Guidelines for humane handling, transport and slaughter of livestock

Food and Agriculture Organization of the United Nations
Regional Office for Asia and the Pacific

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PREFACE

Many developing countries have common problems concerning animal welfare, particularly in the livestock slaughter sector. These problems include handling of livestock, transport, pre-slaughter penning, stunning and bleeding.

The issues of humane treatment of slaughter animals in these countries are of growing importance because:

- In recent decades there has been an increased demand for livestock products, particularly meats;
- Meat output in developing countries now considerably exceeds that in developed countries, resulting in increasing numbers of animals slaughtered;
- Developing countries with a potential for exporting meat, where humane treatment of slaughter animals is not satisfactorily practised, will have to comply with sanitary and welfare requirements of importing countries;
- Humane treatment of slaughter animals not only reduces unnecessary suffering but also reduces loss of quality and value of meat and animal by-products, thus contributing to food security and income in most needy countries;
- Many developing countries have poorly developed and implemented welfare legislation, resulting in harsh conditions for livestock and excessive suffering.

FAO budgetary resources, mainly designated to maximise agricultural production in the food, crop and livestock sectors in developing countries, can provide only limited funds for livestock

welfare. Changes in developing countries towards more humane treatment of slaughter stock must come about by joint efforts of governments, producers, the meat industry and desirably also with the help of Non-Government Organizations (NGOs). However, FAO in cooperation with NGOs could be in a position to co-ordinate these efforts as well as provide technical advice and assistance.

This publication is provided as a joint effort between FAO and the NGO Humane Society International (HSI), to offer guidance to animal welfare personnel, transport operators, farmers and slaughterhouse management etc. in improving slaughter, livestock productivity and welfare.

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INTRODUCTION

Livestock referred to in this manual are animals from which meat is produced. Types of food animals vary in different parts of the world. This booklet will refer mainly to cattle, goats, sheep, pigs, poultry and ostriches. Other slaughter animals of relevance in particular in developing countries are buffaloes, camels and rabbits. The transformation of slaughter animals into meat is a chain of events including handling and loading on the farm, transport to the market, pens or slaughterhouse, off-loading and holding and finally slaughter. During these procedures poor operational techniques and facilities will lead to unnecessary suffering, injury and loss of production.

There are many advantages to improving conditions for livestock destined for slaughter. These will have the benefit of improvements in productivity, animal welfare and personnel safety.

Increased production through humane treatment of slaughter animals can be achieved, for example, through:

- reduced carcass damage and waste and higher value due to less bruising and injury;
- decreased mortality;
- improved quality of meat by reducing animal stress;
- increased quality and value of hides and skins.

Improving animal welfare is necessary to reduce suffering, in line with requirements of Governments, NGOs, and consumers, who are becoming more concerned with welfare of food animals. Better conditions of livestock operations will also improve safety of workers in the livestock and meat industry.

CHAPTER 1

ANIMAL STRESS AND PAIN

Scientific research has shown that warm-blooded animals (this includes livestock) feel pain and the emotion of fear. In particular mammals, including food animals of this group, have brain structures that enable them to feel fear and suffering from pain, and it is likely that they suffer pain in the same way as humans. Fear and pain are very strong causes of stress in livestock and stress affects the quality of meat obtained from this livestock. Pain is usually the effect of injury and suffering, which also affects the quality and value of meat from affected animals.

When animals are subjected to unusual conditions or circumstances due to the wilful actions of people, it is people's moral responsibility to ensure that the welfare of these animals is cared for and that they do not suffer unnecessary discomfort, stress or injury.

Efficient, experienced and quiet handling of livestock, using recommended techniques and facilities, as well as taking measures to eliminate pain and accidental injury, will reduce stress in the animals and prevent quality deficiencies in meat and by-products.

CHAPTER 2

EFFECTS OF STRESS AND INJURY ON MEAT AND BY-PRODUCT QUALITY

A. Meat quality

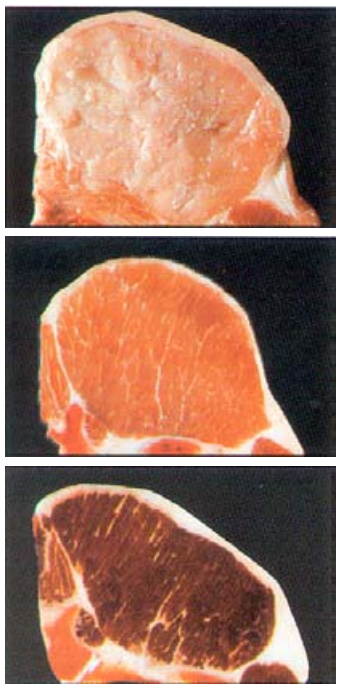
The energy required for muscle activity in the live animal is obtained from sugars (glycogen) in the muscle. In the healthy and well-rested animal, the glycogen content of the muscle is high. After the animal has been slaughtered, the glycogen in the muscle is converted into lactic acid, and the muscle and carcass becomes firm (rigor mortis). This lactic acid is necessary to produce meat, which is tasteful and tender, of good keeping quality and good colour. If the animal is stressed before and during slaughter, the glycogen is used up, and the lactic acid level that develops in the meat after slaughter is reduced. This will have serious adverse effects on meat quality.

Pale Soft Exudative (PSE) meat (Fig. 1)

PSE in pigs is caused by severe, short-term stress just prior to slaughter, for example during off-loading, handling, holding in pens and stunning. Here the animal is subjected to severe anxiety and fright caused by manhandling, fighting in the pens and bad stunning techniques. All this may result in biochemical processes in the muscle in particular in rapid breakdown of muscle glycogen and the meat becoming very pale with pronounced acidity (pH values of 5.4-5.6 immediately after slaughter) and poor flavour. This type of meat is difficult to use or cannot be used at all by butchers or meat processors and is wasted in extreme cases. Allowing pigs to rest for one hour prior to slaughter and quiet handling will considerably reduce the risk of PSE.

Dark Firm and Dry (DFD) meat (Fig. 1)

This condition can be found in carcasses of cattle or sheep and sometimes pigs and turkeys soon after slaughter. The carcass meat is darker and drier than normal and has a much firmer texture. The muscle glycogen has been used up during the period of handling, transport and pre-slaughter and as a result, after slaughter, there is little lactic acid production, which results in DFD meat. This meat is of inferior quality as the less pronounced taste and the dark colour is less acceptable to the consumer and has a shorter shelf life due to the abnormally high pH-value of the meat (6.4-6.8). DFD meat means that the carcass was from an animal that was stressed, injured or diseased before being slaughtered.



A.

B.

C.

Fig.1: A. Pale Soft and Exudative (PSE) meat
B. Normal meat
C. Dark Firm and Dry (DFD) meat

Spoilage of meat

It is necessary for animals to be stress and injury free during operations prior to slaughter, so as not to unnecessarily deplete muscle glycogen reserves. It is also important for animals to be well rested during the 24-hour period before slaughter. This is in order to allow for muscle glycogen to be replaced by the body as much as possible (the exception being pigs, which should travel and be slaughtered as stress free as possible but not rested for a prolonged period prior to slaughter). It is important that the glycogen levels in the muscles of the slaughtered carcass are as high as possible, to develop the maximum level of lactic acid in the meat. This acid gives meat an ideal pH level, measured after 24 hours after slaughter, of 6.2 or lower. The 24h (or ultimate) pH higher than 6.2 indicates that the animal was stressed, injured or diseased prior to slaughter.

Lactic acid in the muscle has the effect of retarding the growth of bacteria that have contaminated the carcass during slaughter and dressing. These bacteria cause spoilage of the meat during storage, particularly in warmer environments, and the meat develops off-smells, colour changes, rancidity and slime. This is spoilage, and these processes decrease the shelf life of meat, thus causing wastage of valuable food. If the contaminating bacteria are those of the food poisoning type, the consumers of the meat become sick, resulting in costly treatment and loss of manpower hours to the national economies. Thus, meat from animals, which have suffered from stress or injuries during handling, transport and slaughter, is likely to have a shorter shelf life due to spoilage. This is perhaps the biggest cause for meat wastage during the production processes.

Bruising and injury (Fig. 2 and Fig. 3)

Bruising is the escape of blood from damaged blood vessels into the surrounding muscle tissue. This is caused by a physical blow by a stick or stone, animal horn, metal projection or animal fall and can happen anytime during handling, transport, penning or stunning. Bruises can vary in size from mild (approx. 10-cm diameter) and superficial, to large and severe involving whole limbs, carcass portions or even whole carcasses. Meat that is bruised is wasted as it is not suitable for use as food because:

- It is not acceptable to the consumer;
- It cannot be used for processing or manufacture;
- It decomposes and spoils rapidly, as the bloody meat is an ideal medium for growth of contaminating bacteria;
- It must be, for the above reasons, condemned at meat inspection.

Fig. 2: Severe bruising
- Cattle carcass

Bruising is a common cause of meat wastage and can be significantly reduced by following the recommended correct techniques of handling, transport and slaughter.

Injuries (Fig. 4) such as torn and haemorrhagic muscles and broken bones, caused during handling, transport and penning, considerably reduce the carcass value because the injured parts or in extreme cases the whole carcass cannot be used for food and are condemned. If secondary bacterial infection occurs in those wounds, this causes abscess formation and septicaemia and the entire carcass may have to be condemned.

Fig. 3: Severe bruising
- Cattle head

Fig. 4:
Transport injury

B. Hides and skins quality

Hides and skins should have the highest value of any product of slaughter animals, other than the carcass. This is particularly so of cattle hides and small ruminants and ostrich skins. In the case of pigs and poultry, the skin forms part of the edible meat.

Useful leather can be made only from undamaged and properly treated skins. Proper handling of these items is important to produce a valuable commodity. Careless damage to hides and skins will cost the industry much loss.

Hides and skins of slaughter livestock (Fig. 5) can be damaged by thoughtless handling and treatment of these animals in the following ways:

Fig. 5:
Hide damage
- Brands and injury

1. Before slaughter:-
   - Indiscriminate branding;
   - Injuries from thorns, whips, sticks, barbed wire and horns;
   - Unsuitable handling facilities;

- Badly designed and constructed transport vehicles.

2. During slaughter:-
   - Causing the animals to become excited and injuring themselves;
   - Hitting or forcefully throwing the animal;
   - Dragging the carcass along the ground, alive or dead.

Consideration for animal welfare during transport and handling will improve the value of these by-products.

CHAPTER 3

MARKETING SYSTEMS AND LOSSES

Holding people accountable for losses

During the production chain from farm to market of meat and by-products, there may be considerable loss in the quality and quantity of meat and by-products. These losses may be in the form of:

- Carcass and meat condemnations due to bruising, injuries and deaths;
- Downgrading and unsuitability of hides and skins due to damage;
- Loss of meat quality due to DFD or PSE;
- Spoilage of meat due to stress and poor animal welfare of livestock.

In many developing countries, these losses are high because the marketing system does not always provide an economic incentive to reduce losses. One of the most efficient methods for improving welfare and reducing losses is to design marketing and payment system that hold people and organisations involved in the marketing chain of livestock accountable for these losses.

One of the worst marketing systems, from both welfare and an economic loss perspective, is to sell slaughter animals on a live mass or per head basis. This system does not provide an economic incentive to prevent bruising, injuries, stress or hide damage or other meat quality problems. When animals are sold to a slaughter plant on a live mass basis, the producer or transporter is not held accountable for losses due to bruises, injuries and other damages.

These losses are paid for by the slaughter plant. It is a common observation that cattle sold on a live mass basis have twice as many bruises as those sold on a carcass mass basis.

However, when cattle are sold based on the carcass mass and quality, both the producer and transporter have an economic incentive to reduce bruising and injuries, much greater care is taken of the handling and welfare conditions. Changing payment systems is one of the most effective ways to improve handling and transport practices.

The same applies to transport insurance. If animals on a transport vehicle are insured, the policy must be designed to encourage good handling practices and discourage poor practices. If a policy pays for all the bruised, crippled or dead animals, the transport operator has no incentive to handle animals carefully. Policies should have a deductible clause to pay only for a catastrophic loss, such as a truck accident, but will not pay for bruised animals or pigs dead from heat stroke. In another scheme, producers pay a bruising levy, which goes into a fund that pays for serious bruising, of say over 2 kg, or downgrading.

Only first-grade hides and skins can be used to make high quality leather. Hides and skins are graded according to the extent and distribution of damage. A bonus should be offered to owners and transporters for better grades, thus encouraging them to ensure that damage from various causes is kept to a minimum. In addition, slaughterhouse skinners should be charged a penalty for skins cut during flaying.

Segmented markets and piecework

Livestock marketing systems that have one or more agents between the producer and slaughter plant will usually result in more damage to livestock than market systems where animals are sold directly from the producer to slaughter plant or butcher. There are two reasons for this:

- First of all, the agents or middlemen have little incentive to ensure that damage to livestock is kept to a minimum;
- Secondly every time an animal is handled by a different middleman, it increases the likelihood of injury and stress. Animals taken to an auction before moving to the slaughterhouse will have to be loaded and unloaded an extra time.

Payment systems for people handling animals can greatly affect the way the animals are treated. Handling animals on a "piece work" basis provides the incentive for handling animals as fast as possible. This encourages abuse and reduces care. Producers have found that paying truck-loading workers on an incentive basis to reduce damages greatly reduced losses. In conclusion, it should be emphasised that appropriately changing payment and marketing systems is one of the best methods for reducing livestock damage and improving animal welfare during handling and transport. Anyone, who causes an animal to become injured, damaged, bruised or die must be held economically accountable for the losses.

CHAPTER 4

PRINCIPLES OF ANIMAL BEHAVIOR

Livestock behave in various ways, depending on circumstances and, to a large extent, species. A basic understanding of animal behaviour in typical circumstances from the farm to the market or slaughterhouse will assist handlers in the management of livestock and thereby prevent undue stress and injury.

For example, animals, which are unaccustomed to frequent contact with humans, such as ranched or extensively raised stock, will not allow people to approach or touch them easily. These animals will require more elaborate loading ramps, pens and handling races than tame ones. People loading extensively raised animals need to understand the psychology of the animal in order to prevent injury to either the animal or themselves. On the other hand, oxen, draught animals, those animals raised intensively or dipped regularly (for tick control) and animals living in close contact with humans, such as in rural areas, are generally more tame and easy to handle.

Relation of animal vision, hearing and smell to stress and injury

Ruminant animals can discriminate between different colours. The ruminant eye is most sensitive to yellow-green and blue light. Experience has shown that livestock, particularly cattle and pigs, as well as ostriches, are very sensitive to light contrast. This causes them to hesitate at and shy away from drains, gates, and changes from wet to dry or concrete to metal floors. Lighting should be even and diffuse and harsh contrasts of light and dark should be avoided. Ultraviolet or diffuse light has a calming effect on poultry and ostriches.

Some livestock species, e.g. cattle and ostriches have a wide angle of vision and to prevent them from becoming afraid of distractions outside confines, the holding pens, crowd races, stunning boxes and gates should have solid sides. Animals will also shy at moving things, as well as darkness and they may refuse to enter a dark place. Animals have a tendency to move from a darker to a lighter place. Extra, indirect lighting may help in moving animals in pens. Adding a light to illuminate a race entrance or removing a lamp to eliminate a sparkling reflection will often improve animal movement. All species of animals may hesitate and refuse to move when they see things in the race that scare them, such as sparkling reflections, dangling chains, moving people or equipment, shadows or water dripping. A calm animal will stop and look right at the distraction that scares it. If air is blowing towards the animal this should be changed. If animals hesitate, the distraction that causes this should be removed instead of increasing the force used to move them. Rapidly moving objects scare animals. Forcing them to quickly approach a vehicle, pen or building may cause them to panic.

Cattle, sheep and ostriches have very sensitive hearing, particularly to high frequency sound. Sounds that do not bother people, such as intermittent high-pitched noise, may hurt animals' ears. Reducing noise from equipment and people will improve animal movement, reduce stress and the risk of injury. People should not yell, whistle or make loud noises. Clanging and banging of equipment will unsettle animals and can be reduced by installing rubber stops. Hissing air is one of the worst noises but also easy to eliminate. It must be said, however, that in many rural circumstances where cattle live in close proximity to humans and where they are mustered, kraaled every night and regularly dipped, some of these noises can be useful aids to droving. For example in rural Africa, where cattle are accustomed to yelling and loud noise it encourages movement.

However, generally it is obvious that noise increases physiological stress levels. This refers also to preslaughter handling and handling at point of slaughter. Slaughter in a small, quiet abattoir produces less stress hormones in animals compared to a large, noisy commercial plant.

With regard to smell, emitted odours, particularly strange smells, may cause animals to become unsettled and excited. This is noticeable in animals, which are strangers to each other or to surrounding conditions. Pre-mixing of these animals, or smearing pigs with litter from a single source will reduce tension and fighting amongst strangers. Many people interested in the welfare of livestock are concerned about animals smelling blood. Cattle will hesitate and sometimes refuse to enter a stunning box or restrainer if the ventilation system blows blood smells into their faces. An exhaust fan to suck away smells will facilitate entry into a stunning box. If an animal becomes agitated and frenzied during slaughter handling, subsequent animals often become agitated as well and an entire slaughter day can turn into a continuous chain reaction of excited animals. The next day, after the surrounds and equipment have been washed, the animals will be calm. A stress pheromone in the blood of severely stressed animals can be smelt by others and cause excitement. Blood from relatively low–stressed animals may have little effect on others. Research with cattle and pigs indicates that stress hormones are secreted in the saliva and urine. Pigs and cattle tend to avoid objects or places, which are contaminated with urine from a stressed animal.

CHAPTER 5

HANDLING OF LIVESTOCK

General principles

The first principle of animal handling is to avoid getting the animal excited. It takes up to 30 minutes for an animal to calm down and its heart rate to return to be normal after rough handling. Calm animals move more easily and are less likely to bunch and be difficult to remove from a pen. Handlers should move with slow, deliberate movements and refrain from yelling.

Animals may become agitated when they are isolated from others. If an isolated animal becomes agitated, other animals should be put in with it. Electric prodders (prods) should be used as little as possible or only on stubborn animals. However it is more humane and causes less damage to give an animal a mild electric shock than to hit it with a stick or twist its tail. Battery-operated prods (Fig. 6) are preferred to mains-current operated ones (Fig. 7). The voltage used should not exceed 32 V and never be used on sensitive parts such as eyes, muzzle, anus and vulva.

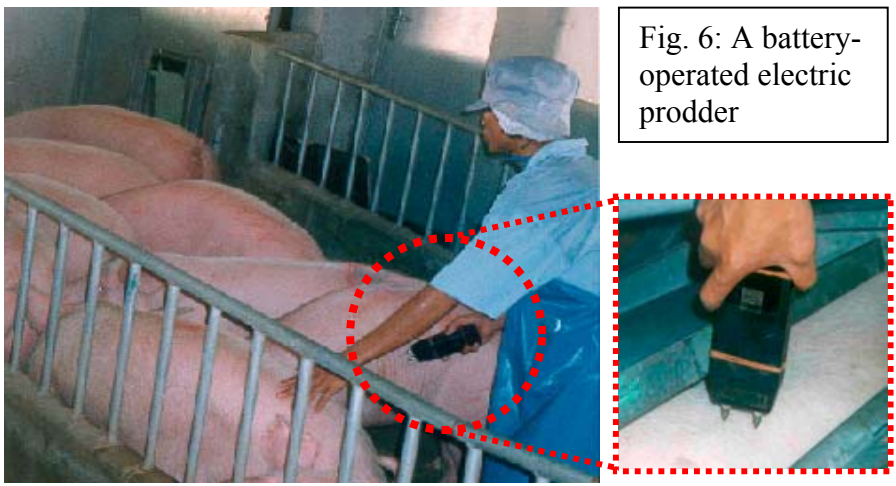


Fig. 6: A battery-operated electric prodder

Fig. 7: Mains-current operated electric prodder (not

Instead of prods, other droving aids should be used such as flat straps (Fig. 8), rolled-up plastic or newspaper, sticks with flags on or panels[1] for pigs. Hesitant animals can often be enticed into pens or vehicles by first leading in a tame animal and the others will follow.

Fig. 8: Flat strap for droving

[1] Panels for droving pigs are boards made of solid material, such as wood, plastic etc. of approx. 1-m square which are held by the drover to block the vision and movement of pigs and so guide its direction. Without such boards, it would be impossible to drove pigs in the convenient way using flags, rolled paper, branches and waving hands as for sheep and cattle.

Ostriches are particularly nervous and should be approached cautiously. They have a vicious forward kick. Tame birds can be led quietly by handlers (Fig. 9). A shepherds crook (Fig. 10) around the neck is a useful leading aid or placing a hood over the head will make the bird more docile.

Fig. 9: Leading tame ostriches to the stunning area

Fig. 10: Shepherds crook used to assist leading ostriches

Handling in crowd pens and races

Overloading the crowd pen is one of the most common animal handling mistakes. The crowd pen and the alley that leads to it from the yard should be only half filled. Handlers must also be careful not to force animals to move by using crowd gates. Animals should walk up the race without being forcibly pushed. If they are pushed up too tightly with a crowding gate, handling becomes more difficult. Tightly packed animals are unable to turn around to enter the race. If animals refuse to enter the single file race, they may be hesitating because of a distraction ahead, such as a moving person.

Flight zone and point of balance (Fig. 11)

An animal's flight zone is the animal's safety zone and handlers should work on the edge of the flight zone. If an animal turns and faces a person, the person is outside the flight zone. When a person enters the flight zone, an animal will turn away. If an animal in a pen or race becomes agitated when a person stands too close to them, this indicates that the person is in the flight zone and should move backwards away from them. The installation of solid sides on races (Fig. 12) and stunning boxes (Fig. 25) will help calm animals because they provide a barrier between the animals and people who approach too closely. The flight zone size depends on how wild or tame the animal is. Animals with a flighty temperament will have a larger flight zone. Animals that live in close contact with people have a smaller flight zone than animals that seldom see people. An excited animal will have a larger flight zone than a calm one. A completely tame animal has no flight zone and may be difficult to drive.

Fig. 11: Flight zone and point of balance

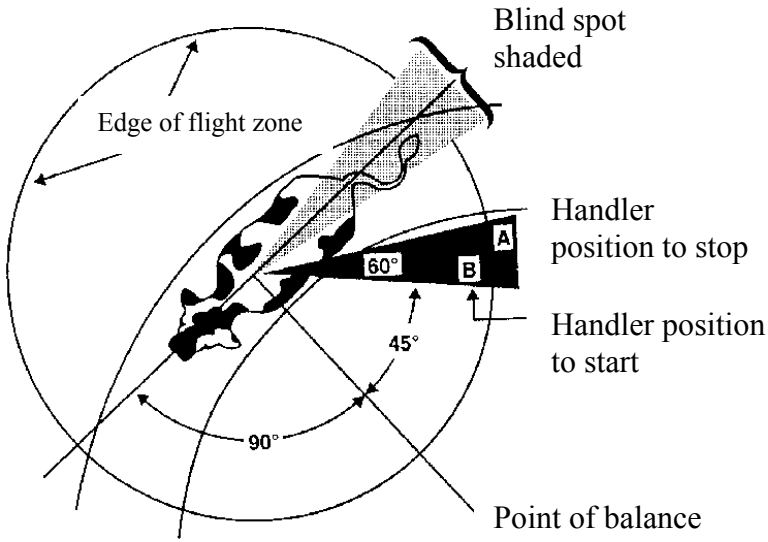
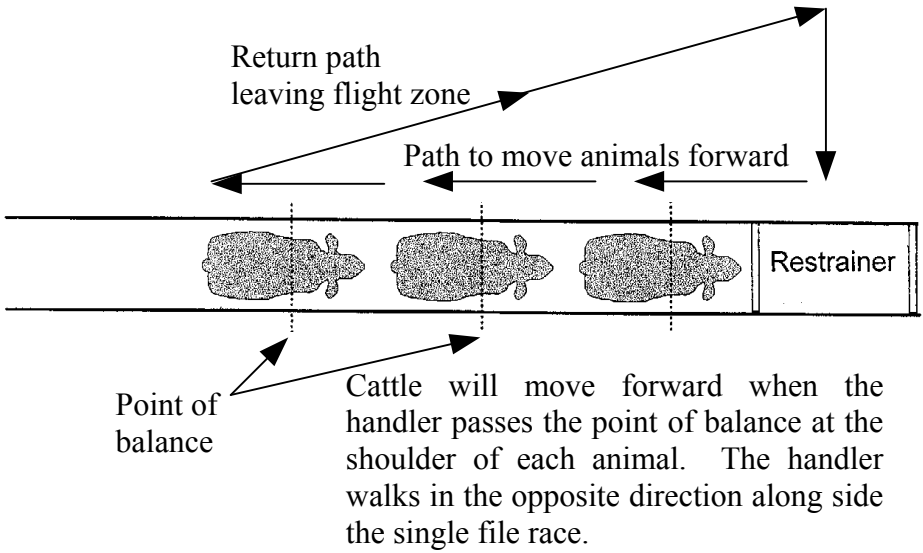


Fig. 12:
Curved cattle race with solid sides

To make an animal move forward, the handler must be behind the point of balance at the shoulder. To get the animal to move backwards, the handler must stand in front of the point of balance. Figure 13 illustrates handler movement patterns, which make it possible to reduce the use of electric prods or goads. Cattle, sheep or pigs will move forward in a race when a handler passes by the animal in the opposite direction of the desired animal movement. The handler must move quickly in order to pass the point of balance at the shoulder to make the animal move forward. The animal will not move forward until the handler passes the shoulder and reaches its hips.

Fig. 13: Handler movement pattern to keep cattle moving into a squeeze chute or restrainer



Designs of handling facilities

The risk of injury and stress during handling of livestock can be high, causing financial loss to producer, transporter and slaughterhouse. Examples are poorly designed pen fencing (Fig. 14), too low or unstable loading ramps, exposure of livestock to heat and intensive sunshine (Fig. 19). Properly designed and constructed facilities on farms, at auction yards and slaughter houses (Fig. 15, 16, 17, 18, 20, 21) etc. will contribute significantly towards the safe handling of livestock, thereby reducing the risk of injuries and stress to animals and workers alike.

Fig. 14: Poor designed fencing

Fig. 15: Well-constructed pens/platform for offloading and holding cattle

Fig. 16: Ramp for pigs and off-loading platform for vehicles leading to holding pens for pigs

Fig. 17: Holding pens for livestock awaiting slaughter

Pens—Livestock pens on farms, feedlots, auction yards and slaughterhouses should have sufficient space for the animals to be able to lie down (Table 1, Fig. 17, 18).

TABLE 1
Required floor space (m^2) per head of livestock for different species

Cattle	loose	2.0-2.8
	tied	3.0
Pigs	baconers/small porker	0.6
	sow	0.9
Calves /sheep	-	0.7

Ostriches	-	0.9

Bulls and boars should be individually penned, and if tied, they should be able to lie down. Water must be easily available. Troughs should be high enough or protected to prevent animals from falling in and drowning. In cold climates, pens should have walls and roofs to protect animals from weather stress. In the tropics, a roof is necessary for holding pens to protect stock, particularly pigs, from heat stroke and sunburn. Water sprays in the pig pens are useful to cool pigs down (Fig. 18). In open pens without roof and shade, even free-range cattle may suffer (Fig.19). Ostrich pens can be partially enclosed to make them darker as this keeps the animals more docile (Fig. 20).

Fig. 18: Nozzle for water spray to cool down pigs

Fig. 19: Open pens
- No shade

Fig. 20: Enclosed ostrich pens to create darker conditions

Fig. 21: Smooth tubular rails for pen partitions

Partitions–Rails made of tubular iron (Fig.20), wood or concrete (Fig. 21, 22) should be smooth and without projections such as hinges, broken ends or wire. Spaces should be adjusted to prevent animals from getting through or stuck and injuring themselves (Table 2).

TABLE 2
Rail distances and heights for different species

	Rail distances	Rail height
Cattle	20 cm apart	Top rail 1.5 m high
Sheep/goat	15 cm apart	Top rail 0.9 m high
Pigs	15 cm apart	Top rail 0.9 m high
Ostriches	20 cm apart	Top rail 1.5 m high

Floors (Fig. 22, 23)—Pen floors should be non-slip and have a gradient of not more than 1:10. If animals slip, this causes bruises, fractures, dislocations and/or skin damage. Concrete floors should have patterns engraved, or covered in mesh to provide traction, at the same time facilitating cleaning. Failing this flat stone will suffice.

Fig. 22: Tubular rails and concrete walls for pen partition, non-slip concrete floor

Fig. 23: Non slip concrete pen floor partition

Raceways—Lanes are necessary for animals to walk or be led on/off vehicles and platforms into holding pens or slaughter facilities etc. Races should be narrow enough so that animals cannot turn around or get wedged beside each other. This results in animals becoming injured, if they panic or are manhandled. Race width for cattle should be approximately 76 cm, depending on breed and size (Fig. 24, 25, 26, 27).

Where possible, raceways should be curved to facilitate animal movement (Fig. 12). Slaughterhouse and pre-stunning races should have solid sides to prevent animals balking.

Ramps and platforms—Both these structures are necessary for loading and unloading livestock from transport vehicles or walking them to slaughter facilities. Ramps should have cross slating or steps (10 cm high x 30 cm deep) to facilitate walking and prevent slipping. The ramp should be sloped at an angle of 20 degrees or less (Fig. 15, 16).

Fig. 24: Raceway for cattle from holding pens to stunning area

Fig. 25: One cattle waiting at the end of raceway in front of stunning box, another cattle staying in stunning box

Fig. 26: Pigs from holding pens entering the raceway to slaughterhouse

Fig. 27: Raceway for pigs to stunning area

CHAPTER 6

TRANSPORT OF LIVESTOCK

The need to transport food animals occurs essentially in commercial agriculture and to a lesser extent in the rural or subsistence sector. These animals need to be moved for a number of reasons including marketing, slaughter, re-stocking, from drought areas to better grazing and change of ownership. Typically, methods used to move animals are on hoof, by road motor vehicle, by rail, on ship and by air.

Generally the majority of livestock in developing countries are moved by trekking on the hoof, by road and rail. Historically, livestock has been moved on foot, but with increasing urbanisation of the population and commercialisation of animal production, livestock transport by road and rail vehicles has surpassed this.

Transport of livestock is undoubtedly the most stressful and injurious stage in the chain of operations between farm and slaughterhouse and contributes significantly to poor animal welfare and loss of production.

Effects of transport

Poor transportation can have serious deleterious effects on the welfare of livestock and can lead to significant loss of quality and production.

Effects of transport and movement include:

a. Stress –leading to DFD beef and PSE pork (Fig. 1);

b. Bruising –perhaps the most insidious and significant production waste in the meat industry (Fig. 2, 3);

c. Trampling –this occurs when animals go down due to slippery floors or overcrowding (Fig. 37-39);

d. Suffocation -this usually follows on trampling;

e. Heart failure -occurs mostly in pigs when overfed prior to loading and transportation;

f. Heat stroke -pigs are susceptible to high environment temperatures and humidity;

g. Sun burn -exposure to sun affects pigs seriously;

h. Bloat -restraining ruminants or tying their feet without turning them will cause this;

i. Poisoning -animals can die from plant poisoning during trekking on hoof;

j. Predation -unguarded animals moving on the hoof may be attacked;

k. Dehydration -animals subject to long distance travel without proper watering will suffer weight loss and may die;

l. Exhaustion -may occur for many reasons including heavily pregnant animals or weaklings;

m. Injuries -broken legs, horns (Fig. 4);

n. Fighting -this occurs mostly when a vehicle loaded with pig stops, or amongst horned and polled cattle.

Methods of transport

Cattle

The most appropriate methods of moving cattle are on hoof, by road motor vehicle or by rail wagon. Moving cattle on the hoof (trekking) (Fig. 28) is suitable only where road and rail infrastructure does not exist, or when distances from farm to destination are short. This method is slow and fraught with risks to the welfare and value of the animals. Rail transport is useful for short-haul journeys where loading ramps are available at railheads and communication is direct to destination. Road motor transport is by far the most versatile, the method of first choice and the most user friendly.

The most satisfactory method of transporting cattle is by road motor vehicle (Fig. 29, 30). Moving by rail truck (Fig. 31) requires more careful management and trekking is satisfactory for well-planned distances.

Fig. 28: Moving cattle on the hoof

Fig. 29: Road motor vehicle for transporting cattle (cross slating of cattle truck floor to prevent slipping)

Fig. 30: Large truck for cattle transport at unloading platform

Fig. 31: Rail truck for transporting cattle

Sheep/goats Of the food animals these are the easiest to transport and generally travel well on hoof, rail or road. Double-deck trucks are also suitable (Fig. 32).

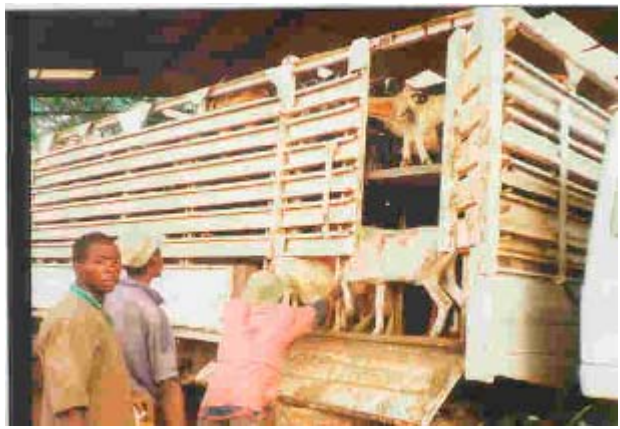


Fig.32: Double-deck truck for transporting sheep/goats

Pigs Pigs are difficult animals to transport, and the only satisfactory method is by road, although rail can be used under careful circumstances.

Poultry Broilers and other poultry such as turkeys or ducks are best transported by road. Flocks of birds should be subdivided in small numbers in crates (Fig. 33). Recommended are plastic crates, which can be stacked on top of each other on a vehicle and which can easily be washed after use. The lid of the crates is for loading and the opening at the side for removal of the birds.

Fig. 33: Crates for transport of chicken

Ostriches — The skin and meat of ostriches is particularly valuable, so careful transport by road vehicle is the only suitable method of transport.

Having selected the preferred method of transport of slaughter animals, it is necessary to take into account numerous factors in order to ensure the health and welfare of the animals.

Types of vehicles

Any vehicle used for the transport of slaughter livestock should have adequate ventilation, have a non-slip floor with proper drainage and provide protection from the sun and rain, particularly for pigs. The surfaces of the sides should be smooth and there should be no protrusions or sharp edges. No vehicle should be totally enclosed.

Ventilation—Transport vehicles should never be totally enclosed, as lack of ventilation will cause undue stress and even suffocation, particularly if the weather is hot. Poor ventilation may cause accumulation of exhaust fumes in road vehicles with subsequent poisoning. Pigs are particularly susceptible to excessive heat, poor air circulation, high humidity and respiratory stress. Well-ventilated vehicles are necessary (Fig. 29, 30, 34). The free flow of air at floor level is important to facilitate removal of ammonia from the urine.

Fig.34: Well-ventilated truck for transporting pigs. Heat combined with hot sun would require a cover (roof) for the vehicle.

Floors—Non-slip floors in all vehicles are necessary to reduce the risk of animals falling. A grid of cross slating made from wood or metal is (Fig. 29) suitable. The grid can be removable, so the vehicle can be used for other purposes. Other forms of non-slip surfaces such as grass or sawdust are not suitable. Additional balance for animals is provided by partitioning the interior of the vehicle with either wood or metal poles or solid boards. Broken floors will cause leg and other injuries (Fig. 35). Vehicle floors should be level with off-loading platforms (Fig. 16), otherwise animals will injure themselves climbing off or be manhandled in order to remove them (Fig. 36).

Floor space—Livestock require sufficient floor space so that they can stand comfortably without being overcrowded. Overloading results in injuries or even death of livestock (Table 3, Fig. 37, 38, 39).

Fig. 35: Cattle leg protruding through broken truck floor

Fig. 36: Poor offloading facilities resulting in injuries from mishandling of animals

Fig. 37: Overloading truck with goats

Fig. 38: Goats being trampled in the back of a truck

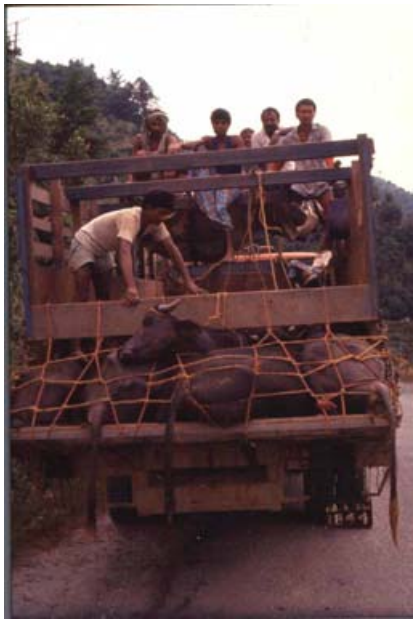


Fig. 39: Overloading truck with water buffaloes

TABLE 3
Approximate floor space for transporting different classes of animals

Classes of stock		Floor area /animal (m^2)
Mature cattle		1.0 – 1.4 *
Small calves		0.3
Pigs	porker	0.3
	baconer	0.4
	sow/boar	0.8
Sheep/goats		0.4
Ostriches		0.8

*50-60cm vehicle length/head loaded cross-wise

Allowances should be made for breed and body size. If the floor area is too large for the number of animals, partitions should be used to avoid animals being thrown about.

Sides—The sides of vehicles should be high enough to prevent animals, particularly pigs, from jumping out and injuring themselves. Insides could also be padded at hip level with, for example, old tyres to reduce bruising of cattle and ostriches. Also there should be no gaps through which a leg might protrude and be broken. Narrow entry doors can lead to considerable bruising of hips. Rail trucks should be fitted with spring coupling to cushion jerky movement.

Roof—A roof is not necessary on a transport vehicle for bovines and small ruminants provided the animals are not exposed for hours in the hot sun (Fig. 29, 30). Vehicles for pigs should have roofs unless the pigs are to be transported in the early morning or late evening. Poultry should be protected from sun and rain. Transporting in cages or crates (Fig. 33) will protect them from physical injury. They should be large enough to allow all the birds to sit down and move their heads freely. Ventilation should be adequate.

At the small-scale level in more primitive conditions animals are often transported under very unsuitable conditions, which may cause a great deal of pain or even death through suffocating, heat stress, dehydration etc. (Fig. 40, 41, 42, 71).

Fig. 40: Unsuitable transport of a

Fig. 41: Unsuitable transport of

Fig. 42: Unsuitable transport of

Pre-loading precautions

There are a number of simple procedures that can be implemented prior to the loading of livestock, which will considerably reduce the risk of injury and stress.

1. Pre-mixing of cattle or pigs leads to greater familiarity and these animals travel better than animals that are strangers. Cattle should be mixed in a pen 24 hours before loading. Victimised or wild animals can be weeded out during this period. Fighting amongst pigs that are strangers is common, resulting in skin damage, wounds and stress. Mix pigs from different pens together before loading, smearing pigs with litter or excreta from the same pen so that they smell similar.

2. Most animals can be fed and watered before transporting. This has a settling effect. However pigs should **not** be fed before transport as the feed ferments and the gas causes pressure on the heart in the thoracic cavity, leading to heart failure and death.

3. Do not mix horned and hornless animals in the vehicles as this causes bruising and injury. Different species should also not be mixed – sheep, goats and calves under 6 months can be mixed and individual animals can be transported in a loose sack tied at the animal's neck. Feet should not be tied, and animals should be turned every 30 minutes or so. Pigs should not travel with other species unless separated by a partition (Fig.43). Bulls should not be carried together with other stock unless separated by a strong partition.

Fig. 43: Malpractice of loading pigs, goats and sheep in the same truck

4. Animals that are diseased, injured, emaciated or heavily pregnant should not be transported, and unfit, heavy, penfed animals should not travel far as they cannot stand up to the rigours of transport.

5. Vehicles should be fitted with a portable ramp to facilitate emergency offloading in case of prolonged breakdowns.

Transport operations

A number of factors must be taken into account during the journey in order that the animals do not suffer, become injured or die.

1. Trekking—Only cattle, sheep and goats can be successfully moved on hoof, and here certain risks are involved. The journey should be planned, paying attention to the distance to be travelled, opportunities for grazing, watering and overnight rest. Animals should be walked during the cooler times of the day and, if moving some distance to a railhead, they should

arrive with sufficient time to be rested and watered before loading. The maximum distances that these animals should be trekked depend on various factors such as weather, body condition, age etc., but the distance given in Table 4 should not be exceeded when trekked.

TABLE 4
Maximum distances for trekking

Species	One day journey	More than one day	
		First day	Subsequent days
Cattle	30 km	24 km	22 km
Sheep/goats	24 km	24 km	16 km

2. Time of the day—High environment temperatures will increase the risk of heat stress and mortality during transportation. It is important to transport animals in vehicles during the cooler mornings and evenings or even at night. This is particularly important for pigs. A combination of high humidity and high environment temperatures is especially deadly to pigs. Heat can rapidly build up to lethal levels in a stationary vehicle. Wetting pigs with water will help keep them cool.

3. Duration of journey[2]—Where possible, journeys should be short and direct, without any stoppages. If the vehicle stops, pigs will tend to fight. Cattle and sheep/goats should not travel for more than 36 hours and should be offloaded after 24h for feed and water, if the journey is to take longer than that. Pigs should

[2] There are recent moves in developed regions, seeking to limit the duration of livestock transports to 8 hours or less.

have access to frequent drinks of water during long journeys, particularly in hot and humid conditions.

4. Driving—Vehicles should be driven smoothly, without jerks or sudden stops. Corners should be taken slowly and gently. The second person should be in attendance to spot downer animals so that the vehicle can be stopped and the animal lifted. Train drivers should avoid "fly shunting" of trucks with livestock.

5. Wind chill—Wind blowing on wet animals being transported in cold weather causes a wind chill factor, where the body temperature is considerably reduced, resulting in severe stress or deaths.

CHAPTER 7

SLAUGHTER OF LIVESTOCK

The obligation in the conversion of food animals into edible products and useful by-products is to slaughter the animal in a humane manner and to process the carcass in a hygienic and efficient way.

Preparing livestock for slaughter

At the time of slaughter, animals should be healthy and physiologically normal. Slaughter animals should be adequately rested. They should be rested, preferably overnight, particularly if they have travelled for some times over long distances. However, pigs and poultry are usually slaughtered on arrival as time and distances travelled are relatively short and holding in pens is stressful for them. Animals should be watered during holding and can be fed, if required. The holding period allows for injured and victimised animals to be identified and for sick animals to be quarantined.

When ready for slaughter, animals should be driven to the stunning area in a quiet and orderly manner without undue fuss and noise (Fig. 8, 9, 26). Droving can be facilitated using flat canvass straps (Fig. 8), rolled plastic or paper, and in the case of stubborn animals, prodders (Fig. 6) can be used occasionally. Animals should never be beaten nor have their tails twisted. Animals should be led in single file (Fig. 24, 25, 27) into the stunning area where they can be held in appropriate restraining device(s) before stunning.

Restraint devices

It is very important that slaughter animals should be properly restrained before stunning or bleeding. This is to ensure stability of

the animal so that the stunning operation can be carried out accurately and properly. Different types of restraints are appropriate for different species:

Cattle

A stunning box is the most common method of restraining cattle (Fig. 25, 44). The size of the box should be just wide enough to prevent the animal from turning around, and so be difficult to stun. The floor of the box should be non-slip. A simple neck crush used by farmers to restrain cattle for weighing is suitable for small-scale operations (Fig. 45). Restraining tame cattle outside the stunning box by securing the head in a halter and then pulling the rope through a metal ring in a concrete floor is effective. It is recommended that the operator should be positioned behind protective steel bars (Fig. 46).

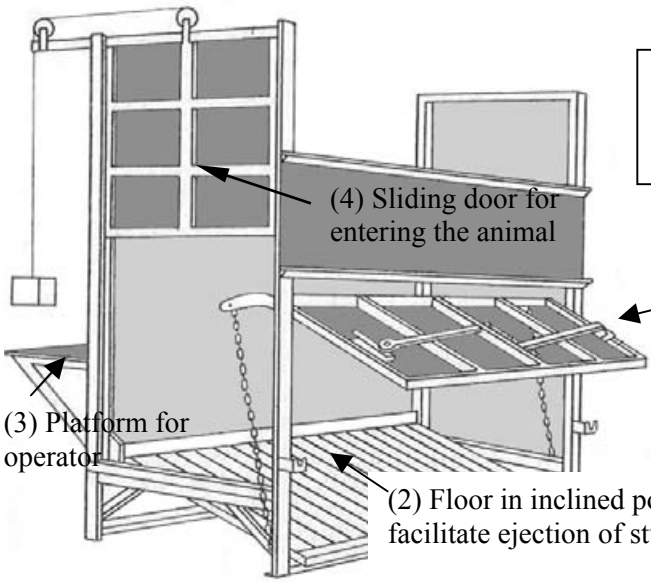


Fig. 44:

Stunning box for

Fig. 45: Simple, effective race and neck crush for cattle restraint

Fig. 46: Small-scale operation position of the pre-stunning operator behind protective steel bars

Sheep/goats A properly constructed metal stunning box is appropriate (Fig. 47). However, they can be restrained manually quite satisfactorily.

Fig. 47:
Sheep/goat
stunning box

Pigs — A stunning box is suitable for pigs (Fig. 48). Putting a few pigs in a small room is suitable but only for electrical stunning (Fig. 57, 58). On no account should pigs be restrained manually.

Poultry — Chickens are shackled by their legs onto a conveyor line (Fig. 49). This must be done gently to avoid injury and stress. In a small slaughterhouse, birds can be placed headfirst in cones (Fig. 50).

Ostriches — These are temperamental animals, and because they will kick, they must be securely restrained. This can be done by leading them into a padded V-shaped pen, with the head facing the apex of the pen. Also the feet can

be clamped immediately after electrical stunning has begun (Fig. 59).

Animals should never be left standing for a prolonged period in a restraint device and must be stunned immediately after being secured. The operator must be adequately trained and supervised. In some countries, people who handle and stun animals have to be trained and licensed.

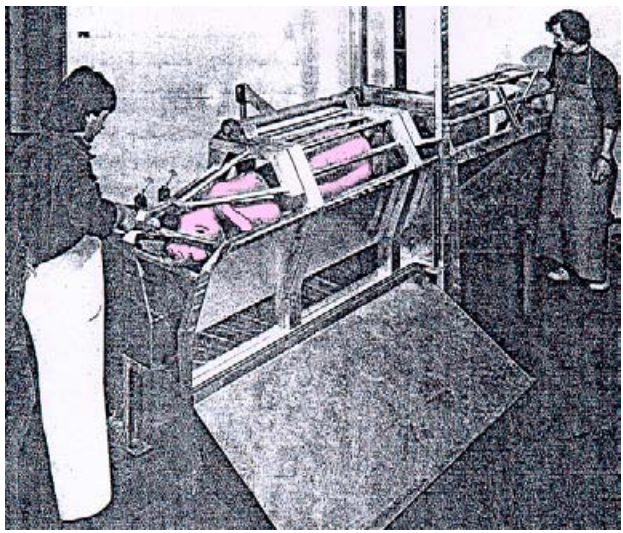


Fig. 48: Stunning box/restrainer for pigs

Fig. 49: Poultry shackled on conveyor by legs prior to electric stun

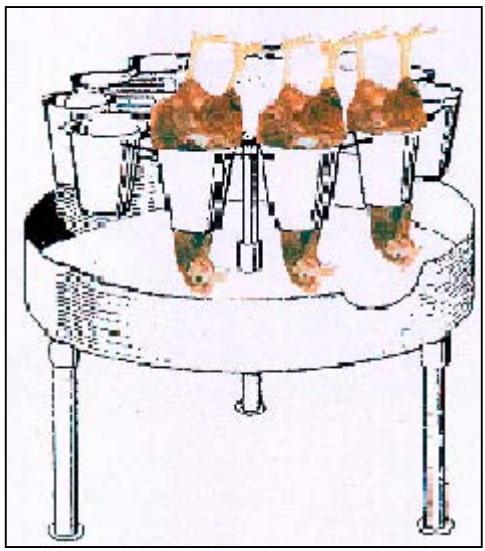


Fig. 50: Stun/bleed cones for small-scale poultry slaughter

Stunning methods

It is desirable to render an animal unconscious before it is slaughtered in order to eliminate pain, discomfort and stress from the procedure. Most developed and many developing countries have legislation that requires pre-slaughter stunning, with the exception of authorised ritual slaughter like Kosher or Halal. In some circumstances, traditional slaughter may be exempt from pre-slaughter stunning. Whatever the stunning method, the animal should be rendered unconscious for long enough so that bleeding results in enough loss of blood to cause death from lack of oxygen to the brain (cerebral anoxia). In other words, death should occur before the animal would have regained consciousness after stunning, had bleeding not taken place. There are three main technologies used to effect stunning—Percussion, Electrical and Gas. Only the first two are commonly used in developing countries.

Percussion stunning: - This method produces a physical shock to the brain (Fig. 51).

Captive bolt — This method works on the principle of a gun and fires a blank cartridge and it propels a short bolt (metal rod) from the barrel. The bolt penetrates the skull bone and produces concussion by damaging the brain or increasing intracranial pressure, causing bruising of the brain (Fig. 52). The captive bolt is perhaps the most versatile stunning instrument as it is suitable for use on cattle, pigs, sheep and goats as well as horses and camels, and can be used anywhere in the world. (Although electrical stunning is preferable to captive bolt pistols for stunning pigs and sheep.) There are several different manufacturers of captive bolt pistols, and after the initial expense, running costs are minimal. Users must ensure

sufficient supply of cartridges, which may be different in caliber for stunning guns from the different manufacturers. These features make the captive bolt the stunning instrument of choice, particularly in developing countries.

There are two variations of the gun. One has a handle and trigger. The other comprises hand-held barrel, which is tapped against the skull, which sets of the cartridge explosion (Fig. 52, 53).

Another type of bolt has a flat, mushroom end (Fig. 55). Unconsciousness is achieved through percussion by strong blow to the skull. The brain is not penetrated, and as the animal is not killed, it is a method that is acceptable in many countries for Halal slaughter. When in use, the captive bolt is positioned on the correct spot on the animal's head (Fig. 51, 53, 54). Poor maintenance is a major cause of poor stunning and the guns must be cleaned and serviced regularly, according to the manufacturer's instructions.

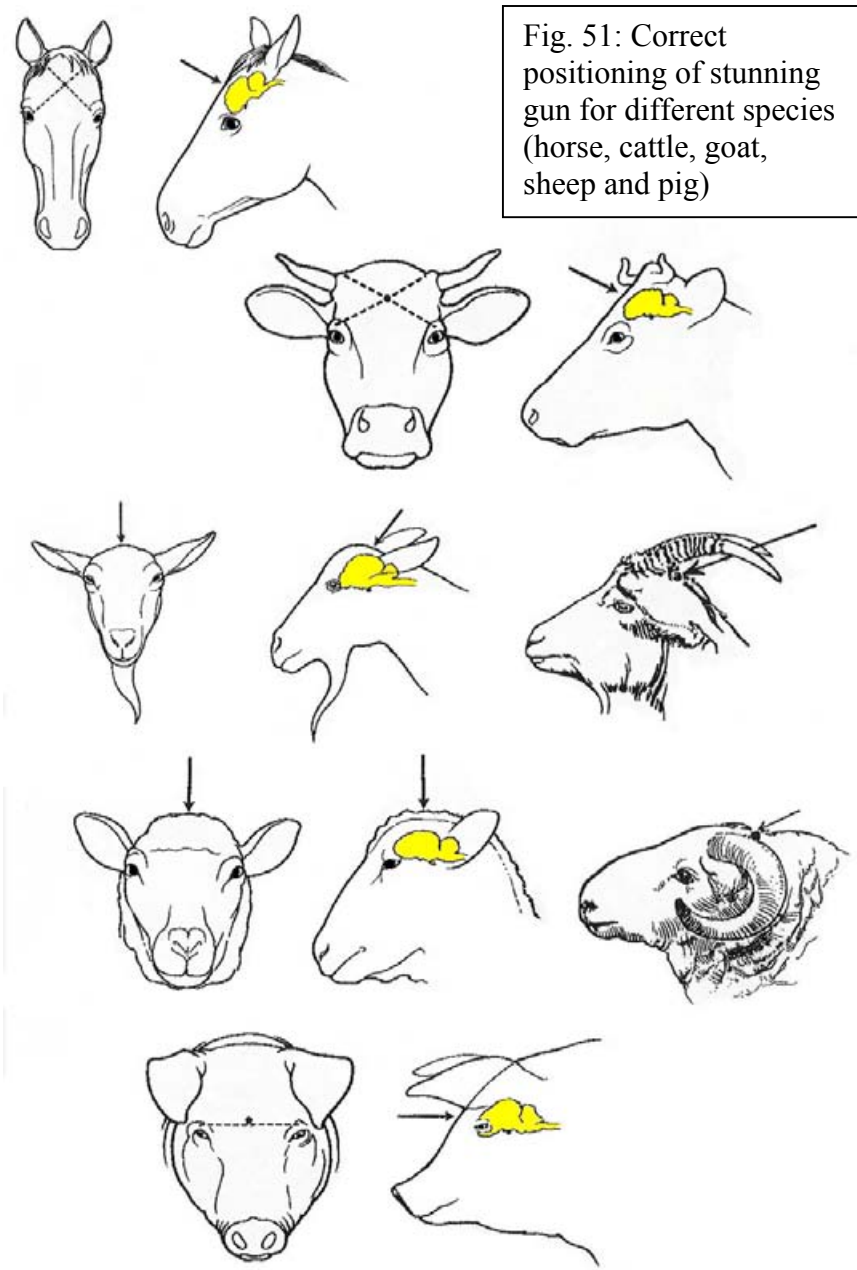


Fig. 51: Correct positioning of stunning gun for different species (horse, cattle, goat, sheep and pig)

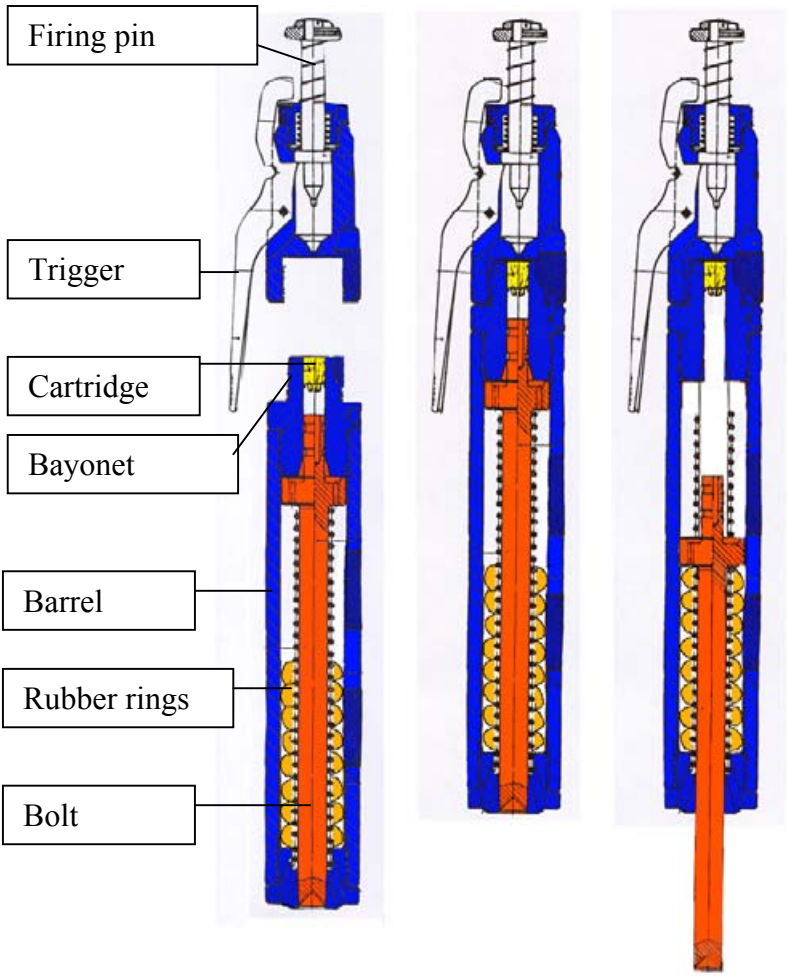


Fig. 52: Use of Captive Bolt Pistol (CBP)

A. Bottom part removed from main part of CBP for loading the cartridge
B. CBP in firing position (firing pin to be released through trigger)
C. CBP with expelled bolt after firing (rubber rings stop expulsion and partially withdraw bolt)

Fig. 53: Hand-held barrel captive bolt gun

Fig. 54: Wrong position of the captive bolt pistol

Fig. 55: Mushroom bolt stun gun

For effective stunning, it is important that the operator is well trained in its use of the stunning gun. If the operator becomes fatigued, accuracy of stunning is reduced, so in large plants, rotation of two stunners is recommended. Stunning of bigger pigs may require a stronger cartridge, as the sinus cavities of the skull are larger. Large bulls have a bony ridge in the forehead and penetration may be more difficult, requiring off-centre aim. A captive bolt gun is **not** suitable for stunning ostriches. Their brain is small and lobulated, and the bolt does not produce proper concussion.

Gunshot

In circumstances where animals are too fractious to be handled in the normal way, such as when they cannot be loaded on the farm or led into the stunning restraint, gunshot with a free, soft-nosed bullet is effective. A 22-calibre bullet is sufficient for most animals. Shooting with a free bullet can be dangerous to operators. If the animal is to be slaughtered on a farm, it should be accurately shot

while standing or lying on soft ground to prevent the bullet from ricocheting.

Electrical stunning

This method of stunning is well suited for pigs, sheep or goats, poultry and ostriches. (Use in cattle or other large species is in development, but if not properly applied it may result in excessive haemorrhage in the muscles or spinal fractures.) Electrical stunning induces electroplectic shock or epileptic state in the brain. This state should last for long enough for bleeding to be carried out so that the animal dies from cerebral anoxia. A low voltage alternating electric current is applied by means of two electrodes, which are placed on either side of the brain using tongs. Since the brain of animals is small, the electrodes should be accurately and firmly placed high up on the sides of the head in sheep, goats, pigs and ostriches (Figs. 56, 57, 58, 59).

Fig.56: Tongs for electrical stunning of sheep or goats

Another way is to place one electrode under the jaw and the other on the side of the neck behind the ears. This type of head-only stunning is reversible and the animal will regain consciousness. For this reason, stunned animals should be bled **immediately** after stunning (Fig. 77).

Irreversible stunning causes cardiac arrest. Here a third electrode is placed elsewhere on the body. Electrodes are applied in the form of tongs. They should never be placed on sensitive areas such as the eye, inside the ear nor rectum.

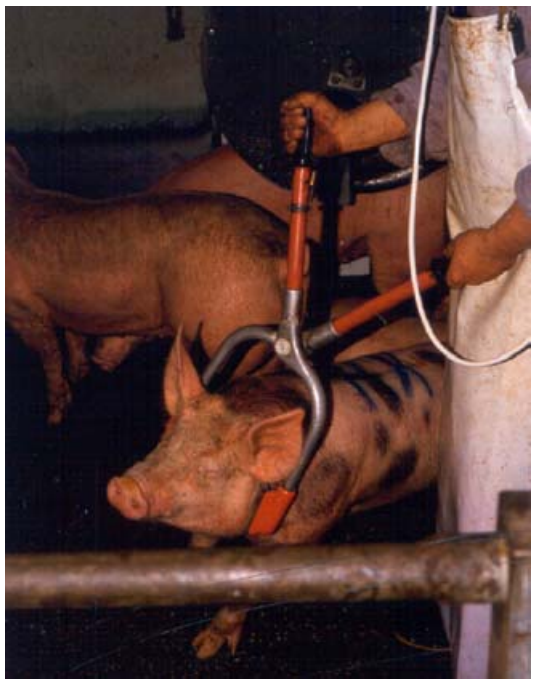


Fig. 57: Tongs for electrical stunning of pigs

Fig. 58: Tongs for electrical stunning of pigs

Fig. 59: Tongs for electrical stunning of ostriches

Ostriches should be stunned only electrically. The tongs are placed either at the sides of the head below and behind the eye or above and below the head (Fig. 59). Poultry can be stunned electrically using a manually operated device (Fig. 60) or using an automatic water bath (Fig. 61). Here birds are dragged through a trough of water that is charged with a low voltage current.

Fig. 60: Manually operated electrical stunning box for small-scale poultry slaughter

Fig. 61: Water bath for automatic electrical stunning of poultry

The strength of the current is a combination of amperage and voltage appropriate for the species. The equipment should be fitted with a meter to measure the correct current. Approximate current/time guides for different species are as follows:

TABLE 5
Recommended current and time characteristics for electrical stunning

Species		M/Amps	Amps	Volts	Time (sec.)
Pig (bacon/porker)		min. 125	min. 1.25	max. 125	max. 10 (until EPS*)
Sheep/goat		100-125	1.0-1.25	75-125	max. 10 (until EPS*)
Poultry[3]	1.5-2 kg broiler	200	2.0	50-70	5
	turkey	200	2.0	90	10
Ostrich		150-200	1.5-2.0	90	10-15

* EPS is electroplectic shock.

For sheep, goats, pigs and ostriches, during this period the limbs extend the back and head arch and the eyes close. After some 10 or more seconds, muscles gradually relax followed by paddling movements. The electrodes should be removed at this stage as stunning is complete (Fig. 58).

[3] An alternative way of electrical stunning of poultry is the utilization of high voltage (300-500 Volts), which causes immediate cardiac arrest. It is claimed that through this method possible insufficient stunning, which may occur in some cases when using the low-voltage stunning, is avoided.

The electrodes should be in good repair and not corroded. They should be cleaned daily. The operator should be competent to ensure correct positioning and good contact of the electrodes. Passage of electric current through the brain is facilitated by cutting the hair over the site or wetting the electrodes. If the whole face or body is wet, the current may short-circuit the brain.

Failure of the operator to apply the apparatus to the correct spot on the head may not produce unconsciousness, resulting in a condition known as missed shock or "the Nightmare State of Leduc". The animal becomes paralysed and unable to vocalise but remains fully conscious. The simplest commercially available electrical stunning units must have a transformer or other electric circuits that will deliver the recommended minimum amperage and voltage required inducing insensibility.

Unfortunately in many developing countries, homemade devices for electrical immobilisation are still being used. These may be simple wires attached to the animal or homemade tongs but without transformers to achieve the correct current parameters (Fig. 70). Home made stunners plugged directly into the mains are painful to the animals and very dangerous to the operator, as there may be exposed wires.

Generally, electrical stunning of cattle or other large species may result in excessive haemorrhages or spinal fractures due to large muscle spasms. This will be particularly so if unsophisticated technology is used. New Zealand and some other countries have developed modern methods for electrical stunning of cattle to overcome these problems, in particular for beef exports to some Muslim countries or for installation in slaughterhouses in Muslim countries where this method is acceptable (Fig. 62, 63). The New

Zealand technique is 'the Ranguiru System[4] or Wairoa Process[5]' and is a head-only stun.

Fig. 62

Fig. 63

Fig. 62 and 63: Electric stunning of cattle for large-scale slaughtering. Device is started through remote control once animal has entered stunning box.

[4] The Ranguiru system is a modified electrical stun, which is applied to Western-type cattle slaughter, where the animal is stunned through the brain and the heart stop beating. It is not accepted as Halal by Muslims.

[5] The Wairoa process is a slaughter technique developed in New Zealand, which involves an electrical head-only stunning. This renders the animal insensitive to pain but able to recover if the slaughter cut is not made. The heart remains beating. The system is humane, safe for workers and generally accepted as Halal by Muslims.

Carbon dioxide gas stunning (Fig. 64, 65)

The use of carbon dioxide (CO_2) gas is a relatively new method of stunning suitable for pigs and poultry. However, it is applicable only at large industrial plants, as the sophisticated technical equipment is relatively costly to install. Basically, animals are stunned using various concentrations of CO_2 in air. Concentrations of CO_2 for the stunning of pigs are at least 80% in air for 45 seconds and poultry of 65% for 15 seconds. The acceptability of this method on welfare grounds has been questioned however. For some genetic types of pigs, it may be satisfactory, and for others may be stressful.

Currently Argon gas is being tested for stunning purposes. It is assumed that Argon gas may have some advantages over CO_2, but the costs may be higher.

Malpractice in immobilization of livestock

The aim of rendering slaughter animals unconscious prior to bleeding is in good slaughterhouse practice achieved by using captive bolt pistols, electrical tongs or CO_2-gas. For the immobilization of bovines and pigs a blow to the skull with a large-sized hammer used to be a wide-spread method and is still being practised, in particular in developing countries. The method requires only manual force, no maintenance of equipment or spares as cartridges, and is therefore cheap (Fig. 66).

A blow with the hammer is certainly preferable to no pre-stunning, but it requires a skilled operator. Very often additional blows are needed, if the animal was not hit properly. The hammer method is prone to a high failure rate and should be replaced wherever possible by one of the above-mentioned stunning methods. Particular malpractice can be observed in pig slaughter, when a

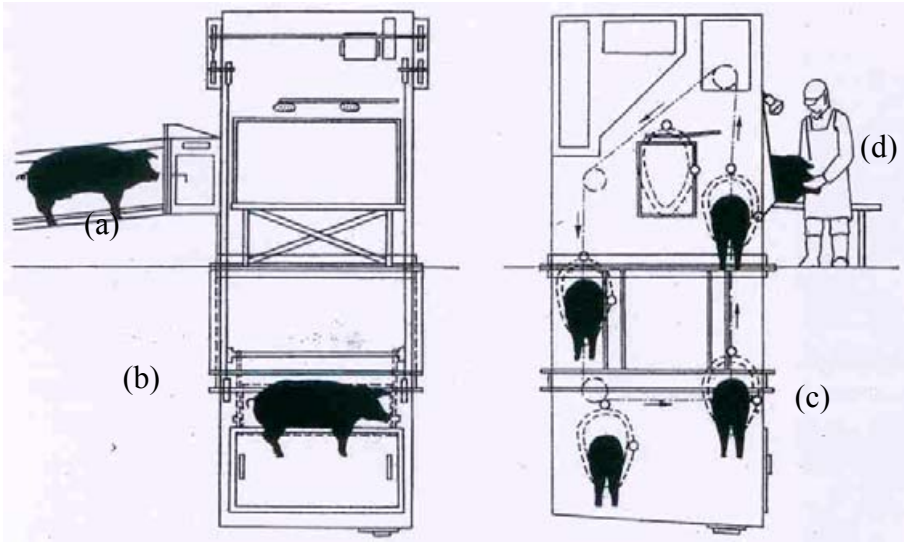


Fig. 64: Schematic view of CO_2 stunning of pigs.
In a discontinuous process the animals enter the CO_2 tunnel (a), are lowered into the pit with high CO_2 concentration where they fall unconscious (b), are lifted up again (c) and expelled from the tunnel (d).

Fig. 65: Runway and entrance to a CO_2-tunnel

Fig. 66: Pre-stunning of buffalo through blow with a hammer

number of pigs are driven into a stunning pen and indiscriminately treated with hammer blows. Because they move around, many animals are not hit efficiently; they need additional blows or arrive fully conscious at bleeding (Fig. 66, 67).

In many places in the developing world, immobilization of large ruminants (cattle, buffalo) is still carried out through the use of a sharp, pointed knife sometimes called a puntilla or Spanish pike (Fig. 68, 69). The knife is used to sever the spinal cord through the space (Foramen magnum) between the skull and neck position of the backbone. Upon inserting the knife and severing the spinal cord, the animal will collapse. It remains immobilized and the operators have easy access; however, the animals remain conscious until bleeding is complete. This practice should be discontinued, as it is not humane.

An equally inhumane method of immobilization of large animals involves severing the Achilles' tendons, which lead to the collapse of the animal. This practice can in particular be observed in camel slaughterhouses. In camel slaughtering it can also be observed that the animals are immobilized by bending the joints of the fore- and hind legs through tying thin wires around. This forces the animals into a painful sitting position. They may be kept like this for many hours before they are slaughtered.

Malpractice can also be observed in the use of electricity for stunning purposes. Electrical tongs can certainly be fabricated through local engineering work in developing countries, but it is essential that the electrical parameters required for efficient and humane stunning be achieved. Stunning tongs without transformers, using the voltage of the mains not only cause a great deal of suffering but also produce inferior meat quality (Fig. 70).

Absolutely unacceptable are practices using electrical wires attached to the limbs and necks of the animals and inflicting an electrical shock on the animal through connecting to the mains current. Similarly, devices resembling mains-current operated prodders (Fig. 7) but using high voltage, which are utilised for "stunning" of cattle, are inhumane. Moreover, they spoil the meat and damage the skins.

One tormenting method of immobilizing pigs is practised in some Asian countries. Pigs, when moving them from the farms to the slaughterhouses, are forced into crates made of steel bars. These crates can accommodate one pig but do practically not allow any movements upon arrival at the abattoir; the crates are piled one on top of each other. Pigs are kept waiting inside the crate for hours without water and ventilation. Finally the bleeding without stunning is carried out with the pig still in this position (Fig. 71).

Fig. 67:
Group of pigs knocked down by hammer blow and being hoisted for bleeding. Some

Fig. 68 and 69:
Puntilla for immobilization of large livestock

Fig. 70: Makeshift electric stunning tongs

Fig. 71: Bleeding of pigs in crates by using a

Religious or ritual slaughter (Halal and Kosher)

Most developed and many developing countries of the world require by law an animal to be rendered unconscious before it is slaughtered. This is in order to ensure that the animal does not suffer pain during slaughter. However, exceptions are made for the Jewish (Kosher) and Muslim (Halal) slaughter of livestock. Here stunning generally is not allowed and the animal is bled directly using a sharp knife to cut the throat and sever the main blood vessels. This results in sudden and massive loss of blood with loss of consciousness and death. However, many authorities consider that religious slaughter can be very unsatisfactory and that the animal may not be rendered unconscious and suffer considerable discomfort and pain in the slaughter process.

A number of factors must be given serious consideration before this type of slaughter is acceptable: -

1. Animals that are slaughtered according to Kosher or Halal requirements should be securely restrained, particularly the head and neck, before cutting the throat. Movement results in a poor cut, bad bleeding, slow loss of consciousness (if at all) and pain. This has serious implications for animal welfare. The knife that is used to cut the throat and the carotid and jugular blood vessels must be razor sharp and without blemishes and damage. This is to ensure a swift, smooth cut across the throat behind the jaw and to ensure immediate and maximum gush of blood. Poor bleeding causes slow loss of consciousness and reduces meat quality.

2. Animals should not be shackled and hoisted before bleeding. This causes them severe discomfort and stress. Hoisting should be done only after the animal has lost consciousness Restraining equipment should be comfortable for the animal.

3. Operator competence is of great importance in order to carry out satisfactory religious slaughter, and the authorities should license all slaughter personnel. A poor technique will result in great suffering and cruelty to the animal. Religious slaughter should be carried out paying attention to detail and ensuring the method, equipment and operators are correct. The slaughter process is slow.

The captive bolt gun is suitable for this stunning when using the mushroom shaped head of the bolt (Fig. 55). The mushroom gun is an improvement on the plain bolt, as this bolt does not penetrate the brain and cause death. This should be more acceptable to the religious authorities, and its use would encourage more humane slaughter amongst Muslims in developing countries, thereby improving animal welfare.

Fortunately, many Muslim authorities accept some forms of pre-slaughter stunning. Many Muslim authorities permit electric stunning of cattle, sheep and poultry, whose meat is destined for Muslim communities, because the animals subjected to this stunning method would recover if no bleeding was carried out. Electric stunning is also the method of choice in meat exporting countries where stunning of slaughter animals is required by law, for export to Muslim countries. Similarly, Muslim minorities in countries with stringent animal welfare regulations are allowed to use Halal slaughter methods, but in combination with electrical stunning.

Any kind of prestunning for livestock to be slaughtered according to the Jewish Kosher method has not yet been accepted.

Bleeding

Bleeding is the part of the slaughter process where the main blood vessels of the neck are severed in order to allow blood to drain from the carcass, resulting in the death of the animal from cerebral anoxia. The bleeding knife should continuously be sharpened. A blunt knife will prolong the incision and the cut ends of the blood vessels will be damaged. This may cause premature clotting and blockage of the vessels, delaying bleeding out and prolonging the onset of unconsciousness and insensitivity. Incisions should be swift and precise. In poultry, sheep, goats and ostriches, the throat is cut behind the jaw (Figs. 72, 73, 74).

Fig. 72: Incision for bleeding of poultry (ducks)

Animals are immobilized and unconscious as they passed through the water bath for automatic electrical stunning.

Fig. 73: Incision for bleeding sheep

Fig. 74: Incision for bleeding ostriches

The standard method for the bleeding of cattle is to open the skin at the neck between brisket and jaw through a 30-cm longitudinal cut. Then, for hygienic reasons, a clean knife should be used and inserted at a 45° angle (Fig. 75) in order to sever the jugular and carotid vessels.

In pigs, a longitudinal bleeding stick is made into the chest to sever the deep vessels (Fig. 76).

For all cuts, the jugular and carotid vessels should be completely severed. If all vessels are not cut, bleeding may be incomplete, causing excessive retention of blood in the tissue, which can result in early spoilage of meat.

A minimum of delay is required between stunning and bleeding for two reasons:

a. A prolonged delay in bleeding may result in a level of consciousness being regained particularly where animals have been stunned electrically. For example, poultry stunned electrically may regain consciousness within 1-3 minutes. Generally, bleeding of poultry should commence within 15 seconds of stunning. For other livestock, the interval between stunning and sticking/bleeding should also be kept very short. Periods of less than one minute are desirable (Fig. 77).

b. Delayed bleeding will result in an increase of blood pressure, and blood vessels will rupture, causing muscle haemorrhage. This extra blood in the tissue will cause the meat to decompose more quickly, resulting in waste of meat.

Fig. 75: Incision for bleeding cattle

Fig. 76: Incision for bleeding pigs

Fig. 77: Good arrangement for stunning and immediate bleeding of pigs at medium-sized

Determining insensibility at slaughter

It is important to be able to determine if an animal has become insensible after stunning, as the bleeding and dressing operations must not begin until complete stunning has been achieved.

When cattle, sheep, goats and pigs are stunned using a captive bolt, the animal should collapse immediately. Regular breathing should cease. There should be no corneal or blink reflex, if the eye is touched. These signs of insensibility should be looked for before bleeding commences, usually when the carcass is hanging on the bleeding rail.

In electrically stunned sheep, goats, pigs and ostriches, a "g*rand mal"*[6] seizure is induced which causes instant unconsciousness. This results in rigid spasms, which can last for up to 30 seconds. The animal should not be evaluated for insensibility until at least 30 seconds after electrical stunning. At no time after stunning should the animal vocalise (squeal, moo or bellow). Vocalising is a sign that the animal can still feel pain. It is normal to have leg-kicking reflexes in an animal that has been properly stunned with electricity, captive bolt or gunshot. If the animal has kicking reflexes, the head should flop like a rag doll. If it makes an attempt to raise its head, it may still be sensible. An animal showing a righting reflex must immediately be re-stunned.

The person assessing insensibility should concentrate on looking at the head and ignore kicking limbs. Gasping is

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[6] A "grand mal" seizure is a severe form of epilepsy characterized by paroxysmal transient disturbances of the electrical activity of the brain. This results in periodic recurrent convulsions of the body or "epileptic fit".

permissible: it is a sign of a dying brain. If the tongue is hanging straight down, limp and floppy, the animal is definitely stunned: if it is curled this is a sign of possible sensibility.

The heads of poultry that have been stunned with electricity should hang straight down after stunning. Birds that have not been properly stunned will show a strong righting reflex and raise their heads.

CHAPTER 8

MAINTENANCE OF GOOD ANIMAL WELFARE STANDARDS

People who handle or slaughter hundreds of animals become desensitised to suffering and have a tendency to become rough or careless unless their daily work is continuously monitored. Managers must maintain high standards of operational animal welfare.

Five major critical control points

It is strongly recommended that an HACCP-type system be used to measure and monitor the efficacy and performance of livestock and slaughter operators. HACCP—*Hazard Analysis and Critical Control Points*—is a system primarily used in meat plants to ensure food safety. By adapting the system to make regular measurements at Critical Control Points (CCPs) in the process, various critical operations, which are carried out by workers handling and slaughtering livestock, can be monitored to ensure that it is done correctly, leading to steady improvements in welfare and operational quality. An objective scoring system for certain operations is described. Evaluations of animal welfare against accepted standards and also between evaluators can be made. Five major critical control points of animal handling and slaughter are briefly outlined here.

Suggested control points for monitoring and evaluation are:

1. Stunning efficacy – the percentage of animals rendered insensible at the first attempt. (Insensibility is assessed according to criteria described on page 84/85.)

a. Captive bolt stunning - correct shooting
b. Electric tongs stunning – correct placement

2. Bleed rail insensibility – the percentage of animals that remain insensible before and after bleeding (using the same criteria as in 1).

3. Vocalisation – the percentage of cattle or pigs that vocalise (bellow, moo or squeal) during adverse events such as missed stuns, excessive electric prod use, excessive pressure from restraint device slipping or falling etc. Each animal is scored as a vocalizer or non-vocalizer during handling and stunning, not in the holding pens. Vocalising scoring is not used on sheep as they often do this anyway.

4. Slipping and falling--the percentage of animals that slip or fall during handling or stunning. Selected stations should be chosen for monitoring.

5. Electric prods – percentage of animals requiring prodding with an electric goad.

Monitoring and audit of these CCPs must be done on a regular basis.

Objective scoring of efficacy standards at critical control points

1.a. Captive bolt - Stunning efficacy

(Score, per day, a minimum of 20 animals or 20% in large plants)

* Excellent – 99-100 % instantly rendered insensible with one shot;

* Acceptable – 95-98 %;

* Not acceptable – 90-94 %;

* Serious problems – less than 90 %.

Action: if one-shot efficacy falls below 95% immediate action must be taken to improve the percentage.

1.b. Electrical stunning - Tongs placement efficacy

(Score all pigs, sheep or ostriches or a minimum of 100 in large plants)

* Excellent – 99.5-100% correct placement of stunning tongs;

* Acceptable – 99.4-99%;

* Not acceptable – 98-95 %;

* Serious problem – less than 95 %.

2. Insensibility after stunning

(Score a minimum of 20 animals or 20% in large plants)

-If the animal is hoisted immediately after stunning, evaluate after hoisting (unless it shows obvious sensibility);

-If the animal is left on the ground, wait 15-30 seconds before evaluating to allow spasms to stop (especially in electrically stunned);

-Any animal, which shows any signs of sensibility, must immediately be re-stunned.

* Excellent - Cattle – less than 1 per 1000 or 0.1%;

  - Pigs - less than 1 per 2000 or 0.05%;

* Acceptable - Cattle – less than 1 per 500 or 0.2%;

  - Pigs - less than 1 per 1000 or 0.1%.

3.a. Criteria for vocalization of cattle

- In crowd pen, lead-up race, stun box or restraint device.

(Score minimum of 20 animals or 20% in large plants)

Score each animal Yes for vocalizer and No for non-vocalizer

* Excellent - 0.05% or less of cattle Yes;

* Acceptable - 3% or less Yes;

* Not acceptable - 4-10% Yes;

* Serious problem – more than 10% Yes.

3.b Criteria for vocalization of pigs

- In restrainer, stunning pen or during stunning.

(Score minimum of 20 pigs or 10% in large plant)

Score each animal Yes for vocalizer and No for non-vocalizer

* Excellent - 0% of the pigs Yes;

* Acceptable - 1% or less pigs Yes for restrainer, 0% due to misplaced tongs;

* Not acceptable - 2% or more Yes in restrainer or pen;

* Serious problem - 5% or more Yes in restrainer or pen.

Reducing the level of pig squealing improves pork quality and decreases PSE.

Do not use vocalization scoring for sheep.

4. Slipping and failing in the stunning area

- Includes restrainer entrances, races, holding pens and unloads ramp.

(Score a minimum of 20 animals or 10% in large plants)

Score on Yes for slip and No for non-slip.

* Excellent - no slipping or falling;

* Acceptable - slipping of less than 3% of animals;

* Not acceptable - 1% falling down (body touches floor);

* Serious problem - 5% falling down or 15% slipping.

5. Electric prodding efficacy

If the prod causes the animal to vocalise, the current is too strong.

(Score a minimum of 20 animals or 10% in large plants)

Score Yes if the animals vocalise and No if don't.

a. Electric prods scoring criteria for cattle:

	Crowd pens to race	**Entrance to stun box**	**Total percentage of cattle prodded**
* Excellent	no Yesses	5% or less	5% or less
* Acceptable	no Yesses	10% or less	10% or less
* Not accept		20% or less	20% or less
* Serious problem			50% or more

b. Electric prods scoring criteria for pigs:

	Crowd pens to race	**Entrance to restrainer**	**Total percentage of pigs prodded**
* Excellent	no Yesses	10% or less	10% or less
* Acceptable	no Yesses	-	15% or less
* Not accept	no Yesses	-	25% or less
* Serious problem	-	-	50% or more

CONCLUSION

The international livestock industry must be encouraged to practice increasingly better handling and welfare of slaughter animals. This is particularly important for developing countries, as this will improve production. Here, the introduction of better stunning practices and improved pre-stunning methods for ritual slaughter are urgently required.

In developing countries good standards of animal welfare can be achieved during transport and slaughter without the use of expensive high-tech equipment. These countries should be assisted to produce simple locally or regionally made improvements such as metal grating on the slippery floor of a vehicle or stun box or materials to construct races and restraint devices, as well as stunning equipment like electrical tongs and cartridges for captive bolt pistols. Importing expensive equipment and the difficulties in securing regular supplies of cartridges causes many slaughterhouse managements to abandon recommended stunning methods and to resort to inhumane methods.

There is also a need around the world to change marketing systems, which will enable people to pass losses such as bruises along to the next segment in the marketing chain. People need to be held accountable for losses from bruises, hide damage, branding and dead animals. Changes in marketing systems and in the way people are paid is one of the best ways to improve welfare and reduce economic losses. People should not be paid on a piecework basis but should receive bonuses for reduced bruising and better stunning.

The formation of producer cooperatives would eliminate middlemen and those cooperatives could also initiate training programmes for staff who handle transport and slaughter livestock, thereby improving the standard of animal welfare and increasing economic return.