Some effects of shade in cattle feedlots

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INTRODUCTION

Finishing of beef cattle in feedlots is increasing in popularity, mostly as a result of expansion in the north Asian beef market. Of the 25 million cattle in Australia, about 350 000 are in feedlots, producing an annual turn-off of 750 000 head worth $500 million.

Cattle gain heat from metabolic activity and can also gain heat from external sources. Heat is lost from the body by convection, radiation, conduction and evaporation. A thermal balance exists when the net effect of heat gain equals the net effect of heat loss. As the air temperature rises, circulatory adjustments occur which increase the rate of heat loss. Further temperature rises invoke increased heat loss by sweating and panting. In beef cattle, two important factors affecting the ability to thermoregulate in overheated situations are cattle breed and the nature of the climatic challenge. Zebu derived breeds are more heat tolerant than other breeds. Air temperature, relative humidity and wind speed are equally important climatic variables.

Because of the availability of grain, store cattle and abattoirs, more than half of Australian feedlots are in Queensland, where the summers can be hot and humid. Australian feedlots tend to be at lower latitudes and altitudes than American feedlots and would presumably have higher heat loads. British breed cattle predominate in Australian feedlots because the export market specifications demand these breeds, rather than the more heat tolerant Zebu derived breeds.

Beef consumers as well as the general public now demand healthy, contaminant-free food products, produced with minimal environmental nuisance and discomfort to animals. Providing shade for beef production and animal welfare reasons has important implications for the design, construction, maintenance, management, profitability and acceptability of feedlots.

A number of authors have highlighted the benefits of providing shade to feedlot cattle in hot environments in terms of higher liveweight gains, better feed conversion, lower respiration rate and lower rectal temperature (Hahn 1985; Garret et al. 1960).

This paper reports the results of three experiments conducted in Queensland feedlots which studied the effect of the provision of artificial shade on beef production, welfare and behaviour.

EXPERIMENT 1

Method and results

At Theodore, in central Queensland, Brahman cross steers (50% Zebu content and 486kg at commencement) were compared in shaded and unshaded feedlot yards. Treatments were replicated three times. Shade was achieved by the erection of 70% exclusion rate, knitted, shade cloth at 3.75m above the feedlot pad to cover 25% of the feedlot yards and provide 10m² per beast. Steers were finished over 127 days on a grain-based diet to meet the specifications of the short-fed Japanese export market. Steers were fed twice daily ad libitum in open troughs. Rectal temperature, liveweight and blood samples for cortisol determination were collected at 1300hrs. Daily dry and wet bulb air temperature, cloud cover and the number of steers using the shade were determined in the feedlot at 0730 and 1500hrs. Carcass quality measurements were collected at slaughter.

Figure 1 Effect of shade on the liveweight gain of Brahman cross feedlot steers

Overall, there was no advantage in liveweight gain (181 vs 177kg), growth rate (1.45 vs 1.42kg) or final liveweight (647 vs 645kg) to the shaded group compared to the unshaded group (Figure 1).

Figure 2 Effects of shade on the feed intake of Brahman cross feedlot steers.

There was no difference in total feed intake (1.71 vs 1.73t) or feed conversion (9.5 vs 9.8).
Some of the blood samples collected for cortisol determination are yet to be analysed and therefore no conclusions can be drawn from the data.

**Figure 3** Effect of shade on the rectal temperature of Brahman cross feedlot steers.

Average rectal temperature was 0.2°C lower in the shaded steers than in the unshaded steers (39.1°C vs 39.3°C, Figure 3).

**Figure 4** Effect of shade on dry bulb air temperature at steer height in feedlot yards during February (1500 hrs)

During February, average dry bulb air temperature at 1500hrs at steer height was 0.9°C lower under the shade than in the unshaded yards (33.9°C vs 34.8°C). The corresponding figure for April was 0.6°C lower under the shade than in the unshaded yards (29.8°C vs 30.4°C). Cloud cover had the effect of reducing air temperature in shaded and unshaded yards (Figures 4).

**Figure 5** The percentage of Brahman cross feedlot steers using the shade during February (0730hrs and 1500hrs)

During February, the percentage of steers which used the shade was 41 and 70% at 0730 and 1500hrs respectively. For April the corresponding usage rate was 47 and 54%. Cloud cover reduced the rate of usage (Figure 5).

**Table 1** Carcass attributes of Brahman cross feedlot steers with and without shade

<table>
<thead>
<tr>
<th></th>
<th>Carcass wt (Kg)</th>
<th>Dressing (%)</th>
<th>P8 rump fat (mm)</th>
<th>Eye muscle (cm²)</th>
<th>Saleable yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaded</td>
<td>352</td>
<td>54.4</td>
<td>24.9</td>
<td>72.5</td>
<td>233</td>
</tr>
<tr>
<td>Unshaded</td>
<td>351</td>
<td>54.5</td>
<td>22.1</td>
<td>72.3</td>
<td>234</td>
</tr>
</tbody>
</table>

1. Objective meat colour measurement, higher values indicate brighter meat
2. Objective subcutaneous fat measurement, lower values indicate whiter fat
3. Subjective 12 point rating of intramuscular fat content, with 1 nil and 12 excessive

Shaded steers had more rump (and rib) fat (Table 1), less intramuscular fat (fat content in the strip loin) and less marbling (Table 2). These fat differences are difficult to explain.

At no time did any steers in this experiment exhibit signs of open-mouth breathing or other displays of thermal discomfort. The ability of the Zebu cross steers to tolerate heat load and to be comfortable at all times, even during handling, was quite apparent.
EXPERIMENT 2

Method and results

At Condamine, in southern Queensland, Charolais cross steers (approximately 50% Charolais content and 450kg commencement weight) were compared in shaded and unshaded feedlot yards. Treatments were replicated three times. Shade consisted of 70% exclusion rate, knitted, shade cloth at 3.75m above the pad to provide 2.5m² of shade per steer. Steers were fed a grain-based diet to meet the specifications of the long-fed Japanese export market. Steers were fed ad libitum twice daily in troughs. Liveweight was recorded approximately every two months, and feed intake daily. Carcass data were collected at the abattoir.

Figure 6 The effect of shade on the liveweight gain and feed conversion of 3 drafts of Charolais cross feedlot steer.

There was no discernible differences between the shaded and unshaded groups over the 3 drafts in liveweight gain (278.0 vs 279.4kg), feed intake (2.55 vs 2.50t) and feed conversion (9.2 vs 9.0) (Figure 6).

Table 3 Final liveweight, carcass weight and dressing percentage of Charolais cross feedlot steers with and without shade

<table>
<thead>
<tr>
<th></th>
<th>PB Rump fat (mm)</th>
<th>Marbling¹</th>
<th>Meat colour²</th>
<th>Fat colour²</th>
<th>Eye muscle area (cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaded</td>
<td>26.8</td>
<td>2.1</td>
<td>1.2</td>
<td>1.7</td>
<td>85.4</td>
</tr>
<tr>
<td>Unshaded</td>
<td>24.6</td>
<td>2.1</td>
<td>1.2</td>
<td>1.9</td>
<td>89.1</td>
</tr>
</tbody>
</table>

Table 4 Carcass characteristics of Charolais cross feedlot steers with and without shade

<table>
<thead>
<tr>
<th></th>
<th>Final liveweight (Kg)</th>
<th>Carcass weight (Kg)</th>
<th>Dressing percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaded</td>
<td>743.2</td>
<td>417.6</td>
<td>56.2</td>
</tr>
<tr>
<td>Unshaded</td>
<td>744.6</td>
<td>417.5</td>
<td>56.1</td>
</tr>
</tbody>
</table>

¹ Subjective 12 point rating of intramuscular fat content
² 9 point scale, 1 = bright, 9 = dark
³ 10 point scale, 0 = white, 9 = yellow

Shaded steers had more rump fat than unshaded steers and there were small differences in fat colour and eye muscle area (Table 4).

During the heat of the day, steers made extensive use of the shade, making only infrequent visits to the feed and water troughs. Visual observation indicated that shaded steers demonstrated less open-mouth breathing than unshaded steers. Steers left the shade for extended periods only during the cooler part of the day.

During a severe heat wave in February, four steers died from excessive heat load in the unshaded group whereas none died in the shaded group.

EXPERIMENT 3

Method and results

In a third experiment at Texas, in southern Queensland, air dry bulb temperature, relative humidity and rectal temperature were measured in shaded and unshaded Hereford steers (approximately 450kg liveweight) over a three day period. Shade consisted of 70% exclusion rate, knitted, shade cloth at 3.5m above the feedlot pad.

Figure 7 The effect of shade on the rectal temperature of Hereford feedlot steers
The average rectal temperature for the shaded Hereford steers was 1.1°C lower than for the unshaded steers (39.0 vs 40.1°C, Figure 7).

Evidence from observations, and aerial photography, from feedlot yards suggest that the shade usage for British and European breeds is higher than for Zebu derived breeds.

CONCLUSIONS AND COMMERCIAL IMPLICATIONS

Provision of shade cloth was effective in reducing air dry bulb temperature at steer height during summer and autumn. The reduction was less than that reported by Garret et al. (1960). The effectiveness of higher exclusion rate shade cloth than that used in these experiments needs investigating.

Shade reduced rectal temperature marginally in Zebu cross steers although the rectal temperature in unshaded steers was not unacceptably high (39.3°C).

Usage of shade by Zebu cross steers was less than that generally observed in feedlots for European and British breeds.

Provision of shade gave little benefit to Zebu cross steers in terms of liveweight gain, feed conversion and carcass quality. Rectal temperature and absence of signs of thermal discomfort indicate that unshaded Zebu cross steers are unlikely to suffer from excessive heat load in Queensland feedlots. This finding is supported by the comparative breed studies of Finch (1985, 1986) and others.

Shade failed to improve the liveweight gain, feed conversion and carcass quality of Charolais cross steers relative to unshaded steers. However, it did reduce open-mouth breathing and deaths from excessive heat load.

Shade was very effective in reducing rectal temperature in Hereford steers from an unacceptably high level of 40.1°C.

These results suggest that shade may increase subcutaneous fat and reduce intra muscular fat. This would have important implications for meeting the specifications in the north Asian export market and needs further investigation.

Clearly, research needs to be continued on the effect of excessive heat load on beef production and cattle welfare in Queensland feedlots, especially with British breeds. More research and development also needs to be conducted on the design and management of shade structures and their integration in the overall design and management of the feedlot.

Installation of shade for trial and commercial reasons is continuing in most big commercial feedlots in Queensland. Useful, practical, field knowledge is being accumulated as to likely benefits to production, waste management and cattle welfare, as well as the advantages and disadvantages of the various designs which are available.

REFERENCES


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