The use of shade and betaine to ameliorate heat load

IT HAS been suggested that certain dietary supplements have the potential to ameliorate the effects of high heat load in feedlot cattle. Betaine is on such supplement. Anecdotal evidence from commercial feedlots in Australia suggested that there were benefits in feeding betaine over the summer months. There was, however, very little scientific data to support a benefit of betaine supplementation in beef cattle, although it has been proven to be of benefit in poultry and pigs. Therefore, MLA-funded the University of Queensland to undertake a project (B.FLOT.0345) to investigate the effects of betaine when fed to feedlot cattle at different inclusion levels over the summer months.

The specific objective of this project was to determine effect of dietary betaine on dry matter intake, water intake, feed efficiency, ADG, core body temperature, respiratory dynamics and carcase quality when steers had either access (S) or no access to shade (NS).

To do this, 164 Angus steers (396 kilograms BW at induction) were on

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Table 1: Effect of diet and shade (no shade and shade) on panting score at three times of the day from induction to day 120.

	Mean panting score		
Induction – day 30	**AM**	**Midday**	**PM**
Diet (D)	No effect	No effect	No effect
Shade (S)			
Nil Shade	0.82^{a}	1.57^{a}	0.96^{a}
Shade	0.67^{b}	1.15^{b}	0.83^{b}
SE	0.02	0.03	0.03
Day 30 to Day 60	**AM**	**Midday**	**PM**
Diet (D)			
Control	0.64^{a}	1.52^{a}	0.88
Betaine 10	0.61^{ab}	1.40^{b}	0.84
Betaine 20	0.51^{bc}	1.34^{b}	0.75
Betaine 40	0.62^{a}	1.39^{b}	0.83
SE	0.03	0.04	0.04
Shade (S)			
Nil Shade	0.61^{a}	1.61^{a}	0.89^{a}
Shade	0.54^{b}	1.21^{b}	0.75^{b}
SE	0.02	0.03	0.03
Day 60 to Day 90	**AM**	**Midday**	**PM**
Diet (D)			
Control	0.57^{a}	1.37	0.72
Betaine 10	0.55^{a}	1.24	0.70
Betaine 20	0.53^{a}	1.22	0.63
Betaine 40	0.57^{a}	1.29	0.69
SE	0.02	0.04	0.02
Shade (S)			
Nil Shade	0.60^{a}	1.52^{a}	0.77^{a}
Shade	0.45^{b}	1.04^{b}	0.61^{b}
SE	0.02	0.03	0.02
Day 90 to Day 120	**AM**	**Midday**	**PM**
Diet (D)			
Control	0.31^{a}	1.32^{a}	0.72
Betaine 10	0.29^{a}	1.20^{b}	0.68
Betaine 20	0.27^{a}	1.16^{b}	0.63
Betaine 40	0.30^{a}	1.24^{ab}	0.69
SE	0.02	0.03	0.03
Shade (S)			
Nil Shade	0.32^{a}	1.42^{a}	0.74^{a}
Shade	0.22^{b}	1.03^{b}	0.62^{b}
SE	0.01	0.02	0.02

feed for 120 days from November 12 until March 11. Four dietary treatments and two shade treatments were used. The dietary treatments (T) were: $B0_{NS}$ – 0 grams/hd/d betaine; $B0_{S}$ – 0g/hd/d; $B10_{NS}$ – 10g/hd/d betaine; $B10_{S}$ – 10g/hd/d betaine; $B20_{NS}$ – 20g/hd/d betaine; $B20_{S}$ – 20g/hd/d; $B40_{NS}$ – 40g/hd/d betaine; and $B40_{S}$ – 40g/hd/d.

Sixteen pens (144 square metres) were used at the Brigalow Research Station feedlot. The feedlot had a north-south alignment. The surface of the pens was soil. Concrete feed bunks were located at the front of each pen. The linear feed bunk area/steer was 588 millimetres for betaine pens. Water troughs were located at the rear of the pens. The linear water trough areas were 242mm/steer. The stocking density (18sqm/steer) was obtained using eight steers/pen Within each dietary treatment group two pens were unshaded and two pens had shade (approximately 3.2sqm/steer). Shade was provided by 80% solar block shade cloth (four metres high) with a north-south allignment. The study was replicated so there were two pens per dietary treatment.

The feeding management used in the study was a modified 'clean bunk at midday' program. The first ration was fed out in the afternoon of November 12 (days on feed – DOF – 0). The starter ration was used for four days, followed by intermediate 1 for seven days, intermediate 2 for six days and finisher for the remainder of the study, except for three days in January when a heat load emergency ration was used. Feed intake was recorded on a pen basis each day.

In order to obtain body temperature, 63 steers were implanted (between the internal abdominal muscle layer and the peritoeum at the right side flank) with a body tem-

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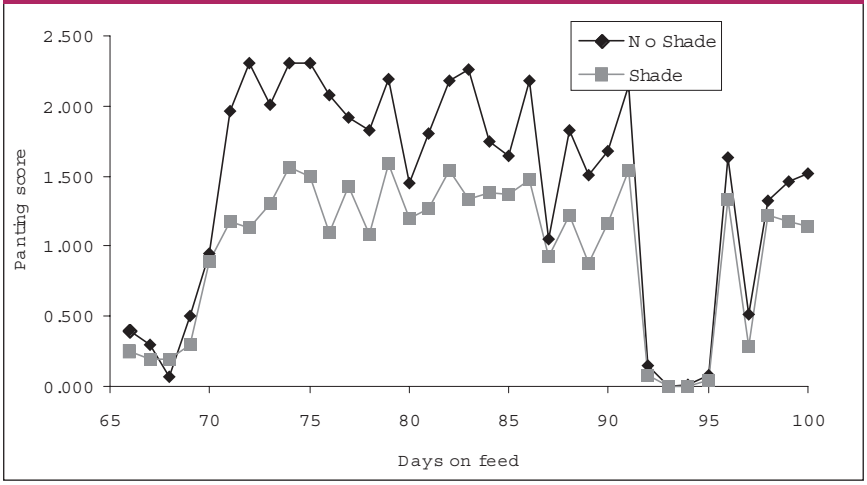
perature transmitter 30 days before the commencement of the feedlot study. Each transmitter (30mm wide by 95mm long) operated on a different radio frequency. The transmissions were detected at 30-minute intervals and logged to a receiver located in an office at the feedlot. Three steers with transmitters were allocated to each. The remaining three steers were retained in a spare feedlot pen in case of failure of a transmitter in the trial cattle.

Results

The findings from this study have provided for the first time in Australia a scientific basis to the use of betaine in diets fed to finishing cattle over the summer months.

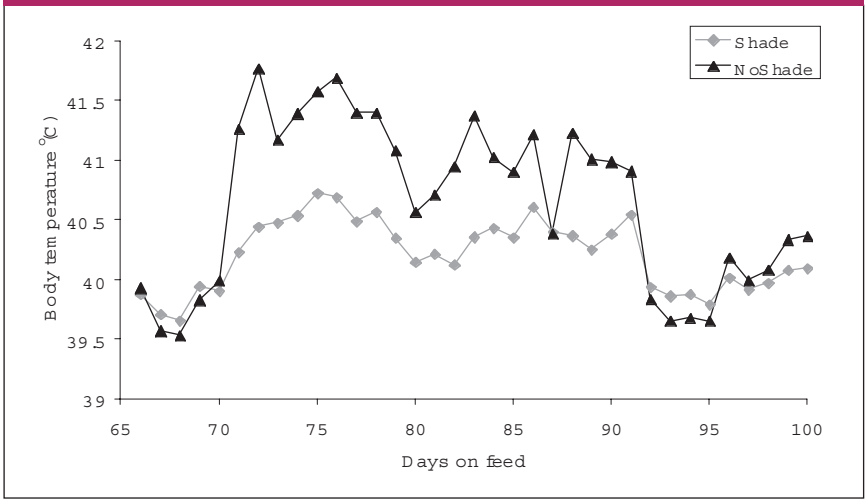
Over the 120-day feeding period the steers (shade and no shade combined) fed B10 and B20 had a better ADG (1.62kg/d) compared to the controls, with 1.55kg/d. The feed efficiency was also better for the B10 (6.35:1) and the B20 (6.32:1) compared to the control groups (6.43:1). Feeding more than 20g of betaine had a negative effect on ADG and feed efficiency. There were no dietary effects on DMI but over the duration of the study shaded steers consumed 300g/d more than un-shaded steers.

Figure 1: The effect of shade on maximum body temperature during a period of high heat load (all points between day 70 and day 85 are significantly [P<0.05] different)



The provision of shade reduced the panting score of steers in the morning (P<0.001), at midday (P<0.001) and in the afternoon (P<0.001) between induction and day 120. The highest magnitude of panting scores was recorded at the midday observation.

Figure 2: The effect of shade on minimum body temperature during a period of high heat load (all points between day 72 and day 82 are significantly [P<0.05] different)



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Panting Score

The provision of shade reduced mean panting score (MPS) at all observation times over the duration of the study. Steers with an MPS>1.2 are under severe heat stress. MPS was not affected by diet (P>0.05) from induction to day 30. However, there were effects for the periods day 30 to 60, day 60 to 90 and day 90 to 120 (Table 1). The cattle feed diets containing betaine had lower (P<0.05) panting scores at midday for the periods 30 to 60 days and 90 to 120 days. The provision of shade reduced the panting score of steers in the morning (P<0.001), at midday (P<0.001) and in the afternoon (P<0.001) between induction and day 120. The highest magnitude of panting scores was recorded at the midday observation.

The effect of shade on panting score during the period of high heat load is presented in Figure 1. During this period cattle with access to shade had lower (P<0.05) panting scores than those with out access to shade.

Body temperature

During periods of high heat load the provision of shade generally reduced (P<0.05) maximum body temperature (Figure 1). Diet did not (P>0.05) reduce maximum body temperature.

An interesting effect of shade is that cattle with access to shade had a higher minimum temperature that those without access (Figure 2).

Carcase value

Carcase value was enhanced by the addition of betaine to the diet. However, there was also an interaction between dietary treatment and shade. The carcass value of the $B0_S$ cattle was \$7/steer greater than the $B0_{NS}$ steers. There was a reduction in the carcase value of betaine fed to steers which did not have access to shade (approximately \$10/steer).

However, when shade and betaine were used together there were significant gains in carcase value. The $B10_S$ steers returned \$1177 per carcase (less feed costs) whereas the $B10_{NS}$ returned \$1124 per carcase – an improvement of \$53/steer. There was also a \$53/steers return for the $B20_S$ compared to the $B20_{NS}$ steers. There were no differences between the $B40_S$ and $B40_{NS}$ steers. The value of carcases from this treatment were similar to the controls.

Conclusions

In conclusion, a number of clear positive, measurable welfare outcomes (reduction in core body temperature and reduction in mean panting score) and production responses have been demonstrated from this study.

The main findings from this study are:

* Betaine inclusion (B10 and B20 g/steer/d) in the diet of cattle with access to shade improved carcase value by \$53/steer compared to controls – a significant production outcome.
• There were no improvements in carcase value when betaine was fed to steers in unshaded pens.

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• There were significant reductions in panting scores of the steers fed the B10 diet during periods of high heat load – a positive welfare outcome.
• During periods of high heat load, cattle with access to shade had lower midday mean panting scores (20 to 30% lower).
• There were no dietary effects on body temperature.
• Maximum body temperature were greater for non-shaded than shaded cattle (41.7°C and 40.5°C respectively) – a positive welfare outcome.
• Access to shade reduced the impact of extreme conditions but did not completely eliminate heat stress.