A DEVICE FOR DETECTING PERIODS OF HIGH HEAT LOAD IN ANIMALS

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Two environmental factors responsible for depressing feed intake and decreasing productivity in dairy and feedlot cattle are high ambient temperature (T) and high relative humidity (RH) (Horst 1983). Previous and current practices to reduce heat load (combination of T, RH, solar radiation and body condition) of cattle offer either partial or high-cost solutions (Shearer *et al.* 1991).

The thermal load monitor (TLM) was built to simulate thermal reactions of cattle to changes in T and air movement (Wd), and to detect these changes at an early stage before they impact negatively on cattle performance and welfare. The TLM consists of a solid aluminium black globe (BG) containing thermo-sensors connected to cooling/heating pumps and a computer-controlled monitoring system. The TLM was tested in an environmentally-controlled room over a temperature range of 24 to 48°C with Wd across the BG of 0.0 (control), 0.2, 0.5, 1.0 or 2.0 m/s, at either 30 or 50% RH. The energy flux (watts, W) from or to the BG was measured and indicated either cooling (+ W) or heating (- W) to maintain the BG temperature at 38.6° C.

A significant relationship exists between W and T, and W and Wd for the different temperatures (Table 1). The regression analysis indicates significant effects ($P<0.001$) of T and Wd on W at 50% RH ($W = -50.69 + 1.33T - 0.99Wd; R^2 = 0.89$) and at 30% RH ($W = -34.65 + 0.89T - 0.39Wd; R^2 = 0.52$). Wd had a significant effect ($P<0.001$) on W at all temperatures when tested at 50% RH, but was less consistent at 30% RH. Generally as air speed increased more energy was used to maintain globe temperature at both low and high ambient temperatures.

Table 1. Least Squares means ± SEM[A] of TLM energy flux (pooled) for ambient temperatures either above or below 35 °C at 30% and 50 % relative humidity

Air movement (m/second)	Energy flux (watts)			
	30% Relative humidity		50% Relative humidity	
	<35°C	>35°C	<35°C	>35°C
0.0 (control)	-5.19 ± 0.26[bB]	1.63 ± 0.46[b]	-5.71 ± 1.18	1.45 ± 1.69
0.2	-8.08 ± 0.36[a]	2.80 ± 0.48[b]	-10.01 ± 1.18[a]	3.82 ± 1.69[a]
0.5	-4.47 ± 0.74[b]	4.11 ± 0.44[a]	-9.22 ± 1.18[a]	3.48 ± 1.69[a]
1.0	-10.15 ± 0.58[a]	4.49 ± 0.56[a]	-12.64 ± 1.18[a]	4.56 ± 1.69[a]
2.0	-5.91 ± 0.55[b]	6.02 ± 0.51[a]	-16.17 ± 1.18[a]	5.29 ± 1.69[a]

[A]SEM = standard error of the means, [B]Means not sharing common superscripts are significantly different ($P<0.05$).

The TLM can be used for early detection of periods of heat load which may affect animal productivity and could be incorporated into an alarm system or automated cooling system. Conventional sprinkler and fan systems could be automatically switched on or adjusted by signals triggered by the TLM. Consequently, losses in animal productivity induced by hot conditions could be reduced. The TLM could be used, after minor modifications, to simulate the thermal reactions of a wide range of animal species. Further work will be undertaken to assess the TLM's response to solar radiation, effects of moisture and evaporative heat loss.

SHEARER, J.K., BEEDE, D.K., BUCKLIN, R.A. and BRAY, D.R.T. (1991). *Agric. Prac.* **12:** 1-1 8.
HORST, P. (1983). *J. S. A.Vet. Ass. 54:* 159-64.