



# Blood Recovery

1997



**B**lood is a valuable by-product of meat processing. Costly losses and effluent disposal problems can occur, however, when collection and processing of blood is unsatisfactory.

An example of blood recovery is shown in Table 1. A typical yield for carcasses in the weight range of 200-300kg is about 2.2kg of dried blood per head. Less than 2kg per head is considered a low yield.

**TABLE 1 Yield of blood per head**

Type of stock dressed carcass weight	Potential raw blood yield (to blood drain) kg	Theoretical dry blood yield* kg	Practical dry blood yield** kg
Cattle 200-300kg	12	2.5	2.25

\* Raw blood has a solids content of about 19%. Therefore the theoretical yield (to a 9% moisture blood meal) is 21% from raw to dry.

\*\* 90% recovery of theoretical, due to losses to effluent (stick water) during processing.

To reduce the evaporation load, most works usually coagulate raw blood before it is dried. This is achieved either by batch coagulation with the use of live steam injected into a blood tank and allowing the blood water to drain at the end of coagulation, or by continuous coagulation with the use of live steam injected into blood pumped through a pipe, followed by continuous decanter.

To maximise yields, a maximum loss to effluent of 5% should be aimed for and the blood should be dried to just under 9% moisture.

## Blood Processing Techniques

### Direct drying

Direct drying, which involves blood being dried in batch cookers, results in a 100% recovery of the collected blood.

With this method, blood tends to stick to the heated surfaces of the dryer, which significantly reduces the rate of heat transfer. Consequently, drying times are very long. Introduction of bones with the blood helps to scour the surfaces and decreases drying times.

Drying uncoagulated blood requires a large amount of steam. Thus, unless the kill is small, it would be more economical to mechanically de-water blood by steam coagulation followed by centrifugation or draining before drying.

### Batch coagulation followed by drying

In this method, blood is coagulated in an open tank into which steam is injected. The coagulum is then drained of free water and dried.

Because uniformly achieving the optimum coagulating temperature of 90°C throughout the blood is difficult, incomplete coagulation can occur. The result is the loss of some blood.

### Continuous coagulation and mechanical de-watering before drying

Continuous coagulation and mechanical de-watering before drying is the most common method of processing blood.

With this method, strained blood from a holding tank is pumped into an intermediate preheating tank

equipped with a slow agitator. Preheated blood then passes to the coagulator which is a stainless steel pipe, fitted with direct steam injection, usually at several points to ensure intimate mixing of blood and steam. The pipe's length is designed to ensure that blood reaching the exit of the coagulator is at the optimum coagulating temperature of 90°C. The rate of steam injection can be controlled by sensing the temperature of blood at the outlet and feeding back a signal to control steam flow.

The coagulum is separated from the liquid effluent or "centrate" or "stick water", by a decanter centrifuge. The amount of de-watering achieved depends on the initial water content, but usually over three-quarters of the water is removed to give a coagulum with about 60% moisture.

### Drying of coagulum

The most common dryers used to dry coagulum are ring dryers. Drying is accomplished by simultaneously grinding and dispersing the wet product into a high-velocity air stream, with the dry solids continuously removed using a cyclone separator.

Other types of pneumatic conveying dryers, contact disc dryers, batch dryers and cascading rotary dryers can also be used for blood drying.

## Minimum 90% Recovery

Failure to attain 90% recovery of the potential blood solids indicates that product losses are higher than they should be, making it worthwhile to examine the process more closely. The first place to check is in the sticking area and blood drain. This is where a little time and common sense could lead to an immediate increase in dried blood production. A large potential loss is from non-collection of blood and inadequate bleeding times.

Procedures for tracing losses in the subsequent coagulation and de-watering process are a little more complicated.

The stick water separated from heat-coagulated blood may contain high levels of suspended and dissolved solids.

### To cut blood losses

- Have adequate bleeding time.

Most of the blood in sheep and lambs can be collected in two minutes. Blood flow in cattle takes up to three minutes to become insignificant. For beef, blood should be collected until the head is removed. For mutton, blood should be collected until the animal reaches the legging table. Electrical stimulation can add up to about 5% to the quantity of recovered blood.

- Check coagulator design.

The coagulator pipe should be long enough to allow sufficient heating. Coagulation

temperature should be controlled, with temperature achieved by thermostatic control of steam and an even flow of blood to the coagulator. Careful control is needed to avoid raw product being blown through the system by live steam.

- Age blood overnight.

Overnight ageing of blood will improve coagulation. Problems with odour can be overcome using suitable additives.

- Minimise added water.

Dilution of blood results in poor coagulation and increases losses in the effluent. High dilution with water will also lead to greater volumes of effluent water which will take blood solids with it. The drain to the holding tank must be blocked off before washdown of the bleeding area. With reasonable control, the final concentration of solids should not fall below 14%.

In practice, the total solids content of raw blood after dilution by extraneous wash water will be about 15% (about 25% wash water to raw blood).

The percentage losses for a range of alternative processes involving different amounts of added water in blood, and different solids content in effluent, are illustrated in Table 2. Table 2 shows the losses from centrifuged blood at 40% and drained blood at 22% solids content.

**TABLE 2** Percentage solids loss in de-watering of coagulated blood

% Solids in drained liquid (effluent w/v%)	De-watered to 40% Solids (Centrifuge)			De-watered to 22% Solids (Drainage)		
		% Solids content of raw blood w/v% feed material				
	20%	15%	10%	20%	15%	10%
	% Blood solids loss			% Blood solids loss		
1.0	3.3	5.0	8.8	1.3	3.0	7.0
1.5	4.5	7.7	13.5	1.8	4.7	10.6
2.0	6.5	10.3	18.3	2.5	6.7	14.6

## Coagulation and centrifugation

After coagulation and centrifugation, total solids in the product will typically be 35%-50%. Total solids in the liquid effluent may range from 0.75%-2.0% but will typically be 1%-1.5 %.

Less favourable operation might result in a raw blood feed of below 10% total solids, with the effluent figure reaching 3.0%.

Checking these figures against Table 2 will show product losses in the range of 3%-18%.

Frequent checks on the solids content of incoming whole blood, the coagulated solids and the blood stick water (effluent) will indicate when collection or processing methods go astray.

## Coagulation and draining

For coagulation followed by draining, the solids content in the residue is 20%-25%, while the solids content of the drained water is similar to that expelled from a centrifuge.

## Losses/Recovery

For any given level of solids in the separated water, percentage losses increase with initial dilution of raw blood. Losses are also significantly higher when blood is centrifuged (continuous coagulation) than when it is only drained (batch coagulation). Of course, direct drying in a batch dryer without prior coagulation gives 100% recovery of blood solids.

A blood solids loss of 4% is about the minimum possible, representing the non-coagulable fraction of raw blood. In practice, a total product loss of less than 10% can be considered satisfactory (i.e. 90% recovery of theoretical dried blood figure).

Ring-dried blood meal and blood meal produced by other pneumatic dryers are heated for only a few minutes to temperatures of not more than 100°C. Total protein content and total and available lysine contents have been shown to be substantially higher for ring-dried than for batch cooker-dried blood. Damage to lysine in blood meals during drying in batch cookers can be considerable. Blood dried in direct contact dryers of large surface area is subjected to slightly less severe conditions than those imposed by batch dryers.

## Additional information

More detailed information on this subject is provided in the following:

"Blood Collection and Processing" in CSIRO *Meat By-products Processing Workshop Notes*, May 1984

"Yields from Rendering" in CSIRO *Proceedings of Meat By-products Processing Workshop*, September 1986

Additional help and advice is available from Australian Meat Technology Pty Ltd. Phone:

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