# RELATIONSHIPS BETWEEN TEMPERAMENT AND CARCASS AND MEAT QUALITY ATTRIBUTES OF TROPICAL BEEF CATTLE

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## SUMMARY

Data from three calf crops were used to determine relationships between flight speed score and carcass and meat quality attributes. There were no consistent, significant relationships between flight speed score and any carcass and meat quality attribute. From these results, flight speed score is a poor indicator of preslaughter stress that results in tougher meat, or the intensive handling that the cattle received over their lifetimes reduced the amount of preslaughter stress they experienced. Alternately, the lack of consistent relationships between flight speed score and meat tenderness may reflect an ability of processing techniques to overcome negative relationships between the different traits.

**Keywords**: Temperament, carcass quality, meat quality, beef cattle

## INTRODUCTION

Under extensive management systems, temperament impacts on productivity of beef enterprises through increased production costs (AMRC 1988) and possibly through losses in carcass and meat quality as a result of high levels of preslaughter stress (see reviews of Grandin 1980; Burrow 1997). Evidence of the latter effect is equivocal. In this study, data from three calf crops were analysed to determine relationships between a measure of temperament and carcass and meat quality attributes.

## MATERIALS AND METHODS

**Experimental animals and measurements.** Experimental calves were from 1989 to 1991 crops born at the National Cattle Breeding Station, 'Belmont', Central Queensland. Bull and heifer calves from 1989 and 1990 crops were from a stabilised composite known as AXBX. AXBX cattle contain 25 % of each of Africander, Brahman, Hereford and Shorthorn breeds. Males from 1991 crop were from AXBX and a second stabilised composite known as AX. AX cattle consist of 50 % Africander, 25 % Hereford and 25 % Shorthorn. AX and AXBX herds were used for within-breed selection experiments from 1982. Details of selection lines, treatments and herd history are given by Burrow (1998). Males from 1989 and 1990 crops were castrated at weaning. Thereafter, steers and heifers were managed together within crop until slaughter. They were treated each three weeks from weaning until start of the finishing phase with flumethrin (Bayticol Pour-On, Bayer Australia) to control ticks, and levamisole (Nilverm Injectable, Cooper's Australia) to control gastrointestinal helminths. Animals from 1989 crop were finished on grain and slaughtered at domestic market weights at ~18 months of age. Animals from 1990 crop were finished on improved buffel grass pasture and slaughtered at Japanese market weights at ~36 months of age. Bull calves in 1991 crop were randomly allocated at weaning to an untreated control or a group that was treated each three weeks from weaning until 18 months of age to control ticks and gastrointestinal helminths. After selection of replacement bulls at 18 months, cull males were castrated and allocated to Korean or Japanese market specifications. All animals were handled more intensively than most commercial cattle, with multiple measurements of productive and adaptive traits recorded from birth to slaughter.

Temperament was assessed on four occasions between weaning and 12 months using a flight speed score, which is the time taken for an animal to cover 1.7 m after leaving a weighing crush (Burrow *et al.* 1988). Fast times indicate animals with poor temperaments. The average of all flight speed scores was used for statistical analyses. Meat quality assessments were made on samples of *M. longissimus dorsi* (LD) and *M. semitendinosis* (ST) after conventional slaughtering of animals, low voltage electrical stimulation and chilling of their carcasses. Only LD samples were available for 1989 crop animals. LD and ST samples were available for 1990 and 1991 crop animals. Carcass and meat quality measurements are described in Table 1. Meat tenderness was assessed by modified Warner-Bratzler Shear Force measurements on strips of meat from cooked samples (Bouton *et al.* 1975*a,b*). Tenderness values were recorded in kg, with higher values indicating tougher meat. Numbers of animals and least squares means (± s.e.) of key measurements within calf crops are shown in Table 2.

**Table 1. Definition of the main carcass and meat quality measurements assessed in this study**

| Abbreviation | Definition of measurements |
|---|---|
| HSCW | Hot standard carcass weight (kg) |
| P8FAT | Fat thickness at the P8 rump site (mm) |
| MeatL, Meata, Meatb | Meat colour values for lightness (MeatL), redness (Meata) and yellowness (Meatb) measured with a Minolta Chroma Meter CR-200 (Minolta Camera Company) on a freshly cut meat surface allowed to bloom at 1°C for 30 min |
| pH | Ultimate pH of meat sample (normal values 5.5 to 5.7) |
| IY | Initial yield (kg), an index of the myofibrillar contribution to meat toughness |
| PF | Peak force, an index which represents total meat toughness |
| PF-IY | Difference between PF and IY, an indicator of connective tissue toughness |
| IC | Instron compression, determines differences in an index of connective tissue contribution to toughness (Harris and Shorthose 1988) |
| MARB | Visually assessed marbling score measured in LD samples on a scale from 1=no marbling to 5=very heavily marbled |

Statistical analyses. Data were analysed within calf crop using Proc. Mixed (SAS 1989). A common model was used for 1989 and 1990 crops, with line and sex fitted as fixed effects. Line, treatment and market were fitted as fixed effects in the model for 1991 crop. First order interactions were never significant (P>0.05) and were not included. Preliminary analyses included flight speed score as a linear and quadratic covariate. Except for meat colour in LD samples in 1991 crop, the quadratic effect was not significant (P>0.10) and was therefore removed. HSCW was analysed with slaughter age and flight speed score as linear covariates and sire as a random effect. Meat quality attributes were analysed with HSCW and flight speed score as linear covariates and sire as a random effect.

**Table 2. Numbers of animals (*n*) and means (± s.e.) of key measurements within calf crops**

| Measurement | *n* | 1989 crop Mean ± s.e. | *n* | 1990 crop Mean ± s.e. | *n* | 1991 crop Mean ± s.e. |
|---|---|---|---|---|---|---|
| Average flight speed (sec) | 71 | 1.06 ± 0.07 | 91 | 1.10 ± 0.05 | 103 | 1.17 ± 0.06 |
| Age at slaughter (days) | 71 | 540 ± 7 | 91 | 906 ± 10 | 103 | 948 ± 17 |
| HSCW (kg) | 71 | 192 ± 3 | 91 | 289 ± 3 | 103 | 292 ± 3 |
| P8FAT (mm) | 71 | 11.0 ± 0.8 | 91 | 13.1 ± 1.1 | 103 | 13.1 ± 0.9 |
| pH (units) | 71 | 5.55 ± 0.01 | 91 | 5.55 ± 0.01 | 103 | 5.57 ± 0.01 |
| MARB (units) | 71 | 1.65 ± 0.15 | 91 | 1.42 ± 0.09 | 103 | 1.40 ± 0.10 |
| PF of LD muscle (kg) | 71 | 4.07 ± 0.23 | 91 | 6.43 ± 0.40 | 103 | 5.08 ± 0.18 |

## RESULTS AND DISCUSSION

There were no consistent, significant relationships between flight speed score and any carcass and meat quality attribute across calf crops. There were some traits where a significant or near significant estimate was observed and these are shown in Table 3. These results are generally not in accord with those reported in the literature. From published reports (Fordyce *et al.* 1985; Burrow and Dillon 1997), a positive relationship between flight speed score and HSCW was expected. In all crops, the relationship between flight speed score and HSCW was positive, but was only significant in 1990 crop. It is possible that the intensive handling received by these animals throughout their lives reduced the magnitude of relationships between flight speed scores and liveweight gains (see review of effects of intensive handling in Burrow 1997).

**Table 3. Relationships between flight speed score and carcass and meat quality attributes**

| Calf Crop | Trait (Sample Type) | Significance | Mean | Regression coefficient |
|---|---|---|---|---|
| 1990 | HSCW | $P<0.06$ | 289 kg | 0.16933 |
| 1989 | PF-IY (LD) | $P<0.05$ | 0.74 kg | -0.00264 |
| 1990 | Meata (ST) | $P<0.05$ | 19.79 units | 0.01405 |
| 1990 | Meatb (ST) | $P<0.01$ | 7.07 units | 0.02027 |
| 1990 | IC (ST) | $P<0.07$ | 2.40 kg | 0.00223 |
| 1991 | IY (ST) | $P<0.09$ | 3.98 kg | 0.00274 |

In the current study, relationships between meat tenderness and flight speed score were equivocal. The majority of relationships were not significant. In 1989 crop, as flight speed score increased, LD PF-IY decreased (the relationship was favourable). In 1990 and 1991 crops, as flight speed score increased, redness and yellowness of meat intensified and IC and IY increased (the relationships were unfavourable). Fordyce *et al* (1988) reported that meat from animals with poorest temperament scores was significantly less tender than meat from other animals. Meat processing techniques to overcome cold shortening were not applied to carcasses in that experiment. Voisinet *et al* (1997) also reported that as temperament score increased from calm to excitable, PF measurements, and incidence of borderline dark cutters that were downgraded, increased. In that study, electrical stimulation was applied and meat samples were aged for 14 days. Effective electrical stimulation and ageing of meat both improve meat tenderness (Harris and Shorthose 1988). However, in the Voisinet *et al* (1997) study, cattle from different groups were co-mingled the night before slaughter. Co-mingling of cattle can increase meat toughness (see Burrow 1997). Animals with poorer temperaments may react more to co-mingling than those with better temperaments. Fordyce *et al* (1988) and Voisinet *et al* (1997) both categorised temperament score from best to worst. Relationships between temperament score and tenderness were pronounced only at the poorest extreme. In this study, relationships between temperament score and carcass and meat quality attributes were evaluated by regression methods that did not distinguish very poor temperaments. However, fitting flight speed score as a quadratic covariate would have detected relationships that were significant at an extreme. Those quadratic regressions were not significant. From these results, either flight speed score is a poor indicator of an animal's response to preslaughter stress that results in tougher meat, or the intensive handling that the cattle received over their lifetimes reduced amount of preslaughter stress they experienced. Alternately, lack of consistent relationships between flight speed score and meat tenderness attributes may reflect an ability of processing practices to overcome negative relationships between carcass and meat quality attributes and temperament.

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