The impact of science developed in the Beef CRCs on feeding and management practices in the Australian beef industry

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Introduction

The outcomes of studies conducted in this field by the two beef CRC's (CRC for Cattle and Beef Industry and CRC for Cattle and Beef Quality) have added substantial value in the area of improved feeding and management practices. In particular the CRC's have contributed through improved understanding and practice in four key areas:

1. past nutrition and management on subsequent performance of beef cattle,
2. role and applicability of hormonal growth promotants (HGP's),
3. composition of feedlot diets and their ability to affect marbling, and,
4. screening animals for IGF-1 as a preliminary estimate of net feed intake.

In addition, opportunities developed in the area of probiotic control of acidosis in feedlot cattle are currently being tested by industry.

The overall impact has been to accelerate a beef industry trend that has resulted in further reduction in age of turnoff, and an increase in carcass weight.

Past nutrition and management on subsequent performance of beef cattle

The profitability of beef production systems is affected by numerous factors such as management constraints, production costs, return on product and is greatly affected by the type of enterprise. Genetic potential sets boundary conditions for production and quality (carcass and eating) and value traits, and is a significant contributor to adaptation across widely varying production systems. However, it is the signals that flow from the retail / consumer level, albeit imperfectly, that set the value of the product. Thus, the impact of actions taken in the production system that impact on cost and productivity, and upon which the producer depends for his/her livelihood, need also to be considered in terms of subsequent affects on product quality, and in the longer term on market sustainability.

This conference features a number of separate contributions that address these issues from a production systems perspective (Greenwood et al 2006, McKeirnan et al 2006). The focus on beef quality that was taken early on in the life of the CRC addressed genetic and non-genetic effects on eating quality as well as the quality of carcass traits and efficiency (cost and reliability) of production. This dual focus contributed greatly to the success of the MSA scheme leading to improvement in domestic demand for beef on one hand, and to the improvement in industry productivity on the other.

Technical aspects of feeding and management were initially addressed as overlays to the core breeding program. Early results from the CRC1 core breeding study indicated that growth rate post weaning and before feedlot entry affected growth rate in the feedlot and subsequent yield and marbling as assessed by IMF% (Robinson et al 2001). In summary, these effects were :

- slow growth prior to feedlot entry was usually associated with faster growth in the feedlot, but
- animals with slow growth prior to the feedlot, did not catch up, even if they grew faster in the feedlot
- marbling (IMF%) was reduced by slow growth prior to the feedlot phase.

There were a number of cases where slower growth post weaning and pre-feedlot was associated with increased sub-cutaneous fatness (and decreased marbling) in progeny: these were predominantly associated with northern bred animals and feedlot finishing in northern Australia. It was difficult to determine if the change in fat distribution was due to different diets, environments or due to effects of poor post weaning growth leading to stunting. Modelling of body composition (J.W. Oltjen, pers comm) suggested that stunting could account for the observed changes in fatness in these northern born animals.

Of course, growth can be less than optimal prior to weaning, and the CRC initially did not address this. In 1994, the CRC conducted a workshop that brought together all the information to that time(see Hennessy et al 1997). Outcomes from that workshop suggested that low weight at weaning (less than 200 kg for normal weaner age of 8-9 months) impaired subsequent growth of animals and reduced the capacity of affected weaners to undergo compensatory growth. These observations (based on more than a decades work at the Grafton Agricultural Research Station, and elsewhere) led to a number of more intensive studies of the effects of early life nutrition on subsequent performance and quality of cattle (Hennessy et al 2000; Greenwood et al 2006). Although this work is still being completed, there are a number of outcomes that are clear, the most important of which is that poor growth, in-utero or before weaning, resulted in overall slower growth of cattle thereafter (confirmation of the older work at Grafton). The anticipated outcomes of increased fatness of animals subjected to poor in-utero or early life growth did not eventuate, nor were there any adverse effects on eating quality of the animals at ~380 kg carcass weight (Greenwood et al 2006).

Overall, the take home message from the CRC 1 core breeding study (apart from the wealth of information on genetic parameters) was that although the pattern of growth post weaning did impact growth in the feedlot, fatness and marbling, the effects were in general small. Results from the work in CRC1 and 2 on pre weaning nutrition supported the idea that poor growth in early life impacted growth potential, but did not have effects on body composition or eating quality. Early results from the regional combinations project of CRC2 support these conclusions. In that yet to be completed work ,(see McKeirnan et al 2006), a whole of lifetime study of genetics, time of calving and growth path effects on ability to achieve market specifications and the economics of different management options has been conducted. Early results support the differences due to sire and dam type anticipated from EBV's, and show a significant saving in feed cost with shift to winter calving in the West Australian environment. However, it is too early to tell if the economics of different pattern of growth differ in different environments. One would think they would, and that when feed costs are taken into account, that faster growth to achieve feedlot entry point is less risky from a product quality standpoint as well as from an economic perspective.

In terms of impact on industry, there is an industry wide trend to growing cattle better to market targets, followed by finishing in a feedlot or on better pastures. Between 1995 and 2005 there has been a (9%) increase in average carcass weight (from 244 to 270 kg), with 3.9% more cows and heifers less than a year of age in the national herd (from 48.7 to 52.7%). These suggest that overall finished cattle growth rate has increased by more than 10% over the past decade, despite two significant droughts in that period. No doubt some of this is due to the structural change from pasture to feedlot finishing, but a substantial additional component is better management and feeding of cattle. Many of the outcomes of work from the CRC Growth and Nutrition program have been incorporated into industry training courses, most recently into modules in More Beef from Pastures. This MLA initiated best-practice manual and associated producer lead program had direct involvement from over 4000 southern beef producers in its first year of operation.

CRC research into use of Hormonal Growth Promotants in northern Australia

Producers use Hormonal Growth Promotants (HGPs) to enhance growth rate on both pasture and feedlot finished animals. Typically HGPs produce about 20kg of extra liveweight over 100-150d of payout (provided sufficient feed is available). HGPs are cost effective, in that the direct cost of mustering and implantation is typically less than a third of the returns from increased liveweight gain (changes in carrying capacity from younger age of turnoff, which is a big reason to use HGPs in the north are an additional benefit). The CRC was involved in work to optimize use of HGPs in Northern Australia. Hunter et al (2001) demonstrated sustained gains of ~30kg p.a. with sustained application of oestradiol-17β implants.

One of the side effects of the more sustained treatment with oestradiol-17β and in particular the more aggressive HGP treatments (particularly those containing Trenbalone acetate) was a trend to increased toughness, and reduced marbling score. As MSA became more widely used, and the adverse effects on meat quality of HGPs became clearer an adjustment factor for use of HGPs that differs for different muscle types was included in the model (Thompson et al 2006). Although processors have options such as tenderstretch and / or extended aging to offset the negative impact of HGPs on tenderness, it more difficult for producers to find alternatives to the growth promoting effects of HGPs in the short term. However, in the medium to long term use of progeny from bulls with high EBV for growth, or from a terminal cross, should be considered, particularly if management practices to increase feed supply are also put in place. One avenue not yet explored, and that may

hold some promise, is to determine if the variation in tenderness ascribed to the favourable alleles for Calpastatin and Calpain (sold as GeneStar Tenderness) can offset the unfavourable effects of HGP's on tenderness.

Diets for increased marbling

A major thrust in CRC 1 was to devise dietary regimes that could be applied in a feedlot to increase marbling. Diets tested included protected and unprotected lipid supplements, addition of Ca (to form Ca soaps in the rumen), alternative grains (oats compared with barley) and use of high and low protein supplements. Much of the work was done at the CRC research feedlot "Tullimba" Armidale and in Vasse, WA with MLA support. None of the diets tested consistently increased marbling. Most of the rations increased costs with the exception of the low protein diets which reduced costs and tended towards increased marbling. From a practical industry perspective, it could be concluded that there were no magical ways to improve marbling in the feedlot alone. The basic principles, now recommended by the CRC, and in use throughout industry, are to combine the right genetics and pre-feedlot growth path, followed by feeding with least cost high energy diets with lower protein than recommended by Australian feeding standards.

Nonetheless, from the perspective of gaining an understanding of what controls intramuscular fat deposition, substantial gains were made. These were summarized by Pethick et al (2004), and in these proceedings (Pethick 2006).

Probiotics for improved control of acidosis in feedlot cattle

Introduction of cattle to grain runs the risk of acidosis, subsequent loss of performance and, in extreme cases, death. Klieve et al (2003) demonstrated that administration of lactate utilising bacteria Megasphaera elsdenii and Butyrivibrio fibrisolvens to cattle given large quantities of finely ground grain reduced the onset and incidence of acidosis. This technology has recently received interest from the feedlot industry. Small scale industry trials are currently underway using M. elsdenii in conjunction with a starch utilizing bacteria to determine efficacy in reducing acidosis during introduction of grains to feedlot cattle.

Development of a screening test for net feed intake in cattle

The first beef CRC brought the opportunity to complete work on selection lines for growth and later to commence work on selection lines for net feed intake (NFI) in cattle. It also provided an opportunity to extend to cattle the earlier work on relationships between IGF-1 and production traits in pigs and sheep (Herd et al 1995; Herd et al 2002). This work lead to the development of the IGF-1 screening test for net feed efficiency which has subsequently had high uptake by industry (RM Herd, pers comm.). Use of IGF-1 as a substitute to measurement of the net feed intake trait, has resulted in a substantial reduction in number of animals tested for NFI. This has raised concerns because, over time, the relationship between IGF-1 and the true NFI trait (as measured by feed intake and weight and weight gain) may breakdown. Although it is unlikely that this will happen within the next few years, it is important that leading sires for the trait continue to be measured using the recommended feed intake test to ensure that the relationship has not broken down. This highlights a difficulty with information transfer to breeders about the need to maintain the measurement of the primary trait, and possibly acts as a warning as to likely behaviour when other markers (gene or indirect) become commonplace.

Conclusion

The two beef CRC's have left a substantial legacy of information that is currently being incorporated into changed management and feeding practices on farms and in feedlots. As with all information-rich research outcomes, it takes considerable time and industry practice to distill the messages into extensive practice change. In a multi-dimensional industry where product quality and cost of production are both important, the challenge to implement is greater than in less complex industries, but is recognized and being met by a wider section of the industry community than would have been possible without the contribution of the beef CRC's.

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