Meat technology update

00/1 – February 2000
Reprinted November 2006

Smallstock slaughter and oesophageal occlusion

In Halal or slash (ear-to-ear) sticking, ingesta leaking from the severed oesophagus (weasand) may contaminate the head and neck/throat area. This contamination could result in smallstock processors facing economic loss.

The weasand normally closes during electrical stunning and stays closed for 20– 30 seconds post-stun. After that period the muscles relax and leakage from the weasand may occur.

Conventional weasand tying procedures used in Australia provide a satisfactory seal but the procedures are usually carried out after bleeding. The head may be contaminated by ingesta leakage while the carcase is still on the bleed rail.

Ideally, the weasand should be occluded (i.e. permanently sealed) while it is still closed off as a result of electrical inputs. If necessary, the period of closure induced by electrical inputs can be extended by using additional inputs such as immobilisation and 'spinal discharge'.

In many New Zealand plants the carcase is placed on spreaders immediately following the Halal stick. Low-voltage immobilisation and possibly high-voltage spinal discharge are applied before the weasand is located and sealed. The advantage is that the weasand can be located and sealed with a ring or clip very quickly after the Halal cut, ensuring minimum head/throat contamination. During bleeding, any kicking helps movement of ingesta into the oesophagus. This can usually be avoided if low-voltage immobilisation is applied soon after sticking.

While electrical inputs constrict the oesophagus and prevent leakage, they also have other effects. The electrical current used for each of the inputs must be carefully selected so that cold shortening, excessively early rigor before dressing is complete and meat quality defects caused by rapid rigor are avoided.

Plants that kill for Halal markets have limited options. Religious requirements stipulate reversible stunning and use of the slash stick. In addition, in accordance with animal welfare requirements, the stun–stick interval (for reversible stunning) should be *no more than* 10 seconds for calves and 15 seconds for other smallstock.

Halal stick

This is the transverse incision of all soft tissue on the under surface of the neck, severing the carotid arteries and jugular veins on both sides of the neck. It severs all the soft tissue of the neck including

MEAT TECHNOLOGY UPDATE
Cutting edge technology for the meat processing industry

FOOD SCIENCE AUSTRALIA
A joint venture of CSIRO & the Victorian Government

AMPC

mla MEAT & LIVESTOCK AUSTRALIA

the windpipe and weasand but leaving the vertebral column intact.

Avoiding cutting the weasand during sticking (non-Halal)

Spear stick

Non-halal plants should consider the more hygienic spear stick, which *does not cut* the weasand or trachea. However, this will require some changes to procedures.

As with slash sticking, it is important, for animal welfare reasons, that both carotid arteries are cut.

With spear sticking, the best way of ensuring that both carotid arteries are cut is by inserting the knife correctly. The side of the neck is pierced with a knife between the trachea and backbone, with the sharp edge of the blade pointing away from the backbone. If this is carried out when the jaw is grasped with one hand and the chin is extended, the carotids are pulled taught against the backbone in the neck. This makes it difficult to cut the carotids as the knife may pass at too shallow a depth and typically, the carotid artery on the side opposite to the point of entry may be missed. Rotating the knife after it has been inserted and withdrawing it with the sharp edge pressed against the backbone can ensure complete severance of the carotids. Alternatively, a double-edged sticking knife can be used and the same pressing action applied without having to turn the knife.

Chest or thoracic stick

The thoracic stick is an incision through the thoracic inlet between the two first ribs, incising the larger vessels, close to the heart, which supply the head and neck. In doing this it severs the common brachiocephalic trunk which leads to the carotid arteries. The blade of the knife must be long enough to reach the brachiocephalic trunk. The stick does not cut the weasand or trachea.

The spear stick is not suitable for calves and for animal welfare reasons the preferred methods are the thoracic stick, or slash stick followed by a thoracic stick. This is because with the spear or slash stick there is a potential for the occlusion of the cut peripheral arteries (e.g. the carotids) by clotting or constriction of the cut end, which can delay bleeding and the onset of death.

Internal oesophageal occlusion and the ‘lockjaw’ problem

All presently available electrical stunning devices induce tension in the jaw muscles and present a major impediment to satisfactory internal occlusion. The muscles will eventually relax.

It is generally agreed that the most effective method of preventing gravitational spillage from the oesophagus is to orally insert a plug or similar internal device while the animal is prone prior to sticking and hoisting to the bleed rail. Tensing of the masseter muscles of the jaw/cheek of electrically stunned animals makes oral insertion of any device during the limited time available while the animal is prone on the shackling table practically impossible. Limited trials of various mechanical devices to prise open the jaws have failed to produce a system that can operate at commercial chain speeds. Should a solution be found to the problem of electrical stunning causing spasm in the masseter muscles, orally inserted devices may be utilised to occlude the weasand after stunning but prior to sticking.

Halal authorities in Australia have approved the use of plugs prior to sticking in beef production. This is commonly carried out with export Halal slash-stick beef (and often irreversibly stunned beef) and involves insertion of a temporary plastic or fibreboard plug after stunning to block the weasand until a more permanent occlusion method is employed. It is labour intensive, but material cost is cheap. Insertion at normal chain speeds is possible.

Modified plugs could be used for smallstock and further R&D is needed to develop equipment to reliably give a positive internal weasand seal.

Characteristics of available stunning methods

Not allowing internal occlusion:

Electrical stunning

- Head-only electrical stunning is reversible and Halal-approved. It is currently the most popular method used in Australia.
- Head-to-back or head-to-foreleg/brisket electrical stunning causes cardiac arrest and is irreversible and not suitable for Halal.

Some innovative ideas based on related research into the effect of special electrical pulses on animals suggest that it may be possible to electrically stun sheep reliably without a lockjaw problem. Some experimental work would be needed to explore this avenue.

Allowing internal occlusion:

Mechanical stunning

- Captive bolt, penetrative stunners are commercially available and it is claimed that these operate at up to 300 per hour. Muscle spasm does not occur. Stunning is irreversible.
- Mushroom-head, percussive stunners are considered to produce a reversible stun and therefore would be Halal-approved. More work is needed to demonstrate animal welfare suitability.

Gas Stunning

The use of carbon dioxide (CO_2) is widespread in the pig processing industry. The process produces a stunned animal with a relaxed musculature. The animal does not kick and the incidence of ecchymosis is almost zero.

The Australian Quarantine & Inspection Service (AQIS) considers the CO_2 stunning method is currently only suitable for pigs and that for this species:

- Concentration of the CO_2 for effective stunning should be a minimum of 60% and the aim should be to maintain 80%.
- Time to return to sensibility after an effective stun is considered to be indefinite if the gas concentration is above 60% CO_2.

CO_2 stunning of sheep, lambs and calves is presently not permitted by AQIS.

Meat & Livestock Australia Ltd (MLA) and the Australian Meat Processor Corporation (AMPC) commissioned members of the Meat Program, Agriculture Western Australia to make a preliminary investigation of the carbon dioxide (CO_2) stunning of sheep and lambs.

Based on a limited number of animals, the following are the conclusions of the investigation:

- CO_2 stunning of sheep and lambs is humane and less susceptible to operator error than manual electrical stunning. Further studies would be required to obtain AQIS and importing country approval. It is in use and approved for domestic plants in some Australian States.
- The quality of meat from CO_2-stunned sheep and lambs is at least equivalent to that from electrically stunned animals. CO_2 stunning, when applied correctly, is mainly reversible. However, in the trials a significant percentage of animals died and further studies are required to establish conditions that would make CO_2 stunning compatible with Halal slaughter.
- A percentage of animals kick for a short time after emerging from the CO_2 but this is of little concern to the slaughtermen. However, in order to insert an internal weasand plug, the operators would have to wait until they stopped kicking and this would adversely affect the stun-stick interval. Further studies would be needed to address this operating issue.

- CO_2 stunning does not result in ‘lock jaw’. In all cases the time of effective anaesthesia would have been sufficient to allow the humane insertion of the oesophageal plug and death by exsanguination.

- The cost of argon is approximately 10 times the cost of CO_2 and argon-CO_2 mixtures seem to offer no clear advantage over CO_2.

- Batch-stunning plants capable of handling 8-10 pigs per minute have been established overseas. The cost of installing and running CO_2 stunning units is high but there is little information to make a quantitative comparison with electrical stunning.

- It has been quoted that it takes between 100 and 300 grams of CO_2 to stun a pig (Troeger and Woltersdorf, 1991). It has been stated that it takes considerably more CO_2 to stun a sheep than a pig because of absorption of the gas by the wool. However, according to the Operations Manager at the domestic abattoir CO_2 stunning sheep, the consumption of CO_2 was the same for sheep and pigs.

Currently available alternatives to manual tying

The traditional method of occlusion entails no constriction of the weasand prior to the carcase being hoisted to the spreader. After the neck/throat area has been flayed, the weasand is located, manually separated from the trachea and knotted. A rodding device is manually inserted and pushed up to the rumen to free the weasand from its natural attachments and assist in evisceration. This method and the alternatives have the disadvantage that the operation is performed while the animal is suspended from the spreader and after some considerable time has elapsed after sticking. Gravitational leakage is largely uncontrolled.

Butterfly clips

With this alternative, butterfly clips are applied to the weasand at a similar stage of production as that for manual tying. Locating the weasand and applying a clip prior to sticking is practised in New Zealand but considerable extra workspace is necessary and the hazards of carcase contamination remain.

Elastrator rubber ring

This method uses a rodding tool/ring applicator to apply (at the forequarter work-up station) a rubber ring to the weasand at the junction with the rumen. The system uses an automatic ring-loading device to enable satisfactory performance at commercial chain speeds. It has the advantage of occluding the weasand at the paunch end and not producing a ‘sausage’ of ingesta-filled gullet that is susceptible to rupture during the evisceration process. It also includes an optional blade attachment so that a thoracic stick may be performed during the sealing/rodding operation. Rubber rings are more difficult than clips to locate and remove if removal is demanded by the further use of the paunch for pet food production or rendering.

Roddable clips

These are applied at the forequarter work-up station and pushed up to the gullet/rumen junction using an applicator, which also rods the weasand. The clips are easily located and discarded if required. As with the elastrator rubber ring device, an optional blade attachment is available.

As noted in page 1, ideally the oesophageal seal should be applied as soon as possible after sticking.

Another approach to this is to consider the use of a moving-top table capable of holding several bodies and, after severing the weasand, to locate and apply the external seal immediately after severance and prior to hoisting. It requires opening the neck on the table to locate the oesophagus to apply the seal (and rod if permitted).

Further Reading

The following reports are available from Meat & Livestock Australia Ltd:

‘Investigation of Carbon Dioxide Stunning of Sheep’, Agriculture Western Australia, 1999.

‘Survey of weasand, rodding and bung tying in NZ’, MIRINZ, 1997.

The following additional references are useful:

AQIS Notice *MEAT 99/17* ‘Animal Welfare Explanatory Notes’, November 1999.

AQIS ‘Operational Guidelines for the Welfare of Animals at Abattoirs and Slaughterhouses’, 2nd Ed., October 1995.

Troeger, K and Woltersdorf, W, 1991, ‘Gas anaesthesia of slaughter pigs. 1. Stunning experiments under laboratory conditions with fat pigs of known halothane reaction type: meat quality, animal protection’, *Fleischwirtsch,* 79, 1063-1068.

Acknowledgement

Acknowledgement is given to Neville G Gregory for information on sticking methods, extracted from his textbook entitled ‘Animal Welfare and Meat Science’, published by CABI Publishing, Wallingford, Oxon OX10 8DE, United Kingdom.

MEAT TECHNOLOGY UPDATE

Cutting edge technology for the meat processing industry

Contact us for additional information

Meat Industry Services is supported by the Australian Meat Processor Corporation (AMPC) and Meat & Livestock Australia (MLA).

Brisbane:
Food Science Australia
PO Box 3312
Tingalpa DC QLD 4173

Ian Eustace
T +61 7 3214 2117
F +61 7 3214 2103
M 0414 336 724

Neil McPhail
T +61 7 3214 211
F +61 7 3214 2103
M 0414 336 907

Alison Small
T +61 7 3214 2109
F +61 7 3214 2103
M 0409 819 998

Sydney:
Bill Spooncer
PO Box 181
KURMOND NSW 2757

T +61 2 4567 7952
F +61 2 4567 8952
M 0414 648 387

Adelaide:
Chris Sentance
PO Box 178
FLAGSTAFF HILL SA 5159

T +61 8 370 7466
F +61 8 8370 7566
M 0419 944 022