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D J. Barker

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Beef marketing as a guide to production techniques

Until about a year ago beef was in strong demand. Almost anything was marketable at favourable prices and good profits could be made even if the production process was wasteful in some respects.

Now the tide has turned. The demand for beef is weak, prices are low and some types of beef are virtually unsaleable. Now more than ever it is important to look critically at the factors which affect beef quality and to seek ways of reducing waste in both feed used and end products marketed.

This article examines production and marketing of beef and points out some inadequacies in both.

Charolais x Brahman bulls in a Department of Agriculture crossbreeding experiment. Breeding can be used to improve milk supply, growth potential and ability to cope with stresses.
D. J. Barker,
Beef Research Officer,
Animal Production Branch

"Beef cattle" and "beef" are by no means synonymous terms, and "beef" itself covers a variety of commodities that are used for various purposes.

This article discusses the factors that affect the value of beef animals in relation to various end-uses, some of the effects of these factors upon cost of production, and the particular types of beef required by some of our major markets.

Beef animals for slaughter vary in merit according to two major features:

(a) The amount of "beef" they contain.
(b) The type or quality of beef they contain.

In this context "beef" means muscle tissue plus an amount of fat which depends on the end-use of the material.

AMOUNT OF BEEF PRODUCED PER ANIMAL

Factors which affect the amount and cost of "beef" produced per animal are

(a) The liveweight of the animal
About a third of a beef animal’s liveweight is muscle tissue. In very fat animals the proportion is decreased slightly, and leaner animals contain a higher proportion of meat.

Producing heavier animals involves either keeping them to a greater age, feeding or managing them better, breeding animals that will grow faster on the same feed supply, or some combination of these.

As an animal gets older and larger it tends to require an increasing quantity of feed to gain each increment in weight. However, in the single-suckling enterprise, the overhead feed requirement for maintaining the breeder is a high proportion of total feed required to produce a weaner. It can be spread over a greater weight of slaughter animal by killing the progeny at higher weights. Thus there may be little difference between the total weight of animal turned off per unit area of pasture by slaughtering the progeny at weaning compared with a year later. Older animals may be fatter, leaner, or the same composition as younger ones.

Feeding animals better improves growth and efficiency by reducing their overhead maintenance requirement, but may not be an economic proposition if the extra feed supplies are relatively costly. Better control of diseases such as internal parasites will only pay dividends if their presence is otherwise limiting performance. Animals which are heavier as a result of better feeding and management will always be fatter at the same age.

Breeding affects the slaughter animal’s weight at a given age in three main ways:

• By improving the milk supply of the calf whilst suckling its dam. In this case the effect is similar to that of other methods of improving feed supplies, and will only be realised if extra feed is available to the cow.

• By increasing the growth potential of the animal itself. In this case the appetite of the animal is also increased, and little or no improvement in growth and efficiency may result if the feed supply is not also improved. Even if feed supplies are non-limiting, animals of higher growth potential are usually leaner, though heavier, at the same age. They usually have to be carried to higher weights and ages to be of similar finish to earlier-maturing types. Retention of male animals as entire bulls has a similar effect.

• By conferring better inherent ability to cope with disease, climatic and feed quality stress factors. The effect is to improve the efficiency of utilisation of a given feed supply and thus produce animals that are heavier and fatter at a given age at the same feed cost.

The effect of heavier weight on carcass value is a contentious point.

Butchers usually pay less per kilogram for heavier carcasses, largely because they associate increasing carcass weight with increasing age, toughness and often fatness. But as outlined above, carcass weight alone is a poor indicator of these characteristics.

It is most unsatisfactory that better carcasses could suffer a price disadvantage because of such inadequacies in the marketing system.

(b) The composition of the animal
The animal after slaughter is first separated into carcass and other fractions, and the percentage that the carcass comprises is the dressing percentage.

Animals may show a high dressing percentage for a number of reasons:

1. A low degree of gut fill. If an animal is held in yards or transported over a considerable distance it loses liveweight in the form of dung and urine, without a corresponding loss in carcass weight for the first day or two. This liveweight loss is most rapid over the first 12 to 15 hours without feed and water and slows up greatly after that. The result is an apparent increase of about 2 to 4 per cent in dressing percentage, the greater increase being when the animals are off high-quality growing pasture diets and the lower increase when off poorer quality dry feeds.

2. The quality of the diet. Animals on very concentrated diets such as grains tend to have a lower weight of intestinal contents and thus have a higher dressing percentage than those on more bulky feeds such as pasture or hay.

3. The degree of fatness of the animal. Fatter animals tend to have a higher dressing percentage because most of the extra fat is deposited on or amongst the carcass tissues. Abattoirs are increasingly tending to remove surplus carcass fat at slaughter and this tends to reduce the dressing percentage of over-fat animals.

4. "Double-muscling". This tends to increase the dressing percentage, but can also be associated with difficult births, reduced stress tolerance, and reproductive failure, and should thus be avoided.

The dressing percentage of beef cattle normally ranges from 50 to 60 per cent at slaughter, but a higher dressing percentage does not invariably increase the value per
unit weight of the live animal, and may in fact reduce it if excess fat is present.

After chilling, the carcass is separated into the edible and inedible fractions. The edible fraction is the muscle plus an amount of fat which depends on the particular market requirement; the inedible fraction consists of bones, tendons and connective tissues, and surplus fat trim.

The proportion of edible material in the carcass is the retail yield percentage of the carcass. It may vary from under 60 to over 70 per cent.

The major cause of variation in retail yield is the degree of fatness of the carcass. A less significant cause of variation is ratio of muscle to bone.

Carcasses generally vary in fat content from about 10 per cent to over 30 per cent. Retail yield percentage is highest for most table beef markets at about 18 to 20 per cent carcass fat content and carcasses should thus be worth most at this fat content.

Increasing the fat content to about 30 per cent decreases the retail yield by about 10 per cent and should thus have a corresponding effect upon carcass value. It is a poor reflection on our marketing methods that carcasses of maximum retail yield fat content often command no better prices per kilogram than over-fat ones, and sometimes poorer prices are paid for them. This is even more a source of waste in the industry when one remembers that the surplus fat is a very expensive part of the animal to produce, and its removal is a difficult and labour-intensive operation, owing to the deposition of fat among the muscles in fatter carcasses.

An average carcass has a muscle:bone ratio of about 3.5:1. A very well-muscled animal would have a muscle:bone ratio of 4.5:1. Above this, double-muscled problems are present. However, the increase from 3.5:1 to 4.5:1 only increases retail yield by about 3 per cent. The characteristic is largely affected by breeding and selection. However, it cannot be accurately measured in the live animal, so should generally be given relatively low priority in selection aims.

Bulls after puberty tend to have higher muscle:bone ratios than steers, but the extra muscle is mainly present in the forequarter, that is, less valuable cuts.

Bruising can also affect retail yield by necessitating trimming. While handling in transit to slaughter can contribute to bruising, handling at the property of origin, temperament, and the presence of horns can also contribute significantly. The design of handling facilities, breeding and culling policy, management operations and the way they are carried out, can thus all affect final carcass value through their effect on retail yield.

**TYPE OR QUALITY OF BEEF PRODUCED**

The type, or quality, of the beef produced depends on factors which affect—

(a) The proportions of higher and lower priced cuts;
(b) Storage and keeping quality;
(c) Processing and eating quality.

(a) Proportion of higher and lower priced cuts

Research has conclusively shown that the muscles of different cattle generally vary little in their distribution. The few small variations from this rule are attributable to—

**Muscle weight:** As the muscles grow during the first few weeks of life their weight increases and their distribution changes. This process is complete by the time birth weight has doubled.

**Age and sex:** After puberty, bulls show a shift towards an increased proportion of muscle in the forequarter, especially the neck. This may occur to a slight extent in steers also. This effect is not seen at less than about one year old.

**Loss of weight:** When an animal loses muscle weight as a result of fairly severe under-nutrition, the least essential muscles tend to lose weight fastest. This has little commercial significance in table beef production since half-starved animals are not usually slaughtered.
Fatness: It has been suggested that over-fatness can slightly reduce the proportion of high priced cuts, but it is not clear whether this is purely an effect of fatness itself or the increased age and weight of fatter animals.

Carcass weight: Local butchers claim to be able to cut more high priced cuts (such as T-bones) from a smaller carcass (baby beef) than from a larger one. There is no scientific evidence in support of this claim, and it is difficult to find any reason why larger carcasses of the same sex, age and fat content should differ from smaller ones in this respect.

Conformation: In spite of the considerable differences in shape that can be observed between live animals there is little if any significant difference in muscle distribution. Most of the differences seen in live animals in fact reflect differences in muscle shape, muscle content, fat content and fat distribution. These have almost no effect on the proportion of high and low priced cuts in the carcass.

Double-muscling: This can improve the proportion of higher priced cuts, but is associated with the other disadvantages mentioned above.

On the whole, there appears to be little scope for improving real value by altering the relative quantities of higher and lower priced parts of the carcass, through either breeding or husbandry techniques.

(b) Storage and keeping quality
The main factor affecting storage and keeping quality is fatness, and it can have different effects at different levels of fatness.

Under-finished animals tend to “dry out” more on the surface of muscles not covered by the normal fat layer, and this tends to make the surface appear darker, tougher and less attractive to the butcher.

On the other hand, very over-finished animals cool more slowly than normal ones, and this can lead to “bone-taint” if the cooling conditions are not efficient. This condition is a bacterial spoilage in the deeper tissues, especially around the joints, and can result in serious loss.

(c) Eating and processing quality
In table beef production, fat content and tenderness are the two most important quality factors. Except in certain specialised markets, such as the Japanese luxury trade, an even skim of surface fat about 6 to 10 mm thick is plenty. Above this, too much fat becomes deposited between the muscles and consumers do not want this.

Tenderness is closely associated with age, younger animals being the tenderer. The meat becomes noticeably tougher after 1½ to 2 years of age, but not to a significant extent before this.

Fatness can influence tenderness, but mainly between very low and normal fat content. In animals of very low fat content the muscles are somewhat reduced in bulk; their connective tissue content is thus increased, making them tougher. Fattening above normal levels (18 to 20 per cent fat content, or 8 to 10 mm fat cover) does not further increase tenderness.

Growth rate can influence tenderness but mainly through its effect on fat content and age at slaughter, since better fed animals are usually

An attractive sight on the hoof—but how will they rate on the hook and what did they cost to produce?
fit for slaughter at a younger age. After slaughter (during chilling) the fat content further affects the tenderness of beef, since very lean carcasses cool too quickly for sufficient of the normal post-mortem tension to be developed in the muscles, which normally tenderises the beef at this stage.

Marbling is important on the Japanese luxury market, but few others. It is generally only attainable at high carcass fat content and thus incurs a heavy production cost.

It is not generally economic to attempt to induce marbling owing to the lack of sufficient price premium for marbled meat to justify the extra costs of its production.

Juiciness is less important than tenderness to consumers, and little is known about the causes of variation in juiciness at the production level.

Flavour is largely associated with the animal's diet and its sex. Dietary flavouring agents tend to be concentrated in the fatty tissue of the carcass, so fatter carcasses can be more strongly flavoured. However, this is by no means invariably so, since some diets, such as grains, can cause production of fat carcasses which have relatively little flavour. This is one reason why the Japanese luxury trade prefers lot-fed beef to pasture-fed beef, since at the same fatness beef off pasture is more strongly flavoured. Pasture-fed beef can vary widely in flavour, depending upon the type of plants eaten.

Entire male animals after sexual maturity develop a characteristic taste and odour which most consumers dislike in table beef. This is of little importance under 1½ to 2 years of age.

The colour of beef is often claimed to affect its attractiveness to consumers. Darker coloured beef is associated with the slaughter of entire male animals, unrested stressed animals and very lean carcasses as mentioned previously. Otherwise, colour is mainly affected by the storage conditions of the beef after slaughter. The degree of stress imposed on an animal before slaughter depends partly on its temperament, since animals of intractable temperament are subjected to more stress than quieter animals given the same treatment. Poor temperament can be a result of both the genetic make-up and the previous conditioning of the animals.

The colour and texture of fat can also affect the attractiveness of the carcass. Fat colour can be affected by the breeding, the diet and the health of the animal. Guernsey and Jersey cattle show the most yellow-coloured fat and crossbreds including a percentage of these types also tend to have yellower fat than other types of dairy and beef cattle. Animals fattened off green feed tend to have varying degrees of fat colour, with animals that are losing weight showing the most colour. Grain and hay fed animals tend to have whiter fat.

Animals affected by liver disorders can be jaundiced and thus show yellow-orange fat and muscle colour, but this is relatively uncommon. Firm to hard fat texture is preferred in the cold carcass, but soft fat is not a common problem in beef cattle. The diet of the animal can have a bearing on the texture of the fat, but cattle tend to convert most of their feed into the firmer types of fat.

The processing quality of beef for the manufacturing trade is considerably affected by the sex of the animal. Bull beef is preferred to steer and heifer beef since, after sexual maturity, it retains and absorbs moisture, which is an advantage in making smallgoods and hamburgers.

In summary, the factors having the greatest bearing on the amount and type of beef produced by a beef animal are:

- Carcass weight
- Sex
- Fat content
- Age

and these also strongly influence production costs.

They should thus be the major criteria used by buyers for determining the value of beef animals, and by producers for setting the aims of the breeding and husbandry methods to be used in production.

MARKET REQUIREMENTS FOR BEEF CARCASSES

Four main types of beef market can be identified:

- Local trade
- G.A.Q. export trade
- Fat chilled export trade
- Manufacturing beef trade.

Each of these has different preferences in terms of different combinations of the characteristics of beef discussed above.

Local trade preferences

The local trade is our biggest market and absorbs most of the production from the agricultural areas. It is also our highest-priced market, owing to the freight, handling and marketing costs of exporting and the relative purchasing power of local consumers.

At present the characteristics of the beef in demand on this market are light weight (less than 200 kg carcasses), moderate fat content (about 20 per cent), and tenderness.

In practice, the light weight is used by the buyer as an indication of tenderness, but this is a very fallible rule since poorly grown animals can be of adequate fatness but light weight at 2 to 2½ years of age and thus not of the required tenderness. Many perfectly suitable faster-grown and larger carcasses are excluded from this market in spite of appropriate fatness and age (less than 18 months).

To be of appropriate fatness at a light weight and young age, early-maturing types of animal are necessary under pasture production systems, especially if their mothers are of poor milking ability. The later maturing the type of animal bred, the higher the plane of nutrition necessary to finish it at light weight and young age.

Buyers tend to assess muscle content of the animal by live visual appraisal, which frequently leads them to prefer over-fat animals in the mistaken assumption that the nicely rounded outline of the animal is due to its muscularity. This further aggravates the producer's problem of "finishing" later-maturing types of animal. As we have seen, differences in muscularity contribute
relatively little to extra carcass yield in comparison with the effects of optimum fatness.

There are some signs of the lessening of this prejudice against heavier carcasses, since the upper weight limit for "baby beef" was less than 180 kg a few years ago. However, we cannot expect any major changes until the marketing system uses more realistic criteria for determining carcass merit for this trade.

G.A.Q. export trade preferences
The beef required on this trade carries a similar specification to that for the local trade, but with the important difference that light-weight carcasses are not wanted, the lower weight limit required being about 200 kg. In practice the age of the animals used for this trade is not closely checked, and many older and tougher carcasses no doubt find their way on to the market, which does not enhance our overseas reputation as producers of quality table beef.

This trade has not yet been of great importance to us, since we have not produced large export surpluses from the agricultural areas. If output from the agricultural areas is increased to any extent, or if a shift in local trade preference occurs, this is the type of material for which demand will most probably increase. Abattoir costs per kilogram are also reduced at higher carcass weight, since heavier carcasses cost little more per head to slaughter than lighter ones.

Breeding has an influence on the suitability of animals for this trade, since if they are to be of adequate weight at a young age, but without excessive fat cover, they must be of a somewhat later-maturing type than those which will be of the same fat cover at a lighter weight for the local trade. However, if excessively late-maturing types are used, there could be considerable difficulty in achieving the ideal fat cover off pasture, especially in lower rainfall areas, at the ideal age.

Costs of production per kilogram of this type of beef tend to be a little lower than for light-weight local trade beef, owing to the spreading of the overhead costs of maintaining each breeding cow over more kilograms of beef production, and the relatively trouble-free nature of the production phase after weaning.

Fat chilled export trade preferences
The fat chilled export trade is a specialised market oriented exclu-

There is a need for the meat industry to adopt routine objective assessment of carcass merit, much as is done in agricultural show trade cattle classes. These competitions provide perhaps the most critical assessment now received by beef carcasses.
sively to the Japanese luxury beef consumer. The specification required is tenderness, heavy weight (more than 225 kg carcass), of high fat content (22 to 25 per cent), with white fat, marbled flesh and a bland flavour.

Fairly early-maturing types of cattle are best suited to the production of this combination of characters, but very high planes of nutrition are necessary to induce the required fatness and weight by a suitable age. To induce the most desirable fat colour cereal grains must be fed as a large proportion of the diet.

Older animals are more easily fattened for this trade, but the effect of this on toughness is adverse, and should be avoided.

Costs of production are very high for this category of beef because of the expensive types of diet necessary and the inefficiency of conversion into the heavy-weight and high fat content carcasses required. A considerable price premium over other types of beef is essential to justify production for this market, and prospective producers should ensure that suitable sale prices are negotiated before investing cash in such a venture.

This type of beef comprises a relatively low proportion of the total Japanese market, and future expansion possibilities must be considered doubtful in relation to the more likely increase in demand for cheaper G.A.Q. export beef on this market.

**Manufacturing beef preferences**

Specifications for beef on this market are essentially heavy weight, low fat content and no particular requirement for tenderness. Mature bull beef is particularly suitable, as noted previously.

This type of beef is relatively inexpensive to produce, but needs the use of later-maturing genotypes of cattle to effect a satisfactory combination of high weight and low fat content. The lack of requirement for tenderness means that suitable animals can be produced off relatively poor feed supplies, by keeping the growing animal to a greater age than for the other types of beef.

This type of production has in fact suited the pastoral areas very well for the past 15 years or so, with the U.S.A. hamburger trade as our largest market outlet. This outlet has also been a very useful market for cull breeding and dairy stock. Some price discrimination against excessively fat cows has been apparent at local sales, but many over-fat animals have also fetched prices per kilogram comparable with those in less fat, and thus more suitable condition for this trade.

Future prospects for this type of production are doubtful because it is vulnerable to competition from artificial meats. However, most forecasts have suggested that artificial meats will tend to fill the gap between world supply and demand, and thus be used to supplement manufacturing beef production rather than replace it.

Because of its lower production costs it is economic to produce manufacturing beef when its sale price is slightly lower than that of G.A.Q. beef.

**MARKETING AS A GUIDE IN BEEF PRODUCTION IN W.A.**

Beef for the local trade passes through a chain of individuals, consisting at least of producer-wholesaler-retailer-consumer. On the export trade further links are added to this chain.

In either case, if communication from link to link is faulty the goods produced may not economically match the requirements of the consumer. This can have two important consequences:

(a) the consumer becomes dissatisfied with the goods, which is reflected in lower future demand, and

(b) the producer incurs unnecessary costs and thus waste or a reduction in returns.

I suggest that our present beef marketing system *does* include considerable waste, and that this arises from two basic causes:

- **The lack of use of realistic criteria for determining the merit of different carcasses for different purposes.**
  
  Most buyers classify animals into basically sex and weight categories, but these criteria alone are quite inadequate to define the value of a carcass, and as applied can result in highly unrealistic assessments of the merit of different carcasses. The buyer's use of an "averaging" system to assess retail yield and quality (other than in cases of gross deviations from the average) results in a failure to provide incentive payments for carcasses of high value.

- **The misapplication of certain criteria as indices of carcass value.**
  
  The techniques of visual appraisal usually employed tend to over-value over-fat animals, owing to a failure to differentiate muscle tissue from fat in the live animal. The use of carcass weight as a major determinant of carcass value discriminates against the faster-grown young animal, quite unnecessarily. Even at the carcass stage over-fat animals are frequently over-valued compared to those of optimum fat content, suggesting a failure to recognise the importance of fat content in determining the yield percentage, and thus value, of a carcass.

There is therefore a real need for better techniques of carcass classification to be employed in the processing industry, and that without these there is little prospect of an adequate price premium for better-yielding animals. The Australian Meat Board is intensively investigating the application of such criteria in abattoirs, but the move is not attracting much enthusiasm from processors.

If such a process were implemented and the results used to set prices, this would positively encourage the production of better quality carcasses, with minimum waste of either feed or end-product and maximum satisfaction to the end-user.