Improving cattle performance and meat quality by measuring temperament

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Abstract

In the CRC, temperament .is measured by the animal's flight time, an electronic measure of the time taken for an animal to cover a distance of ~2 metres after leaving a weighing crush. During long distance transport, docile animals lost less weight during transit and recovered that lost weight more rapidly than their more temperamental contemporaries. In the feedlot, British and tropically adapted breeds performed similarly, with the difference in daily weight gain over the feedlot period between animals with the best and worst temperaments being ~0.4 kg/day. Animals with slow flight times (good temperaments) grew faster in feedlots to achieve higher final weights and heavier carcases, with better feed conversion ratios. In a single experiment in British cattle, no calm (good temperament) animal was pulled, whereas 42% of nervous animals were taken to the hospital pen at some time during the feedlot period. In CRCI, significant favourable genetic relationships were found between flight time and beef tenderness and eating quality in tropically adapted breeds (temperate breeds were not measured for flight time). From CRC and other studies, it appears that use of best-practice processing may be a more effective way to improve tenderness in the current herd (i.e. at the phenotypic level). The best way for producers to improve temperament is to select breeding stock for good temperament. Short-term training may change an animal's behaviour in familiar environments, but does not change temperament in the longer term or in unfamiliar environments. Nor does it change the genes that an animal passes to its progeny. Measures of temperament are moderately to highly heritable and good genetic progress has been made by selection for flight time. EBVs for flight time are now being introduced to BREEDPLAN, Australia's national beef genetic evaluation scheme.

Why temperament?

"Temperament" is an animal's behavioural response to handling by humans. Poor temperament impacts on profitability of beef enterprises through increases in production costs (mustering costs, costs of cattle handling facilities etc.), increased risk of injury to the cattle and their handlers and decreases in production resulting from the relationships between temperament and production traits (e.g. growth, fertility, carcase and meat quality). In some cases, it also affects profitability through correlations between temperament and resistance to environmental stressors such as gastrointestinal helminths (worms), where favourable relationships reduce the costs of chemical treatments to control worms.

Animal welfare aspects of handling cattle with poor temperaments also need to be considered, for both economic and social reasons. Modification of management practices to reduce stress is one way to improve animal welfare. Another option is to improve the temperament of cattle to reduce the amount of stress experienced during routine handling procedures.

An important consideration for beef producers and feedlotters is that to achieve maximum performance under intensive production systems, cattle should not only be culled for bad temperament, but also ***selected for good temperament***. To achieve this, producers and feedlotters need to be able to easily distinguish cattle with poor, average and good temperaments. This can only be achieved by effective measurement of temperament.

Poor temperament impacts on profitability of beef enterprises through decreases in production resulting from correlations between temperament and production traits, increases in production costs and increases in risk of injury to both the animals and their handlers

How is temperament measured?

Temperament can be measured in many different ways. A single measure of temperament generally does not identify all behaviours that beef producers aim to improve in their cattle. However, some tests that identify particular aspects of animal behaviour also have favourable relationships with other aspects and hence, multiple behaviours can be improved by use of a single test. Tests that measure temperament fall into two primary categories:

1. Restrained tests ~ in these tests, the animal's movement is physically restricted during the test, that uses a subjective scoring system to assess the animal's behaviour in different situations, where specific behaviours are scored. The most common is the ***Crush Score***, assessed on a scale of 1-5, from very good to very bad. Animals are confined for ~10 seconds in a crush immediately prior to weighing but are not restrained in a head bail. An overall temperament score is subjectively recorded, but the behaviour that is primarily assessed is the amount of movement exhibited by the animals, from calm to struggling wildly.
2. Non-restrained tests ~ during these tests, the animal is free to move in a relatively large test area, either in the presence or absence of an observer. Behaviours assessed include an animal's fear response to being handled or to the presence of an observer and, in some tests, an exploratory or investigative component of behaviour. The test used by the CRC for Cattle and Beef Quality is the ***Flight Time***, an electronically recorded time taken for an animal to cover a fixed distance (1.5 to 2 m) after leaving a weighing crush, with low flight times (fast exit from the crush) indicating animals with poor temperaments (see Figure 1).

Figure 1. Measuring flight time, an electronically recorded measure of temperament

Generally, behaviours related to an animal's fear response to handlers are the behaviours that affect ease of handling in beef herds. They are best identified by non-restrained tests such as the flight time test. Tests in the restrained category are inexpensive, quick and easy to implement on-farm and they identify animals that are difficult to handle when restrained. However, it is not always possible to relate behaviours in a restrained situation to behaviours in a non-restrained situation, because some animals that are difficult to handle in a paddock demonstrate a "freeze" response when restrained. This is a common problem with tropically adapted breeds. Producers aiming to improve ease of handling in paddocks or yards should use a non-restrained test. Due to favourable correlations between flight time and restrained tests, improvements in ease of handling in restrained situations will also occur.

Relationships between temperament and performance in intensive production systems.

Research from Australia and the USA in both temperate and tropically adapted breeds of cattle has consistently demonstrated a favourable relationship between temperament and performance in intensive production systems such as feedlot environments. In Australia, CRC experiments show that temperament has a significant effect on weight loss during long-distance transport and for the initial recovery period, but no effect on subsequent weight gains when animals are grazed at pasture under extensive management (Burrow *et al* 1998). Docile animals lost less weight during transit and recovered that lost weight more rapidly than their more temperamental contemporaries. Flight time measures were found to be useful predictors not only of individual animals that lost weight during transport but also of how well groups of animals fared during such transit.

In feedlot environments, Burrow and Dillon (1997) found that *Bos indicus* crossbred steers with slow flight times (good temperaments) grew faster and hence, had heavier carcases than steers with poor temperaments (see Figures 2 and 3). Unpublished data indicates this occurred because more docile animals had higher feed intakes, and consequently better feed conversion ratios (kg feed required per kg weight gain) than their more temperamental contemporaries. In the USA, Voisinet *et al* (1997a) reported that animals with >25% Brahman breeding had a higher average temperament rating or were more excitable than animals with 0% Brahman (Angus) influence. However, within each breed type, cattle with higher temperament scores had lower average daily gains in a feedlot. Subsequent research by the Beef CRC shows that European breeds may have temperament scores similar or worse than high grade Brahman cattle (Burrow and Corbet 2000), so the conventional wisdom that Brahmans have poorer temperaments than *Bos taurus* breeds may not be universally true.

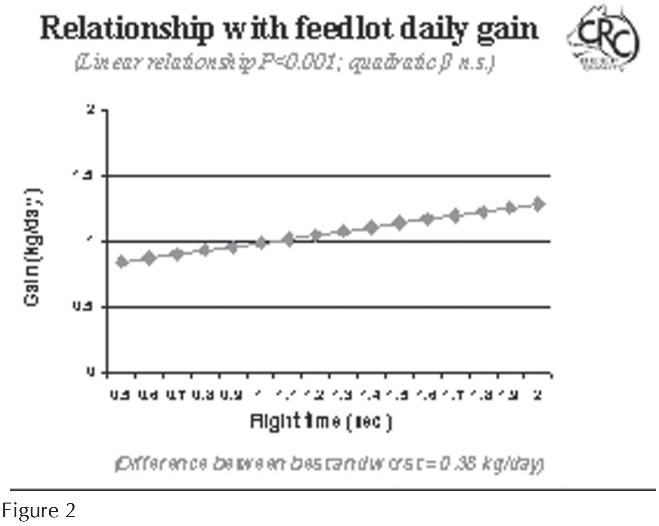


Figure 2

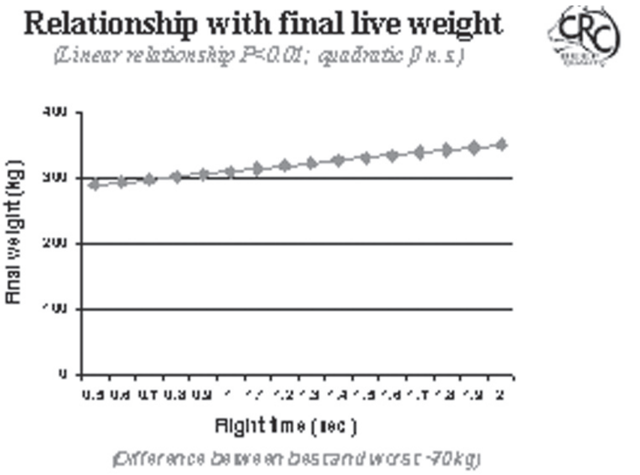


Figure 3. Figures 2 and 3 show the relationship between flight time and feedlot daily gain and final live weight

Other CRC feedlot experiments used groups of cattle selected divergently (high and low) for temperament prior to feedlot entry. Fell *et al* (1999) reported that nervous British breed (Angus x Hereford cross and Hereford) steers had significantly lower average daily gains and significantly higher morbidity over 85 days in the feedlot. After 78 days on feed, nervous animals had grown at 1.04 ± 0.07 kg/day relative to the 1.46 ± 0.05 kg/day of the calm animals. None of the calm animals was pulled during the feeding period, whereas 42% of the nervous animals were taken to the hospital pen at some time during the feedlot period. Clinical examination revealed that only one of these animals was demonstrably affected by respiratory disease. Petherick *et al* (2002) reported that in *Bos indicus* crossbred steers, flight time was correlated with measures of production and was a predictor of performance. Cattle with poorer temperaments had poorer average daily gains, feed efficiencies, body conditions and dressing percentages relative to those with good temperaments.

Relationships between temperament and carcase and beef quality attributes

Genetic and phenotypic correlations range from –1.0 to +1.0 and indicate the degree of relatedness of two traits either at the genetic (next generation) or the phenotypic (current herd) level. A zero relationship indicates the two traits are totally independent of each other, whilst a relationship of +1.0 indicates that exactly the same genes control both traits. Figure 4 shows the genetic correlations between flight time at weaning and a number of carcase and beef quality attributes measured in ~4,000 tropically adapted steers and heifers (Reverter *et al* 2002). These results show strong favourable genetic relationships between beef tenderness (measured objectively by shear force values and subjectively by Meat Standards Australia (MSA) consumer taste panel tests) and MSA overall eating quality score. There is also a favourable genetic relationship between flight time and meat colour, reflecting the favourable genetic relationship between meat colour and beef tenderness. Genetic relationships between flight time and body composition traits such as yield and marbling are close to zero.

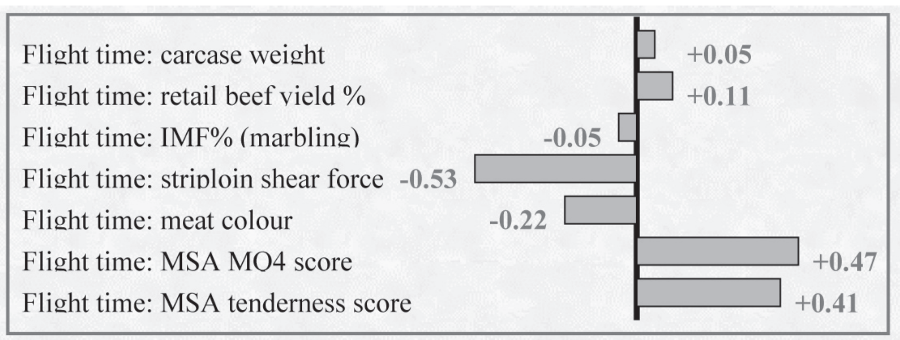
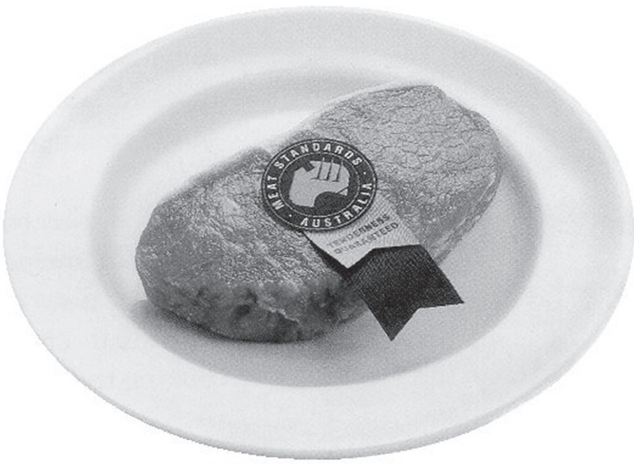


Figure 4. Genetic relationships (range –1.0 to +1.0) between flight time at weaning and carcase and beef quality attributes in tropically adapted cattle (low (fast) flight times indicate poor temperament; low shear force values indicate tender meat; low meat colour values indicate bright (good) colour; and high MSA overall acceptability (MQ4) and tenderness scores indicate good eating quality and tenderness)

Research from Australia and the USA using both temperate and tropically adapted cattle consistently shows a favourable relationship between temperament and weight gain and feed conversion ratio in intensive production systems such as feedlots

Phenotypic relationships between flight time and carcase and beef quality attributes were also close to zero in all animals where best-practice processing occurred. Phenotypic results in the literature have been equivocal. Voisinet *et al* (1997b) reported that as temperament score increased from calm to excitable, shear force measurements and the incidence of borderline dark cutters increased. Best practice processing occurred in their study, except co-mingling of different groups occurred the night before slaughter. Burrow *et al* (1999) analysed data from 3 calf crops and reported a negative relationship between flight time and shear force (an objective measure of tenderness, with higher values indicating tougher meat) in year 1 but positive relationships in years 2 and 3, when best-practice processing was applied in all years. Petherick *et al* (2002) reported that temperament grouping did not influence carcase traits, but there was evidence of lower initial pH levels and indicators of "heat-shortening" in the meat of steers with poor temperament, suggesting that the poor temperament steers were more susceptible to pre-slaughter stressors than the good temperament animals. However, the meat quality differences were not detected in eating quality measurements. These equivocal results possibly indicate that use of best practice processing can be used to overcome problems of beef tenderness associated with poor temperament.



CRC results show strong favourable genetic relationships between beef tenderness and MSA overall eating quality and temperament. Animals that have poor temperaments produce progeny that have beef that is tough and of unacceptable eating quality

To date, the only experiments to examine relationships between temperament and carcase and beef quality attributes have been based on tropically adapted genotypes. Work is underway in the Beef CRC to determine the magnitude and direction of relationships in British and European breeds.

How should producers and feedlotters use this information?

The best way to improve the temperament of beef cattle is to select breeding stock for good temperament. Measures of temperament are moderately to highly heritable (Burrow *et al* 1988; Burrow 1997; Burrow and Corbet 2000; Johnston *et al* 2002) and good genetic progress can be achieved by selection for the trait (not just culling animals that have poor temperaments). Some producers attempt to change animal behaviour through training programs. But results from experiments world-wide consistently show that short-term intensive training (e.g. at weaning) does not change temperament of beef cattle in the long-term (Burrow 1997; Fell *et al*. 1999). Intensive training may change an animal's behaviour whilst it remains in a familiar environment, but temperamental behaviours reappear when an animal is transferred to a new environment (for example, to an abattoir for slaughter, where it is essential that pre-slaughter stress does not impact on an animal due to the effect that such stress has on eating quality of beef).

Ruddweigh Australia have developed a commercial prototype to allow breeders and feedlotters to easily measure an animal's flight time on-property. Machines may also be available on loan from local beef research and extension agents or some breed societies throughout Australia. Flight time measurements are also being added as a new trait to Australia's beef genetic evaluation, BREEDPLAN.

These developments will allow breeders to record flight times of contemporary groups of animals shortly after weaning, when animals are familiar with the yard facilities but their behaviour has not been modified by repeated exposure to them. Comparative flight times can be used to identify animals from within that group which will perform well under intensive production systems such as feedlots. BREEDPLAN Estimated Breeding Values (EBVs) can be used for selection purposes by cattle breeders, to directly improve temperament and indirectly improve carcase and meat quality attributes in their progeny. Feedlotters can use flight times as a selection tool prior to feedlot entry to identify those animals which will grow fastest and have the best feed conversion efficiencies during feedlot finishing.

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Notes