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THE WELFARE OF FARM ANIMALS DURING TRANSPORT

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Nowadays, transport distances of farm animals are increasing because of the economic consequences of greater opportunities for long distance and international trade. The most common means of transport for all farm animals is the road vehicle even though it is generally found that road transport is worse for the animals than rail-, sea- or air transport. To protect animals during transport, regulations have been laid down in national and international legislation. The conditions during transport and the welfare of transported animals are more and more the subject of discussion. Transport and associated handling always have some adverse effects on the welfare of animals. Adverse effects are related to psychological, physiological, physical and environmental factors. The term stress is used where control systems are overtaxed and biological fitness is reduced. Animals should be fit for the intended journey. For poultry and pigs, food should be withheld approximately 6 and 12 h, before transport respectively, while water remains available. For cattle, horses and sheep food and water need to be available before and during transport and in transit. Withdrawal may result in e.g. dehydration and ketosis. Animals must be able to stand and to lie down at the same time. Minimum allowances in relation to the weight of the animal are recommended. The most common method of ventilating compartments and containers is via vents. For breeding pigs and poultry, airconditioning during transport and lairage has been developed. In lairage a rest of approximately 2 h and showering before slaughter is necessary for pigs to recover and improve meat quality. It is recommended to stimulate and initiate programmes for the improvement of transport conditions.

Keywords: handling, welfare, stress, meat quality, environmental factors

INTRODUCTION

Several centuries ago the increasing numbers of inhabitants in towns made it necessary to transport animals to slaughterhouses. In Europe the farmer walked to the municipal slaughterhouse leading one or a few animals. On the prairies of the USA a large number of animals was driven by cowboys or shepherds to the towns. Occasionally animals were transported by ship to new areas and ships would also carry animals as a food store which, after slaughter could be used as food for the crew. In the present century walking to market or slaughter was gradually replaced by transport. This ranged from large numbers of cattle transported by train in the West, to, in the far East single pigs tied and transported by bicycle or trailer to the slaughterhouse. At present transport by train is not common, because the animals have to be transported to a station and reloaded so increasing the adverse effects of loading and lengthening some jour-

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neys. However, conditions by train can be very good. The use of aircraft is limited to breeding anima and day-old-chicks, because it is expensive. A large number of sheep is shipped from Australia to tl Middle-East. Cattle are also sometimes transported by ship.

The most common means of transport for all farm animals is the road vehicle even though it is gene ally found that road transport is worse for the animals than rail, sea or air transport. Nowadays transpo distances of farm animals by road to an other farm or to the slaughterhouse are increasing because of tl economic consequences of greater opportunities for long distance and international trade. Within tl European Community (EC), free movement of animals from one member state to another and mo uniformity of subsidies has resulted in more long distance travel to slaughter. Regulations to prote animals during transport are laid down in the Council of Europe Convention of Strassbourg (1971), i an EC-council directive (1991) and in governmental legislation. Consumers are now demanding bett treatment of animals in the whole production chain including transport. The conditions during trans port and the welfare of transported animals are more and more the subject of discussion.

WELFARE

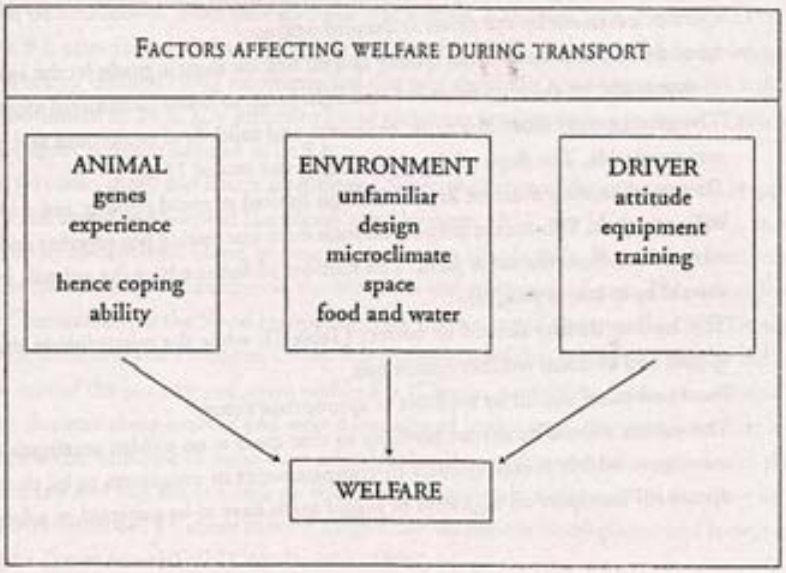
The welfare of an individual is its state as regards its attempts to cope with its environment (Broom, 1986 1991; Broom and Johnson, 1993). Transport and associated handling always have some adverse effect on the welfare of animals unaccustomed to them (van Putten and Lambooij, 1982). Adverse effects ar related to psychological, physiological, physical and environmental factors (Figure 1). Indicators of poo welfare include behaviourial, physiological, or immunological responses indicating coping difficulty, injuries and effects on the carcass in slaughtered animals and effects on the health of animals which are no immediately slaughtered. Where control systems are overtaxed and there is likely to be a reduction of biological fitness the term stress is used (Broom, 1988; Broom and Johnson, 1993). It is clear that welfare and health may be disturbed during transport. Well-known diseases related to transport are shipping fever in cattle (Hails, 1978) and Porcine Stress Syndrome (Tarrant, 1989).

The most detrimental effect of transport is death which normally follows a period of very poor welfare. Stress activates hormones via the pituitary-adrenal system (glucocorticoids) and the sympathetic-adrenal medullary system (cathecholamines) resulting in behaviourial (overreaction to normal stimuli) and clinical (increase in heart and respiration rate) deviations from normal functioning, followed by exhaustion. The death rate following transport is approximately 0.01% in cattle, 0.3 to 1.7% in sheep (Connell, 1984), 0.1 to 0.3% in pigs (Lambooij and van Putten, 1993) and 0.4 to 1.3 in broilers (Knowles and Broom, 1990; Warris et al., 1992).

During loading and unloading transport injuries and bruising commonly occur in all animal species (Lambooij and Hulsegge, 1988; Grandin, 1990; Knowles and Broom, 1990). These defects occur by forceful contacts in passage ways, in compartments and in containers, by fighting between animals and mounting (Connell, 1984). Loss of live weight and of carcass weight are the result of excretion, evaporation and respiratory exchange (Dantzer, 1982), which is a normal physiological reaction. However, when food and water are withdrawn for a longer time dehydration and mobilisation of fat and muscle glycogen may occur (Tarrant, 1989).

Transport conditions may affect post mortem meat quality, either via adrenal or other stress responses or by fatigue of the animals. It is assumed that stress before slaughter leads to an increased breakdown of glycogen and a greater decrease in the energy store. In pigs and broilers this results in pale, soft and exudative (PSE) meat (Tarrant, 1989; Nicol and Scott, 1990). This explanation is too simply postulated, because the physiological response to stressors from the environment is partly influenced by the genotype of the animal (Figure 1). The occurrence of dark, firm and dry (DFD) meat is more readily attributable to effects of the transport environment and is less variable amongst genetic lines. It occurs when the animals are fatigued. In this case glycogen energy store is exhausted, resulting in lack of acidification and dark coloured meat. In well-fed rested animals, meat pH falls to about 5.5-5.8. Then glycogen breakdown ceases even if residual glycogen still remains undergraded in the muscle (Smulders, 1984; Hillebrand, 1993; Klont et al., 1993).

FIGURE 1



PROCEDURES AT LOADING AND UNLOADING

Farm animals are kept under specific housing conditions for several months, the exact time depending on the species and production system. After that period the animals have to be transported to a slaughterhouse. Transport causes physical and behaviourial problems, because the animals are not accustomed to transport conditions and procedures. The loading procedures, the design and the other animals are unfamiliar to the animals and will frighten them. The drivers may not treat the animals in a proper way to minimise stress and sometimes animals are mixed or regrouped, thus increasing stress and resulting in fighting amongst the animals to determine social order (Figure 1) (Connell, 1984).

Climbing a loading ramp is easy for horses, cattle and sheep when ramp design and handling procedures are good. For pigs, climbing a loading ramp is difficult since the situation is often psychologically

disturbing. The animals may simply refuse to try and even turn their sides towards the ramps. As a resu the heart rate may increase to a level where the heart starts to loose synchronization. The angle of t loading-ramp should not be greater than 15-20° (van Putten and Elshof, 1978; Phillips et al.; 1988, Fra and Broom, 1990). Descending a loading ramp steeper than 20° is difficult for all animals and shou be avoided (Grandin, 1981). In general, poultry are picked up manually by their legs and carried upsi down to a container or crate. It is estimated that up to 30% of broilers and hens are injured. Brok bones, dislocations, haemorrhages and bruises are observed (Knowles and Broom, 1990). Machines f collecting broilers are available, but their uptake by the industry has been slow, because there can be dif culties in operating them in broiler sheds. In both manually and mechanically caught birds the heart ra may rise to similar high values but in mechanically caught birds the rates return to near normal valu more rapidly. These results suggest that broilers affected less by mechanical than by manual captur During catching and handling, birds display escape responses which increase the likelihood of damag A practical method of subduing the birds is a reduced light level (Knowles and Broom, 1990), but caref handling and taking the transport containers close to the birds should always be practised.

Correct treatment by the driver is detailed below:

- Load and unload the animals quietly and do not use electric goads; let the animals observe their env ronment and let them go from reduced light levels to better illuminated areas.
- The passage ways should be sufficient width and solid. Steel projections and channels in the walls a not acceptable. The slope of the ramp should not exceed 15-20°.
- Groups of animals must be kept stable and limited to avoid fighting and stress when put with unfa miliar animals. This means keeping animals from one rearing pen together and not mixing them, eve with others from the same farm. The number of farms where the animals have to be fetched fro should be as low as possible.
- The loading density should be correct (Table 1), while the microclimate should be adapted to th species and ambient weather conditions.
- Food and water should be available at appropriate times.
- The vehicle should be driven carefully so that there is no sudden acceleration, braking or sideway movement which causes animals in compartments or containers to be thrown around or undul disturbed. Transport on highways or bigger roads have to be preferred to urban traffic.

TREATMENT DURING TRANSPORT

Feeding and watering

Animals should be fit for the intended journey irrespective of the purpose of the journey. Animals requir a proper preparation before transport.

This means that in pigs feed should be withheld for 16 to 24 h before slaughter (Warris, 1993; Eike lenboom et al., 1990). Depending on the distance to the slaughterhouse or transit station feeding shoul be stopped the night before transport, but water should be available. It is suggested that pigs becom motion sick as a result of low frequency vibrations (Randall, 1993) and may vomit when the stomach i full. The pigs may die by choking and by inhalation of their own vomit (Guise, 1987). Other advantage of feed withdrawal are less labour at slaughter, less contamination of the carcass, less spillage of the cu

contents, a decreased weight loss of the carcass during chilling and a lower percentage of PSE-meat (Warris and Bevis, 1987; Eikelenboom et al., 1990). Withdrawal of feed before transport is also recommended for poultry for the same reasons and to minimise heat stress (Veerkamp, 1986; Nicol and Scott, 1990). However, due to rapid food utilisation in poultry, a few hours of deprivation are sufficient and deprivation for 12 h or more is inadvisable.

During stops in transport of long duration piglets were observed to drink from bite nipples (Barton-Gade and Vorup, 1991). Observations of slaughterpigs during such journeys showed that pigs drank only 0.65 or 1.6 litres water per pig when available via bite nipples during motion or in a trough after unloading (Lambooij, 1983, 1984). If feed was supplied vomiting was observed. There were no physiological differences between watered and non-watered animals, due to mobilisation of water within the fat cells (Lambooij et al., 1985). However, an increased blood protein concentration was found in pigs after 6 h transport (Warris et al., 1983).

Although the stress of handling, transport and fasting lowered blood glucose level, additional energy was obtained from fat breakdown. Most liver glycogen was utilized in the first 18 h of transport and fat was broken down 9 h after feed withdrawal (Warris and Brown, 1983). Because of the physiological changes the EC-Working Group (1992) recommended that pigs should be given water each 8 h and the transport should be limited to 24 h. It is difficult to feed and water poultry during transport. Therefore the limit of the transport is recommended to be 8 h.

The conditions for cattle, sheep and horses are different. When the design of the compartment is appropriate the animals can be fed and watered (Lambooij and Hulsegge, 1988; von Mickwitz, 1989). In the first hours of transport of cattle the blood glucose concentration significantly decreased and increased again in cattle. The concentration of ketones in the blood showed an opposite figure. The haemoglobin concentration and haematocrit in the blood increased during the journey (Kriesten et al., 1976; Dantzer, 1982, Kenny, 1985; Lambooij and Hulsegge, 1988). It is recommended that cattle and horses be fed and watered until the start of the journey and again within 8 h (Chupin, unpublished data; von Mickwitz, unpublished data). Because sheep evolved and were domesticated in dry areas, it is speculated that they may be able to cope better with lack of water than other species. If compartments are supplied with deep litter consisting of straw and hay, sheep nibble on this during a maximum recommended transport of 24 h. However, after a transport of 14 h sheep showed a significant decrease in blood glucose and lactate and signs of dehydration (lower osmolality) (Knowles et al., 1993).

Loading density

Animals must be able to stand in their natural position and all must be able to lie down at the same time. For animals which may stand during the journey, the roof must be well above the heads of all animals when they are standing with their heads up in a natural position. This height will ensure adequate freedom of movement and ventilation and will depend on the species and breed concerned (EC-Working Group, 1992). Loading density has a major effect on animal welfare and post mortem meat quality. At loading densities of over 200 kg/m^2 pigs showed increased body temperature, heart rate and breathing frequency after a short journey and a high frequency of PSE-meat post mortem (Heuking, 1988; von Mickwitz, 1989). When the loading density is higher than 235 kg/m^2 not all pigs are able to lie down, hence there is a continual changing of positions and the pigs cannot rest. The consequences are more skin blemishes, rectal prolapses and a bad meat quality (Lambooij et al., 1985; Guise and Penny, 1989; Lambooij and

Engel, 1991). A loading density for slaughterpigs of 235 kg/m² is suggested to be accepted as a compromise between animal welfare, meat quality and economics of transport. In cattle at a loading density of 200 kg/m² animal movement was unrestricted and the preferred orientation was standing parallel the direction of travel during journeys of 4 h and perpendicular the long axis of the truck during 1 h journeys. Losses of balance were associated with specific driving events such as braking and cornering. Animals going down underfoot was associated with a density of 600 kg/m². When down they were sometimes trapped down destabilizing other animals of the group in a domino effect (Kenny and Tarrant, 1987; Tarrant et al., 1988). The loading densities for different weight groups and species are presented in Table 1.

TABLE 1

LOADING DENSITIES RECOMMENDED BY THE EC-WORKING GROUP (1992)

	kg live weight	m²/animal	animals/m²
Cattle	<50	0.40	2.50
	200	0.95	1.43
	400	1.70	0.59
	600	2.00	0.50
Pigs	<25	0.15	6.60
	60	0.35	2.80
	100	0.42	2.35
	120	0.51	1.96
Horses	100	0.70	1.43
	300	1.30	0.77
	500	1.80	0.56
	700	2.20	0.45
Sheep	<16	0.14	7.0
	32	0.22	4.54
	48	0.30	3.33
	64	0.34	2.94
Poultry	<1.6	0.030	33.33
	2.0	0.032	31.25
	4.0	0.048	20.83
	>5.0	0.055	18.18

A high loading density results directly in a higher percentage of skin damage in cattle and horses (Lambooij and Hulsegge, 1988; von Mickwitz, 1989). The figures presented in Table 1 are the minimum space allowances in relation to the weight of the animals. The height of the compartment for transport of horses is recommended to be the shoulder height plus 58 cm. At this height a horse is able to stand in a natural position (Plath and Schütte, 1990).

Little information is available about correct loading densities for poultry. The figures presented in Table 1 are based on the recommendations of the Council of Europe (1972) and commercial practice.

Microclimate

The effect of climatic conditions are difficult to measure. The weather conditions are dependent of the location, the time of the day and the season. During hot weather conditions the number of transport deaths is increased in pigs and poultry, while cortisol levels in sheep are higher during cold weather conditions (van Logtestijn et al., 1982; Knowles and Broom 1990; Knowles et al., 1993). Experiments in climate controlled calorimeters showed that the lowest heat production ante mortem and best meat quality post mortem in pigs occurred at an environmental temperature of 16°C and an air velocity of 0.2 m/s (Lambooij et al., 1987).

The most common method of ventilating compartments and containers is via vents positioned at the upper part of the left and right sides. During the journey the correlation between the outside and inside temperature was positive and significant but for humidity this was not the case. The temperature during stops increased with 1 to 4°C in the compartments (Lambooij, 1988; Lambooij and Hulsegge, 1988). Thus the microclimate depends on the ambient weather conditions. The ventilation can be varied by placing covers at the holes, which can be opened or closed. In pigs this variable ventilation only improved meat quality when it was combined with showering during the journey (Lambooij and Engel, 1991). In poultry the provision of detachable solid or curtain sides on vehicles protect them from ambient weather conditions. However, the outermost birds in the load may become hypothermic in winter, while reduction in internal movement and heat dispersion may promote conditions like hyperthermia (Kettlewell et al., 1993; Mitchell and Kettlewell, 1993).

Artificial ventilation in compartments and containers may improve conditions during transport. When pigs were ventilated artificially during transport, the rigor mortis value post mortem was decreased, which pointed to a decreased energy loss in the muscles (Lambooij, 1988). In poultry, vehicle and load ventilation are being improved using a combination of results of laboratory simulations and computer modelling. When this system is applied there will be a reduction of the heterogeneity of the on-board environment, a dissipation of water vapour accumulation and an enhancement of forced convective cooling (Michell and Kettlewell, 1993). For breeding pigs airconditioning during transport is developed and applied during short and long journeys by road. The air velocity is low and the temperature is held at 16°C.

HANDLING DURING TRANSIT OR LAIRAGE

Passageways

After arrival at the slaughterhouse or transit station the animals need to be unloaded carefully and as soon as possible because ventilation in stationary vehicles is often not good. Loading ramps at height of the deck are necessary because all species have problems with descending loading ramps. Another possibility is the use of the decklift in which the whole deck moves upwards or downwards. The passage ways need to be solid, while projections and channels should be avoided. The floors must not be allowed to be slippery (Grandin, 1990). Different colours and shadows may frighten the animals and they walk most easily from a dark to a lighter place (van Putten and Elshof, 1978; Grandin, 1990). Electric goads are in common use in lairage and in transit. However these goads cause stress to the animals and should be banned (van Putten and Elshof, 1978; Grandin,1988). Moreover, petechial haemorrhages can then be reduced (Grandin, 1988). In pigs the width of the passage way is sufficient when 4 to 5 animals can walk side by side. Groups

of approximately 15 animals should be driven. With such a group, the use of force such as an electric goad on the last animals is not effective. Unwanted returning of animals can be reduced by using gates (Grandin, 1990). A fully automatic system which is controlled by a computer is developed in Denmark (Barton-Gade et al., 1992). Special designs of race to drive cattle and pigs to the stunning place have been developed. The pigs are brought to a single file step by step (Hoenderken, 1976) or via a curved crowd pen to a double race ramp with an entrance restrictor to prevent jamming (Grandin, 1990). For cattle a curved passage way with an inside radius of 5 m and a slope is recommended (Grandin, 1990).

The containers or crates used for poultry are unloaded mechanically in most slaughterhouses and this should be done carefully. In lairage the birds have to wait until the crates can be unstacked. Then the birds are manually removed from the crates and hung on the shackle line. When this method is performed roughly a high incidence of physical injuries such as dislocations and haemorrhaging may occur (Knowles and Broom, 1990; Nicol and Scott, 1990). Ruptured blood vessels in the wing may also occur when birds flap their wings on the shackle line (Gregory et al., 1989; Hillebrand, 1993).

Waiting pens

In transit stations horses, cattle and sheep need to be watered and fed. The design of the pen should be sufficient for all animals to drink and eat. After feeding and watering sheep recover totally after 96 h (Warris 1993). In hot condition cattle and sheep are sometimes given a bath. This is also used before slaughter to clean the skin of the animal. Pigs have to be showered, to rest a few hours. Before long journeys they can be fed with a thin porridge consisting of one part feed (high sugar content) and three parts water prior to reduce weight loss. Birds in containers during lairage require artificial ventilation to prevent heat stress (Knowles and Broom, 1990).

A resting period of 2 to 4 h before slaughter of pigs is recommended. This may result in a lower percentage of carcasses with PSE-meat. When the period is longer the percentage of carcasses with DFD may increase (Verdijk, 1974; Culau et al., 1991; Warris, 1993). During lairage the pigs should be showered intermittently. Showering has the following advantages: 1) The stress reaction as a result of the transport is reduced caused by the calming and cooling effect; 2) fighting will be reduced resulting in less skin damages; and 3) the animals are cleaned (van Putten et al., 1983; Tarrant, 1989; Warris, 1993). A loading density of 2 pigs/m^2 is recommended, because higher densities diminish meat quality (van Putten et al., 1983).

CONCLUSIONS

What has been achieved?

It has been established that transport and associated handling of animals always have some adverse effect on animal welfare and health, due to inadequate human behaviour, environmental conditions and the inability of the animal to cope with that situation.

What has been neglected?

Governments, transport organisations and research institutes have their programmes for improvement of transport conditions. However, more effort is needed to stimulate this process, which is too slow.

What needs to be done?

Transporters should be aware of that the quality of transport of animals has to be improved because of consumers' demands. Correct facilities for loading, unloading design of compartments and environmental conditions should be available. Drivers should be educated, trained and licensed. Courses should be taught in each country.

A minimal acceptable level of effects of these procedures on animals should be specified for each species and laid down in regulations. It is necessary that government inspectors control the transport procedures during loading, movement, unloading, transit and lairage, independent borders.

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FARM ANIMAL WELFARE AND TRANSPORT; A COMMENT

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Dr. Lambooij et al. have dealt with the subject of animal transport and welfare in a very comprehensive way. I have no real opposition to what has been said, but I would like to stress one point which, in my opinion, could also be matter of discussion.

Ever since the Paris convention on protection of animals during international transport (13 December 1968) there has been a consistent production of regulations dealing with animal welfare during transport. Such regulations have laid down general rules and something could be done to make them more stringent. New rules could be useful but, maybe, not extremely necessary.

What is most urgently needed in my opinion, is a full implementation of existing legislation. The type and extent of transport damages most commonly occurring is good evidence of this assumption. Transport injuries can easily be evaluated at the slaughterhouse by taking advantage of veterinary control at arrival.

In the case of pigs, for example (but similar data can be collected for other species) the most common lesions include bruises, both diffuse and confined, subcutaneous haematoma, fractures of the limbs, of the caput femoris and of the tuber ischiadicum. Any survey on the conditions the animals are loaded/unloaded and transported can show, among other things, that corridors and passageways are narrow and have slippery floors, sidewalls have uneven surfaces and sometimes hooks or protuding metal bars, loading ramps are too steep and/or have high steps, lorries are often overcrowded and headspace is reduced to ridiculous levels, temperature control during summer is lacking, driving is too fast as related to the animal load and the condition of the road, etc.

People in charge of loading and transport take no care except in jostling the animals to get the work done as quickly as possible. The use of electric prods is widespread, just as that of clubs of various types. Brutalities can also be met with. Undoubtedly, the working environment which can be found in pig farms, transport and slaughterhouses aggravates things. People having to deal with live animals sometimes seem to have been recruited from the least motivated population. The outcome of all this are injuries of various gravity with losses sometimes reaching thousands of dollars a week. And let us forget for a moment the 'more subtle' problem of the negative effects on meat quality.

Substantial improvements could be obtained if actual rules were implemented, i.e. if people could be convinced to stick to them. A great effort should be put into labour education. To this end a thorough and independent evaluation of transport losses needs to be performed with identification of responsibilities and economic impact. People should be made aware and accountable of the consequences of their deeds. At the same time public control over the enforcement of the rules should be more severe, making use of heavier penalties, if necessary.