EVALUATION OF HEAT RESISTANCE OF F1 PROGENY OF BORAN, TULI AND BRAHMAN BULLS AND HEREFORD DAMS

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SUMMARY

Three steers from each of the following breeds Hereford, Hereford x Boran, Hereford x Tuli, Hereford x Brahman and Brahman were subjected to heat stress in an environmentally controlled room. Heat tolerance was assessed by comparing respiration rates, sweating rates, rectal temperatures and by visual assessment. Under high heat load, the mean respiration rate of the Brahmans was lower than that of all other breeds, except for the Hereford x Boran. Sweating rate for Hereford x Brahman was greater than that of all other breeds. The Brahman had the lowest rectal temperature and the Hereford the highest. These data suggest that the Hereford x Boran and Hereford x Tuli are similar to Hereford x Brahman and better than the Hereford in maintaining homeostasis when heat stressed.

Keywords: Boran, Tuli, Brahman, Hereford, heat stress.

INTRODUCTION

Hot humid conditions during summer months in Northern Australia are known to depress the reproductive and growth performance of heat susceptible breeds of beef cattle. *Bos indicus* breeds, notably the Brahman are used to combat the effects of heat stress, and in addition because of their resistance to ticks. However, some of the traits of the Brahman negatively impact on their productivity. For example their lower reproductive and growth performance compared to *Bos taurus* and Brahman crossbred cattle (Frisch 1989; Galina and Arthur 1989). To increase the pool of adapted genotypes in Australia, and improve overall productivity, a number of tropical breeds including the Boran and Tuli have been imported (Frisch 1989; Ralph 1989). Before the widespread use of these genotypes can be recommended, they need to be evaluated for their adaptability to Australian conditions.

The objective of this study was to evaluate the resistance to heat stress of Boran (*Bos indicus*) and Tuli *(Bos taurus)* crossbred steers when exposed to ambient temperature and humidity in an environmentally controlled room.

MATERIALS AND METHODS

The number in each breed and their starting weights were, 3 Hereford (246 kg), 3 Hereford x Boran (264 kg), 3 Hereford x Tuli (249 kg), 3 Hereford x Brahman (256 kg) and 3 Brahman (247 kg). The steers were approximately seven months old at the start of the trial. The Hereford (H) and the Brahman (B) steers were purchased locally. The Brahman (H x B), Boran (H x Bo) and Tuli (H x T) crossbreds were obtained through the regular breeding programme at UQG.

The steers were restrained in individual stalls (n=6) by a head halter within a temperature controlled room. Rectal temperature (RT) was measured using probes as per the method of Gaughan *et al* (1996) and was recorded every 5.4 minutes using a datalogger (Smart Reader; ARC Systems, Brisbane) over a 12 h test period. Ambient temperature and relative humidity were recorded continuously (Mini-logger; Mini-Mitter, USA). Respiration rate (RR) was measured each hour (visual observation for 60 seconds). Sweating rate (SR) was measured hourly by the method of Schleger and Turner (1965). Feed was removed at 1700 h, the day prior to testing to minimize the effect of metabolic heat production from the feed. Water was available *ad libitum.*

The steers were exposed to thermonuetral conditions (THI[1] ≤ 64) for 12 h to establish base readings for respiration rate and rectal temperature. They were then exposed to hot conditions for 10 hours. On the days of test, a gas heater and a water misting unit were turned on at 0600 h and THI was allowed to reach 97.5 and was then maintained at 97.5 by adjusting water input (misters) and temperature (gas heater). The gas heater and misters were turned off at 1600 h and room conditions were allowed to equilibrate to ambient conditions. The animals were monitored continuously (via video camera) when exposed to high heat load. When RT exceeded 41.5 °C or the steer showed visible signs of distress, it was immediately removed from the room. Each animal was exposed to the hot conditions five times and were spelled for at least four days between exposures.

The data were analysed using the Statistical Analysis System (SAS 1988).

RESULTS AND DISCUSSION

From 0800 h to 1600 h each day of test the mean ambient temperature was 36.8 °C and ranged from 32.9 to 40.3 °C. The mean relative humidity was 92.6 % and ranged from 71.1 to 100 %. Humidity and ambient temperature were generally maximum by 1000 h and 1400 h respectively each day with a mean THI of 96.3 (range from 91.3 to 100.2). Under thermonuetral conditions THI did not exceed 64. *Bos taurus* dairy cattle are considered to be under mild heat load when THI exceeds 72 (Du Preeze et al. 1990; Armstrong 1994), and 79 for beef cattle (Mader *pers.comm.*).

The least squares means ± standard error of means for RR, SR and RT at two THI values are presented in Table 1. RR under thermonuetral conditions (THI = 64) for the H, H x Bo, H x T and H x B are similar to previous studies Gaughan *et al.* (1996) and Rometsch and Becker (1993). In the present study, RR of the B steers was about significantly lower (P<0.05) than that for H, Bo x H and T x H. There was little difference between H x B and B steers for RT but RR were significantly different. Under high heat load (THI = 97) the RR for all breeds was significantly higher (P<0.05) than under thermonuetral conditions. Again, RR of the B steers was lower than that measured for all other breeds. There was little difference between the H and Bo and T cross steers. Both RT and SR were not influenced by breed type under thermonuetral conditions.

[1] THI = (dry bulb temperature °C) + (0.36 x dew point temperature °C) + 41.2

However, under hot conditions SR for H x B steers was greater than that of any other breed. RT was influenced by breed. The B steers had the lowest (P>0.05) RT and the H the highest. There was no significant difference between the crossbred steers. These data suggest that the H x Bo and H x T have similar capacity compared to H x B steers and a better capacity than the H steers to maintain body temperature when exposed to high heat load.

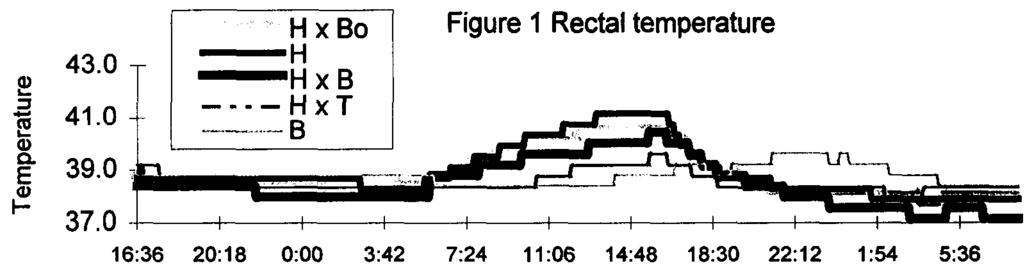
Table 1. Least square means ± standard error of means for respiration rate (breaths/min), sweating rate ($g/m^2/h$) and rectal temperature (^oC) under thermonuetral (THI=64) and high heat load (THI=97) conditions

	B	H	H x Bo	H x T	H x B
THI = 64					
RR	$32.85^{a} \pm 5.20$	$66.55^{b} \pm 5.20$	$50.70^{c,b,e} \pm 5.20$	$51.05^{d,b,e} \pm 5.20$	$46.14^{a,e} \pm 5.20$
SR	113.99 ± 19.50	118.45 ± 19.50	98.55 ± 19.50	101.01 ± 19.50	81.77 ± 19.50
RT	38.50 ± 0.18	38.30 ± 0.18	38.10 ± 0.18	38.26 ± 0.18	38.46 ± 0.18
THI = 97					
RR	$119.55^{a} \pm 7.39$	$172.75^{b} \pm 8.26$	$177.68^{b} \pm 4.99$	$174.83^{b} \pm 5.10$	$142.20^{e} \pm 5.22$
SR	$188.22^{a} \pm 14.82$	$185.11^{a} \pm 16.56$	$220.84^{a,c} \pm 9.01$	$187.58^{a} \pm 10.22$	$224.99^{b,c} \pm 10.47$
RT	$39.29^{a} \pm 0.18$	$40.56^{b} \pm 0.21$	$39.67^{a,d} \pm 0.11$	$39.79^{c,d} \pm 0.13$	$39.96^{d} \pm 0.13$

a,b,c,d,e Means in a row with different superscripts differ (P<0.05).

The time taken for RT to peak and then to return to normal is a good indicator of the animals ability to dissipate body heat. This has important implications especially under periods of prolonged exposure to high heat load because RT would not have a chance to decline. Feed intake drops as ambient temperature rises above 24 °C (Gaughan *et al.* 1996; NRC 1981) and also when body temperature increases above normal (Blackshaw and Blackshaw 1994; Hahn 1995). Therefore, an animal in which the body temperature returns to normal faster may eat more than an animal whose body temperature remains elevated. RT for five steers is presented in Figure 1. Typically once the external heat was removed RT fell and returned to normal within three hours. In all cases RT increased as ambient temperature increased. SR and RR followed a similar pattern to RT. SR of H and T x H steers increased for the first four hours and then declined. SR for all others continued to increase or leveled out. RR for H increased over the first four hours and then fell, indicating an inability to cope with the conditions imposed. RR for all others increased and then leveled out.

The H steers were least able to cope with the hot conditions. The H steers were removed (by 1400 h) from the trial on three of the four occasions. On one occasion a B steer was also removed (at 1400 h). In these cases the animals had raised RT, rapid breathing and excessive salivation. All animals recovered rapidly once removed to an outside yard. The remainder of the animals appeared to cope with the hot conditions. Overall the H x Bo and H x T were able to tolerate the hot conditions better than either the H or H x B steers.



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