MEAT QUALITY OF BOS INDICUS CROSS STEERS GROWN AT TWO DIFFERENT LOCATIONS FROM THIRTY MONTHS OF AGE TO SLAUGHTER


SUMMARY

Nutritional history had little direct influence on the meat tenderness of Bos indicus cross steers finished at two locations in northern Australia. Differences recorded in meat tenderness were related to the age of the steers, with age a result of their nutritional history and growth rate.

Bos indicus cross steers aged 29-31 months were allocated at Swans Lagoon in north Queensland into two groups. One group (EMD) was relocated to good quality pastures near Emerald, central Queensland, while the other group (SWN) grazed lower quality pastures at Swans Lagoon. Steers were grown at both locations to a target carcass weight of 290 kg then slaughtered at the same meatworks. The EMD steers grew 20% faster - 0.304 v 0.252 kg/hd/d (P<0.05) resulting in an earlier turnoff.

Commercially, rump subcutaneous fat cover was similar between groups - 16.5 v 14.8 mm. These carcasses produced low fat meat, a critical factor in human nutrition today. Longissimus dorsi (LD) intramuscular and intracellular fat content was 3.24% and 2.18% respectively for the EMD and SWN steers. The EMD steers had lower (P<0.05) Warner Bratzler initial yields - 5.37 v 6.08 kg and peak shear force values - 6.27 v 7.02 kg (P<0.05) than the SWN steers. Mean sarcomere lengths of LD samples were similar and mean Instron compression values of the EMD steers were less (P<0.05) - 2.220 v 2.426 kg reflecting a lesser contribution of connective tissue to meat toughness. Overall, less than half the LD samples were of average tenderness or better, reinforcing the perception that northern Australian meat can be tough.

INTRODUCTION

Unsubstantiated claims have been made that meat from cattle grazing native pastures in northern Australia is tough. Such claims appear to be based on three factors suggested as having relevance to meat quality, namely, breed, plane of nutrition and age at slaughter. In northern Australia, Bos indicus cattle predominate (ABS 1988). Cattle experience a saw tooth growth pattern of weight gain followed by weight loss (Winks 1984) and age at slaughter tends to be in the three to four year range. Most studies on the effect of growth rate on meat quality have been carried out overseas, were short term and involved other than pasture based diets. In contrast there is no information from longer term (three to four years) meat quality studies involving Bos indicus cross animals grazing native pastures, or the effect of annual liveweight fluctuations on the meat quality of such animals. Many steers in northern Australia are transferred either as yearlings, or at two years of age or older to more favourable environments for growing and finishing in order to reduce age at turnoff.

* Qld. Dept. Primary Industries, Box 6014, Rockhampton Mail Centre, Qld. 4702.
** CSIRO, Meat Research Laboratory, P.O. Box 12, Cannon Hill, Qld. 4170,
*** Qld. Dept. Primary Industries, Swans Lagoon, Millaroo, via Ayr, Qld. 4707.
+ Qld. Dept. Primary Industries, Animal Research Institute, Moorooka, Qld. 4105.
++ Qld. Dept. Primary Industries, P.O. Box 81, Emerald, Qld. 4720.
This paper reports on the comparative meat quality of *Bos indicus* cross steers that were either transferred at thirty months of age to higher quality pastures in central Queensland or remained grazing inferior quality native pastures in northern Queensland.

**MATERIALS AND METHODS**

At Swans Lagoon, via Ayr, north Queensland, 192 *Bos indicus* cross steers (1/2 or 3/4 Brahman; or 1/2, 3/4 or high grade Sahiwal) were randomly assigned within genotype and sire group to two groups based on their weight per day of age in May 1985. The mean weight and age of both groups was 390 kg and 30 months. Previously, these steers had grazed native pasture since birth. One group of 97 steers (EMD) was transported after allocation to a commercial beef property near Emerald in central Queensland. These steers remained at this location until slaughter in November 1986. A group of 95 steers (SWN) remained at Swans Lagoon until slaughter in April 1987. Live weights were recorded at marked breaks in the season and prior to turnoff.

The EMD steers grazed a high quality pasture consisting of grazing oats (yield = 378 kg DM/ha; 116 g/kg DM crude protein) and buffel grass (yield = at least 2314 kg DM/ha; 119 g/kg DM crude protein), whereas the SWN steers grazed native pastures that were declining in quality (38 g/kg DM crude protein) in the fortnight prior to slaughter.

At turnoff, the animals at each location were randomly assigned within genotype to one of two slaughter day groups and were transported to arrive at a meatworks in Rockhampton by 1200 noon of the day preceding slaughter. The EMD steers were weighed before transport after a 16 hour fast with water available, whereas the SWN steers were weighed without a fasting period. The EMD steers travelled 320 km (approx. 5 h) while the SWN steers travelled 690 km (approx. 16 h) for slaughter at the same meatworks.

At slaughter, all carcases were electrically stimulated within 10 minutes of stunning with a Koch Britton unit utilizing 36 V for a 40 second continuous cycle. Hot standard carcase side weight and subcutaneous fat depth at the P8 rump site were measured within 45 minutes of stunning. Following chilling (minimum temperature -2°C), carcase sides were boned (24 h after death) and 1 kg samples of the 'cube roll' were collected adjacent to the quartering point between the 8th and 12th thoracic vertebrae. Samples were wrapped in plastic sheet, cartoned, blast frozen at -26°C then held in storage freezers at -18°C until transferred to Brisbane.

A 100 gm sample was sawn from the frozen *longissimus dorsi* (LD), before the samples were thawed at 5-6°C for 48 hours. These 100 g samples were finely minced, freeze dried, then soxhlet extracted with petroleum ether (b.p. 40°C - 60°C) for 16 hours in order to determine total fat content. LD ultimate pH values and *BacoMore* lengths of the LD samples were determined (Bouton et al. 1973) before weighed samples (approximately 200 g) were cooked in a water bath at 80°C for an hour. Cooked samples were stored overnight at 1°C before a minimum of six Warner Bratzler Shear and Instron compression values were determined (Bouton and Harris 1972).

A fixed effects ANOVA model for an unbalanced two way factorial design was fitted using the method of least squares. The main effects of location and genotype and the location x genotype interaction were fitted. The covariate 'ultimate pH' was included in the analysis of all meat quality attributes except for fat. Means were compared using the protected LSD procedure at the 5% level of significance. There was no significant location x breed interaction, nor any significant effect of slaughter day for any of the parameters measured.
RESULTS

The live weight of both groups is shown in Fig. 1. The EMD steers had a slower growth rate, over the initial 12 month period compared to the SWN steers. Weight loss of the SWN steers between May 1986 and November 1986, coincided with the annual ‘dry’ season (Fig. 1), which established the difference between groups in mean liveweight gain to turnoff. There was no evidence of compensatory growth. The mean average daily gain (kg/hd/d) between May 1985 and turnoff was greater (P<0.05) for the EMD group (0.304) than for the SWN group (0.252).

![Fig. 1. Mean live weights of the experimental groups from thirty months of age to turnoff](image)

The EMD steers were slaughtered at 555 kg in November 1986, 151 days earlier than the SWN steers at 566 kg in April 1987. Of the EMD steers 44% had more than six (6) permanent incisors at slaughter compared with 69% of the SWN group. There was no effect of previous location on hot carcase weight (291 v 286 kg for EMD and SWN steers respectively). However, the EMD steers had more (P<0.05) subcutaneous fat than the SWN steers (16.5 v 14.8 mm). Mean ultimate pH values of the EMD and SWN groups were 5.59 and 5.64 respectively (P<0.05).

Table 1 Meat quality traits of longissimus dorsi samples taken from the experimental groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Sarcomere length (µm)</th>
<th>Warner Bratzler Initial yield (kg)</th>
<th>Warner Bratzler Peak force (kg)</th>
<th>Instron Compression (kg)</th>
<th>Fat content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMD</td>
<td>1.807</td>
<td>5.37&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.27&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.220&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.24&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>SWN</td>
<td>1.795</td>
<td>6.08&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.426&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.18&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>l.s.d. (P=0.05)</td>
<td>0.039</td>
<td>0.51</td>
<td>0.51</td>
<td>0.085</td>
<td>0.40</td>
</tr>
<tr>
<td>c.v. (%)</td>
<td>7</td>
<td>27</td>
<td>23</td>
<td>11</td>
<td>49</td>
</tr>
</tbody>
</table>

For each column, those values with a different superscript are significantly different (P<0.05)

Meat quality traits are shown in Table 1. There was no difference in sarcomere lengths due to location. The samples from the EMD steers had lower Warner Bratzler shear force, both initial yield and peak force values, and Instron compression values (P<0.05) than samples from the SWN steers. The EMD steers had a greater (P<0.05) LD total fat content.

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Fat content of the LD lean portions is considered low. In comparison Sinclair and O'Dea (1987) recorded higher values - 3.9% for Bos taurus steers (258 kg carcass weight) and similar values - 2.4% for Bos taurus cross steers (273 kg carcass weight). The greater LD intramuscular and intracellular fat content of the EMD steers was in part related to their heavier carcass weight and greater carcass fatness, as indicated by rump fat depth.

The mean Warner-Bratzler initial yield shear values of the EMD steers was less than that of the SWN steers, and was probably due to a slower rate of cooling in the LD muscles of the slightly heavier and fatter EMD steers resulting in shorter sarcomere lengths. Mean sarcomere length values, Table 1, support this contention. Mean initial yield values were higher and sarcomere lengths shorter than expected for both groups indicating that electrical stimulation may not have been effective. Using the equation of Shorthose and Harris (1989), to relate Warner Bratzler and Instron compression values to taste panel tenderness values, only 12% of the LD samples from the SWN group were of average tenderness, or better, compared to 42% of the LD samples of the EMD group. The higher Instron compression values of the SWN samples suggested that connective tissue would have contributed more to meat toughness in that group. This is an expected result due to the age of the SWN steers at slaughter (4.5 years) and the slower growth of this group. From the data of Shorthose and Harris (1989) the age difference would have resulted in a 0.13 difference in Instron compression values.

The relatively slower growth rate of the EMD steers in the 12 months after relocation was unexpected. It may have been due to the physical act of relocation as has been reported by Ryan et al. (1987) or that Swans Lagoon had more than normal rainfall during the 1985 'dry' season. The weight loss in the SWN cattle between July and November 1986 is a typical expectation of cattle grazing native pastures in that environment. The steers at each location had gained liveweight at similar rates over the five to six months pre-slaughter, with the EMD steers grazing a higher quality pasture than the SWN steers immediately prior to slaughter.

In conclusion, the differences in Warner Bratzler shear and Instron compression values between the two groups of steers were probably due to age related effects (i.e., the contribution of connective tissue to muscle toughness). The effect of these nutritionally related differences in age at slaughter on Warner Bratzler and compression values were not large when compared with the differences which can result from preslaughter stress or carcass processing.

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REFERENCES