Introduction

For most animals transport is at the most infrequent and probably a unique experience ending at the slaughterhouse, except perhaps for some intrafarm movement of young stock (Figure 47.1). They are therefore likely to find the experience alarming and stressful, but the process can be managed to minimise discomfort and distress. Increased lengths of journeys for animals, as slaughterhouses become reduced in number and therefore further from the sites of production, add to the problem. Nevertheless, we should consider the animals’ needs and reduce the stress experiences insofar as this is possible. This applies from an animal welfare perspective, but also from a strictly economic one; stress and mechanical damage from injury reduce both the quality and quantity of useable meat produced at the end of the operation. This section considers warm-blooded farm animals. Those wishing to consider the issues regarding the transport and slaughter of fish are recommended to access the Humane Slaughter Association’s website listed below in the recommended reading section.

Transport

Broom (2000) reviewed the welfare problems associated with the transport of farm animals. EU legislation regarding the transportation of animals covers regulation of the design and maintenance of vehicles, and is designed to ensure that personnel involved are sympathetic to the needs of the animals under their temporary care, that they are properly trained, that the stress experienced by transported animals is minimised and thereby welfare conditions are optimised.

Measures used to estimate the welfare of animals during transport include physical measures: weight loss (particularly in poultry; Mitchell et al., 2003), incidence of injuries, bruising, mortality, evidence of morbidity, panting/shivering and assessment of carcase quality. Behavioural measures might include a decrease in time

Figure 47.1. Moving young calves within a farm. Fine for a very short trip but hardly suitable for a longer journey. Photo: H. Jaakson.
spent ruminating and lying and physiological indicators might include heart rate and analysis of cortisol and fatty acids in serum. Assessment of the suitability of the transport should also be included in any audit of the welfare of the transport process; is it clean, likely to cause injury, does it have sufficient ventilation and is it appropriate? In this last regard, low-volume animals, such as wild boar, ostrich and deer, have been reported to be transported in unmodified trailers designed for other stock (Borrett-Gauci et al., 2006). Transport facilities designed for the purpose of such species are at best much less easily available than those for more familiar livestock species.

Inappropriate handling during the entire transport operation (loading, journey time and unloading) can result in poorer meat quality (Voisinet et al., 1997), and this can be more stress-inducing than the transportation itself (Waas et al., 1999). Impairment of meat quality is not only through mechanical damage to the carcase, but also the chemical changes in the meat, such as reduced pH, (a value higher than 6 leads to dark cutting meat) and the consequence of high levels in the meat of cortisol, which is released during periods of stress (Smith and Dobson, 1990). Poultry are at particular risk during loading. In many European broiler systems they are picked up from the floor by the legs in handfuls of up to eight per person (Mitchell and Kettlewell, 2004). The working conditions (low light, dusty, high volumes of bird removal, 1,000 birds per man hour expected) and poor pay are not conducive to an appreciation of the birds’ welfare. Mechanical collection devices have been developed which are increasingly being used on production units. While there is some evidence that stress to the chickens can be reduced with these, there is also evidence that physical damage to the chickens can be increased (Ekstrand, 1998).

Consideration of the transport process should include loading and unloading (including personnel handling skills, conditions, widths of approach passageways and the angle of the ramp – this should not be steep), as well as the actual journey. All chutes and other facilities for loading animals should be designed to minimise stress to the animal as they proceed through the loading process. The flooring around the loading area should provide sufficient traction for the animals to avoid slipping. Factors to consider during the journey include the length, road type (road surface, topology and the number and severity of curves; Jago et al., 1997), vehicle type, how the animals are grouped, where they are positioned in the vehicle and the quality of the driving, which should be smooth and steady with no unnecessarily sharp braking or acceleration; Tarrant (1990) found that a third of floored animals during transport were caused by sharp cornering. For the transport of poultry it has been proposed that the greatest threat to their welfare is heat stress (Mitchell et al., 1998), even in conditions where the external temperature is sub-zero (Knezacek et al., 2000).

Regarding the extent of journey time, findings in the literature differ, but there is evidence that longer journeys increase the welfare problems for transported animals linearly, for poultry (Carlyle et al., 1997; Nijdam et al., 2004) as well as for mammal species (Dalin et al., 1993; Waas et al., 1999). There is also evidence of habituation by animals to transport events.

Animals should preferably be transported in groups that are familiar, or at least with animals of the same size, to reduce aggression. Animals ought not to be moved during the sensitive part of their sexual cycle, and if possible single species should be moved together. If the numbers of animals being transported are high, stress is increased and this can lead to mortality in poultry (Nijdam et al., 2004). However if there are too few animals being transported this increases the chances of individual animals losing their balance and falling over. There should be enough room for the animals to lie down if they choose. Guidance figures for cattle have been suggested by Tarrant (1990) of: 0.77 m$^2$ for a 250 kg animal, 1.13 m$^2$ for a 450 kg animal and 1.63 m$^2$ for a 650 kg animal. It has been recommended that when deer are being transported there should be a space allowance of at least 0.4 m$^2$ per animal (Waas et al., 1997), somewhat lower than the previous figures. Higher numbers will increase the need for sufficient ventilation for all animals, and this is of particular importance for poultry (Mitchell and Kettlewell, 2004). Regarding the position in the vehicle, higher heart rates have been found in animals at the back of the vehicle (Waas et al., 1997). It can be assumed that this is because of more movement, both horizontal and vertical, experienced at the rear, so if possible animals should be loaded towards the front.

Less commonly transported animals may be at more risk of welfare problems through unfamiliarity with their needs (Borrett-Gauci et al., 2006), and the use in prac-
tice of equipment and vehicles designed for other species. Consequently, on-farm slaughter of animals such as deer is probably preferable to transport to an abattoir; comparison of animals shot in the field with those transported for slaughter has shown that cortisol and incidences of dark cutting meat in the carcase both increased (Pollard et al., 2002).

Different animal species are affected differently by transport and handling. More domesticated species are generally less disturbed, while low-volume farm animals such as deer, wild boar, ostrich and wild animals that have not been habituated to transport events are more likely to suffer from the experience (Bornett-Gauci et al., 2006). Broom (2000) has suggested that, of domesticated animals, sheep are least affected, cattle are sometimes affected, pigs are always affected and poultry handled by humans are always severely affected. There may also be breed differences within species.

Lairage

This is the time and place spent between arrival at a slaughterhouse and the beginning of the slaughter operation, a period that should be kept to a minimum, although there should be sufficient time allowed for recovery from the stress of the journey – three hours for pigs (Warriss et al., 1998). It is a stressful environment that is strange, with unfamiliar sounds and smells. The vocalisations of stressed animals, combined with human shouting, which is thought to be particularly abhorrent to animals (Weeks, 2008), can make this a particularly stressful auditory environment, especially as the auditory thresholds of these animals are thought to be lower than that of humans (Heffner and Heffner, 1983). Personnel should be sympathetic and trained to recognise problems and to move animals calmly and quietly. The longer the time that animals spend in lairage, the more bruising is to be found on the animals (Warriss et al., 1998), the more broiler chickens found dead before the slaughter process begins (Nijdam et al., 2004), and the greater the increase in physiological stress indicators (at least in rabbits; Liste et al., 2009). Behavioural welfare indicators, including vocalisations, suggest that the welfare of animals in lairage can be improved by dim lighting, misting (Figure 47.2) and large pen size. Weeks (2008) has suggested minimum space allowances of 1.7 m$^2$ for cattle, 0.56 m$^2$ for sheep and 0.42 m$^2$ for pigs, in ideal conditions, with a short lairage period.

The area should be well ventilated. This is true for all animals, but poultry are at particular risk of heat stress while in lairage (Hunter et al., 1998). There should be access to drinking water at all times, and to feed and appropriate bedding if kept overnight. Ideally, animals should not be kept next to other species and not next to unfamiliar conspecifics. If different species need to be kept in close proximity while at lairage the types of species mixed should be considered. For example in the case of deer at lairage the presence of pigs was found to be the cause of more stress than cows. Aggressive animals should be separated. There should be a designated casualty pen for animals that are sick or injured, and animals that are unable to walk should be slaughtered in situ.

Slaughter

The slaughter of animals commonly involves stunning (rendering unconscious), rapidly followed by sticking (exsanguination), which should rapidly lead to death. Carried out correctly this should involve as little pain
and suffering to the animals as possible. Welfare problems arise if something goes wrong in this process, either the animals are insufficiently stunned or the period between stun and stick is so long that the animal regains consciousness. Signs of effective stunning include a tonic phase: collapsed animal, no regular breathing, fixed and dilated pupils with no corneal reflex, a relaxed jaw with the tongue hanging out and a clonic phase: muscle relaxation, involuntary kicking, eyeballs drift downwards and urination or defecation. These signs are not common to all methods of stunning, which can lead to inaccurate estimation by personnel who are more familiar with one system.

Methods of stunning are commonly either mechanical concussion of the central nervous system or electrical stunning. Larger animals, such as cattle, are stunned with a captive bolt to the head. Sheep and pigs are usually stunned by electrodes applied to the head, and poultry have their heads immersed and electrocuted in water baths. The design of the water baths, and the birds’ entry, should be such as to reduce the likelihood of an electric shock prior to effective stunning of the bird. Animals, pigs and poultry particularly, may also be stunned using carbon dioxide in gas tunnels, but there is concern that although the stunning may be effective this may be more stressful than the other methods (Hänisch et al., 2009).

Prior to slaughter, animals should be moved calmly along the race, which should ensure easy passage, with no sharp angles. Poultry have a more complicated pre-stunning procedure as they need to be shackled. This can lead to wing flapping, pain for the birds, and downgrading of the carcass quality. Stress can be reduced at shackling by holding the bird’s legs for 1-2 seconds afterwards (Wotton and Wilkins, 2003). As there is wide variation in the electrical resistance of birds (between and within species), the current required to effectively stun birds also varies (Wotton and Wilkins, 2003). As birds are commonly stunned in groups of more than 10, this means that in any group of birds some may not be stunned, while others may be stunned but suffer impairment to their meat quality (Gregory and Wilkins, 1989). The method of stunning with gas is becoming more widely used, particularly for poultry. It removes the need for uncrating after transportation, removes the necessity of handling and shackling of birds while they are conscious, and all birds in a crate are stunned at the same time, avoiding the problem described above of individuals in a group remaining conscious (Hänisch et al., 2009). These are all positive welfare benefits.

Appropriate handling is important at slaughter too. Both stunning and sticking procedures need to be correctly and quickly applied (Anil et al., 2000). It is particularly important that the stun to stick interval is as short as possible (Figure 47.3). With electric water bath stunning for poultry, the current applied is very important for welfare; too high and the meat will be damaged, too low and the bird will not be stunned. In light of the welfare problems associated with transport, it might improve welfare if animals could be slaughtered on-farm. Indeed this is the case with animals that are wild or recently domesticated, and which comprise a small proportion of total livestock, such as deer, which can be shot in the field or slaughtered in mobile abattoirs. Although the former sounds crude it is probably much the best method in terms of welfare:
shooting with a rifle is accurate up to a range of 40 m, and up to 10 individuals can be shot without noticeably disturbing the rest of the group (MAFF, 1989). However, deer are still transported to distant abattoirs for slaughter, because of concerns about hygiene standards, legislative restrictions, cost-effectiveness and the aversion that some farmers have to killing animals that they have reared themselves (Bornett-Gauci, 2006).

**Religious Slaughter**

This is a subject heavily loaded with controversy. Muslim (*Halal*) and Jewish (*Shechta*) slaughter involves the sticking of an animal without it having been previously stunned. The animal is handled and stuck while still conscious. It is believed by defenders of this method that this ensures a thorough bleed-out of the animal, leads rapidly to unconsciousness and is painless. Opposition to this method is based on the belief that without stunning the animal is more likely to endure pain and distress. Many would say that the experience of being held and stuck, even with a sharp knife as its defenders claim, is undoubtedly stressful and painful. Work by Anil et al. (2004) on sheep slaughter suggests that stunning, by captive bolt or electrical electrodes, has no impairment on the bleed-out efficiency, and some Muslim groups accept that animals that have been stunned before being bled can be regarded as *Halal* slaughter. We can use science to estimate the suffering endured by animals in any slaughter method, but as individuals and as societies, we need to address whether to permit the freedom for people to follow religious imperatives or to recognise the importance of animal welfare, which in this case probably conflict.

**Conclusions**

Transport is a rare event in the life of most farm animals, usually to slaughter, but we should not neglect the fact that this can be a serious welfare problem. Not only this, but poorly designed and executed handling and transport can also cause economic losses, the quality of meat can be impaired by stress and injury, and the amount of recovered meat for human consumption can also be reduced in quantity. There are a range of factors to be addressed when considering optimal transport conditions, including handling, loading and unloading procedures, and selection of animals to be transported, in addition to the design of the vehicle and details of the journey, not only the length but also the smoothness of the ride. Lairage is also potentially stressful, an unfamiliar environment with, probably, strange animals and even species in close proximity. The length of time spent in lairage should be short, as longer duration leads to more physical damage in addition to welfare concerns, but should be sufficiently long to allow the animal to recover. The slaughtering process usually involves an initial stunning before the animal is killed by sticking. The animal should not regain consciousness between these two events, and so the stun-stick interval should be as short as possible. Slaughter that is carried out differently, e.g. in accordance with Jewish and Muslim religious codes, involves no stunning prior to sticking, so the animals are conscious when stuck. It is believed that this leads to a more thorough bleed-out of the slaughtered animal, although this has been disputed. And that the suffering endured by the animal is no different, which is also disputed.
Chapter 46

Further reading

Recommended Reading
Humane Slaughter Association, website: http://www.hsa.org.uk

Chapter 47

References


Chapter 48

93/119/EC Council Directive of 22 December 1993 on the protection of animals at the time of slaughter or killing


EC No 1099/2009 Council Regulation of 24 September 2009 on the protection of animals at the time of killing


Chapter 49


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