INDUSTRY BENEFITS FROM OUTCOMES OF THE CATTLE AND BEEF CRC

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SUMMARY
Outcomes of research in the CRC for the Cattle and Beef Industry are relevant to the beef industry's agenda to guarantee eating quality of beef for consumers. Results highlight the importance of electrical stimulation and ageing on beef tenderness. There is significant genetic variation in retail beef yield in seven Australian breeds participating in the CRC progeny test. Grain finishing significantly enhances tenderness, but this effect is independent of intramuscular fat percentage. Grain feeding significantly improves marbling, but only in Korean- and Japanese-weight carcases.

Keywords: Meat quality, electrical stimulation, tenderness.

INTRODUCTION
The CRC for the Cattle and Beef industry was formed in July 1993 to carry out research on meat quality to enhance the domestic and international competitiveness of the Australian beef industry. Its funding comes from the Commonwealth Government Cooperative Research Centres Program which now funds 61 CRCs in various sectors. Over the seven-year life of this CRC we will deploy some $20 million in Commonwealth funds plus matching funding from the CRC's four Core Parties: Queensland Department of Primary Industries, NSW Agriculture, CSIRO and the University of New England. We also have significant cattle industry support and funding from the private sector. The CRC research thus complements research funded by the Meat Research Corporation using cattle industry levy funds. The Cattle and Beef CRC is run by an industry-driven Board, comprising cattle breeders, feedlot representatives, meat processors and exporters. About half our resources are devoted to temperate zone and half to northern cattle industry issues. Although the work is confined to eastern Australia almost all CRC research outcomes in the areas of Meat Science, Genetics, Growth and Nutrition, Health and Welfare (vaccines) will have potential relevance to all Australian beef industry regions.

MEETING MARKET SPECIFICATIONS
The CRC strategy is quite simple. We wish to identify what our beef consumers (or customers) want and then set about consistently meeting these requirements at least cost and maximum profit for every sector of the chain. Whether the customer is a beef consumer in Perth, Brisbane, Darwin, Sydney or Tokyo, or a live cattle importer in Indonesia, there will be strict specifications as to what they require. As part of the overall industry effort involved in this challenge the CRC has initiated a suite of research strategies to assist in achieving the goal of meeting these market specifications more consistently. Our research targets the different sectors shown in Figure 1.
THE CONSUMER

Fundamental to the challenge of meeting market requirements is knowing what the consumer wants. This knowledge is paramount if we are to maintain or capture more of the consumer's dollar spent on meat. Of the available consumer data, two things are clear: with the exception of price, the total amount of fat present is one of the most important traits governing pre-purchase preferences whilst tenderness is the most important post-purchase quality issue. This was recently reinforced in consumer surveys commissioned by the Meat Research Corporation in 1994. In these surveys the proportion of fat present in fresh beef accounted for 99% and 35% of the consumer pre-purchase preferences in Australia and Japan, respectively. The important distinction to note here is that whilst Japanese consumers preferred beef that was marbled (AUS-MEAT marble scores to 4), they still preferred meat which was virtually devoid of any external fat. Tenderness was shown to account for 70 to 80% overall acceptability of cooked beef regardless of whether it was being consumed in households in Tokyo or Sydney.

Having defined what the consumer wants, these requirements must be converted into product specifications which are transportable across the marketing chain, meaningful to all sectors within it and most importantly, measurable at any stage. Good progress has been made in the development and implementation of specifications for fatness. However, the same cannot be said for tenderness. Specifically, we lack reliable and practical tools for the measurement of tenderness. While objective measurement of tenderness of meat samples is reasonably reliable (for example, shear force accounting for about 40 to 50% of sensory tenderness, shear force (Index) may account for 70 to 80% of tenderness), the real need is for a technique that can predict tenderness on either the carcase or the live animal. The failure of the TENDERTEC probe is a disappointment for the whole industry. With respect to beef in the restaurant sector, tenderness is still paramount. However, failure to deliver the steak to the ordered degree of
doneness (that is, rare, medium and well done) was recently highlighted as a major source for dissatisfaction in a Meat Research Corporation study. In this study, one in three consumers believed their steaks were not delivered as per their order in terms of doneness. As a result, the CRC has commenced investigations into understanding what regulates the colour change in beef during cooking and to use this knowledge to develop new ways of cooking beef to ensure the right degree of doneness.

PROCESSING SECTOR

Accurate product description. The yield of saleable beef is a primary factor governing carcase value. Yield is largely determined by the fatness of the carcase and, to that end, we have relied on measurements such as fat depth and carcase weight to predict yield. However, Video Image Analysis or VIASCAN®, as it is now known, offers a new, more accurate alternative to the current combination of carcase measurements. The CRC is working closely with the Meat Research Corporation in the validation of VIASCAN®. The results to date are extremely encouraging as they continue to show that VIASCAN® can predict yield more accurately than the combination of carcase weight and P8 fat depth. Moreover, it achieves this accuracy automatically on the slaughter-floor and therefore offers additional benefits in terms of labour savings. Ultimately, the technology will enhance the implementation of value-based marketing of cattle.

Optimizing processing technologies to maximize product quality. Tenderness can be influenced by an animal’s genetic and nutritional history, as well as pre-slaughter stress, and the conditions which apply to an animal’s carcase within the first 24 hours after slaughter are critical. The results of a recent CRC study help to put this into proper perspective. In this study the relative effects of Bos indicus content (0, 25, 50, 75 and 100%) versus the post-slaughter treatments of electrical stimulation and ageing on tenderness as assessed by 960 consumers were examined. Of the total variation explained in consumer tenderness scores, electrical stimulation accounted for 50 to 60%, ageing accounted for 35 to 40%, and percentage Bos indicus content accounted for less than 5%.

The procedures involved and results are shown in more detail in Figure 2.

![Figure 2. Tenderness results for cattle from 0 to 100% Brahman content.](image-url)
Results as dramatic as these are not new. However, the uptake and utilization of effective electrical stimulation and ageing for domestic beef has not been widespread.

**PRODUCTION SECTOR**

**Straight-breeding project.** The objective is to provide industry with the knowledge and techniques to select cattle whose offspring will meet market specifications and be profitable for all parts of the beef production chain.

To provide the knowledge needed there are a number of questions which we are working to answer.

- How much genetic variation is present for meat quality traits and feed conversion efficiency?
- How can you select to improve these traits while still maintaining or improving the fertility, growth rate and adaptability of the breeding herd?
- Do sires rank in the same order whether their offspring are finished at pasture or in feedlots, in northern or southern Australia, to light or heavy weights?

Seven breeds are involved - Brahman, Santa Gertrudis, Belmont Red, Shorthorn, Hereford, Angus and Murray Grey. Over 45 cooperating breeders, scattered throughout eastern Australia, breed calves of known pedigree. The CRC buys these calves at weaning and grows them out at “Duckponds” or at research stations in southern Australia. For finishing the cattle are split between pasture and feedlot finishing. They are slaughtered at either a light (domestic), medium (Korean) or heavy (Japanese) weight endpoint. Of the northern-bred cattle, some stay in the north, but some go to grow-out and finishing in the south. This complicated design is necessary to answer the question about the ranking of sires under different environments and for different markets.

**Crossbreeding project.** The CRC’s crossbreeding program is based on about 700 high-grade Brahman cows, most of which were generously donated by individual producers and the major northern pastoral companies. These cows were transported to the CRC’s leased property, “Duckponds”, for the first joinings in 1994/95. A further 300 females have been provided by the Queensland Department of Primary Industries for the program, initially at Toorak Research Station, Julia Creek. These cows have subsequently been transferred to Brigalow Research Station, Theodore.

The Brahman cows have been joined to bulls of nine breeds representing:

- *Bos indicus* (Brahman)
- *Bos indicus* x British and European derived (Santa Gertrudis, Charbray);
- Sanga x British derived (Belmont Red);
- British (Angus, Hereford, Shorthorn);
- European (Charolais, Limousin).

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RESULTS FOR CARCASE TRAITS

Other papers in this AAABG conference report the latest results from the CRC breeding projects. In all breeds studied, there is significant genetic variation in retail yield, adjusted to a common carcase weight. Subcutaneous fat trim, also highly heritable, does not explain the differences in retail yield. Based on progeny slaughtered so far, the estimates of heritability for shear force and intramuscular fat percentage are not significant (see Ferguson et al., these Proceedings).

Shear force, objective tenderness measure. Shear force is the maximum force (kg) required to shear through a piece of cooked beef. Before discussing the results, it is pertinent to place the relationship between shear force measurements and consumer tenderness scores into perspective. Shear forces below 5 kg are considered to be tender by consumers.

Genetic variation in shear force. Although overall there is little genetic variation in tenderness amongst CRC progeny so far, for the striploin, the differences between the Santa Gertrudis and Belmont Red sires were significant. The difference between the sires was 1.2 kg. The progeny of all sires were acceptably tender, with shear forces less than 5.

The effect of grain versus grass finishing. Progeny of each sire are finished on grass or grain. The results show a small, but statistically significant, difference in striploin shear force values between grain- and grass-finished animals for both Bos taurus, Santa Gertrudis and Belmont Red groups. The magnitude of the effect within each market category is shown in Figure 3. The interesting aspect of this result is that it is not age related as the analysis was adjusted for slaughter age. Typically, we would expect that older cattle would be less tender due to the increased contribution from connective tissue. The data were adjusted for slaughter age because the feedlot-finished steers reached their market weight at a younger age than their pasture-finished half-brothers. Similarly, we tested whether the difference might be ascribed to the contribution of marbling which will obviously be higher in feedlot finished cattle. After adjusting the data to the same intramuscular fat percentage, the difference still remained. This means grain finishing influences tenderness of the striploin by a mechanism as yet unexplained. The tenderness advantage of the grain-finished steers, although small, might still be related to their faster growth rates which, in turn, may express an effect through increased protein turnover within muscle.

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Figure 3. Shear force measures of striploin show a small, but significant, difference in tenderness in favour of grain finishing.

INTRAMUSCULAR FAT PERCENTAGE (MARBLING)
Grain finishing had little effect on intramuscular fat percentage of domestic weight carcases, but had the expected effect in the Korean and Japanese carcases (Figure 4). This area of CRC research will be most interesting as it unfolds.

Results already presented indicate intramuscular fat percentage of the striploin in CRC cattle varying from 0.5 to 13.3%. The heritability estimate (0.41) is not significant at this stage because of large environmental variation.

Figure 4. Percentage fat.

CONCLUSION
The CRC has already achieved significant outcomes for industry. Sire information will soon be released for retail beef yield, fat trim and tenderness (in Santa Gertrudis and Belmont Red breeds). Gene markers and candidate genes associated with carcase traits have been identified. Non-genetic strategies to
manipulate growth carcase fatness and yield have been described and adopted by industry. New insight into the effects of grain feeding on tenderness, independent of marbling, have been exposed. Two new vaccines against bovine respiratory disease have resulted from CRC research. These are to be commercialized by Australian companies in 1997, to improve the profitability of the feedlot sector. New technology to measure net feed conversion efficiency of feedlot cattle has been developed and is ready for commercial release.

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