<u>Integral quality assurance in slaughtering and cutting</u>

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SUMMARY: Integral quality assurance from the farmer to the consumer is a challenge for livestock and meat industry. Quality assurance means basically that potential quality problems are identified and appropriate control measures are taken in all stages of the meat chain. In this paper an overview is given of new developments in identification, information and quality control.

To optimize the overall production chain identification, process and product data can be collected by Electronic Data Interchange (EDI). Interactive implantable chips, video imaging and voice recognition are possibilities for automatic communication to provide relevant and real-time information for management and employees. By using data processing systems activities such as planning, costing and product handling can be carried out more efficiently.

In quality control blood analyses can serve as a tool for a animal health monitoring and surveillance system. Improvements in hygiene, pathogen and antibiotic sensors can contribute to rapid product and process information.

INTRODUCTION: Future developments in pig (meat) processing will be stimulated by:

- legislation (environment, health care)
- consumer behaviour (quality, price, the need for "new" products, attitude towards the meat industry, animal welfare)
- the availability of new tools (robotics, sensors, information technology).

It is important for the management to keep in touch with these continually changing aspects and to develop a dynamic innovation strategy. Very close cooperation with experts from research centres and engineers is necessary.

A good balance between the necessary investments in new developments (including the costs of changes in organization, training, natural forces against changes, etc.) on the one hand and a realistic estimation of the useful returns on the other is an important precondition for a successful innovation strategy.

One specific area of interest is the consumer's increasing concern about safety and health in relation to food - particularly meat - products. Integral quality assurance from the farmer to the consumer is a challenge for the livestock and meat industry. Quality assurance means basically that potential quality problems are identified and appropriate control measures are taken in all stages of the meat chain.

More effort should be spent on restructuring regulatory activities, including codes of hygienic practice, to rationalize meat inspection in a total concept of quality assurance for the whole meat chain from farmer to consumer.

A quality system - Model for quality assurance in production and installation (ISO 9002) - is now being introduced into the agribusiness network for pigs and meat.

In combination with activities in the livestock industry aimed at developing disease eradication programmes, research on slaughter technology and hygiene will result in standardized measures, minimizing health hazards to the consumer.

Several aspects concerning integral quality assurance in pig production and pork processing and distribution are summarized in Figure I. Essential for such a system is:

- reliable communication between the various production stages
- reliable communication with the production process
- reliable connection with data carriers
- effective organization and integration of data flow and product flow.

This means that the organization of the whole production chain and the information technology (software and hardware) have to meet the highest standards.

DEVELOPMENTS IN IDENTIFICATION AND INFORMATION:

Electronic Data Interchange

Three types of data can be distinguished:

1. Identification data. These data are needed to identify the hog, carcass or product during the whole production process (identification number of the implantable interactive chip and the hook identification chip, bar-code, etc.).
2. Process control data. Examples of this kind of information are breeding and feeding conditions, stable conditions, stunning voltage and current, time and temperature during scalding, singeing and chilling, control on absence of pathogens, antibiotics, etc.
3. Product control data. These data can relate to carcass classification, PSE/DFD, weight, blood analyses and "predictive modelling" parameters such as contamination level and pH.

Data from all production stages are collected by means of Electronic Data Interchange (EDI). Much writing and re-writing is made redundant and hence human mistakes are prevented. For instance, conventional cargo bills can be replaced by electronic equivalents ("electronic mailbox"), sent from one computer to another. Computers in different production stages can communicate without human interference. Management and employees only receive relevant and real-time information. Another advantage is the possibility to evaluate data with a central computer and to optimize the overall production chain, for instance by selecting breed combinations with low primary production costs combined with a high market value.

Identification methods

Every production stage has his own identification difficulties. In the breeding and feeding stage the interactive implantable chip can collect data about conditions and veterinary treatment in these stages. The data in the chip cannot be skipped or altered. Before transportation the data can be read by a local computer and be sent to a central computer system by electronic mailbox (EDI).

In the future the implantable interactive chip can possibly be connected with miniature sensors that can measure stress indicators (blood pressure, blood composition, body temperature, heart rate, pH).

In the slaughterhouse the use of the interactive implantable chip is limited because the chip is lost when the pig's head is removed (the most reliable injection spot is in the ear base; Merks and Lambooy, 1989, Instituut voor Veeteeltkundig Onderzoek, Zeist, Netherlands). Another problem in the slaughter line is the necessity to carry out three actions to store data in the chip: reading the identification number, writing data and reading the data again to check if the stored information is correct. Also for technical reasons writing takes more time than reading. A read-only chip mounted on the slaughter hook can overcome these problems.

In the cutting room the carcass is cut in several parts. Similar parts are put together and are given a cluster identification. For this purpose a read-only chip can be used, for instance mounted in a "Christmas tree" or in trays. At the moment the first of a number of carcasses is released from the hook, the computer designates different trays for the different parts to the cutting tables where the carcasses are cut. At the same time the computer links the carcass identification number with the identification numbers of the trays.

Video imaging

Applications of video imaging have become very promising since the development of electronic neural networks. Neural networks are based on a design similar to the human brain. The algorithms do not require programming. By means of back-propagation the system is able to learn to recognize certain patterns. When the algorithm has to be adapted to new conditions, the network will just have to be re-trained with a revised data-base.
This new technique can be very useful in the development of automatic classification and offers opportunities for partial automation of post-mortem inspection of carcasses and organs.

Voice recognition

Information on initialization of the implantable interactive chip, diseases, feeding conditions, medication, etc. can easily be acquired by means of a voice-recognition system, which translates speech into alpha-numeric data and sends the information to the local computer.

In the slaughter line, a voice-recognition system in combination with head sets can be used to carry out the ante-mortem and post-mortem inspection of the carcasses hands-free. No time is needed for writing, the information is being transferred during inspection. Routeing of the carcass is dependent on information given by the inspectors. In other words, voice recognition is a direct interface between "human sensors" (palpation and vision) and the production process. Successful application of voice-recognition systems in the slaughter line requires the use of individual voice-recognition systems. These systems ensure a more accurate elimination of environmental noises and a much higher recognition rate (less critical selection of users) than universal voice-recognition systems.

Data processing systems

"Integral quality assurance" has been improved by automated information, handling and processing. With the new management support decision system (PROPREP) for processed meat manufacturing, combined with a laboratory data management system, quality assurance is now shop-floor-operational. Activities such as planning, costing and product development can be carried out more quickly, more target-orientated and more efficiently with these data processing systems

DEVELOPMENTS IN QUALITY CONTROL:

Blood analyses

Blood analyses at the farm and in the slaughterhouse in relation to biochemical/clinical parameters might be an approach towards establishing the animals' health index (ODINK, 1990; ELBERS et al., 1991). Haematological and clinicochemical parameters can give an indication of the health status of animals. The possibility of routine random collection of blood samples in the slaughter line as a tool for a animal health monitoring and surveillance system is being investigated in the Netherlands. Similarly, blood samples routinely collected at random in the slaughter line could be used for haematological and/or clinicochemical diagnoses for supervision programmes of the Animal Health Services. However, it cannot be excluded that the values of some of the blood parameters are influenced by the transport of the pigs and/or the slaughter process itself. Therefore, the influence of blood sampling conditions and the changes in haematological and clinicochemical profiles of blood samples between the farm and the slaughterhouse has been investigated in relation to the severity of lesions. Although there were significant differences between the sites of blood sampling (farm and slaughterhouse), this effect was only apparent in groups of animals classified by defined inflammatory processes. This implies that haematological and/or clinicochemical profiles of groups of pigs at slaughter reflect the herd health status at the farm (Figure II).

Hygiene sensor

Up to now hygiene during slaughtering, cutting and manufacturing of raw meat is mostly monitored retrospectively. For the introduction of a quality system, such as the HAZARD ANALYSIS CRITICAL CONTROL POINT (HACCP) concept (TOMPKIN, 1990), it is necessary that results of microbiological testing become available sooner to provide tools for adjusting the production process. In the past decade several rapid techniques based on quite different approaches have been developed. Roughly, these techniques can be classified into two groups:

- rapid methods taking less than 12 hours, i.e. impedimetric and turbidimetric techniques
- very rapid methods taking less than 1 hour, i.e. the Limulus amoebocyte lysate (LAL) test, the ATP/bioluminescence technique and the direct epifluorescence technique (DEFT).

Only very rapid methods offer monitoring possibilities, but detection levels are still too high (LABOTS AND STEKELENBURG, 1988).

Pathogen sensor

All instrumental methods discussed are not fit for a rapid and reliable detection of very small numbers of pathogenic micro-organisms such as Salmonella. It is expected that molecular biological/biochemical principles - such as enzyme immuno assays and DNA probes - will prove their usefulness in the years to come. These methods can reveal the presence of an antigen or a specific nucleotide sequence on the bacterial DNA or RNA with great reliability. It will take some 2-5 years to make these methods suitable for routine control of food samples.

Antibiotic sensor

Antibiotics are now detected according to the EG 4-plates technique. Results of this agar diffusion test can be obtained not earlier than after 13 to 18 hours incubation. At the Netherlands Centre for Meat Technology a technique was developed, based on ATP/bioluminescence, in which results are available after 3 hours (LABOTS AND STEKELENBURG, 1988). With this technique it is possible to screen instrumentally many samples on the presence of antibiotics. By using this method slaughter animals suspected of containing antibiotics can be selected even before transportation.

In the future monoclonal antibody-based sensors may prove their usefulness for more rapid and, if necessary, selective detection of antimicrobial residues.

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FIGURE I SEVERAL ASPECTS CONCERNING INTEGRAL QUALITY ASSURANCE IN PIG PRODUCTION, PORK PROCESSING AND DISTRIBUTION

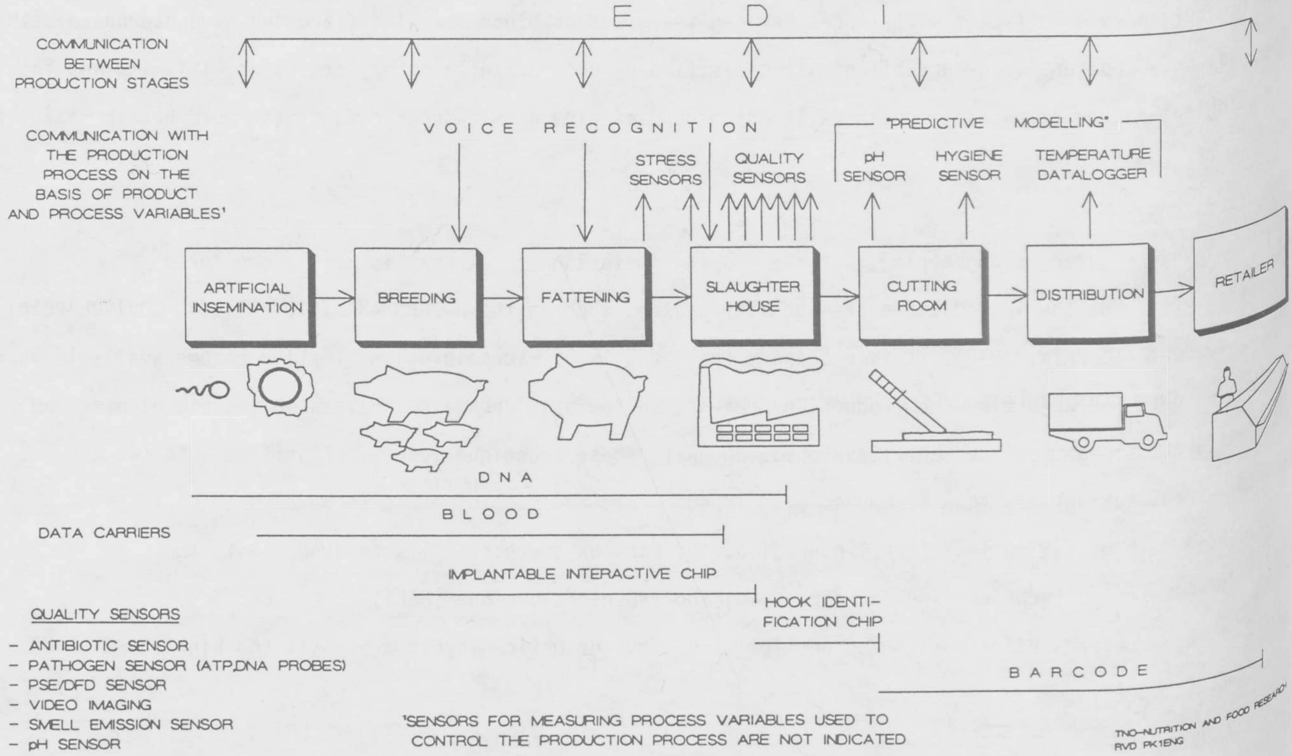

FIGURE II ESR (MEAN) IN BLOOD FROM PIGS COLLECTED ON FARM AND AT SLAUGHTER, CLASSIFIED BY THE SEVERITY OF INFLAMMATORY PROCESSES