Department of Agriculture
Farmnote
No. 26/2004
Replaces 46/93
Reviewed 2007

Yield of Saleable Meat in Beef Cattle

By Brian McIntyre, Senior Research Officer, South Perth

'Yield of saleable meat' is the proportion of the beef carcase that is saleable as meat. This important characteristic has a large influence on value. 'Fatness' is the most important factor influencing yield of saleable meat. 'Muscling' (muscle to bone ratio) can also have a significant effect on yield. Yield can be estimated from measurements that are routinely made on the carcase following slaughter. The accuracy of yield estimates can be improved by the use of video image analysis (VIASCAN) technology.

The amount or proportion of meat in a carcase that can be sold is referred to as 'yield' or 'yield of saleable meat'. For a carcase of a given weight and value per kilogram, the more meat that can be sold from a carcase, the higher the return. Because yield is important to the retailer or processor it has important implications for the beef producer.

Conversion of the live animal to meat

The first stage in the conversion of the live animal into meat is slaughter and the removal of the head, feet, hide, blood, alimentary tract and its contents, organs such as the heart and liver, bruise trimmings and other trimmings. The components that can be removed are specified in the preparation of a 'standard carcase'.

Dressing per cent

The relationship between the carcase weight and the liveweight is known as the 'dressing per cent':

$$\text{Dressing per cent} = \frac{\text{Carcase weight}}{\text{Liveweight}} \times 100$$

$$\text{Carcase weight} = \frac{\text{Liveweight} \times \text{Dressing per cent}}{100}$$

Dressing per cent can vary between 45% and 60 %. One of the major causes of variation is gut fill because of its effect on liveweight. Gut fill is influenced mainly by the type of feed and time since last feed or drink. Fatness, muscularity, sex, pregnancy status and age of the animal can also affect dressing per cent.

Dressing per cent is sometimes incorrectly referred to as yield or carcase yield. Although a high dressing per cent is desirable, particularly if animals are sold on the basis of their carcase weight, it does not necessarily provide an accurate indication of the value of the animal. Approximately 30% of the carcase consists of bone and fat trim which is not saleable as meat.

Yield of saleable meat

The carcase is made up of basically three components: muscle, fat and bone.

Bone is unsaleable except for small amounts that can be sold in cuts such as T-bone steak and standing rib roasts.

Fat makes up most of the remainder of the unsaleable component, though some fat is saleable in conjunction with the muscle. As the fat content of the carcase increases, the proportion of fat that is saleable decreases.

Muscle is the only tissue that is totally saleable although a small proportion is lost in the boning process because it cannot be completely removed from the bone and waste fat.

Yield is the term used to describe the portion of the carcase that is saleable as meat. It can be expressed as either 'weight of yield' or 'per cent yield'.

Weight of yield – the absolute number of kilograms of saleable meat from the carcase

Weight of yield is closely related to the size or weight of the carcase and does not provide an accurate indication of the value per unit of weight of the carcase.

Per cent yield – the proportion of the carcase weight that can be sold

Per cent yield provides a direct estimate of the proportion that can be sold as meat and is calculated as follows:

$$\text{Per cent yield} = \frac{\text{Weight of saleable meat}}{\text{Carcase weight}} \times 100$$

Yield and commercial value

Table 1 shows the impact of differences in yield on commercial value of carcases. In this example, two carcases of equal weight (250 kg) but differing in yield (70% and 60%) are compared. The purchase price of $4.00 /kg is the same for both carcases. If all meat from both carcases was sold for $7.00 /kg, the difference in the 'profit' is $175.

The difference in yield illustrated in Table 1 is within the range encountered in cattle slaughtered in Western Australia. The importance of yield to meat retailers and processors is clearly evident from the example in Table 1.

Table 1. The importance of yield in determining carcase value

	Carcase 1 70% Yield	Carcase 2 60% Yield
Carcase weight (kg)	250	250
Purchase price ($/kg)	4.00	4.00
Purchase price ($)	**1000**	**1000**
Yield (%)	**70**	**60**
Weight of saleable meat (kg)	175	150
Return if saleable meat sold for an average price of $7.00/kg ($/kg)	**1225**	**1050**

Relationship between yield and carcase composition

The yield is determined entirely by the composition of the carcase. The relative proportions of muscle, fat and bone determine how much can be sold and how much is wasted. The proportion of the three components can vary widely and approximate ranges are as follows:

- Muscle 40% – 70%
- Fat 10% – 50%
- Bone 10% – 20%

Within an individual animal, the changes in composition as the animal grows are almost totally determined by the changes in carcase fatness. Fatness is the component of composition over which the producer has most control. As fatness increases, the proportions of muscle and bone decrease.

The relationship between muscle and bone (or muscle to bone ratio) remains relatively stable over most of the life of the animal. Minor changes in muscle to bone ratio do take place within the first few months of life, but, for practical purposes, the ratio is fixed over the period when the animal is likely to be slaughtered and cannot be greatly influenced by the beef producer. Muscle to bone ratio averages about 4:1 but can vary among animals from below 3.5:1 to over 5:1.

Effect of carcase fatness on yield

As the fatness of the carcase increases, progressively more trimming of the fat covering the various cuts is required to produce meat that is acceptable to the consumer. The fat that is trimmed results in a decrease in the yield of saleable meat. This is shown in Table 2 where two carcases of varying fat content but with the same muscling (muscle to bone ratio of 4:1) are compared. In this example, it is assumed that 1 part of fat is saleable with 5.7 parts of muscle (meat consists of 15% fat).

Table 2. Effect of variation in carcase fat content on saleable yield of meat from the carcase

	Carcase 1 20% fat	Carcase 2 30% fat
Muscle to bone ratio	4:1	4:1
Fat content (%)	**20**	**30**
Bone content (%)	16	14
Muscle content (%)	64	56
Saleable fat (%)	9.6	8.4
Yield of Saleable Meat (%)	**73.6**	**64.4**

Table 2 shows that a 10 % increase in fat content is associated with more than 9% decrease in yield of saleable meat. When calculated over the possible range in carcase fat content (that is, 40%) the yield can vary by as much as 30%.

Effect of degree of fat trim on yield

The degree of trimming can also have a substantial effect on yield. The greater the amount or proportion of fat that remains untrimmed, the higher the yield of meat. In Figure 1, the relationship between carcase fat percentage and yield is shown for meat with 5% and 20% of fat in the saleable meat. The difference in yield that results from the difference in fat content of the saleable meat can be over 5%. Thus, carcases that are trimmed so that the meat is very lean will produce much lower yield than where the meat contains considerable amounts of fat.

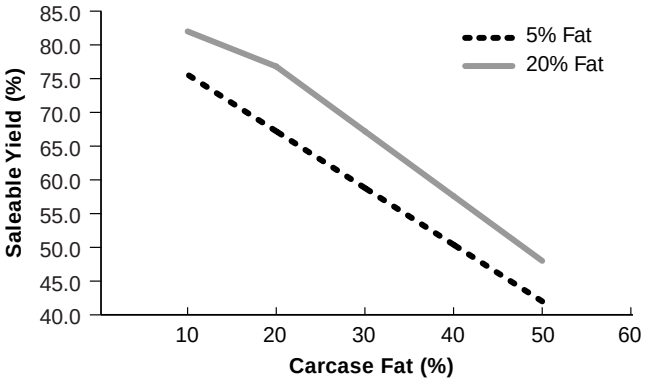

Figure 1. Relationship between carcase fat content and yield for meat with 5% and 20% fat in the saleable meat

Estimating fatness and yield

A reliable estimate of fat content can be made from measurements of fat thickness that are routinely made in abattoirs following slaughter. Fat thickness is measured at the P8 site according to AUS-MEAT carcase description procedures and at the 10th rib as part of the Meat Standards Australia grading system. A 1 mm increase in either fat thickness measurement represents approximately 1% increase in carcase fat content. The effect of a 1 mm increase in fat thickness on yield of saleable meat is around 0.5%.

Effect of muscling on yield

'Muscling' is a source of much confusion in live animals and carcases. This has arisen because of differences in interpretation of the meaning of muscling.

In terms of carcase composition, 'muscle to bone ratio' (M:B – the weight of muscle relative to the weight of bone) provides the best definition of muscling. Alternative definitions such as 'muscle weight' are greatly influenced by the size of the animal or carcase. Bigger animals have greater muscle weight than smaller animals without being necessarily more 'muscular'.

Similarly, 'muscle percentage' is largely determined by fat content. As animals get fatter, the muscle percentage drops so that it is much easier for a lean animal to have a high percentage muscle.

M:B is not affected by size or by level of fatness. A carcase with a greater weight of muscle attached to a skeleton of a given size has more 'muscling' than one with less muscle weight on the same skeleton. M:B normally remains relatively constant within an animal over its lifetime, but can vary between animals.

Table 3 shows the effect of variation in muscling on yield. Two carcases of the same fatness (30%) but differing in M:B are compared. In both cases, the fat content of the meat is 15%. This example shows that an increase in M:B from 3.5:1 to 5.0:1 results in an increase in yield of 4.4%. This represents almost the entire range in M:B likely to be found except in so-called 'double muscled' cattle.

Table 3. Effect of muscling on yield

Carcase	1	2
Muscling (M:B)	**3.5:1**	**5.0:1**
Fat content(%)	30.0	30.0
Bone content(%)	15.6	11.7
Muscle content(%)	54.4	58.3
Saleable fat(%)	5.4	5.8
Yield of Saleable Meat (%)	**59.8**	**64.2**

Figure 2 shows the effect of muscling on yield over a range in carcase fatness. In this example, the effect of an increase in muscle to bone ratio from 3.5:1 to 5.0:1 (1.5 units) varies according to the fatness of the carcase. At 10% carcase fat content, the difference in yield is about 5.5%, while at 50% carcase fat content the difference is reduced to 3.1%. In these examples, the fat content of the meat is held constant at 10%.

The effect on yield of variation in muscle to bone ratio is lower than the potential effect of differences in fatness. However, the effect of muscling will become relatively more important as the range in fatness of carcases becomes narrower in response to tighter market specifications.

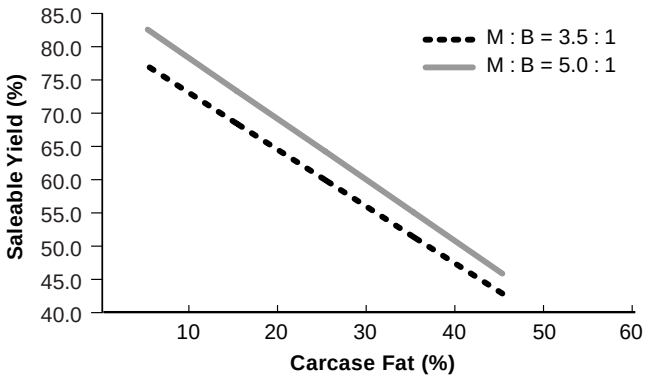

Figure 2. Relationship between carcase fat content and yield for meat with various levels of muscle to bone ratio (M:B)

M:B is difficult to measure and assess in live animals and carcases and the only accurate method is from physical dissection of the carcase tissues.

Estimation of yield

As indicated above, an estimate of yield can be made from carcase fat thickness measurements. Measurements of eye muscle area can also be used in conjunction with fat thickness measurements to account for differences in carcase muscling.

In more recent years, video image analysis or VIASCAN has been developed and can be used for estimating the yield of carcases. VIASCAN is based on the analysis by computers of video images. There are two versions for the evaluation of beef carcases. The chiller assessment system is for use following ribbing of the carcase. A video image is taken of the surface exposed after quartering and the proportion of muscle and fat in the image is analysed by computer. This information is then used to provide an estimate of saleable yield.

A whole carcase or side system is also available for use on the slaughter chain. This system measures carcase dimensions, fat distribution, fat cover and colour and these measurements can be used to predict meat yield.

The more detailed nature of the measurements that are possible with VIASCAN (for example, whole cross section of the rib compared with single incision for fat measurement) and the capacity of the technology to perform calculations, results in improved accuracy of predictions of carcase composition and meat yields compared with simple carcase measurements. Combining the carcase and chiller assessment VIASCAN systems further improves the accuracy of predictions.

01178/03/04-1800-Key2Design

ISSN 0726-934X