Meat Industry Research Institute of New Zealand (Inc.)

No. 10

BULLETIN

Maximizing yields from conventional blood processing

Guidelines to improve production

The dried blood yields that meat processing plants are satisfied with may be less than what they can achieve (see Table 1). Inefficient blood collection and processing reduces yields and often results in embarrassing and expensive effluent disposal problems.

This Bulletin outlines blood collection and conventional processing, including possible problem areas, and describes ways of increasing yields. New techniques that yield high-value products are also described.

The amount of blood collected depends on

- Carcass weight

  Larger animals yield more blood. The most blood that can be collected under industrial conditions is about 9% of the carcass weight. This may vary due to differences in an animal's physical make-up and reaction to slaughter. For example, blood may lodge in the viscera or spleen of a stressed animal reducing the amount collected.

- Stunning and sticking procedures

  To ensure good yields, the correct combination of stunning and sticking must be used.

  A head-only or captive-bolt stun does not stop the heart and should be followed by a gash cut. The open wound allows better bleeding and lessens the risk of clots forming as the blood pumps through the carotid arteries.

  A head-to-back stun stops the heart and should be followed by a thoracic stick. To maximize blood collection in sheep, the hind leg needs to be shackled and the forelegs placed in a spreader so that the blood pools in the great veins and venous side of the heart making the thoracic stick more effective.

- Bleeding time and rate

  Most of the blood in sheep and lambs can be collected in 2 minutes. Blood flow in cattle takes up to 3 minutes to become insignificant.

  The initial bleeding rate is faster for a thoracic-stuck animal than for one that has been gash cut. However, after 3 minutes the blood yield will be the same, whichever method is used.

  Adoption of standardized Halal slaughter procedures throughout the Industry is reducing variations in blood yields between plants.

Table 1. Typical dried blood yields and achievable dried blood yields.

	Typical company figures, kg*	Maximum yields kg*
1000 lambs+	165	215
1000 sheep	240	310
1000 prime cattle	2440	3490
per 1000 kg dressed wt	11	16

* 6% moisture content

\+ The average New Zealand carcass weight for lambs, sheep and cattle has been used.

WHAT CAUSES PROCESSING LOSSES?

Dried blood is manufactured by coagulating the blood protein, then dewatering and drying the coagulum to produce a stable product. Losses can occur at each processing stage.

Poor coagulation procedures

Good coagulation is the key to low losses during dewatering of blood solids; temperature control and processing time are critical. About 92% of blood solids can be coagulated by heat, with a slightly higher temperature being needed for fresh than for aged blood (Fig. 1).

Continuous coagulation, which involves injecting live steam into the pipe carrying blood to the decanter centrifuge, offers good mixing and temperature control. Process control is more difficult when blood is coagulated in batch cookers.

The effect of coagulation conditions is seen at the decanter. If blood is not heated enough, the solids are difficult to dewater and decanter throughput must be reduced to improve solids recovery. The dried product contains fine particles that can cause dust problems in ring dryers. If blood is heated too much, the coagulated mass becomes rubbery and can overload the decanter, causing blockages. The rubbery coagulum reduces dryer efficiency and gives a coarse end product.

You should test the performance of your coagulator to determine the best processing conditions (see below).

Adding water

Diluting blood with wash water

- reduces solids recovery, especially if blood is processed fresh.

- increases processing time.
- increases steam usage.
- increases effluent loading.

During collection, minimize hosing or any other activity that adds water to the blood. At clean-up, remove solids from floors and collection troughs with a squeegee, and plug the drain to the blood tank before hosing begins.

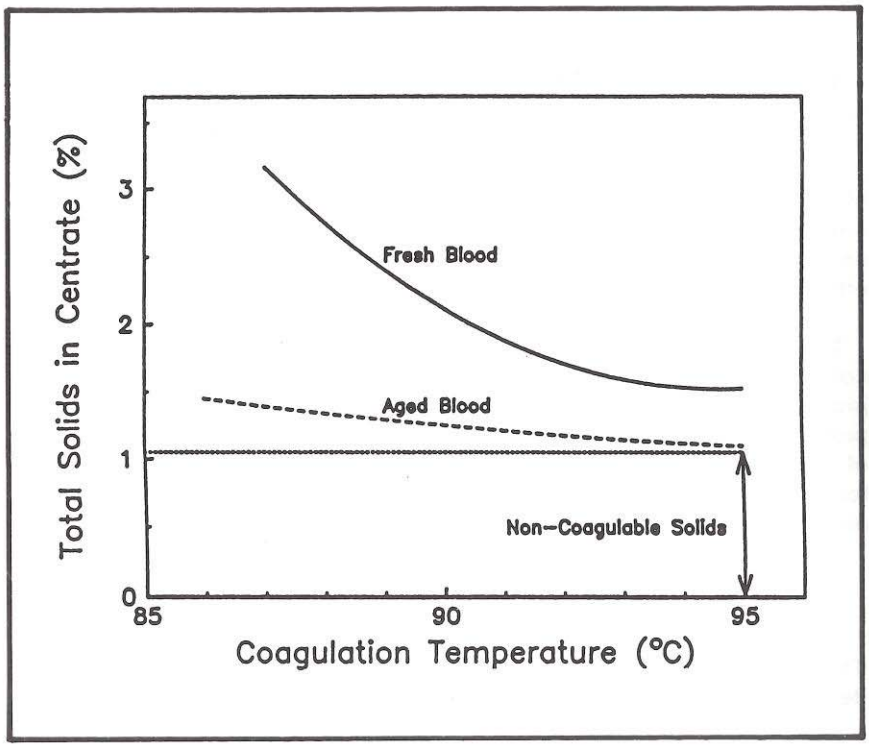

Figure 1. Effect of coagulation temperature on solids losses in the centrate of one plant processing aged and fresh blood.

REDUCE PROCESSING LOSSES BY

Aging the Blood

Blood held overnight is easier to coagulate, and coagulation conditions are less critical (Fig. 1). If overnight aging is impractical even storing blood for as long as possible for same-day processing will improve coagulation.

During aging, foul odours can develop in the holding tank, so some form of odour control is necessary, particularly if blood is held over a weekend. Scrubbers on air exhaust systems are expensive and not particularly effective. Adding preservatives will slow the rate of decay and prevent unacceptable odours.

Sodium metabisulphite is cheap and easy to use. Suitable concentrations of this compound are up to 300 g/1000 litres for overnight holding, and 400-600 g/1000 litres for weekends.

Another method of improving coagulation without overnight aging is to add 1% calcium chloride to the blood in the holding tanks and then stir continuously for two hours before processing.

Monitoring process performance

Regular checks, carried out by either the rendering department or the laboratory, will tell you how well collection and processing are being carried out and allow you to take corrective measures where necessary. A quality-control programme will indicate how often these checks should be done.

- Check added water

Sample blood from the holding tank and have the laboratory determine its solids content. Undiluted blood contains approximately 19% solids. If the sample contains less than 15% solids, too much water is being added, particularly if the blood is to be processed fresh (Fig. 2).

- Check coagulator losses

Sample the incoming blood, the centrate (blood water) and the coagulum (coagulated mass), and have the laboratory determine their total solids contents. Consult Fig. 3 to determine your approximate solids loss, *or* use the laboratory figures in the following formula:

Approximate % total solids lost =

$$\frac{100\ C}{B} \times \frac{1.1\ S\text{-}B}{S\text{-}C}$$

where
B = % total solids in incoming blood
S = % total solids in coagulum
C = % total solids in the centrate

For example, if analysis shows the whole blood to be 15% solids, the coagulum 38%, and the centrate 4%, then:

Approximate % loss =

$$\frac{400}{15} \times \frac{(1.1 \times 38) - 15}{38 - 4}$$

= 21%

A loss of 21% is unacceptable and can be reduced by increasing the total coagulated solids (S) and/or reducing the total solids in the centrate (C). For example, if blood containing 16% total solids is processed, the centrate should contain no more than 2% total solids. Higher levels of total solids in the centrate indicate poor coagulation and/or overloading of the decanter. Total processing losses should be kept to about 10%.

- Check moisture content of the dried blood

Monitor moisture content regularly to ensure that it remains at 6 to 8%. If moisture content rises above 10% the dried blood

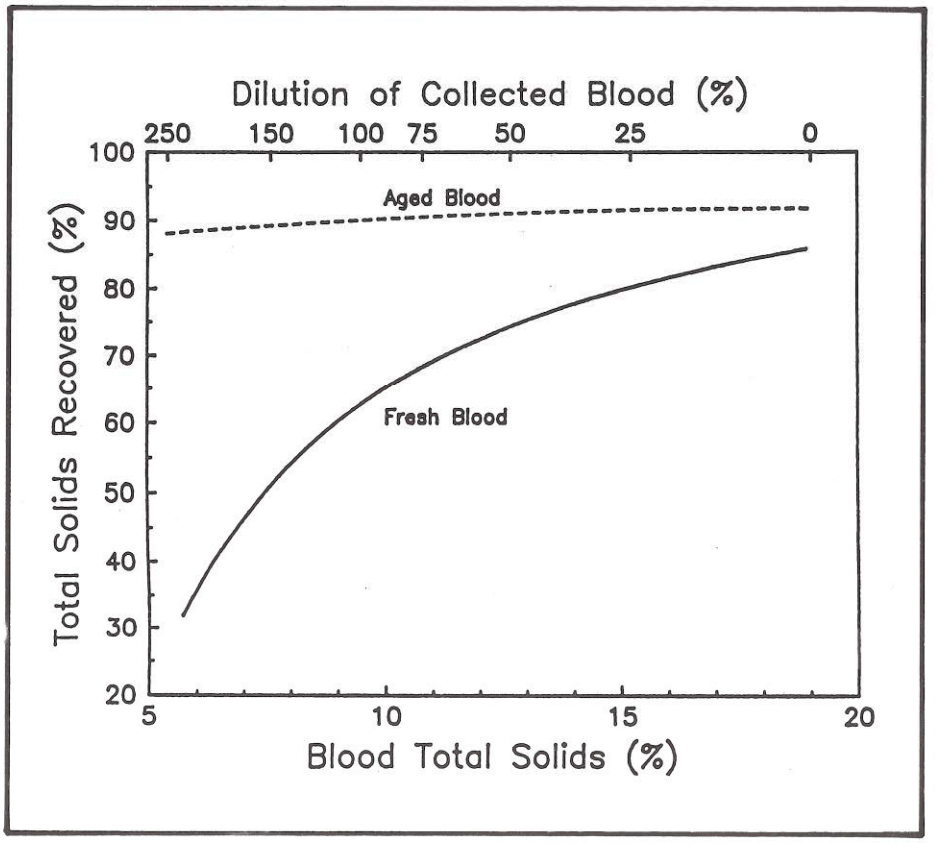

Figure 2. Effect of adding water on product yield when processing fresh and aged blood.

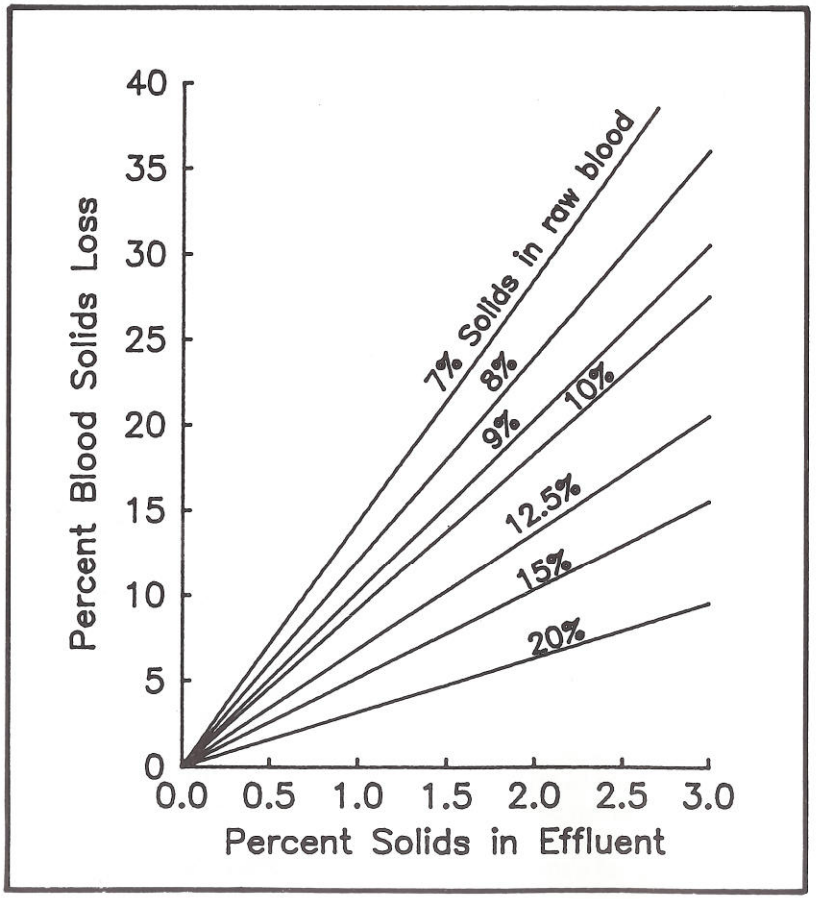

Figure 3. Solids loss in dewatering of coagulated blood (from Pilkington, 17th Meat Industry Research Conference, 1975).

could deteriorate during storage.

- Check holding tanks

  Processing losses can also occur because of clotted blood or foreign material such as wool remaining in the holding tanks after processing. Pre-screening of the blood to remove wool and continued stirring of the holding tanks to break down clots will minimize losses.

In summary, to obtain maximum dried blood yields:

- Collect blood for at least 2 minutes.
- Avoid adding water to the blood.
- Age blood overnight.
- Check coagulator performance.
- Ensure the best coagulation temperature is used.
- Monitor the process by regularly checking blood dilution, coagulator losses and product moisture.

Other Processing Methods

Blood is a valuable protein source. If it is collected and processed carefully, high-value edible and technical-grade products such as plasma, blood cell hydrolysate and soluble dried blood can be produced. The conventional blood processing method described in this Bulletin gives an insoluble product that has a limited number of end uses when compared to other processing techniques that are now available.

Direct drying

MIRINZ has developed an alternative blood processing system that is now commercially available. Whole blood is concentrated and dried directly in a spouted-bed dryer. The high grade product is 80 to 90% soluble. Yields approach 100% of the solids present in the blood because the non-coaguable protein is also in the product rather than being lost in the centrate.

Fractionation

Blood can be separated into plasma and blood cells. These fractions can be dried or further processed; for example, blood cell hydrolysate (BCH) can be produced. The high-value products from fractionation are used in the food and biotechnological industries. The fractions can be worth up to 40 times more than crude dried blood (see Table 2).

Table 2. Products of blood processing and prices (1984).

	$/t
Crude dried blood	500 - 800
Soluble technical blood	800 - 1600
Plasma	4000 - 6000
BCH	10 000 - 40 000

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