



# Rendering Yields

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**M**anagers of rendering plants must be able to predict and to measure yields of product from raw material. This task can be challenging because the quantities of raw materials processed are not necessarily known and assigning a production to a specific amount of raw material may not be possible. In addition, bulk meal bins and tallow tanks may not be calibrated accurately.

Sometimes the only way of measuring production is to deduce it from loadouts.

The best way to determine yields is to measure the production from a known amount of raw material, ie. conduct a test cook. If this is not possible, yields can be obtained by predictive methods. This information brochure describes some of the predictive methods for estimating yields and discusses possible control of yields.

#### Yields from Test Cooks

Assuming that quantities of raw material inputs and finished products can be measured, test cooks provide reliable information about yields.

Conducting test cooks with continuous rendering systems is difficult. Test cooks are usually confined to batch cooking systems.

All fat and bone and all slaughterfloor materials do not give the same yields. The yield of tallow and meat meal depends on the composition of raw materials. Table 1 illustrates this point, showing yields of tallow and meat meal from various raw

materials. The yields shown in Table 1 were determined from test cooks.

#### Predicting Yields from Production

Abattoir renderers should be particularly interested in the yield of by-products per head of animals slaughtered.

Yields per head can be estimated from historical data using the statistical technique of multiple regression. This technique involves comparing the inputs to the rendering plant with the outputs and determining equations which can best describe the contribution of each input to the outputs.

Although carcase weight is a better input than numbers of head, the inputs can be described as the number of various classes of livestock. Part of the inputs should include the weight of other inputs such as boning room materials, condemned animal or material brought in from outside sources.

The outputs are the weight of product produced. The more accurate the measurements of inputs and outputs, the more reliable the yield predictions will be. To perform a regression analysis, daily sets of data for inputs and outputs should be used, and at least 20 sets of data are required.

The Meat Industry Research Institute of New Zealand (MIRINZ) has published yield figures based on regression analysis of historical data on inputs and outputs at different rendering plants. Table 2 shows estimated yields from carcasses and boning room material determined by MIRINZ by regression analysis.

Table 2 shows the considerable variation in the estimated yields at different works. For example,

Works A has a yield of 0.124 tonnes of meat meal per tonne of lamb carcasses while Works C yields only half as much meat meal from lamb carcasses (0.063 tonne per tonne of carcass). The results from this type of yield prediction are specific to the works where the yield data is collected.

The estimation of yields by regression analysis is simple to carry out with a statistical

TABLE 1 Yields from test cooks at different rendering plants

Raw Material	Rendering Plant	Tallow Yield (% of Raw Material)	Meat Meal (% of Raw Material)
Boning room bones (Beef)	A	16	54
	B	19	58
	C	24	42
Boning room fats (Beef)	A	58	13
	B	64	11
	C	68	9
Unwashed intestines	A	19	14
	B	16	14

**TABLE 2 Yield of tallow and meat meal determined by regression analysis**

Product Type	Rendering Plant	Yield (tonne of rendered product per tonne of input)				
		Lamb Carcase	Sheep Carcase	Beef Carcase of Carcase Wt)	Boning Room (Yield per Tonne	Other Material
Meat meal	A	0.124	0.093	0.095	0.082	-
	B	0.086	0.083	-	-	0.320
	C	0.063	0.095	0.080	0.160	0.160
Tallow	A	0.079	0.083	0.065	0.038	-
	B	0.059	0.070	-	0.057	0.162
	C	0.122	0.066	0.045	0.146	0.111

software package, and the results can be used to determine the effect of kill adjustment on the expected yields.

Unfortunately, the estimated yield will probably not be accurate enough to be used controlling yields. The accuracy of the prediction depends on the accuracy of the input and output data, and the predictions are likely to be more reliable when there are a small number of inputs and outputs.

### Yield from Carcase Components

Another way of figuring yields is to estimate the potential yield from individual carcase components and to determine the total yield from the sum of the carcase components in the raw material.

With this approach, a value can be assigned to individual items in the raw material, and this value can be compared with the value of the component if it is used for purposes other than rendering.

The yield of individual items in the raw material can be estimated from the chemical composition of the item. For example, the composition of beef heads, as determined by chemical analysis, is 19.6% protein, 12.9% fat, 23.4% ash and 43.3% moisture. All the protein and all the ash contribute to meat meal when a head is rendered. In addition, some tallow (about 11%) and some moisture (about 5%) remain in the meal. Thus, the meat meal yield available from heads is about 51% while the tallow yield, which is the fat content of the unprocessed head less the amount of residual fat in the meal, is 7.3%.

If the amount of individual items of raw material available from different carcase types and the potential yield of the item are known, the total

yields of tallow and meat meal from a carcase type can be estimated by totalling the yield from individual items.

Tables of yields of offals from different carcase types and the yield of tallow and meat meal from the offals are published in CSIRO Meat Research Report 2/92. Abattoir renderers can create their own tables of yields by measuring the amount of rendered items available from a carcase and analysing the composition of the items.

Table 3 illustrates how the yield from slaughterfloor material available from a 220kg steer can be calculated. The table takes into account the proportion of each offal type available for rendering.

The data displayed in Table 3 can be entered in a spreadsheet. Yields can then be quickly recalculated when the proportion of offal available for rendering is changed to consider different condemnation rates or other uses of offals.

A similar approach can be taken for material available from boning rooms.

From the type of information shown in Table 1, boning room bones yield about 19% tallow and 45% meat meal while boning room fats yield about 60% tallow, 12% meat meal. The proportion of fat-to-bone in boning room material should be measured to determine the total yield of tallow and meat meal.

TABLE 3 Yields from 220kg steer

Offal Type	*Tallow Yield (%)	*Meat Meal Yield (%)	Yield of Offal (kg)	Proportion of Offal Available for Rendering (%)	Tallow Yield per Carcase (kg)	Meat Meal Yield per Carcase (kg)
Head	7.8	50.6	11.0	100	0.8	5.6
Tongue	12.4	19.3	3.0	10	0.04	0.06
Tongue roots	15.8	19.4	1.2	50	0.09	0.1
Hocks	5.0	43.9	7.5	100	0.4	3.3
Liver	4.6	21.7	5.5	50	0.1	0.6
Lungs	-	20.6	2.1	100	-	0.4
Trachea and trim	12.9	16.6	1.2	100	0.15	0.2
Heart	6.6	18.2	1.1	20	0.01	0.04
Skirt	5.9	20.8	0.75	20	neg	0.03
Spleen	3.6	20.5	0.6	100	0.02	0.1
Paunch	4.6	16.9	7.0	40	0.13	0.5
Bible	17.2	14.0	7.5	100	1.3	1.0
Intestines	23.0	13.3	13.0	100	3.0	1.7
Caul fat	89.3	1.4	4	100	3.6	0.05
AUS-MEAT trim	69.8	5.6	14	100	9.8	0.78
<b>TOTAL</b>					<b>19.4</b>	<b>14.4</b>

\* Assumes 5% moisture and 10% fat in the meat meal.

Table 4 shows the average amount of fat and bone available from different types of carcasses, and the yield of tallow and meat meal from fat and bone based on yield percentages shown above.

### Yield Control

The methods of predicting yields described above are not likely to be accurate enough to be used for fine yield control. It is more effective to control the yield by examining

TABLE 4 Yields of tallow and meat meal from fat and bone

Stock Type	Carcase Average Weight (kg)	*Amount of Fat (kg)	*Amount of bone (kg)	Yield of Tallow (kg)	Yield of Meat Meal (kg)
Domestic grass-fed	194	14	42	16.4	20.7
Korean grass-fed	282	32	52	29.1	26.8
Japanese grass-fed	322	42	57	36.0	30.6
Domestic grass-fed	208	21	41	20.4	21.0
Korean grain-fed	282	41	50	34.1	27.4
Japanese grain-fed	322	57	54	44.3	31.1

\*The average amount of fat and bone available from the specified carcass types has been supplied by the Cattle and Beef Industry (Meat Quality) CRC.

the areas where yield losses may occur, rather than by comparing actual yields with predicted yields.

Yield losses may occur in raw material collection and in processing.

One way to assess losses in raw material collection is to measure the amount of material collected from the Saveall. Saveall tallow is no more than 80% of the total fat washed down to the Saveall. If the amount of Saveall tallow recovered in an abattoir is more than 5% of the total tallow production, there is probably a major loss of raw material before the material gets to the rendering plant.

Gut hashing and washing are a common source of loss of raw material. Tests on disc washers and trommel washers have shown that about 1 tonne of fat can be lost in the washer effluent when washing gut from a kill of 400 cattle. The loss of fat from gut washing operations can be reduced by about 75% by using scissor-type gut cutters.

In dry rendering systems, the only source of product loss (apart from spillages) is from tallow refining. If tallow is refined by centrifuges, some fat is lost in the polisher effluent. Solids may be lost when the polisher bowl discharges, although the discharged solids can be recovered.

The fat lost in centrifuge effluent is usually negligible, unless the fat content of the effluent and the amount of water used in the centrifuge are out of control. For example, the typical fat content of centrifuge effluent is 0.1% and the amount of water used is about 10%-20% of the volume of tallow. This equates to a loss of about 2kg of tallow from refining 10 tonnes of tallow. Even in extreme circumstances of 0.5% fat in the centrifuge effluent and water usage equal to 50% of the tallow, the loss is 25kg per 10-tonne of refined tallow.

When tallow is water washed by hand, losses can be up to 10% of the tallow. Washing tallow while it is hot (90-95°C) and allowing sufficient settling time (at least 2 hours) will minimise losses.

Losses of tallow and protein solids from water-washed tallow are relatively high when there are excessive amounts of fines in the tallow. Excessive fines are generated by overcooking – particularly if a pressure cycle is applied in the early stages of a batch cooking cycle – and by failing to cut raw material to a uniform size. If raw material size is not uniform, small pieces of material may be overcooked in the time and temperature required to cook large particles.

Although there should be no other losses during dry rendering, yields are affected by the residual moisture content and residual fat content of meat meal.

Moisture in meat meal is difficult to control with continuous dry rendering systems. A production of 10 tonnes of meat meal at 2% moisture equates to a production of 10.65 tonnes of meat meal at 8% moisture or a gain of 6.5% in the yield of meat meal. Similarly, 10 tonnes of meat meal with a residual fat content of 14% equates to a loss of 50kg of tallow compared with 10 tonnes of meat meal with a fat content of 9%. Of course, in this case, the loss of tallow is balanced by a corresponding gain in meal yield.

In wet rendering systems, losses of solids and tallow in the stickwater expressed from rendered solids can occur.

The losses from stickwater are greatly affected by added water in the raw material. The typical solids content of stickwater from wet rendering is about 2%, and the amount of stickwater generated from raw materials containing 60% moisture is about 2.4% (assuming water is not added during rendering). The total loss of solids in stickwater in this scenario is shown in Table 5.

Table 5 also shows loss in stickwater corresponding to other scenarios. Clearly, control of added water in raw material and measurement and control of the solids content of stickwater can have a major impact on product losses.

**TABLE 5 Approximate losses of solids in stickwater from wet rendering**

Added Water in Raw Material (%)	Total Water in Raw Material	*Approx. Amount of Stickwater per 100 tonne of Raw Material (tonnes)	Solids Content of Stickwater (%)	**Loss of Meat Meal from 100 tonne of Raw Material (tonnes)
0	60	2.4	2	0.06
10	64	12	4	0.13
20	67	20	2	0.30
			4	0.56
30	69	24	2	0.47
			4	0.94
			2	0.60
			4	1.13

\*Assumes no water is added in the wet rendering process and that the dewatered solids contain 55% water and 4% fat.  
 \*\*Meal calculated at 9% fat content and 6% moisture content.

### Conclusion

Rendering yields can be predicted either by conducting test cooks, by examination of historical yield data or by adding the potential yield of components in raw materials. These predicted yields are useful for projecting costs and returns from rendering and for assigning average values for raw materials. The predictions are usually not accurate enough for controlling day-to-day yields in rendering plants because the losses that affect day-to-day yield such as raw material losses, tallow and solids losses from tallow refining and losses in stickwater from wet rendering, are generally small compared with the errors inherent in yield predictions. Yield control should be directed at investigating and measuring the potential product losses in rendering plants.

### Additional information

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

"By-Product Yields from Sheep and Cattle"  
 CSIRO Meat Research Report 2/92

"Yields from Rendering" in CSIRO Proceedings of Meat Byproducts Processing Workshop, September 1986

"Rendering Yields" by M P F Loefflen and J E Swan in 25th Meat Industry Research Conference, MIRINZ, Hamilton, 1988



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