

Overview of CRC Research for the Feedlot Industry

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Introduction

The CRC for Cattle and Beef Quality has been committed to feedlot-related research since 1993. The Australian Lot Feeders' Association played a significant role in formulating the original CRC proposal. This was at a time when the feedlot sector was expanding to take advantage of deregulation of the Japanese market as well as increased demand for grain-fed beef in Australia.

The CRC initiative (in 1991) was based on a Meat Research Corporation proposal called "*Breeding Directions for Grain- and Grass-fed Cattle*" developed in 1990 by Bernie Bindon, Keith Hammond, John Thompson and Alex McDonald. The project did not gain MRC support, primarily because the \$12 million budget was beyond the MRC budget at the time. However, the Project was fundamental to the emerging issues in the beef industry at the time and was re-worked for our successful CRC application in 1992. The comprehensive progeny test project, to identify cattle best suited to grain and grass finishing, became the centrepiece of the CRC portfolio between 1992 and 1999. The CRC's most important achievements are derived from this activity.

At the CRC/ALFA Seminar in Toowoomba on 27 June 2002, experts from the CRC network will present feedlot-related outcomes from research covering:

- Genetic improvement of meat quality.
- Growth, nutrition and feed efficiency.
- Ultrasound scanning to predict marbling.

The outcomes from these areas are not the only achievements from the CRC's investment, but they are areas that have significant potential for "*Making Profit from Feedlot Research*", the focus of today's Seminar. The purpose of this paper is to provide an overview of these CRC achievements.

Research Achievements

Genetic Improvement of Meat Quality

The CRC invested more than \$32 million in the progeny test program based on four temperate cattle breeds and three tropically adapted beef breeds. The CRC has now released definitive genetic information on:

- Heritability estimates of tenderness, marbling and Retail Beef Yield (RBY%).
- Genetic associations (correlations) between all major growth and meat quality traits.
- Genetic correlations between grain- and grass-finished performance for all the above traits.
- Genetic correlations between tropical- and temperate-finishing environments.
- Genetic associations between the three market sectors: Domestic, Korean and Japanese specifications.
- Genetic merit (EBVs) of some 600 individual sires for each of the traits examined. (This information has been released to industry via BREEDPLAN).
- These estimates provide a blueprint for genetic improvement of carcase and meat quality in Australian beef herds.
- Direct and Linked Gene Markers for Tenderness, Marbling and Net Feed Efficiency and Retail Beef Yield. These markers have not yet been commercialised but two products (Tenderness I and II) have been patented and prepared for commercial release. These will be taken to market by a consortium involving CRC/CSIRO and MLA, already responsible for the successful GeneStar Marbling test.

Growth, Nutrition and Feed Efficiency

Nutritional Manipulation of Marbling

At the start of the CRC in 1992 we were confident that there were opportunities to use nutritional manipulation to increase the proportion of cattle achieving marble scores 4 and 5 in long-fed programs aimed at the Japanese export markets. CRC scientists at this Seminar will describe the effects of different grains and grain treatments (e.g. steam-flaking, dry rolling), diets with high protein; low protein; protected lipid; protected



protein; added oil, with and without calcium; diets deficient in vitamin A. These studies add to our understanding of the marbling phenomenon but fall short of enabling feedlot operators to consistently achieve marbling performance in cattle of diverse breeds and genotypes.

The CRC has been successful in quantifying the effects of grain versus grass finishing in the seven breeds in the CRC's progeny test. These included cattle fed for the Domestic, Korean and Japanese export markets. A feature of the CRC work is that we have both marble score and intramuscular fat percentage (IMF%) measurement in the *L.dorsi* muscle (striploin) of some 8000 carcasses.

Growth path effects on carcase and meat quality

The CRC's progeny test, described elsewhere in the Seminar provided an extraordinary opportunity to follow the growth and development of 8000 pedigree cattle from seven breeds, finished on grain or grass for three markets. Their growth was closely monitored and we have comprehensive measurements of carcase composition and meat quality. The results should lead to conclusions about whether periods of extreme weight loss or weight gain have any serious impact on ultimate carcase composition or eating quality of the cattle breeds investigated.

Genetic and Non-genetic effects on feed efficiency

A highlight of CRC activities has been the study of genetic variation in Net Feed Intake (NFI), studied jointly with MLA and NSW Agriculture. This could now be regarded as "mature" science, with significant industry acceptance and commercial adoption. The feedlot sector should be a major beneficiary of this work when there are sufficient progeny of high NFI sires available to make an impact on profitability. Of special significance are the CRC results showing the genetic associations (correlations) between NFI and the other traits of importance (e.g. growth, fatness, marbling, RBV%, tenderness) which allow a balanced approach to genetic improvement of NFI.

By contrast, the CRC results probably contain useful information about non-genetic effects on NFI which have not yet been captured. This might include effects of age, sex and time of year.

Acidosis

The CRC has had a special interest in acidosis of grain-fed cattle since 1993. We began in a partnership with UNE with a patent based on immunising cattle against the micro-organisms in the rumen that produce lactic acid. Early experiments confirmed that immunisation could produce protective levels of antibody against the rumen organisms, which led to reduced lactic acid

production in cattle fed high grain diets. Our initial expectation was that a vaccine based on this principle would protect cattle against sub-clinical acidosis for up to 120 days.

The next phase of the work was carried out by UNE, in collaboration with a commercial vaccine manufacturer. Unfortunately the commercial emphasis concentrated on a vaccine to protect against *acute* acidosis experienced when naïve cattle suddenly ingest large quantities of starch in grain diets. It was perceived that commercially successful acidosis vaccine would protect cattle against this condition, even though it rarely occurs in well managed feedlots.

In 1991 the CRC again invested ALFA funds to pursue this *acute* acidosis vaccine in one final experiment. The vaccine did not protect against an extreme grain feeding challenge. The commercial partner withdrew support.

The irony is that the acidosis vaccine is still an attractive proposition for controlling *sub-clinical* acidosis in feedlot cattle adapted to high-grain diets. Commercial reality probably dictates that the technique will not reach the market place.

"Pre-boosting", Respiratory Disease vaccines and minimisation of stress in feedlot cattle

"Pre-boosting" and Yard weaning

NSW Agriculture's Dr Lloyd Fell was responsible for these most interesting studies funded by MLA and the CRC. They were designed to carry out *best-practice* management strategies at weaning aimed at preparing cattle for feedlot entry some months later. These experiments provide a new understanding of the merits of minimising the stress normally associated with paddock weaning. 'Yard weaning' (five to seven days hand feeding of weaned cattle in yards with or without handling, training and vaccination against respiratory disease) is now widely adopted by producers preparing young cattle for ultimate sale to a feedlot. In some areas (e.g. New England) it is regarded as an essential "backgrounding" specification by agents acting for large feedlots.

Bovine Respiratory Disease Vaccines

The CRC has been responsible for two (killed) vaccines directed at the Bovine Respiratory Disease (BRD) syndrome. The first is directed against *Pastuerella hemolytica*, a bacterium that pre-disposes to BRD commonly seen in the first 30 days after feedlot entry. This efficacious vaccine has been commercialised by Intervet. The product is being marketed to registered feedlot veterinarians on a pre-registration arrangement. The Registration process is said to be complete.

A second vaccine is directed at Pestivirus, a causative agent of Mucosal Disease or Bovine

Virus Diarrhoea (BVD), which causes infertility and evidently predisposes to BRD in feedlot cattle. This product has been commercialised by CSL Pty Ltd and has been marketed ("*Pestigard*") on a pre-registration basis prior to completion of registration by the National Registration Authority (NRA).

The vaccines should receive widespread adoption by the feedlot sector, to prevent sickness and loss of performance by feedlot cattle. Until now there has been only one vaccine (against Infectious Bovine Rhinotracheitis (IBR)) available to combat the BRD syndrome.

Feedlot Waste Management

Environmental Monitoring Database

A significant achievement of the CRC has been to complete a project called "*Defining the Nutrient and Salt Cycles of Feedlots and their Waste Utilisation Areas*". This was achieved from a zero base at the CRC's "Tullimba" Feedlot. This was a unique opportunity to track all nutrients from records of all inputs (cattle, feed, water) and outputs (cattle turned off, forage produced, manure and effluent applied to soil). The database produced is one of the most complete ever produced from an Australian Feedlot. This will be invaluable for a regulatory point of view, as it allows guidelines (for feedlot development and licensing) to be based on actual data rather than data simulated from other agricultural (cropping) enterprises, sometimes from overseas.

The results have a bearing on the responsible and sustainable development of the Australian Feedlot sector.

Waste utilisation

Sustainable feedlots depend on re-use of effluent and manure as fertiliser for cropping on the feedlot site. The CRC studies have quantified the crop yield response to manure and effluent application and compared this to the response to inorganic fertiliser on the same soils. Important conclusions are that certain crops (e.g. forage sorghum) are capable of "harvesting" significant amounts of Nitrogen, Phosphorus, Potassium and Sulphur from manure applications of up to 60 tonnes per hectare. Continued manure application to soils of low fertility cause an increase in soil organic matter (expressed as soil carbon) which increases the ability of the soil to "bind" nutrients from feedlot waste. This in turn leads to increased crop yields, capable of increased re-use of the nutrients in waste material.

Tenderness and Eating Quality of Grain-fed Beef

Tenderness

The design of the CRC's Progeny Test provided for a direct contrast between the progeny of each sire, half finished on grain and half on grass. Across more than 8000 progeny, from 7 breeds, grain fed cattle had higher marbling and were consistently more tender than their grass finished half-sibs. The effect was consistent for cattle of domestic, Korean and Japanese carcass weights. Interestingly, the increased tenderness of grain fed cattle could not be explained by their higher levels of marbling. There must be other, subtle effects of grain feeding that contribute to tenderness.

Marbling and eating quality of beef

The CRC/ALFA Seminar will deal with comprehensive studies of marbling and its links to eating quality. A significant opportunity arises from the CRC's involvement in the MSA-Grading Scheme, in which 4300 carcasses from the CRC Progeny Test were subjected to full MSA Taste Panel evaluation, leading to the MSA-MQ4 "score" for eating quality.

Australian consumers confirm that for MSA "3 star" graded product, there appears to be little influence of marbling on their assessment of eating quality. As we progress to MSA "4 star" and MSA "5 star" graded product marbling score has a significant effect on the "Flavour" and "Juiciness" components of the MQ4 score.

From a genetic improvement point of view marbling is now more important. CRC analyses show that marbling, measured as IMF% has a positive genetic correlation with MSA-MQ4 score. In fact IMF% is positively correlated with MSA-flavour score, MSA-juiciness score and MSA-tenderness score. In practical terms this means that even if cattle breeders have no direct interest in marbling (e.g. they may believe marbling is unrelated to beef eating quality) they should still consider marbling in their breeding objective, because of its powerful genetic influence on beef eating quality. This applies to temperate and tropically adapted cattle, but the effect is more pronounced in temperate breeds.

Conclusion

The CRC for Cattle and Beef Quality is grateful for the support of the Australian Lot Feeders Association since 1992. A new set of feedlot-related projects are now underway in the new CRC Program and these will add additional strategies to maintain the competitiveness of the Australian Feedlot sector.

The brief overview in this paper confirms that CRC research has led to both genetic and non-genetic strategies to enhance the performance of feedlot cattle. Many of the areas covered will be dealt with in detail by experts of the Seminar.

The panel of technologies developed by the CRC will help achieve the following:

- Breeding better cattle. Quantitative and molecular genetic results and progeny test information will help the industry to breed cattle that have the tenderness, RBY%, marbling and eating quality to meet premium markets for grain fed beef.
- Feeding cattle better. Nutritional information and growth path knowledge, together with genetic improvement of NFI will mean a higher proportion of feedlot cattle meet the carcass and meat quality specifications at least cost.
- Maintaining healthier feedlot cattle. “Pre-boosting” and the use of CRC vaccines against respiratory disease will mean less sickness, reduced antibiotic usage, increased growth rates and efficiency leading to more profit.
- Sustaining the feedlot environment. Better understanding of nutrient cycling and waste utilisation will mean more informed regulatory guidelines and a sustainable feedlot sector.
- Expanded markets for grain fed beef. The CRC’s results dealing with tenderness and marbling of grain-fed beef provide a solid basis for expanded consumer preference for feedlot beef in the domestic and export markets.

Acknowledgements

The CRC gratefully acknowledges the financial support of the Commonwealth CRC’s Program, the Australian Lot Feeders’ Association and Meat and Livestock Australia.

