EFFECT OF GENOTYPE ON PERFORMANCE AND CARCASS CHARACTERISTICS OF SUMMER-INDUCTED FEEDLOT CATTLE

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SUMMARY
Five hundred and seventy four *Bos taurus* steers (Angus, Hereford and Murray Grey) were used in a study to determine the effect of high heat load on performance and carcass characteristics when fed a high energy diet for 165-183 days. The trial was undertaken at a commercial feedlot between December 2002 and June 2003. Regardless of coat colour, body surface temperature of feedlot cattle rose ($P<0.05$) as climatic conditions changed from thermoneutral (Temperature and Humidity Index (THI)<74) to moderate (THI 74-77). Under extremely hot conditions, body surface temperature was higher ($P<0.05$) for Angus compared with Murray Grey (43.4°C and 38.4°C, respectively) steers. Murray Grey steers had greater average daily gain than either Angus or Hereford. There were no differences between breeds for carcass weight, eye-muscle area and marbling score. However, Murray Grey steers had an ideal subcutaneous fat coverage, and in terms of reduced labour costs, Murray Grey steers could be economically more efficient than either Angus or Hereford steers.

Keywords: high heat load, body surface temperature, feedlot, carcass characteristics

INTRODUCTION
A number of factors affect carcass quality of beef cattle (Johnson *et al.* 1990). Growth rate and feeding regimen both have an affect on physical properties of muscle. Cattle receiving high energy diets grow more rapidly and have increased collagen turnover compared with cattle receiving low energy diets (Fishell *et al*. 1985; Ducket *et al.* 1993). Between 5 and 10% of the variation in tenderness can be accounted for by marbling and, generally, meat from *Bos indicus* cattle is less tender than meat from *Bos taurus* cattle (Koch *et al.* 1988; Wheeler *et al.* 1994).

Coat colour may be an important contributor to the high heat load status of cattle. Cattle with dark coats absorb more solar radiation than those with white coats (Finch 1985; Blackshaw and Blackshaw 1994) and, therefore, may be more susceptible to the negative effects of high heat load. Under hot conditions, *Bos indicus* cattle tend to have lower rectal temperature than *Bos taurus* cattle (Turner and Schleger 1960; Gaughan *et al*. 1999). Consequently, *Bos indicus* cattle often have better overall productivity than *Bos taurus* cattle under hot conditions, although they may be inferior under temperate conditions (Syrstad 1990).

The hypothesis of this study was that performance and carcass quality would be closely associated with genotype and coat colour under high heat load conditions. Our objective was to examine this relationship using cattle inducted into a feedlot in summer.

MATERIAL AND METHODS
Location
This study was undertaken at a 9000 head feedlot in south-east Queensland between December 2002 and June 2003. In order to reduce pen effects, 2 adjoined soil-surfaced unshaded pens, with a pen area of approximately 3000 m², were used. Stocking rates were between 18 and 20 m²/hd. A float activated water trough was located on the middle of each pen, and a concrete feedbunk approximately 60 m long was located at the front of each pen.

Cattle
Five hundred and seventy four Angus, Hereford and Murray Grey steers were used in this study. The steers were individually identified with ear tags, were weighed, number of teeth recorded, and breed identified. The steers were vaccinated against pulpy kidney, black disease, tetanus, blackleg and malignant oedema, and were also treated by oral administrations and pour-ons for control of internal and external parasites. Body condition scores (BCS) of cattle were visually assessed (BCS 1 – skinny; BCS 5 - fat) after approximately 30 days on feed.

Feeding
Due to commercial-in-confidence, details of diet composition cannot be revealed, however, the steers were fed wheat/sorghum based diets for 165-183 days, and were fed twice daily (0630-0830 h and 1300-1700 h). Feedbunks were evaluated daily at approximately 1100 h; feed remaining in the bunk was measured (FBS 0 - no feed remained; FBS 4 - untouched feed) and the daily allotment of fed was then determined. In summer, 70-75% of the daily allocation was fed in the afternoon while in winter, 60% was fed in the afternoon. Daily dry matter intake (DMI) was recorded on a pen basis.

Data collection
Each day at 1400 h, positional behaviour and body surface (BS) temperatures were recorded. Data were collected on 11 days; 4 extremely hot days (EH) (Temperature and Humidity Index (THI): >80), 2 hot days (H) (THI: 77-80), 3 moderate days (M) (THI: 74-77) and 1 thermoneutral day (TN) (THI: <74). The temperature and humidity index (THI) was calculated as:

$$THI = 0.8 \times Ta + RH \times [(Ta-14.4) + 46.4]$$

where Ta = ambient temperature and RH = relative humidity. Body surface temperature (BST) was measured using an infra-red gun (Raytek®, ST series) aimed at the short rib area.

Approximately 24 h prior to slaughter, cattle were transported to an abattoir. Soon after slaughter, carcasses were ribbed (between the 12^{th} and 13^{th} ribs) and hot carcass weights (HCW) were recorded within 1 hour post-mortem, and then chilled. After an overnight chill, P8 fat thickness, marbling score, meat colour, fat colour and eye-muscle area (EMA) were recorded using the Aus-Meat grading system.

Statistical analysis
The General Linear Models procedure of SAS was used for statistical analysis. The carcass characteristics were evaluated. The statistical model included coat colour, genotype x coat colour within a pen, BS temperature x genotype and BST x coat colour. Initial liveweight and carcass weight were used as covariates.

RESULTS

Genotype had an effect on average daily gain (ADG) (Figure 1). The ADG was greater ($P<0.05$) for MG than either Hereford or Angus. There were no differences ($P<0.13$) between Angus and Hereford steers.

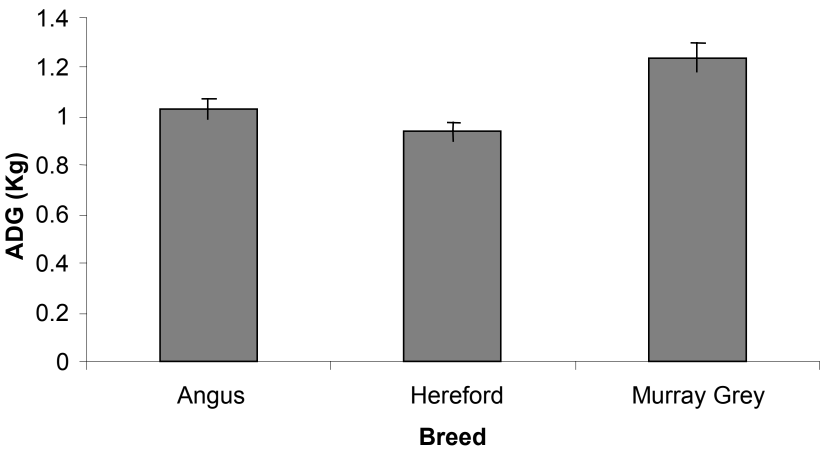

Figure 1. Average daily gain (ADG) of Angus, Hereford and Murray Grey steers during the study (15 December 2002 to 3 June 2003).

Cattle were exposed to EH and H during the first 100 days. Regardless of coat colour, body surface temperatures of cattle rose ($P<0.05$) as conditions changed from TN to EH (Figure 2). Under EH, Angus (black coat) steers had the highest BST and Murray Grey (light coat colour) steers had the lowest, being 43.4°C and 38.4°C, respectively. Furthermore, body surface temperature of Murray

Grey steers did not differ between H and EH, although there was a significant rise (P<0.05) for Angus and Hereford steers.

Cattle spent more time standing while climatic conditions changed from H to EH. However, feed intake was not affected by climatic conditions.

There were differences (P<0.05) between Angus, Hereford and Murray Grey steers for carcass characteristics (Table 1). Murray Grey steers had a lower percentage yield than Hereford steers, less P8 fat and lower initial liveweight than either Angus or Hereford steers. There were no differences between breeds for EMA, HCW, final liveweight and marbling score.

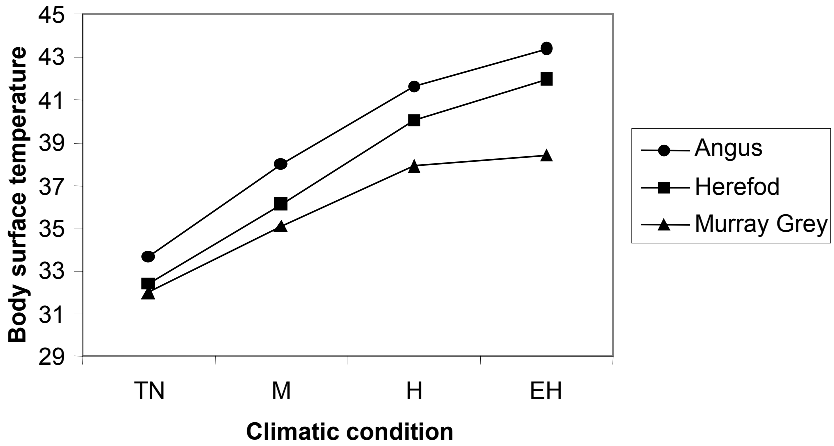

Figure 2. Body surface temperatures of Angus, Hereford and Murray Grey steers under different climatic conditions (see the text for definition of climatic conditions).

Table 1. Carcass characteristics of Angus, Hereford and Murray Grey steers after 165-183 days on feed.

Traits	Angus	Hereford	Murray Grey	P value
Initial wt (kg)	436 ± 4.0[a]	427 ± 3.3[a]	386 ± 20.3[b]	P<0.01
Final wt (kg)	599 ± 7.44	592 ± 8.32	577 ± 20.3	ns
HCW (kg)	359.7± 5.3	362.9± 3.6	338 ± 16.8	ns
Dressing (%)	60 ± 0.7[a]	62 ±1 [a]	58 ± 1.4[b]	P<0.01
EMA (cm²)	79.6 ± 1	79.8 ± 0.8	78.1 ± 2.7	ns
P8 fat (mm)	19.7 ± 0.7[a]	19.5 ± 0.6[a]	14.4 ± 1.1[b]	P<0.01
Marbling	1.6 ± 0.09	1.56 ±0.07	1.52 ±0.14	ns

Values in rows followed by different letters are significantly different

DISCUSSION

Lypolytic events associated with climatic condition and lypolysis in ruminants is very sensitive to catecholamine, with sensitivities in cattle some 100 times greater than for pigs (Pethick *et al.* 2002). Furthermore, carcass quality is downgraded for either inadequate or excessive subcutaneous fat coverage, and extra costs incurred through the labour required to trim of excessive subcutaneous fat and loss of meat yield (Browne and Johnson 1994). The highest numbers of dark cutting occurred in carcasses of cattle that were finished during summer (Kreikemeier *et al.* 1998). In this study, Murray Grey steers had an ideal subcutaneous fat coverage, and the results of this study indicate that Murray Grey steers could be economically more efficient than either Angus or Hereford steers. However, there were no differences between breeds for marbling score, HCW, EMA and meat colour.

Ambient temperature and/or solar radiation affects the fatty acid profile of cattle (Kelly *et al.* 2001). We suggest that ambient temperature and/or solar radiation affect intramuscular fat deposition directly by altering hormonal secretions or gene expressions. Research at a physiological and molecular level needs to be continued to determine the effect of climatic conditions on performance and meat quality of feedlot cattle.

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