PRE-SLAUGHTER TREATMENT AND TRANSPORTATION RESEARCH IN DENMARK

PATRICIA A. BARTON-GADE

Danish Meat Research Institute, Maglegårdsvej 2, DK-4000 Roskilde, Denmark

INTRODUCTION

Denmark is a small Northern European country with a population of just over 5 million people. The country is agricultural with little heavy industry. In 1988 15,8 million pigs and 867,500 head of cattle were slaughtered. Sheep and lamb slaughter is insignificant, the 1988 slaughter fugures being estimated to be about 50,000. Pig slaughter has been relatively constant for a number of years, whereas cattle slaughter is falling. Slaughter cattle production has mainly been based on the milk herd and EEC restrictions on milk production have reduced the number of calves available for fattening. Sheep and lamb slaughter on the other hand is expected to increase in the future.

Most slaughter animals produced are slaughtered in Denmark and very few are exported live for slaughter in other EEC countries. Veterinary regulations at present preclude the import of live animals from other countries for fattening and slaughter in Denmark.

The Danish pig sector is highly integrated. Most producers are members of one of the 9 slaughterhouse associations, who in turn are members of the Danish Bacon and Meat Council. The associations sometimes have processing facilities on the slaughter plant itself, sometimes centralised in processing factories. In contrast to most other countries factory economy does have consequences for Danish producers, as with one exception the factories are run on a co-operative basis.

Slaughter pig weights have been increasing in recent years and in 1988 reached an average of 71 deadweight. Nearly 80% of the production is exported, the 1988 figures being as follows:

	% of tonnage	% of kr
Total figures	861,039	15,557.4*
Live pigs & sows	0.1	0.1
Bacon sides/ products	13.5	14.5
Pigs, fresh & frozen	1.6	1.0
Fresh cuts	51.9	55.6
By-products	10.6	4.6
Canned meat	18.6	20.9
Other processed products	3.6	3.3

* excluding FEOGA: 1,184 m Dkr.

Source: Statistics 1988, Danish Bacon and Meat Council.

The beef sector is less well integrated. Farmers can supply animals to both private and co-operative meat plants and supply can either be direct (about 70% of total) or via markets (about 30% of total). Most calves are fattened, only 1.8% of the production being slaughtered at live weights lower than 220 kg in 1988. Three quarters of these were bull calves - mainly bull calves of the Jersey breed. Steer production is insignificant. In 1988 only 0,5% of the production were slaughtered as steers as against 47.5% as young bulls or breeding bulls. Young bulls are raised indoors and fed intensively.

Nearly 70% of the beef produced is exported, mainly as a fresh or frozen carcasses or carcass halves/quarters. The total value of the export was 4,062 m Dkr in 1988 including FEOGA payments (statistics 1988, Danish Livestock and Meat Board). Thus, the export of pork and beef products is of importance for the Danish economy amounting to over nearly 11% of the total exports.

All pigs are identified by farm of origin (slap mark) and classified according to meat percentage. Since 1975 the system has been based on MFA-measurements (Pedersen and Busk, 1982), but is now being replaced by the carcass classification centres. Similarly, all slaughter cattle can be identified by farm of origin using ear tags or some other method of identification. An identification system for individual animals is used for some of the cattle and it is expected that this system will come into increasing use in the future. All slaughter cattle are classified according to the EUROP-system.

Welfare Regulations

There is a general law regarding the protection of animals (No. 335, Ministry of Justice, 8 July 1983), but over and above this there are regulations specifically covering transport and slaughter of farm animals (Table 1). These regulations should ensure that the basic elements for animal protection are taken care of. Regarding the ritual slaughter of cattle and sheep the regulations allow slaughter without stunning, but specify that larger animals should be restrained and small animals hand-held during the slaughter itself. The Commission of European Communities is now preparing regulations for the protection of animals during transport, as well as the movement, lairaging, restraint and slaughter of animals. When finalised, this legislation will be valid in all European countries.

Over and above these regulations the general situation is followed continuously by the Ethical Committee. This Committee, which refers to the Minister of Justice and has representatives from all walks of Danish life, evaluates and gives advice on ethical problems in general. It has announced that in 1989 it will specifically look at the area of pre-slaughter treatment of animals.

Research

Research into the area of pre-slaughter handling is carried out by the Danish Meat Research Institute, which is a private institution affiliated to the Federation of Pig Producers and Slaughterhouses. The Institute has a small group working on cattle research, which includes pre-slaughter handling.

This centralisation of research has ensured that all parts of the industry can receive advice on the latest knowledge when changes are contemplated or problems encountered. Conversely, the close collaboration with industry means that the research carried out is relevant and on a practical level. It is for this reason that in comparison with most

Table 1. Danish regulations regarding the welfare of animals for slaughter

Regulations	Authority	Date
Government Notice, No. 208, on animal transport	Ministry of Justice	17 June 1964
European Convention on protection of animals for slaughter	Ministry for Foreign Affairs	10 May 1979
Government Notice, No. 200, on slaughter of farm animals	Ministry of Justice	26 March 1986
Circular on stunning of slaughter animals	Veterinary Services	3 May 1984

other countries the standard of pre-slaughter handling is high in Denmark, and relatively constant across the country.

When all this is said and done, however, not all recommendations are immediately put into practice even in Denmark. The reason for this is partly economic, partly a lack of awareness in the industry that there may in fact be a problem.The latter is not insensitivity as such but more a differing of opinion as to when a given treatment is "acceptable". The Chairman of the Ethical Committee Janne Norman has said that everyone has a different scale of acceptability in ethical questions and what to one person is acceptable, to another is completely unacceptable, mainly because of differing backgrounds. It is therefore important for the industry to maintain a dialogue with welfare groups and consumers so that a consensus can be attained.

When problems do arise, which have clear economic consequences, then solutions are rapidly incorporated in the industry because it is readily apparent that a given investment will have a given effect and pay-back time. A good example of this can be seen in the beef industry. Young bulls are particularly prone to the DFD-problem, if strange animals are mixed, either in markets or in the lairage at the abattoir. DFD-carcasses have a poorer quality and cannot be used as prime beef. As more and more young bulls were reared loose and hence could not be tied during the pre-slaughter handling, the incidence of DFD-carcasses increased to an unacceptable level. Most young bulls are now delivered direct to the abattoir and slaughtered soon after arrival. Moreover, they are often penned separately in the lairage. Himmelstrup (1983) has described these Danish developments in detail.

Developments in the industry

Industry develops and adjusts to changing economic forces and some of these developments can have consequences for welfare.

For cattle it is a greater concentration of animals on fewer farms and the greater tendency to keep animals loose instead of tied. Moreover, more animals are delivered directly to abattoirs. In 1977, only 47% were delivered direct as against 70% in 1988.

Keeping animals loose instead of tied has had consequences for both transport and handling, as such animals are less easy to handle. The development of systems to accommodate these animals is therefore necessary to attain optimal welfare (see above). The trend towards direct delivery is positive from the welfare point of view. Off-loading at markets, holding there and reloading for transport to the abattoir increases the length of the pre-slaughter treatment and the risk of poor welfare. Slaughter rates incidentally are low in Denmark being at present 40-70 animals per hour. With the exception of the small percentage of animals ritually slaughtered, all cattle are stunned before slaughter, mainly using a captive bolt pistol.

For pigs the developments are the concentration of pigs on fewer farms, the wide introduction of cross breeding and slaughter at fewer abattoirs. The last equipment for electrical stunning has now been replaced by CO_2-equipment.

The concentration on fewer farms has occurred at the same time as the systems used have become more intensive. In addition, most commercial animals are crosses between two or more of the four breeds used: Landrace, Large White, Duroc and Hampshire. For collection purposes concentration on fewer farms is a positive development because it means that transport vehicles have fewer stops to collect a full load. Indeed in the best instances a full load can be collected on one farm. Larger units also make it easier to inve

in good loading facilities at the farm. On the other hand intensively raised pigs are sometimes more difficult to handle, as in some systems they are less used to human intervention. Some crossbreeds are more aggressive than others, so that collection facilities which do not mix strange pigs before loading are important. In our experience crosses between Large White and Landrace are more agressive than crossbreeds containing the coloured breeds.

The concentration of slaughter on fewer abattoirs means that the average transport distance is increasing as well as the average slaughter speed. Transport distances are, of course, not very long in Denmark and the increase we are talking about is probably from an average of about 1 1/2 hours to an average of about 2. However, increasing transport costs have accelerated another trend - towards more pigs per transport. The traditional single-deck vehicle with a load of 40-60 pigs is therefore increasingly being replaced by double-deckers or the use of trailers. All these developments mean that it is more and more important to ensure optimal transport equipment and optimal use of that equipment for maximum welfare during transport.

Slaughter speeds have increased from an average of 230-250 pigs per hour in the seventies to 350-400 per hour at present. One factory runs above 400 at present and plans to rise to 600 pigs per hour. This trend is unfortunate seen from a welfare point of view because it means that force must often be used to maintain the required flow of pigs to stunning equipment. Optimum layout and design of lairage equipment is therefore absolutely essential, if as many pigs as possible are to reach the stunning equipment of their own volition. Highly motivated personnel can, of course, counteract the effect of a less than optimal layout and it is important to choose people with a flair for pig handling to get the best result.

The total replacement of electrical stunning by CO_2-stunning has occurred to improve meat quality and reduce blood splash and fractures (Klovborg-Larsen, 1982). Stunning now takes place mainly in the compact equipment, where pigs are restrained during stunning itself, although some factories are beginning to install the latest development, the combi-equipment, where 2 pigs are stunned together without restraint. In all cases it is important that the CO_2-concentration and time of exposure are optimal for proper stunning and that the equipment is checked routinely.

There has, of course, been a great deal of debate regarding CO_2- and electrical stunning. Dutch workers in the late seventies (Hoenderken, 1978, Hoenderken et al. 1979, Wal, 1978) claiming that high voltage electrical stunning causes instant unconsciousness and must be preferred to CO_2-stunning which first causes a loss of consciousness about 20 sec. or so after exposure to the CO_2-gas. They stated that pigs experience pain during this initial period, that they are suffocated not stunned, and for this reason CO_2-stunning was banned in Holland and later in Sweden too. Danish specialists contested these statements, maintaining that CO_2-anaesthesia is like anaesthesia with any other kind of anaesthetic gas. There are three phases, a phase of induction, a phase of excitation and a phase of anaesthesia. Experiments showed that pigs do not seem to experience any sensation of pain during the initial exposure to CO_2 and they maintained that the pigs are not conscious when the phase of excitation sets in.

The question has been the subject of much research since this time (Drawer and Grätz (1984), Forslid (1988), Gregory (1985), Lomholt (1980), Ring et al. (1988), Zeller et al. (1987)) and although not all aspects have been completely resolved the consensus seems to be that CO_2-stunning is acceptable from the welfare point of

view. The research has, however, highlighted the importance of an optimal treatment immediately prior to the stunning itself, whether stunning is electrical or by CO_2.

Future developments in pig handling

It is apparent from the foregoing that developments in the pig industry increase the possibilities for poorer welfare during the pre-slaughter handling period and that greater efforts must be made to reduce these risks as far as possible. The industry has realised this and has committed itself to providing maximum welfare during the pre-slaughter treatment. The reasons for this are an awareness of increasing consumer demands for an "acceptable" treatment pre-slaughter as well as an expectation of a better meat quality.

The pig industry has already decided to put into practice the knowledge gained by the Institute during many years of research and implement the so-called 13 point programme (Barton-Gade, 1989). This programme lays down guidelines for producers, hauliers and abattoirs, which ensure:

- a considerate treatment
- a good, uniform meat quality
- a low transport mortality
- a delivery ensuring protection of a herd's health
- a rational collection and transport

It is the aim that by 1992 the PSE frequency in longissimus dorsi muscle will be no higher than 2% on a nationwide basis.

Even when the 13 point programme has been implemented in practice there are still certain points in the chain of events from producer to stunning which can never be completely optimal in the present system from the point of view of animal welfare. Developments in the transport system, the movement of large groups of pigs within the lairage as well as the passage from the lairage pens to the stunning itself, especially the race system, all give problems for some pigs.

Regarding transport, a framew agreement has been signed by Federation of Pig Producers Slaughterhouses and the Haulie Association on the treatment of pi during collection at the farm transport. Similarly, the Federati together with the Institute contacted the Minister of Justi with a proposal for a nationw system for the approval of transp vehicles, which will ensure certain minimum standards are att ned.

Regarding treatment at the abatto itself the Institute has start development work with the aim providing optimal welfare. Previo work on the container transport pigs showed that it was much easi to drive small groups of pig, eg. than it was to drive groups of 30 even 60. Prototype equipment for fully automatic lairage system wi compartments consisting of 15 pi was tested at the Meat Trade Schoo Dividing pigs into small groups many advantages. Fighting was min mised and pigs lay down to re within half an hour. Both automat filling and emptying of compartmen occurred without problems and me surements of pulse rate showed th stress was minimised. The system now under testing at another facto under full-scale conditions with slaughter speed of 420 pigs per ho and up till now the results ho confirmed those from the Meat Tra School. When the meat quality eval ations have been carried out, t factory will choose which of t three variations it will install the rest of the lairage. Many oth factories have expressed interest the system and there is no doubt th it can combine a high slaughter spe with good welfare and that it will the future system in Denmark.

Improvement in lairage conditions h heightened our awareness of t disadvantages of the race. The re installed at the above factory w

optimised according to the latest knowledge but even with a double race and an optimal profile and lighting there were still problems in getting pigs to enter the race of their own free will. Work is now being planned to find an alternative system that takes advantage of the flock instincts of pigs and makes the use of force unnessary. This work, which has high priority, will be co-ordinated with another project being carried out with the Swedish Meat Research Institute, which will also include the optimisation of CO_2-stunning.

It is the hope that the above developments will form the basis for the best possible welfare before slaughter in the future. One thing, however, is the hardware, another is how this hardware is used. Improvements in equipment must therefore be accompained by motivation of all personnel in the chain towards a better treatment and include the necessary supervision if the best possible results are to be attained.

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