NEW TECHNOLOGY IN THE SLAUGHTER AND PROCESSING OF PIGS

Peter Hök
Skanek,
P.O. Box 505,
244 00 Kävlinge,
SWEDEN

Slaughter technology has been much the same for the past 50 years. Scalding tank, dehairing and brushing machines and so forth have not changed very much. However, abattoirs are now much bigger and therefore more costly; the line normally having a capacity of 180 to 300 pigs per hour. The abattoirs of today are strictly flow-directed. Every class of material is separated very carefully. Material for human consumption is separated from waste material, pet food and so on. Buildings are designed in such a way that they are easy to clean.

The difficulty with these bigger plants is the adaptation of the production, or the capacity, to the supply of pigs. Such flexibility is important to be able to adjust the capacity to the supply of animals.

Lairage and pre-slaughter handling

Let's go through the slaughtering process from the beginning and look at the state of the art and the future potential within each stage. Conditions for the animal at the stage prior to stunning have been under criticism for a very long time. In particular, the marshalling areas prior to stunning, together with the C02-chamber or high voltage restrainer, is a gruelling encounter for the animals. The instinct of the animals to be within a group is hindered by the fact that the pigs are forced into a straight line where they become heavily stressed and excited. A fairly new transport system which utilizes the instinct to be in a group and helps them to move as a single group would solve the last 'blackspot' on the slaughtering line. It will be a great challenge to improve these conditions.

Stunning

The most common stunning method for pigs in the USA and Europe, for bigger plants, is stunning with high voltage electricity through the brain. This method can cause meat quality problems, with the occurrence of blood splashes in the musculature and broken back and blade-bones.

From the workers' point of view it is difficult to perform sticking since the animal cramps a lot. The same thing applies for the shackling of animals and collecting their blood with a trocar-knife. None of the automatic stunning devices designed to date will stun all pigs correctly. The high voltage system works at its very best if the animal is stuck without collecting its blood and if the animal is lying on a horizontal conveyor belt.

Low voltage stunning

Another method which is common today is low voltage stunning. The voltage used varies between 80-115 V. This low voltage stunning is generally considered as being unsatisfactory from an animal welfare point of view, and tests show that unconsciousness only arises quickly enough when the current reaches at least 1.0 A (Hoenderken, et al., 1979). This current is normally not reached at voltages between 80-115 V. The minimum voltage should be 150 V. Floor stunning is used in abattoirs with lower capacity production. You have a humane and sensible marshalling with acceptable animal handling and you get a safe stunning if the voltage is around 150 V. However, low voltage stunning produces 10 per cent bladebone breakage and bleeding in the shoulder meat and loin occurs, but not to the same extent as for higher voltages (above 300 V).

C02 stunning

There are different opinions among experts and Authorities as to whether the use of C02 is humane.

Criticism against C02-stunning of pigs is mainly directed towards the excitation phase that occurs after 10 seconds in the gas. The pigs then throw their heads and legs with violent averting movements (painful and filled with agony according to the critics). Other experts claim that these movements are an excitation phase quite normal under gas anaesthesia, similar to the effects of ether anaesthesia on humans and animals, both of whom show similar averting movements. In the current scientific work, the physiological condition of the pig during the period of 10-30 seconds under gas remains to be determined. By measuring the brain activity by EEG from three different areas of the brain, one will, hopefully, obtain a reliable answer (Forslid, A. 1987). It is obvious that C02-stunning has benefits vis-a-vis the meat quality and the workers' comfort, as the animals hang completely calm after stunning.

From the discussion above it is clear that there are no stunning methods which meet all criteria in terms of meat quality, animal welfare and workers' safety. C02-stunning seems, however, to be the method which has most potential for further development. It offers obvious potential, for example, for group stunning.

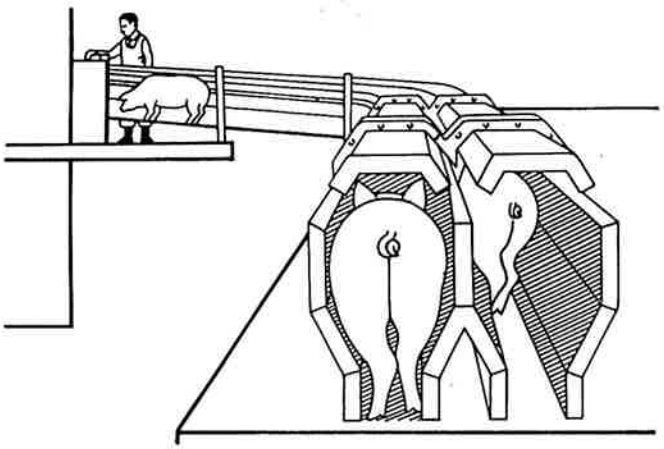

Figure 1. The CO2-stunning system

Other stunning methods tested are :
- Stunning by microwave energy – unfortunately too much energy leakage;
- Laughing gas – calm anaesthesia but too expensive and has environmental disadvantages.

Scalding

Scalding is the most important part for achieving a good dehairing result. By raising the temperature round the hair-root the connective tissue is dissolved and the hair-root then loosens. This alone decides if the result will be good or bad. If the roots remain and you burn or shave hair you will get bristles. But scalding also entails risks. Too high a temperature produces a boiled skin followed by mechanical damage from the dehairing-machine as the skin softens. The result is contaminated pigs. Too hot a scalding temperature and/or too long a time in the scalding tank also creates a higher level of PSE.

Three types of scalding method are in use :
- Scalding in a tank filled with water (Selo-Gjerstrup);

– Scalding by re-circulated water sprinkled over the pigs (Banss);
– Individual scalding by steam (Mitab).

Whether scalding water contaminates the meat has, on and off, been under debate. Is the water scalding a cleaning operation or a contaminating one? That meat is contaminated primarily via the sticking wound is an established fact. However, investigations have shown no difference in the shelf-life or taste between meat from carcasses scalded in steam or water. Nevertheless, scalding in steam is the method most likely to be used in the future. The problem with steam scalding today is that of non-uniform heat transfer.

Particularly difficult areas to scald correctly are head, front leg and groin-fold. Heat transfer will gradually be improved by modern regulation techniques so that optimal temperatures will be reached on different parts of the pig.

Another method which is often used (in for instance West Germany) is scalding by sprinkling of recirculating water – initially in a hanging position followed by a dehairing machine. The dehairing result is very good due to the fact that the animal is being processed for a longer time during dehairing and the heat transfer is more uniform since the pig is rotating. The hair-roots are kept warm during the entire dehairing process.

To minimise criticisms associated with water scalding, the pigs are washed free of dirt before scalding. This is executed by a precleaning machine or a whipping wash machine. This wash also causes the hairs to ruffle up. Wetting problems are thereby reduced and the hot water reaches the clean skin directly, ensuring a more even and efficient heat transfer all over the pig. The scalding water is kept considerably cleaner due to washing the animal before the scalding tank.

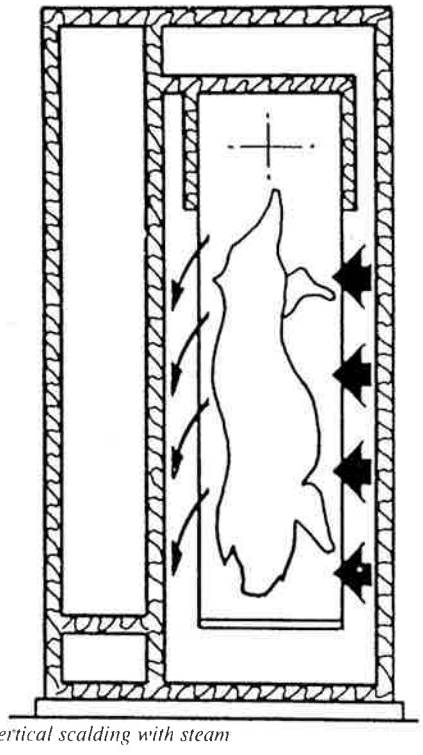

Figure 2. Vertical scalding with steam

Singeing

Singeing with oil or gas are the methods used depending on your production set-up.

A newly developed ceramic material coated on the inside of the furnace reflects the energy from the flame and reduces energy consumption. An exhaust-gas heat exchanger re-gains half of the energy which passes through the system. After singeing, sometimes the scraping treatment is followed by brushing machines regulated by PLC-computer technology. The brush positions are hydraulically adjusted with regard to where the front legs are positioned. Every individual pig is measured and the rolls are adjusted to an optimal level for each pig so that maximum accessibility will be achieved. This has meant a muc better dehaired pig which is brushed and scraped on every inc of its skin.

More refined automatic adjustment will consider the shap of the animal, its weight and length. But the basic design, as wi the car, will remain. Many of the machines today are ver difficult to clean. In the future, they will be designed wi automatic cleaning systems and with better accessibility. Th last machines on the line will determine the final hygiene statu of carcasses. It is therefore important to clean these machine regularly.

Dehiding

The methods of dehairing discussed above consume a lot energy and water. One way to avoid this is to dehide the pigs

If your market demands skinfree cuts and if you have hig water and energy costs, dehiding will be an interesting alternati for the future. The prices of the hides have also risen over rece years and better dehiding machines are now available. Thes dehide the pig vertically with a good result leaving a minimu of fat on the hide. Following are some experiences from dehidin pigs :

Advantages

– Longer shelf-life, up to three days longer because of bette hygienic slaughtering;
– Less PSE – because the pig is not heated by scalding singeing;
– Lower energy and water costs:
– Reduced production area.

Disadvantages

– More work with dehiding;
– Grading circumstances are different;
– Stamping more difficult.

Slaughtering

Labour costs are the major concern in this department. Europe, labour is approximately $10 per pig. In Europe, there a great lack of manpower because of a four year old industri boom.

To manage a situation like this companies have had to inve in training, good working conditions and ambitious recruitme programmes. Automation is, therefore, very attractive but difficu to implement.

For example, to eviscerate pigs without contaminating th carcass with faeces requires careful and skilful personne However, tools have been designed to assist in this operation an to improve the quality of the job. One example of this is the f and end loosener which drills out the fat end with the help of vaccum. Prime quality fat ends have improved from 75 per ce to 95 per cent with use of this machine. Other examples on th market include the lard loosener which increases the yield fro diaphragm and lard and the automatic front leg cutter.

Tests have been carried out cutting pigs with the assistanc of a robot. Robots, however, could not manage the different pi shapes that occur from time to time. Before the robot can start i operations it must know the shape of the animal. However, th procedure takes longer than a man to do the work himself. Fo robots to be effective they must be able to quickly 'see' and g a clear idea of the carcass shape.

ID number and automatic sorting (grading)

By using a barcode or an electro-magnetic radio sens every hanger will be equipped with its own unique identity. Thi will replace labelling by hand.

Optical readers are placed strategically along the line at th grading and weighing station. Automatic weighing is thu

obtained. Information is fed into the computer more easily as the operator doesn't have to check the tag on the pig.

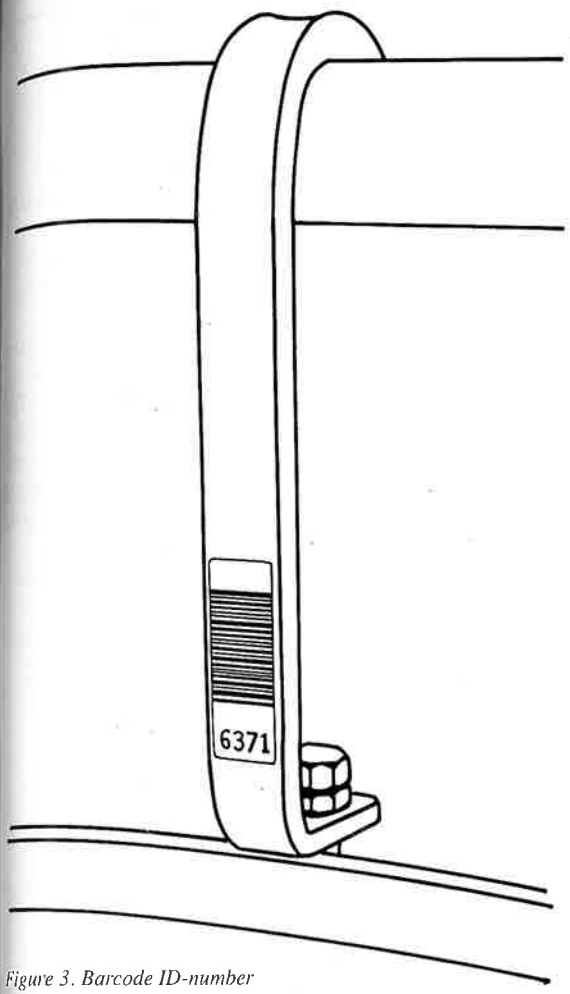

Figure 3. Barcode ID-number

Later the carcasses can be sorted with the help of a computer. You can sort according to meat per cent, breed, or farmer, whichever you wish. This technique has just started and will probably establish itself within the bigger plants.

Chilling

The chilling of pigs has given rise to much debate about business ethics. For instance, evaporating chilling has been prohibited in many countries. The most common method is shock chilling air temperatures for the first 60 – 90 minutes of chilling at very low; (-12°C to -30°C) air temperatures. A directed stream of air increases the cooling efficiency. Thereafter, a temperature of around 14°C is maintained along with low wind velocities. Investigations have shown that you can get cold shortening if the air temperature drops below -24°C at the start (Barton-Gade, P.A., 1985). Tests have been performed with liquid gases but they were not successful, as cold shortening and discolouration resulted.

Warm boning

Warm deboning is being practised more and more but so far only within the plant. The pigs are slaughtered before noon and deboned in the afternoon. The ideal core temperature of the ham is +15°C, the loin +7°C and the shoulder +12°C. The complete chilling programme takes four hours. Because of the fast turnover of meat the hygiene status is not affected. The process would appear to have a promising future owing to the improved working conditions and better yields.

The rules regarding the temperature of carcasses which leave the plant will however limit the spread of hot deboning. Presently, it is prohibited to move carcasses from a plant until the temperature is below +7°C throughout the carcass. Investigations have, however, proved that shelf-life is not reduced even if the carcasses are transported for a few hours while they are still warm.

Quality

Products from the pig must also be of a quality that the market demands. However the concept of quality, especially for pork, has become more comprehensive. Some quality characteristics can be objectively measured, for example tenderness and shelf life. Other characteristics cannot be measured but they are still important, e.g., animal welfare. How good has the life of the animal been? What about hormones and antibiotics? Was the transport to the abattoir humane? These and other aspects are subject to ethical considerations and can together be called ethical qualities. This means a lot to the inhabitants of large towns and cities in particular.

The consumer also wants a system of payment, directed to the farmer, that corresponds with the demands of the market and not the intermediates. Grading (classification) does not take into account the eating quality (meat quality). Instead, it describes the content of the carcass vis-a-vis meat, fat and bone, ie., the composition of the pig.

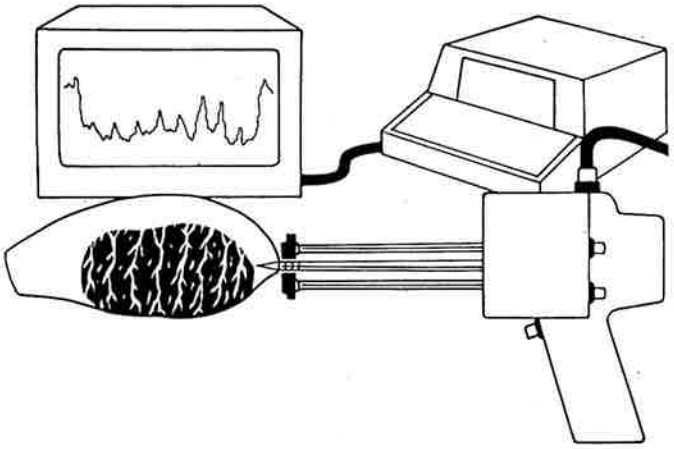

Figure 4. MQM (Meat Quality Marbling) equipment

Today intense research is being carried out which aims to produce equipment which makes the grading more consumer oriented. Advances are being made towards developing methods of classifying the quality of the raw material, e.g., the development of the MQM (Meat Quality Marbling) apparatus.

By sticking a probe into the meat and continuously measuring the internal reflectance as the probe is being withdrawn from the muscle a picture of its cross-section of meat and fat is obtained. The average value of the base line (the meat portion) is taken as a measurement of the PSE-status. MQM-equipment can select pigs having PSE one day after slaughter but it is less accurate in doing so, on the line, one hour after slaughter, where it would be most advantageous. It is particularly important to register the parameters of water handling capacity and intramuscular fat on the chain.

Automatic grading

A great technical development has been the Automatic Classification Centre in Denmark which manages to grade and stamp the pigs automatically. Similar centres will be installed all over Denmark. The capacity is a minimum of 360 pigs/hour. The main element of the centre consists of automatic measurement to secure the correct position of the 17 optical probes which measure the meat and fat thickness. The optical probe measures a light reflection picture of the cross-section. The light profile is transferred to a computer for determination of fat and meat

thickness. Subsequently the carcass is stamped automatically with grading figures on every single cut.

The computer transfers information to the production planning data and to the farmer's accounting system. We should hear more about this centre at the next Meat Congress in Copenhagen in 1989. The system has showed one way for the future. On the slaughtering line you start with a measuring station, the shape of the pig is determined and stored in the computer. After that follows the automatic cutting of tails and ears, and the removal of the spinal marrow and lard. Computer technology will in the future make further inroads into the slaughter process.

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