Results for today; Ideas for tomorrow

Meat Technology Update

Newsletter 4/03 *August 2003*

Optimising blood collection

Dried blood is a valuable co-product from the slaughtering process and is currently valued at between $600 and $800 per tonne for ring-dried blood. On occasions the price of blood meal exceeds $900 per tonne. It is important for both economic and environmental reasons that as much blood as possible is collected in the defined blood drains on slaughter floors. Blood deposited further along the line will be hosed to waste where it will create a load on the effluent treatment system. It has been reported by various authors that blood has a biochemical oxygen demand (BOD) of around 200,000 mg/L compared with abattoir effluent BOD of about 2,500 mg/L.

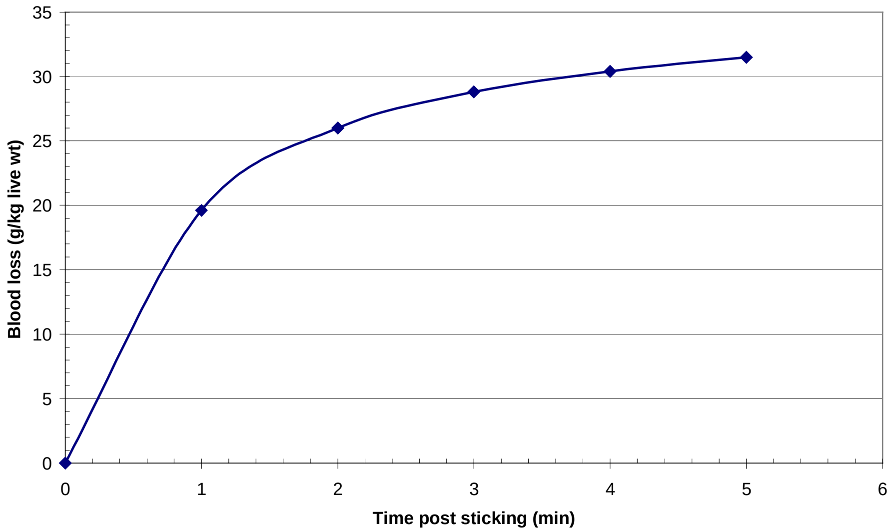

Figure 1. Rate of blood loss from cattle after sticking (Gregory et al. 1988)

Blood can be collected for edible purposes but this newsletter only discusses the collection of blood for the production of blood meal and the effect of electronic aids on blood yield and meat quality.

Cattle

The quantity of blood collected from slaughtered cattle and the rate at which it drains depend on factors including animal size and efficiency of sticking. In particular, the rate of bleeding following a Halal stick where the major blood vessels of the neck are cut transversely is slower than after a thoracic stick where the blood vessels in the neck and the chest are cut. A range of figures is quoted for raw blood yield but these often do not specify over what time period the quantity is measured. Figures quoted range from an average of 10 kg in 60 seconds to 23 kg per ox.

Gregory et al. (1988) measured the amount of blood collected at one-minute intervals for 5 minutes after sticking from 207 kg dressed-weight Friesian-cross cattle. Based on this and other studies, an abattoir should expect the quantity of blood collected in the blood drain to be at least 3% of the animal live weight – equivalent to about 5.7% of the dressed carcase weight. The amount of blood collected at 1 minute intervals after sticking is shown in Figure 1.

As can be seen from Figure 1, blood continues to drain from the carcase at a decreasing rate along the processing line and at 10 minutes after sticking it is still dripping at about 190 g per minute. In most plants, this blood draining along the line cannot be directed to the blood drain, and instead, is hosed away. This increases the BOD and nutrient loading of the effluent and also increases the amount of cleaning that has to be done on the slaughter floor and chillers.

During the application of electrical currents to carcases (e.g. electrical immobilisation and electrical stimulation) it is often observed that there is an increased release of blood. Even when stimulation is applied to beef sides at the completion of dressing,

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blood will be observed on the slaughter floor at the stimulation site. Furthermore, there is anecdotal evidence that chiller floors remain cleaner when carcases have been stimulated.

The effect of electronic bleeding

There are several potential benefits of application of electrical currents to slaughtered cattle. They include immobilisation of carcases in the landing area, improved meat quality and reduced kicking response along the slaughter chain. As a part of recent studies on electrical inputs, the effect of the application of an electric current (electronic bleeding) on the volume of blood released was measured to see if improved blood collection is another benefit of electrical inputs.

A low voltage stimulation system in a bleeding area following a thoracic stick was tested for its effect on blood release. The electrodes of the stimulation system made contact with the hind leg and the shoulder region via rubbing bars on opposite sides of the carcase about 2 minutes after sticking (Figure 2). The duration of application of the current was approximately 35 seconds.

Figure 2. Electrical stimulation via rubbing bars.

Blood, which would normally have gone into the blood drain, was collected in tubs beneath the carcases for the duration of stimulation. Grass-fed cattle from the same lot were divided into stimulated and non-stimulated control groups. Electrical currents of 300 mA and 500 mA at frequencies of 5 Hz and 14 Hz were applied to groups of 15 bodies.

The results (Table 1) indicate that all treatments increased blood yield by at least 1 kg per head with the higher currents giving a better yield. Similar results were obtained using a nostril-rectal electrical stimulation system employing an alternating square wave form with 45 V peak and 36 pulses per second.

Table 1: Quantity of blood collected during stimulation

Group	Frequency (Hz)	Peak current (mA)	Blood weight per head (kg)
I	14	300	1.5
II	14	500	1.8
III	Control		0.6
IV	5	300	1.5
V	5	500	1.9

These results compare with an earlier trial by Graham & Husband (1976) where an extra 0.68 kg on average was collected from stimulated carcases

Trials have also shown that when stimulating in the bleeding area, the rate of dripping 10 minutes after sticking, was reduced by 30%.

Sheep & lambs

The yield of raw blood from sheep and lambs is normally quoted at 1 to 2 kg per animal but a range of values up to 3 kg per sheep have been reported.

As with cattle, blood will continue to drip from the carcases along the dressing line but recovery of blood at the blood drain can be enhanced by using a thoracic stick after the Halal stick and by applying an electrical current.

Thoracic stick

When beef carcases are processed to meet the Halal religious requirements, the initial bleeding incision is similar to that used with sheep i.e. a transverse incision across the neck which cuts the major blood vessels and also the trachea and oesophagus. Subsequently there will be a lengthwise incision which severs the major blood vessels in the vicinity of the heart (a 'thoracic stick'). This thoracic stick is rarely used in sheep-processing plants in Australia. It could be expected that this extra stick could lead to increased blood removal from the carcase.

Many New Zealand sheep plants do a thoracic stick when the body is suspended by all four legs. There is a combined elastrator rodding/ thoracic stick knife available for this purpose. One of these devices (Mutton Rodder with Blade – Heiniger Australia Pty Ltd, Airport West Vic. 3042) was tested in a trial to find out how much additional blood could be collected by following the Halal stick with a thoracic stick.

In this trial, the lambs were electrically stunned for 4 seconds with a twin-probe head-only handpiece. They were then stuck with a Halal-type cut across the neck which severed the major blood vessels on both sides of the neck, together with the oesophagus and trachea. Immediately after sticking, the oesophagus was tied with string, the head removed and the body shackled and hoisted.

The forelegs were placed in a spreader suspended from a rail at a height that had the carcase sloping forward at an angle of 45°. The carcase was held in this position until 2 minutes after the original Halal-type cut had been made. At this time, the initial bleeding was usually complete and there was generally very little blood dripping from the neck. The rodder/knife was then inserted into the exposed end of the neck and pushed forwards and upwards with the blade in the upper position. At the same time a plastic tray was placed under the carcase to collect the released blood. This tray remained in position for 2 minutes, then it was removed and the blood weighed. With the control (no thoracic stick) group of carcases, blood was collected for the same 2-minute period.

Figure 3. Rodder with blade used for the thoracic stick.

The results (Table 2) show that there was considerable variation in the quantity of blood collected within both groups; however, the difference between mean values was quite significant. On average, about 75 grams of extra blood was obtained with the use of the thoracic stick knife.

Table 2: Weight of blood released per body in the period 2 to 4 minutes after the initial throat cut.

	Range (g)	Average (g)
Halal-type incision only	16 – 98	48
Halal-type + thoracic	11 – 239	125
Increase		77

It was found that in practice the knife could be used either before or after head removal. Care must be taken to avoid contact between the knife and the fleece. To prevent contamination, it may be necessary to make a Y-cut to the forelegs before the thoracic stick. The hearts were not damaged in any way.

The knife used in the trial is shown in the photo (Figure 3). It is not essential to use this type of rodder/knife. The same effect could presumably be obtained if the thoracic stick was performed with a standard curved sheep-skinning knife. Some employees modify their knives by welding a pig-tail rodder to its tip; however, the knife pictured has the advantage that it can be used for the following three tasks:

- rodding to separate the oesophagus;
- sealing of the oesophagus with a rubber ring;
- thoracic stick.

Electric current application

The application of an electric current to the carcase after the thoracic stick was found to lead to a further small (average approximately 15 grams) increase in released blood. It is unlikely that this amount would justify the installation of an electrode system for current application; however, if electrical current was being applied for immobilisation purposes, or as part of an electrical stimulation (meat tenderisation) process, then the extra blood release would be a bonus.

Additionally, these currents may exert a conventional electrical stimulation effect with an increase in meat tenderness and an improvement in meat appearance – lighter, brighter muscle.

Minimising blood losses

All plants aim to maximise the quantity of dried blood produced. The two main factors at the collection stage that affect this are:

- length of the bleed drain, and
- amount of added water.

The bleed drain

The correct slaughter floor layout is crucial to efficient blood collection. Some blood will inevitably be lost but it is important to contain and collect all the blood for at least 3 minutes and preferably 5 minutes after sticking.

It is possible to collect the residual blood draining from the carcase for a longer period by installing stainless-steel troughs under the dressing line. These should be designed to be easily dry-cleaned during production breaks, using rubber squeegees shaped to fit the trough. The sides of the trough should be as high as possible to minimise splashing of blood onto the floors and walls and to prevent water getting into the trough.

The spoon drain below the dressing line could also operate as an extended blood drain all the way to the hide puller. The drains to waste can be fitted with plugs so that the drain can be dry-cleaned by squeegeeing the blood to the main blood drain during breaks. When hosing is carried out the plugs are removed to drain the water to the effluent system. This system would be less expensive than troughs but may allow greater contamination with wool, hair, skin and feet.

The effect of added water

The collected blood is normally coagulated in a continuous steam coagulator before drying. The efficiency of coagulation and later separation of the liquid and solid fractions is reduced when the solids content is diluted with added water. This is because red blood cells rupture when they contact pure water resulting in poor coagulation.

Table 3: Loss of yield of blood meal by centrifuge-dewatering of coagulated blood to 40% solids.

Solids in drained liquid effluent (%)	Solids content of raw blood (% w/v)		
	20%	15%	10%
	Loss of yield of blood meal (%)		
1.0	2.7	4.1	7.5
1.5	3.7	6.3	11.2
2.0	5.0	8.2	15

It is inevitable that some water will find its way into the blood drain through splashing from hoses, wash basins, sterilisers etc. It is important that the amount of added water is minimised especially during washing down of the blood drain. Raw blood without added water will have a solids content of 19 to 20%. Under ideal conditions, the solids in the stick water (the liquid phase expressed from the coagulated blood) will be 1.0 to 1.5%. This represents a product loss of about 3%. If the raw blood is diluted to 10% solids by the addition of water, the losses will increase to near 10% (Table 3).

The typical yield of blood meal from cattle is about 2.7 kg per head. With careful collection and no added water, blood meal yields up to 3.1 kg per head can be achieved. The electronic bleeding techniques described above should add about 0.25 kg per head to the yield of blood meal.

Further reading

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Gregory N G, Wilkins L J, Gregory, A M S (1988) Studies on blood engorgement in beef carcasses. *J Sci Food Agric* 46: 43-51.

Johnson B Y (1986) Yields in rendering. *Proc Meat By-Products Processing Workshop* 130-154.

For more information, contact one of the Meat Industry Services staff listed below.

Food Science Australia Meat Industry Services Section

The Meat Industry Services (MIS) section of Food Science Australia is an initiative supported by Meat and Livestock Australia (MLA) and the Australian Meat Processor Corporation (AMPC) to facilitate market access for, and support world-class practices in, Australia's meat industry.

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