contract productions with premiums to the farmers and along with these goes a traceability set-up as well as independent audit.

For feedstuff the authorities are responsible for the control of ingredients and quality. Also the traceability issue is more and more in focus here.

The results of the quality control is published regularly as a name-and-shame list identifying the feed companies in question.

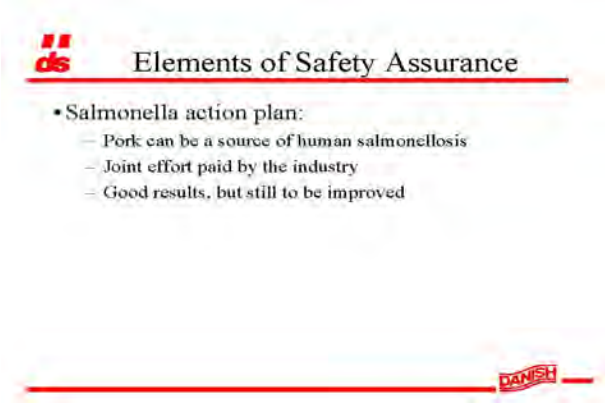
In 1998 the Danish Government completed a report on food safety highlighting the priorities within food safety. This plan is very much in line with our efforts and priorities.

The general food safety plan from our government consists of following elements:

a) Reducing the number of salmonella incidents.
b) The level of other food borne diseases, should be kept at the current low level
c) The use of antibiotic growth promoters should be prohibited in the European Union
d) The use of antibiotics or other medicine in animal production shall be reduced
e) Food products shall be free of pesticide residues and other chemical pollutions
f) The use of additives shall be reduced
g) Peoples overall diet/nutrition should be improved

I will explain in detail the most relevant issues today.

Slide 11
Elements of Safety Assurance
Salmonella action plan

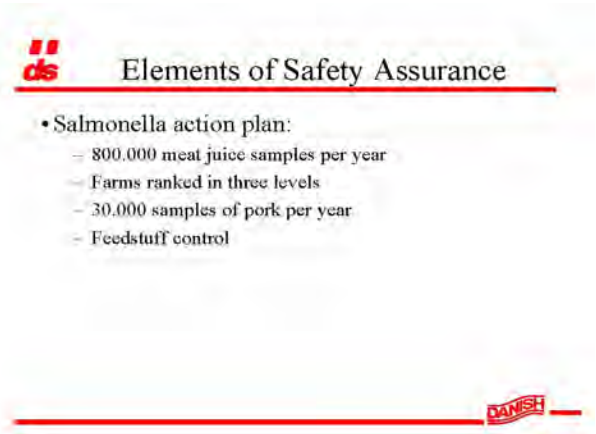


Salmonella

I will start with addressing the salmonella issue. In 1993 a national programme was introduced in Denmark for the surveillance and control of Salmonella in pigs throughout the production chain.

The Danish Salmonella action plan initiated in 1993 included monitoring of animal feeds for salmonella bacteria, breeder and multiplier herds for salmonella antibodies, slaughter pig herds for salmonella antibodies and slaughter under increased hygienic precautions. It also undertook monitoring of the prevalence of salmonella in pork.

Slide 12
Elements of Safety Assurance
Salmonella action plan



In January 1995 a serological surveillance of slaughter pig herds began. This was conducted on herds producing more than 100 slaughter pigs per annum which amounts to around 16.000 herds representing 98% of all Danish slaughter pigs. The number of meat samples taken was dependent upon the herd size but more than 800.000 meat samples are analysed every year.

Based on the results of the preceding three months' meat sample tests the herds are ranked at one of three levels. A level 1 standing indicates no or very few reactors and no intervention in the herd is required. Level 2 signifies a higher proportion of reactors. The producer is then immediately required to seek advice on how to reduce the salmonella prevalence in the herd. Level 3 indicates an increased number of reactors and the producer is required to seek advice and the pigs are slaughtered under increased hygienic precautions. If the farmer doesn't take action, a series of penalties will follow.

Today 97% of all herds are in level 1, only 2% in level 2 and less than 1 is categorized as level 3 herds. In other words, we have just above 100 farms in level 3.

In addition to herd surveillance Danish Bacon and Meat Council also monitors salmonella in fresh pork, offal and meat for processing. Nationally, approximately 2.200 sam-

ples of pork are examined every month; the number of samples per plant is proportional to the number of slaughtered pigs. As a result of this Salmonella Action Plan , salmonella is currently found in just around 1% of pork sampled from the Danish slaugterhouses.

Feeding stuffs

All Danish feed compounders are routinely monitored for Salmonella by the authorities. Monitoring includes routine sampling of compound feeds during feed processing and from feed materials, including raw materials of animal origin. The Danish authorities collect samples of feeding stuffs from the production plant and retailers. The number of samples depends on the size of the production, but is increased if Salmonella is detected in samples other than raw materials.

We will in Danish Bacon and Meat Council continue to do our utmost in order to decrease the number of salmonella incidents, but to completely remove the risk will be impossible. The target of our government of reducing the occurrence of salmonella in pigmeat to half of the current level in year 2002, is very ambitious, however we still believe it is realistic.

In order to improve the situation even more, Danish Bacon and Meat Council, are putting a lot of pressure on the European Commission in order to get other member states to implement the current EU-Directive on zoonosis, since only few members have implemented the directive into national law. We insist that the harmonised rules should be fixed at a high level of protection and it should cover all meats poultry, pigs and cattle. If this directive is not implemented, it will be difficult for the European Union to refuse imported product on the basis of these grounds.

We also see other bacteria and food borne diseases, and so we have the HACCP system in place in the plants as another element of good manufacturing practice.

Antibiotic resistance

The next important subject I would like to address is antibiotic resistance.

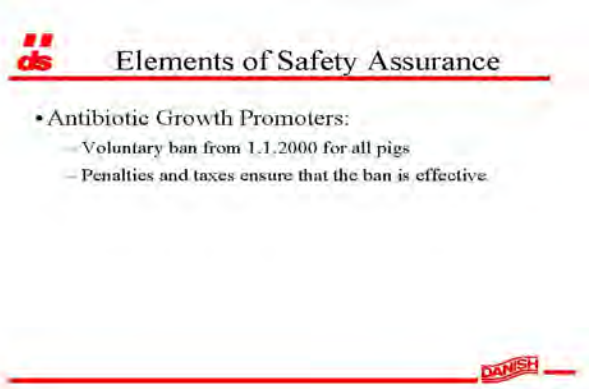
The use of antibiotics in feeding stuff is very important issue of consumer concerns. Antibiotics have been used as growth promoters in animal feeding for several decades.

Now there is widespread concern that the growing incidence of antibiotic resistance, particularly in bacteria, represents a major threat to the effectiveness of antibiotics as agents for controlling pathogens.

The world-wide concern that the widespread use of antimicrobial agents in animal production may promote resistant bacteria or genes that can be transferred to bacteria pathogenic to humans, lead the Danish Ministry of Food, Agriculture and Fisheries to set up a collaborative programme for the surveillance and research of antimicrobial resistance, the "DANMAP".

Slide 13
Elements of Safety Assurance

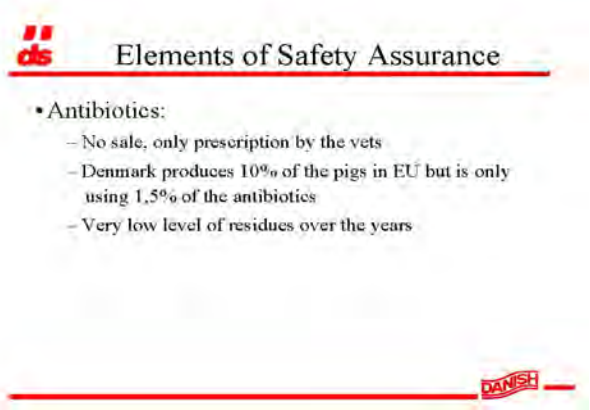
Antibiotics Growth promoters



Danish Bacon and Meat Council decided last year voluntarily to ban all use of grow promoters in animal feed as from the first of January this year. The uncertainty among consumers – particularly in Denmark - concerning the use of antibiotics in feedstuff convinced us that a complete ban was the most optimal thing to do. We are aware that some producers do have problems in getting the pigs to gain weight, but our organisation is advising the farmers about how to handle the problem, typically diarrhea.

Slide 14
Elements of Safety Assurance
Antibiotics

Controls on the use of veterinary medicines



In Denmark all antimicrobials used in therapy are "Prescription Only Medicine" and must be distributed through pharmacies. The pharmacy sells medicine either to veterinarians for use in practice, or directly to the farmer on presentation of a prescription.

All veterinary medicines must be registered by the Danish Medicines Agency, and all manufacturers and importers are obliged to provide an annual feedback on the quantities sold to this agency.

The use of antibiotics in production animals is very strictly regulated, in order to protect consumers against residues and the development of antibiotic resistant bacteria.

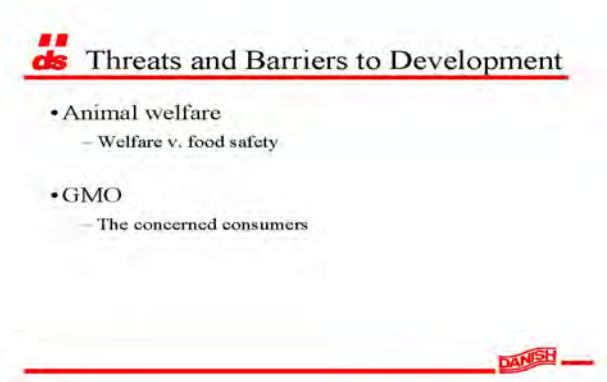
Antibiotics used for therapy can only be prescribed by the herd veterinary surgeon when a diagnosis has been showing or indicating a bacterial infection. The veterinary surgeon is not allowed to sell medicine and, as a consequence of that, not allowed to gain profits through selling medicine.

A total separation of veterinary advice by the veterinary surgeon and selling of medicine by the pharmacists has been one of the most effective ways of regulating the use of antibiotics in Denmark. The veterinary surgeon no longer has an economic interest in prescribing more medicine than needed and the farmers know can't coerce the veterinary surgeon into selling medicine. The total consumption of antimicrobials for treatment of food animals has fallen by approx. 25% from 1992 to 1999.

When looking at antibiotic residues in pigmeat the number of positive samples are extremely low. In 1999, Danish Bacon and Meat Council sampled 21.154 pigs out of a total of 20.4 million slaughtered for antibiotic residues and found only 4 positive samples (0.02%).

Another area, which also seems to be related somehow more subjective to food safety are areas such as animal welfare and use of new technology.

Slide 15
Threats and Barriers to Development



The requirements concerning animal welfare are currently becoming stricter, and individual EU countries are leading the way with requirements that go further than the common EU- rules. This is notably a northern European problem, and for countries such as Denmark and Holland it creates problems for competitiveness as improved animal welfare costs money. In the White Paper there is a link between animal welfare and food safety, which has not been proved scientifically. On the contrary there are many examples that animal welfare increases the risk of diseases in particular when looking at the fight against zoonosis, where the prohibition on slatted floors and spreading of straws has a negative impact on food safety. Therefore I believe even though animal welfare is becoming an important sales parameter in some countries in particular the U.K. it will be a big mistake to equate animal welfare with food safety. Furthermore it is partly an issue of distorting competitiveness in relation to southern Europe where a similar tightening of the regulations is not taking place, but especially with regard to exports out of the EU. Animal welfare legislation must be observed, regardless of whether the markets the meat is being exported to demand this special dimension of quality. For example, in Japan and Korea we compete with local production and imports from e.g. the USA, where animal welfare is currently not an issue.

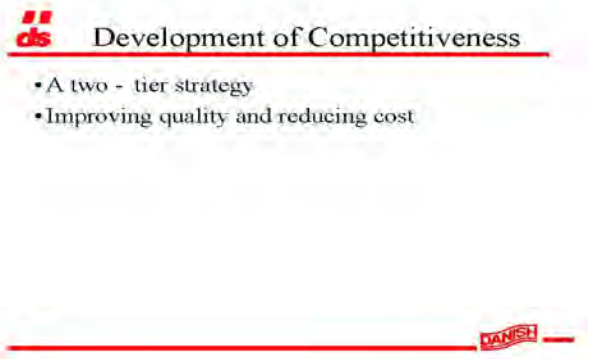
- Consumer concerns about biotechnology in Europe, in terms of environment, health and other issues have tended to focus on foodstuffs. The use of biotechnology in other sectors is less apparent and tends to present a different risk/benefit aspect. No matter which side you represent in this debate, I will dare to say that the introduction of GM food and food ingredients in Europe has been disastrous for everybody: producers, industry and consumers. It has undoubtedly added negatively to the food safety debate, even though it seems that there is no inherent general risk to human health in the use of these products. In light of this, the European Commission last summer decided to put into force a moratorium, which has brought all new applications on setting out different genetically modified crops to a stand still. We believe this negative attitude towards this new technology is another serious threat for the European farming and foodstuff industry since they are being restricted in their exploitation of the possibilities presented by biotechnology.
  Danish agriculture firmly believes that modern GM technology is part of farming of the future. We have made this opinion public. But, today, it is extremly unclear when we can work from this position.
  Consumers, especially those in northern Europe, re-

gard GM technology as being too full of risks. We have not been sufficiently clever in talking about the advantages for consumers, and the media have not been helpful.

Unfortunately, in the battle to win consumer confidence, several dominant retailers in Europe have, as you perhaps know, promoted themselves as being anti-biotechnology, and changes in consumer attitudes will to a large extent depend on the position these chains decide to adopt in future.

The danger with the European attitude towards biotechnology is, firstly, that we thereby hand over this interesting area of research and development to others and secondly, that we forfeit the possibilities we have for solving some of the problems that farming will face in future.

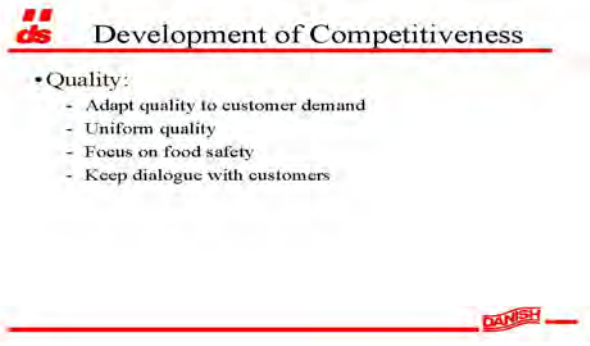
Slide 16
Development of Competitiveness



In the light of the intensifying competition, which is expected on the world market, particularly from the US, we need to plan a two-tier strategy to develop the competitiveness of the pigmeat industry. We have to aim at increasing competitiveness with regard to both price and quality.

Competing on quality depends on continuous activities in the industry in areas such as:

Slide 17
Development of Competitiveness



Quality

Adaptation of technological quality and eating quality to customer demands. This is an area where we are strong, thanks to the cooperative structure which enables customer demands to be communicated to all parties in the pigmeat chain. Well-functioning payment systems ensure that the necessary changes are quickly effected.

- Uniform quality. On this point we benefit from both uniform supplies from the producers and good butchery.
- As I have already mentioned increasing importance is being attached to quality control, food safety and traceability. Food safety is one of the most important issues in food production, clearly illustrated by different food safety scares over the years. Our efforts are concentrated in areas such as foreign bodies, residues and pathogenic bacteria.
- It is an important part of our quality strategy to encourage dialogue and close cooperation with customers within retail, processing and catering about both product development and marketing.

The other part of the Danish strategy is to keep costs down. Therefore projects in the individual companies, as well as joint projects, are aimed at:

Slide 18
Development of Competitiveness

Reducing costs

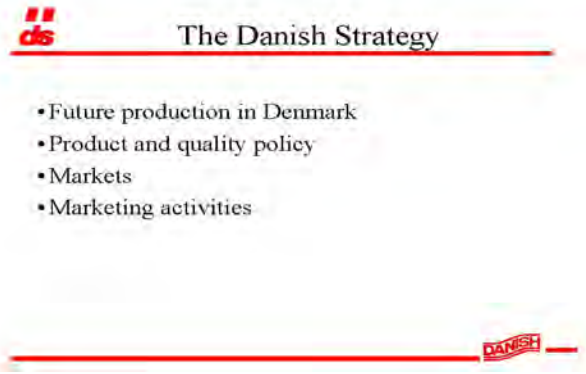
- Optimising yields, including systems for the sorting of raw materials and the monitoring of yields and performance of individual employees. Training and supervision is also an important element in maintaining a high level in production yields.
- The automation of processes in slaughtering, cutting and meat processing. The falling number of young people and the large departure of older people at

slaughterhouses in the coming years necessitates increasing automation. In addition, tougher rules governing the working environment, hygiene regulations, demands for animal welfare and traceability all contribute to the industry's reliance on automation as the way forward. There are developments underway involving projects costing in the region of 200 Mill. DKK over the next 5 to 6 years.

- Simplifying product ranges. This allows the advantages of large-scale production to be realised in the form of low unit costs. This is a tough area as the demands of the supermarkets for continual product development and innovation lean towards smaller runs and more frequent production changes.

Even with the successful implementation of the above-mentioned projects, the export of Danish pigmeat will face considerable difficulties when competing on the world market, particularly in relation to US and Canadian exporters. The other EU exporters will have similar problems. Many of the extra requirements and legally based production conditions will entail extra costs.

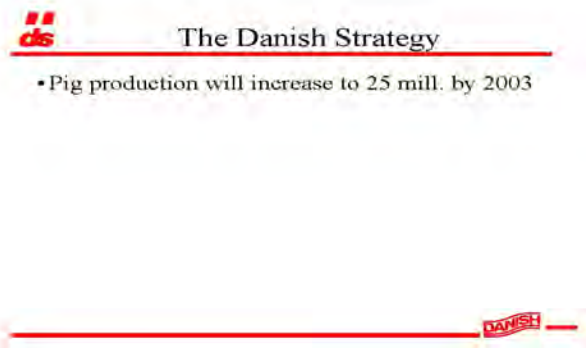
Slide 19
The Danish Strategy



Future production in Denmark

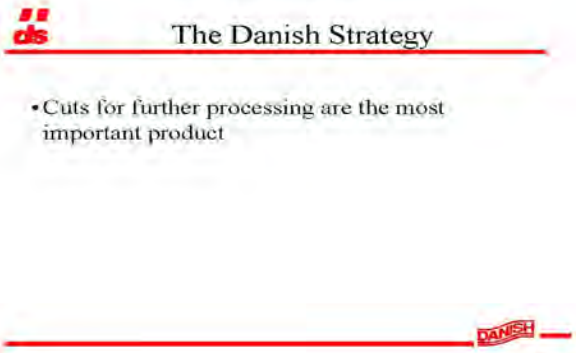
The strategy for the Danish farmers and the abattoirs consist of the following elements.

Slide 20
The Danish Strategy



Firstly we will expand production in the coming years

Slide 21
The Danish Strategy



Secondly we will keep the focus on export of cuts for further processing, but also increase the export of processed products.

Slide 22
Future Exports Markets

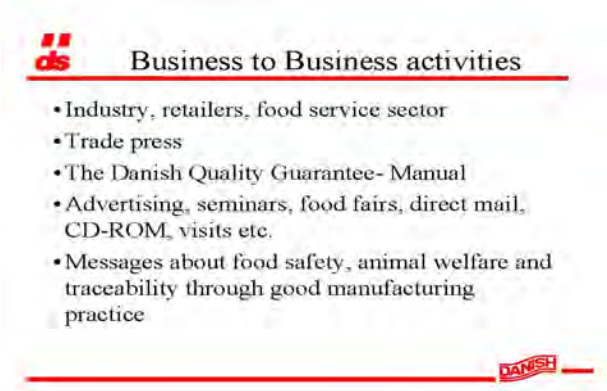
The share of the different markets in the future is estimated to be 2/3 for EU and 1/3 for the 3rd countries.

Slide 23
Marketing Activities

Despite the fact that the Danish slaughterhouse companies compete on the individual export markets there has for decades been a strong sense of unity concerning the development of a good image for the Danish pigmeat products.

The reason for this has been, and still is, that Danish pigs are of a very uniform quality because the collaboration that has taken place with animal husbandry, research and experimentation, technological development of machines and equipment, quality management systems, etc., has been very extensive. The joint marketing activities are rooted way back in the advertisements for bacon in the UK in the 1960s, when the DANISH logo achieved a strong position by the consumers which has been maintained to this day.

Slide 24
Business to Business activities



On the main business-to-business markets DBMC is building up the Danish image with the industry, the retailers and the food service sector. Furthermore we deal with the press on PR-issues. The activities consist of face to face contacts as well as advertising, newsletters, manuals, CD-ROMs etc. The messages are naturally about welfare, safety and quality assurance.

All in all we have been building up a market position on the main markets, where we – according to our surveys – are seen as the foreign supplier with the best esteem. But we also know that we must defend our corner everyday.

Thank you for your attention.

Resolution - Workshop 3 of the Virtual Conference "Sustainable Animal Production"

Vechta, June 23, 2000

The meeting used the following framework for its discussions:

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs",

and in more detail
"Improving the quality of human life while living within the carrying capacity of supporting ecosystems, with sustainability being defined as a characteristic of a process or state that can be maintained indefinitely".

The participants of Workshop 3 therefore declare that pre-harvest food safety measures and on-farm quality assurance procedures are indispensable components of the concept of sustainable animal production.

These pre-harvest food safety measures complement the traditional tools of food hygiene and the increasing use of science-based risk management principles, such as HACCP, in the harvest and post-harvest areas of the food chain. They are targeted at the protection of the population against chemical and antimicrobial residues, food-borne pathogens and bacterial resistance to antimicrobial drugs.

The on-farm quality assurance procedures turn livestock producers from anonymous suppliers of an indistinguishable raw product into identifiable, non-replaceable partners of distinct food production chains. They are targeted at the implementation of specific certifiable standard operating procedures (SOPs) at farm level (including application to farm input suppliers such as feed mills), which will improve the quality and marketability of the product, and improve the compliance of the production procedures with the latest knowledge on environmental protection and animal well being.

There is growing societal unease about agricultural production procedures (due in part to lack of knowledge and understanding in urban populations), and dissatisfaction with governmental single-point inspection systems. There is a clear need to provide transparency of production procedures, effective control of food-borne hazards through the full production and marketing chain, and traceability of end products back through the production chain to the farm of origin.

Development of systems to achieve these goals should be the major objective of any effort to implement food safety and quality programs through the total chain, including pre-harvest food safety and on-farm quality assurance programs

Such an approach will work most effectively if based on a partnership strategy, in which producers and processors work together to achieve food safety and quality objectives, subject to official oversight and audit of the activities.

The development of this approach will be best achieved through the formulation, implementation and practical evaluation of systems which can provide an initial working model of the approach. This first example can then be progressively enhanced to cover all of the essential features of an effective food safety and quality system.

This will require research on:

1. Identifying what "action packages" of measures are required to deal with each of the specific food safety hazards of importance to human health, including the capacity to adapt the approach to varying needs and goals.

2. Developing information tools and systems which can be effectively integrated into the production and processing chain, in order to achieve food safety and quality objectives.

3. Evaluating how best to integrate such systems in a cost-effective way into the food chain, such that benefits flow to chain participants who contribute to the success of the system.

General evaluation of forum 3 and workshop 3

Speakers, participants, and organisers of the forum and the workshop agree, that:

- both were very valuable in bringing farmers, politicians, people from the industry and from administration as well as scientists together to discuss the future development of production systems,
- the papers presented, the discussion of these papers, and the final meeting of speakers and experts contributed to the insight that a global convergence with respect to visions of the future development of production systems can be observed,
- that the results of both, forum and workshop, will play an important role in the development of a global vision of modern intensive animal production that is grounded in scientific facts and is committed to finding solutions for the world food crisis.

Basic Paper

Conference:
Forum 3: Product Safety: Basic Paper

A.A. Dijkhuizen, H.-W. Windhorst

Food production systems are developing continuously. Increasing demands are being put on both the product and the production process. These demands seem to be related to the wealth of the people and (hence) will further increase in future. Questions that arise are how far and in what way they will develop, and how the livestock farmers and industry should anticipate.

In 1998 Thomas Urban wrote an interesting and challenging paper on this subject in Choices, a semi-scientific journal of the US agricultural economists. He stated that over the next 25 years a food system will develop (that he called the Prescription Food System) that will make the present system primitive, unorganised, and unregulated. He predicts a significant shift in consumer attitudes, buttressed by research discoveries, that will move the traditional commodity-based food production system into a prescription system. Consumer expectations for food are already beginning to include standards which reflect safety, health, and the environment.

Cost, taste, and availability, the traditional elements of food preferences, are still important and will continue to be, but the future structure of the world's food system will primarily be patterned after pharmaceutical standards for research, production, distribution, and pricing. The operating and structural consequences of this significant shift will be extraordinary for each step in the development, production, distribution, and purchase of food, according to Urban.

The key elements in his prescription system are transparency and traceability. The consumer will expect to be able to trace each food item back to its earliest production step. This is a revolutionary change in the world's food system. The purchaser of a sirloin steak will know which animal it came from, with what and how the animal was fed, the range or confinement growing conditions of the animal, and how the animal was slaughtered and packaged. This process can in essence be considered a prescription for a sirloin steak, and similar prescriptions will be required for all foods (meat, grains, vegetables, and fruits - fresh and processed), according to Urban.

The first driver behind this system is our heightened sensitivity to food-borne diseases. Our concern for health, the perceived relationship between diet and disease, and production practices and diseases (pesticides and herbicides) have increased consumer sensitivity. The second driver is our increasing concern for animal welfare and the environment. The recognition that the 'how' of food production has significant consequences in this respect. The third driver, according to Urban, is that as we begin to develop specific genetic profiles for individuals, we will relate those profiles to nutritional needs. We then have the ability to 'prescribe food', as we do that today for obesity, high blood pressure, allergens, and diabetes.

The consequences of these changes for the players in tomorrow's food system will be enormously. A farm may well come to resemble a drug manufacturing site, albeit still open to the weather, requiring detailed record keeping and restrictions on the choice of inputs and practices. Each farm will be required to provide transparency and traceability to all of its inputs (saleables, crops, and animals), as well as its waste (water, manure, and unused roughage). The government will require that waste be chemically analysed and its further use follow prescribed procedures. Food processors will be required to look very much like a pharmaceutical manufacturing, taking the product from the farm along with the accumulated records and continuing to document the process, thereby describing traceability and transparency. These same control and identification procedures will be required in each step until the product reaches the consumer. The consumer will be able then to trace all foods back to their origins. Such changes will require significant upgrading of the professionalism, talents, and expertise at all levels of the food system. The need for traceability and control will be re-

inforced by liability issues that expectations of consumers will generate. Information management and quality control issues will speed the integration of farmers. Those who do not meet the new demands will be rapidly removed from the system. Those who adapt will remain.

Urban expects these changes to be global in nature. As food is produced world-wide, these new standards will also quickly be required in the developing world which aspires to be part of the world food system. The unease present in consumers' minds over problems with imported foods is pushing the system toward 'international traceability'. Modernisation and industrialisation of agriculture have come rapidly, but these changes will pale in significance to the changes driven by the changing consumers' definition of food from commodity to prescription.

Urban's thoughts raises a number of interesting question to discuss, such as:

1. Do we agree with him, and if not, what food production system(s) do we foresee?
2. What are the major missing links in our current system(s) that we should overcome when moving toward more consumer concerns and requirements?
3. How to fill the missing links, what are the costs, and who will pay for this?
4. Meeting the more strict demands on food safety will certainly ask for the implementation and use of more high-tech tools in livestock farming. How to combine this with the wish of the public in various countries to move towards more natural and animal-welfare friendly production circumstances?
5. What do such new developments mean for the geographical spread / location of farming and agribusiness activities?
6. What do such new developments mean for the future organisational patterns of animal production? Which role will farmers play in the developingproduction systems?
7. What impacts will the new developments have on the distribution systems for food, especially for animal products?

A. A. Dijkhuizen
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