FEEDLOTTING INCREASES *ANTE MORTEM* TEMPERATURE OF BEEF CATTLE

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Abstract –The core body temperature and post slaughter loin temperatures of steers fed on grass pasture was compared with those of steers fed a grain based feedlot diet. The feeding treatments were grass for 300 days (Grass), grass for 150 days then feedlot for 150 days (Short feedlot) and feedlot for 300 days (Long feedlot). Temperature telemeters were inserted into the peritoneum of the steers and temperature measured at intervals of 1 minute for the 48 hour period prior to slaughter. The pH and temperature decline post-mortem was also measured. The carcasses of the feedlot steers were heavier and fatter than those from the grass fed steers. The core body temperature of the steers from the feedlot treatments was 0.3- 0.4°C higher than for the grass treatment at the time of slaughter. The loin temperature was higher in the feedlot treatments than the grass treatment at all times measured post mortem as was the temperature at pH 6. Feedlotting can increase the likelihood of "heat toughening" conditions of high temperature and low pH occurring post mortem in beef carcasses, and this is possibly associated with an increase in carcass weight and condition score.

Key Words – Ante mortem, Temperature, Cattle

I. INTRODUCTION

High temperature (>35°C) and low pH (<6) conditions, occur in many beef carcasses in Australia [1]. Reduced water holding capacity [2], reduced tenderization [3], pale colour [4], premature browning during retail display [5] and sarcomere shortening [6] have all been associated with these conditions. Factors that increase *ante mortem* body temperature could predispose carcasses to heat toughening conditions, because body temperature at the time of slaughter represents the starting point, from which carcass temperature declines post slaughter. Management on the farm/feedlot, during transport and in lairage at abattoirs [7] could therefore influence carcass temperature post slaughter. This study aimed to compare temperatures from cattle finished on grass pasture and grain feeding (feedlot) systems, to determine whether grain finishing in a feedlot system might predispose beef carcasses to high temperature and low pH conditions post slaughter.

II. MATERIALS AND METHODS

Eighteen *Bos taurus* Angus steers (live weight 369 ± 14kg; mean ± sem) were randomly assigned to one of three finishing treatment groups. Group 1 (Grass, n = 6) were fed on pasture (average 9 MJ/kg and 12% protein) for 300 days. Group 2 (Short feedlot, n = 6) were fed on pasture (average 9 MJ/kg and 12% protein) for 150 days followed by a grain based feedlot ration (12.6 MJ/kg and 13.2% protein) in a commercial feedlot for 150 days. Group 3 (Long feedlot, n = 6) were fed a grain based feedlot ration (12.6 MJ/kg and 13.2% protein) for 300 days in a commercial feedlot. At the end of the 300 day feeding period all cattle were transported to a commercial abattoir and slaughtered as a single consignment, after a 24 hour lairage period.

To measure the core body temperature T_{core} of the steers, temperature telemeters (iButton, DS1922L, Maximum Dallas, California, USA) were surgically implanted into the peritoneum of each steer following the methodology described by Beatty *et al*, [8]. Temperature telemeters logged temperature every minute for the duration of the experiment and were retrieved post slaughter. Loin (*m. longisismuss thoracis et lumborum*) temperature and pH were measured by a Meat Standards Australia accredited grader at hourly intervals for 5 hours post slaughter and again at the time of grading

20 hours post slaughter. Carcass and fat measurements were taken from abattoir records [9]. One way analysis of variance was used to analysed the data with separation of means determined by calculation of least significant difference (P<0.05).

III. RESULTS AND DISCUSSION

The mean core body temperature of feedlot steers during the *ante-mortem* period (P<0.01) and the temperature at slaughter (P=0.051) were significantly higher than for grass fed animals (Table 1).

Table 1. The effect of treatment on carcass grading and temperature parameters

Parameter	Grass	Short feedlot	Long feedlot	LSD
Fat score (mm)	6.7^{a}	20.8^{b}	27.0^{b}	6.9
Hot carcass weight	301.4^{a}	401.2^{b}	438.1^{c}	26.5
$^{*}T_{core}$ *ante-mortem*	38.74^{a}	38.95^{b}	39.02^{c}	0.02
T_{core} at slaughter	39.2^{a}	39.5^{b}	39.6^{b}	0.28
Temperature at pH =6	35.6^{a}	41.0^{b}	40.4^{b}	4.2

$^{*}T_{core}$ ante mortem = mean value for core body temperature during the 48 hour period before slaughter
Values with different superscripts a, b, c in a row are different.
LSD = least significant difference P<0.05.
Temperature at pH=6 was calculated by interpolation.

The carcasses of the feedlot steers were heavier and fatter (P<0.01) than those from the grass fed steers (Table 1) and this may have predisposed them to heat stress. Brown-Brandl *et al.* [10] found that respiratory rate was 6.8% higher in finished animals compared to lean animals for heifers kept in a feedlot when ambient temperature was greater than 25.5°C dry bulb. Another possible reason is a difference in heat production from fermentation in the rumen due to different diets. However, any such difference is likely to have diminished after 24 hours of fasting during the transport and lairage periods [11]. The differences observed in body temperature could therefore have been more likely due to differences between treatments in body size and condition.

Two spikes in core body temperature were evident during the 36 hour period prior to slaughter (Fig. 1), occurring just prior to transport (truck) and just prior to slaughter for all treatments. Whilst unrelated to treatment, this is consistent with increased heat production due to stress events occurring at these times [11] during loading and unloading and movement to the knocking box, as has previously been reported in sheep [12]. Another spike occurred on farm about 40 hours before slaughter but the movement history of the animals is uncertain during this period, so this event cannot be explained, but might also have been due to the stress and exercise associated with mustering the cattle from their paddocks and feedlot yards.

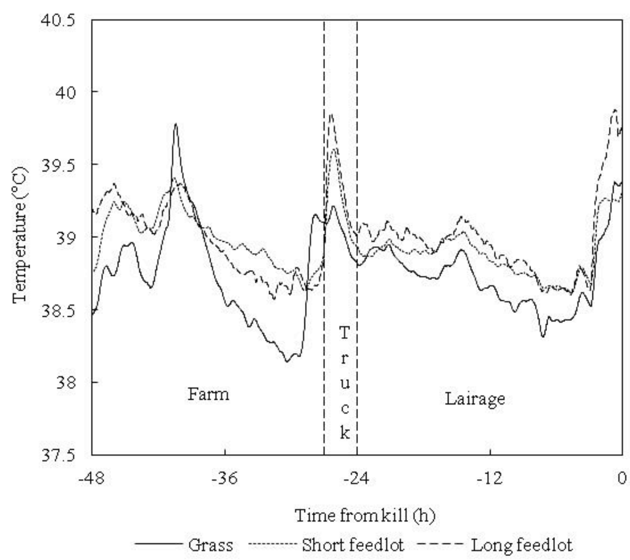

Figure 1. Core body temperature (T_{core}) during the period 48 hours before slaughter; Farm refers to the period when steers were on farm, truck to the period taken for transport from farm to abattoir lairage, and lairage the period the steers spent in abattoir lairage

The loin temperature of the grass fed steers (Fig. 2) was lower (P<0.01) than Short feedlot and Long feedlot steers at 1, 2, 3, 4, 5 and 20 hours and was not different between Short and Long feedlot steers at any time (P>0.05) post slaughter. The *longissmus thoracis* pH was higher at 4 and 5 hrs post-slaughter (4 hrs; 4.48, 4.46. 5.69, SED = 0.089, P=0.031. 5 hrs: 5.40, 5.41, 5.63, SED=0.055, P=0.002; for short feedlot, long feedlot and grass respectively) and similar (P>0.05) at the other time points. Using the temperature at pH 6 as an indicator of rigor onset, it is evident from the higher temperature at pH 6 in the loin muscle of feedlot cattle that they went into rigor at an earlier time, and were clearly in the 'heat-toughening' region.

There were no differences between treatments (P.0.05) for pH at any time point post slaughter. However the difference between grass and feedlot treatments in rate of temperature decline resulted in the temperature at pH= 6 being different (P<0.01, Table 1). Meat from steers in the Short and Long feedlot treatments would therefore have been exposed to heat toughening conditions for a longer period than those in the Grass treatment.

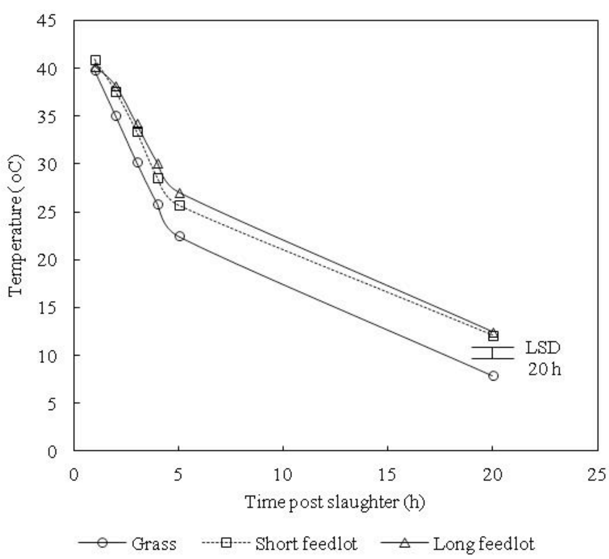

Figure 2. Loin temperature (°C) measured at 1, 2, 3, 4, 5 and 20 hours post slaughter.

Higher muscle temperature post-slaughter in the carcasses of grain-fed cattle has previously been attributed to heavier, fatter carcasses and consequent slower temperature decline post-slaughter. But in this case, the higher temperature in grain-fed cattle/carcasses was observed pre-slaughter and at slaughter, as well as post-slaughter.

IV. CONCLUSION

Carcasses from feedlot steers tend to be heavier, fatter and have a higher temperature at the time of slaughter than carcasses from grass fed steers. Subsequently they cool at a slower rate during the postmortem period.

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