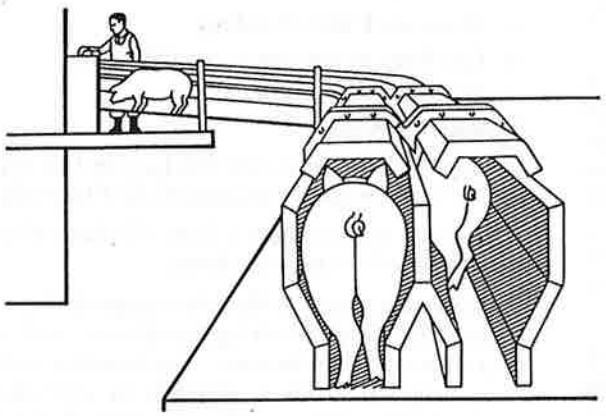
NEW TECHNOLOGY IN SLAUGHTER AND PROCESSING: PIGS

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

If one looks back into the past you will find that slaughter technology has been much the same for the past 50 years. The machine zone with scalding tank, dehairing and brushing machines and so forth has not changed very much from its original outfit. The build-up, however, of slaughter lines and plants is considerably different now compared to the past. 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.

STABLE AND DRIVING

Let's go through the slaughtering process from the beginning and look at the state of the art and the future potential within its different sections. The situation for the animal at the stage prior to stunning has been under criticism for a very long time. In particular the last 15 yards prior to stunning, together with the CO_2-chamber or high voltage restrainer, is a gruelling part 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 this instinct to be in a group and helps them to move as a single herd would solve the last "blackspot" on the slaughtering line. It will be a great challenge to improve these conditions.



The CO_2-stunning system.

STUNNING

The most common stunning method in the USA and Europe, for bigger plants, is stunning with high voltage electricity through the brain. Recent experience of high voltage stunning is not only positive. On the contrary, it means problems with the meat quality, with the occurrence of blood splashes in the musculature and breakage of backbone and blade-bone. From the workers' point of view it is difficult to perform sticking since the animal cramps a lot. The same thing goes for shackling the animal and collecting its blood in a trocar-knife. The automatic device on existing equipment is designed in such a way that 100% correct stunning of all animals has not yet been achieved. The high voltage system works at its very best if you only stick the animal without collecting its blood and if the animal is lying down on a horizontal conveyor belt.

LOW VOLTAGE STUNNING

Another method which is common today is low voltage stunning. The voltage varies between 80-115V. This low voltage stunning is generally considered as not being satisfactory as regards animal welfare, and performed tests show that unconsciousness does not arise quickly enough if the current does not reach at least 1.0 A (Hoenderken, R). This current is normally not reached at voltages between 80-115 V. One should work at 150 V. Floor stunning is so far the method which best fulfills the demands of lower capacity production. You have a humane and sensible driving in with acceptable animal handling and you get a safe stunning if the voltage is around 150 V. But low voltage stunning also produces 10% bladebone breakage. Also, bleeding in the shoulder meat and loin occurs, but not to the same extent as for higher voltages above 300 V.

CO_2-STUNNING

There are different opinions among experts and authorities as to whether the use of CO_2 fulfills the demands with regard to animal welfare. Criticism against CO_2-stunning of pigs is mainly directed towards the excitation phase that occurs after 10 s 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 anaesthesia by gas, similar to the circumstances which occur under anaesthesia by ether for both humans and animals who also show similar averting movements. In the scientific work in progress, the physiological condition of the pig in the area of 10-30 s under gas remains to be charted. By measuring the brain activity by EEG from three different areas of the brain, one will hopefully obtain a reliable answer (Forslid, A). It is obvious that CO_2-stunning has benefits *vis-a-vis* the meat quality and the workers' situation, as the animals hang completely calm after stunning.

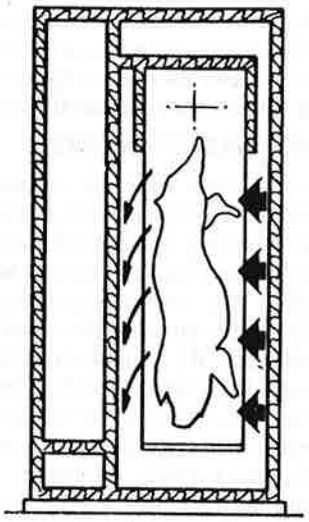
From the previous facts it is clear that there are no stunning methods which meet all the demands applicable to meat quality, animal welfare and workers' safety. CO_2-stunning seems however to be the one method which has most potential for further development, for instance driving in groupwise etc.

Other stunning methods tested are the following:

- Stunning by microwave energy - unfortunately too much energy leakage;
- Laughing-gas - calm anaesthesia but too expensive and environmental disadvantages.

SCALDING

Scalding is absolutely the most important part for achieving a good dehairing result, 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



Vertical scalding with temperated steam

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 methods are in use:

- Scalding in a tank filled with water (Selo-Gjerstrup);
- Scalding by recirculated water sprinkled over the pigs (Banss);
- Individual scalding by temperated 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 the meat is contaminated primarily via the sticking wound is a fact. However investigations have proved that neither shelf life nor taste have been affected negatively by the fact that it is scalded in water or in steam. The debate is problematic which is why scalding in steam or rather individual scalding is most likely to be used in the future. The problem with steam scalding today is the 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 hog.

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 thanks to the fact that the animal is being processed for longer time during dehairing and the heat transfer is more uniform since the hog is rotating. The hair-roots are kept warm during the entire dehairing process.

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 the energy consumption. An exhaust-gas heat exchanger retains 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 hog is measured and the rolls are adjusted to an optimal level for each pig so that the accessibility will be reached.

DEHIDING

Above mentioned methods of dehairing consume a lot of energy and water. One way to get out of this is to dehide the hogs. An old way to slaughter pigs that has fresh possibilities. If your market demands skinfree cuts and if you have expensive water and energy costs dehiding will be an interesting alternative for the future. The prices of the hides have also risen over recent years. Better dehiding machines are available. These dehide the hog vertically with a good result leaving a minimum of fat on the hide. Here following are some experiences from dehiding pigs:

Advantages:

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

Disadvantages:

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

SLAUGHTERING

Salaries is the highest cost you have in this department. In Europe, it is approximately AUD 10 per pig.

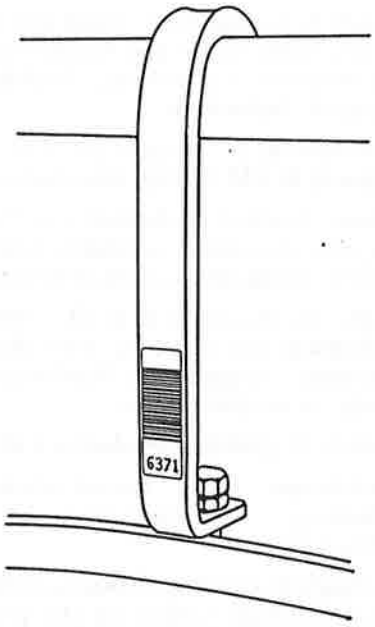
In Europe, there is a great lack of industrial manpower because of a four year old boom.

To manage a situation like this companies have to invest in training, good working conditions and ambitious recruitment programmes. Automation is therefore necessary. But this is difficult to implement. For instance, evisceration of the hog without contaminating the carcass with faeces. In this operation you need every inch from a careful and skilful personnel. However, tools have been designed to help the operations and to improve the quality. One example of this is the fat end loosener which drills out the fat end with the help of a vacuum. Prime quality fat ends have improved from 75% to 95%. Other examples on the market are laid loosener which increases the yield from diaphragm and laid. Another example - automatic front leg cutter.

Tests have been carried out cutting pigs with the assistance of a robot. The robot couldn't manage the different shapes of the pigs from time to time.

An abnormal pig or sow destroy the possibilities of the robot. Before the robot can start its operations it must learn the shape of the animal. This procedure takes too long, longer than for a man to do the work himself. The

robot must first be able to "see" and get a clear idea of the shape of the pig. Only then will the robot have any possibility of competing with the worker.



Barcode ID-number

ID-NUMBER AND AUTOMATIC SORTING (GRADING)

By using a barcode or an electro-magnetic radio sensor every hanger will be equipped with its own unique identity. This will replace labelling by hand. Optical readers are placed strategically along the line - by the grading station, weighing in and out. Automatic weighing is thus obtained. Information is fed into the computer more easily as the operator doesn't have to check the tag on the pig. Later on, you are able to sort the pigs with the help of a computer. You can sort according to meat percent, breed, or farmer, whatever 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 around business ethics. For instance, the evaporative chilling has been prohibited in many countries. The most common method used is chilling (chock) the first 60 - 90 minutes very cold; -12°C to -301°C. A directed stream of ar increases the cooling efficiency.

Thereafter, follows a storage chilling with low wind velocities and a temperature around +4°C. Investigations prove that you can get cold shortening if the temperature is below -24°C at the start (Barton-Gade, P.A.). Tests have been performed with liquid gases but weren't successful, as cold shortening and decolouring were obtained.

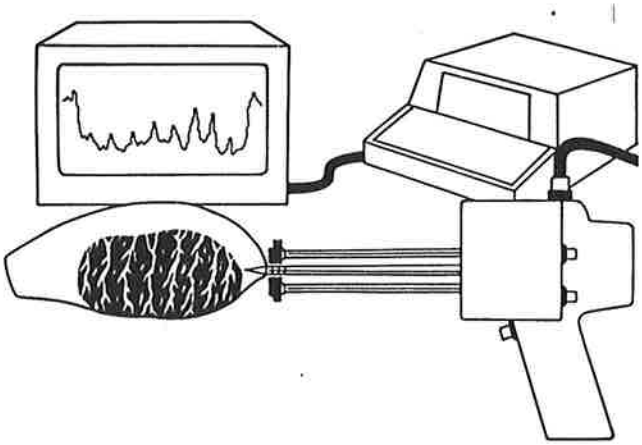
TEMPERATED DEBONING

Temperated deboning is being practiced more and more but so far only within the plant. The hogs are slaughtered before noon and deboned in the afternoon. The ideal centre temperature of the ham is +15°C, the loin +7°C and the shoulder +12°C. The complete chilling programme takes 4 hours. Because of the fast turnover of the meat the hygienic status is not reduced. The better working conditions achieved together with a better yield seem promising for future practice. The rules regarding temperature of carcasses which leave the plant will limit the spread of the method. Today, 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 negatively affected, even if the animals are transported a few hours when they are still temperated.

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, the composition of the pig.

Today intense research is being carried out which aims to produce equipment which makes the grading more consumer oriented. Great contributions are being made towards developing and finding methods of classifying the quality of the raw material. One prototype for this type of equipment is the MQM (Meat Quality Marbling).

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 is less accurate in doing so on the line one hour after slaughter where it would have been most advantageous. In particular two parameters are of importance to register on the line namely, Water Holding Capacity and the amount of intramuscular fat.



MQM (Meat Quality Marbling) equipment

AUTOMATIC GRADING

One great technical achievement is the Automatic Classification Centre developed in Denmark. The centre manages to grade and stamp the hogs automatically. These centres will be installed all over Denmark. The capacity is a minimum of 360 hogs/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 will probably hear much more about this centre at the next Meat Congress in Copenhagen 1989. The system has showed one way togo on. On the slaughtering line you start with a measuring station. The shape of the hog is determined and stored in the computer. After that follows automatic operation working with cutting tail, ears, removing the spinal mallow and lard. Computer technology will make inroads into the slaughter process.

REFERENCES

Andersen, I-L.E. (1984). Some experience with the portable Danish probe for the measurement of pig meat quality. Pig-Meat Quality manuscript nr 658 E.

Barton-Gade, P.A. (1985). Developments in the pre-slaughter treatment of slaughter animals. Proc. 31 E.M.M.R.W., Albena.

Barton-Gade, P., Olsen, E.V. (1984). The relationship between water holding capacity and measurements carried out with th automatic Danish meat quality probe. Pig-Meat quality manuscript nr 659 E.

Braathen, O.S. (1985). Meat production, mechanisation and robotisation, sanitation and meat quality. Proc. 31 E.M.M.R.W., Albena.

Braathen O.S. (1985). Meat production, mechanisation and robotisation, sanitation and meat quality. Proc. 31 E.M.M.R.W., Albena.

Buttenschön, V (1980). *Undersögelser vedrörende PSE-syndromet. Dansk Vet. Tidskrift*; **63** (3) 1/2 93-103.

Eikelenboom G. (1983). Stunning of animals for slaughter. Proc. C.E.C. Seminar at Zeist, Mart. Nijhoff Publishers, Dordrecht.

Forslid, A. Transient necortical and hippocampal EEG silence induced by one minute inhalation of high concentration CO_2 in swine. 33rd Int. Congr. of Meat Science & Technology.

Hoenderken, R., Logtestijn, J.G., Sybesma, W. & Panjaard, W.J.M. (1978). *Fleischwirtsh* **59**, 1572-1578.

Human Slaughter Of Animals For Food. (1986). Proc. Symposium London, Universities Federation For Animal Welfare, Hertfordshire EN6 3QD England 1986.

Kragh, H., Petersen C & O. (1981). Vurdering av ökonomien ved slagtning med skoldning/ svidning/ -skrabning. Slagteriernas Forskningsinstitut, Roskilde. Arbejde nr 0.4.360 rapport.

Lomholt, N. (1980). *Fleischwirtsch* **60**, 1646-1649.

Paardekooper, E.J.C. Recent advances in fresh meat technology. 33rd Int. Congr. of Meat Science & Technology.

Pre-slaughter stunning of food animals. (1987). Seminar Eur. Conferens. Group on the protection of Farm Animals Brussels 2-3 June 1987.

Troeger, K. & W., Wolfgang (1987). *Fleischwirtschaft*; **67** (1), 66-70.

Wyss, R. The electrical stunning of pigs observations, current flow, stunning grade. 33rd Int. Congr. of Meat Science & Technology.