EFFECT OF ELEVATED AMBIENT TEMPERATURE ON SWEATING RATE, RECTAL TEMPERATURE AND RESPIRATION RATE OF HEIFERS

J.A. Vizcarra[1], R.P. Wettemann[2], D.K. Bishop[1], S. Al-Shorepy[1], M. Aslam[1], L.A. Baker[1], B. De Rodas[1] and D.L. Wall[1]

Story in Brief

The effect of elevated ambient temperature on sweating rate, rectal temperature and respiration rate was evaluated in heifers adapted to cool (47 F) or warm (65 F) ambient temperatures. Sweating rate was measured on the ribs and on the rump. When exposed to elevated ambient temperature (92 F), heifers adapted to a cool environment tended to produce more sweat than heifers adapted to a warm environment. Exposure of heifers to heat stress, after adaptation to a cool environment, increases rectal temperature, respiratory rate and sweating rate within 135 min.

(Key Words: Acclimatization, Heat Stress, Rectal Temperature, Respiration Rate, Sweat.)

Introduction

Sudoriferous (sweat) glands are the main avenue of heat dissipation and body temperature regulation in cows (McDowell et al., 1961; Amakiri, 1974). The rate of sweating over different body regions has been investigated. Fourteen parts of the body were measured by Berman (1957) and the highest evaporation rates occurred on the muzzle, neck, vulva and front flank. Hyperthermia causes decreases in feed consumption, milk production and estrous behavior of cattle. Finch et al. (1982) concluded that sweating response was a good indicator of thermoregulatory ability of cattle.

Different methods to measure the rate of sweating have been investigated. In humans, suitable methods have been developed for measuring cutaneous water loss from the whole body surface, but the collection of moisture from cattle skin presents great difficulty. The objectives of this study were to determine an efficient method to measure the sweating rate of cattle, and to determine the effect of adaptation of cattle to a

---

[1]Graduate Student [2]Regents Professor

cool or warm environment on sweating rate respiration rate, and rectal temperature when cattle were exposed to elevated ambient temperature.

Materials and Methods

Four mature heifers were acclimated to either 47 F or 65 F for 8 days. They were then exposed to 92 F for 135 min and sweating rate, rectal temperature and respiration rate were determined. A 32.5 cm^2 patch of absorbant lab mat (paper backed with a thin plastic film) was soaked in a saturated solution of calcium chloride and water for 30 min. Patches were dried at 125 F for 24 h. Each dried patch was sealed in a plastic bag to minimize absorbtion of moisture from the atmosphere. Hair was removed from the rib and rump areas of heifers. The plastic bag and the patch were weighed. The patch was removed from the bag, and placed immediately on the animal and covered with aluminum foil for 10 min. The patch was removed, placed in the plastic bag and re-weighed. The uptake of moisture was measured by the difference of weight of the patch before and after exposure to the heifer. Respiration rate was determined by counting movement of the ribs for a period of 30 seconds. Rectal temperature was obtained with a clinical thermometer.

Results and Discussion

The amount of sweat collected on the rump and ribs, rectal temperature and respiration rate increased with time after exposure to elevated ambient temperature. The amount of sweat measured on the rump increased linearly ($P<.02$) with time when animals were heat stressed. There was a tendency ($P<.11$) for the heifers that were adapted to the cool environment to produce greater amounts of sweat on the rump than the heifers adapted to the warm environment when the animals were exposed to 92 F for 135 min (Fig. 1). The increase in rectal temperature during exposure to heat stress was also greater ($P<.01$) for heifers adapted to the cool environment compared with heifers adapted to the warm environment (Figure 2).

As the rectal temperature of heifers increased between 100.2 and 102.5 F, the sweating rate on the rump tended to increase ($r=.41$; $P<.12$) (Figure 3). Sweating rate increased to 1 gm/100 cm^2/10 min in some heifers when rectal temperature was 102.5 F. Rectal temperatures of the heifers were correlated ($r=.77$) with respiratory rates.

We conclude that heifers adapted to cooler ambient temperature have greater sweating rates and rectal temperatures when exposed to heat stress than heifers adapted to a warmer environment. Absorption of sweat by calcium chloride can be used to quantify sweating rate in cattle.

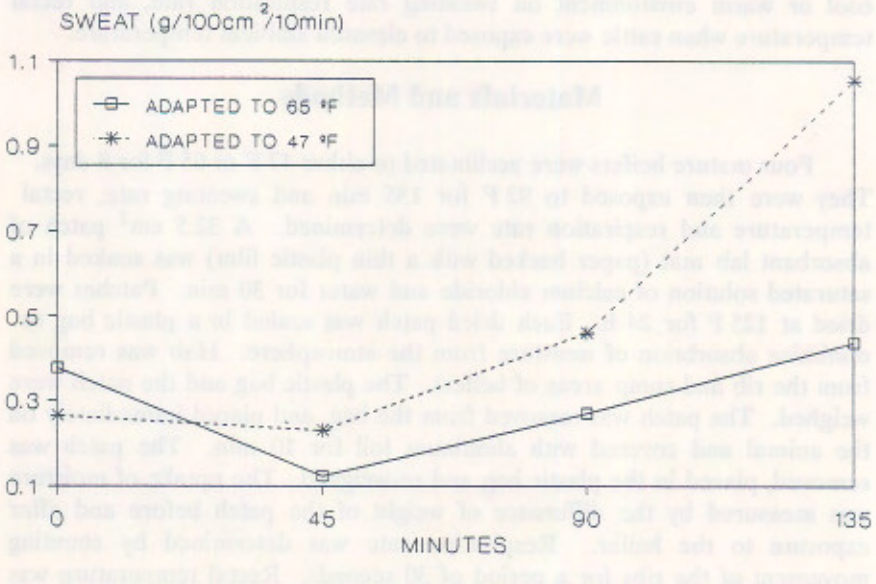

Figure 1. Sweating rate of heifers adapted to a cool or warm environment and exposed to 92°F.

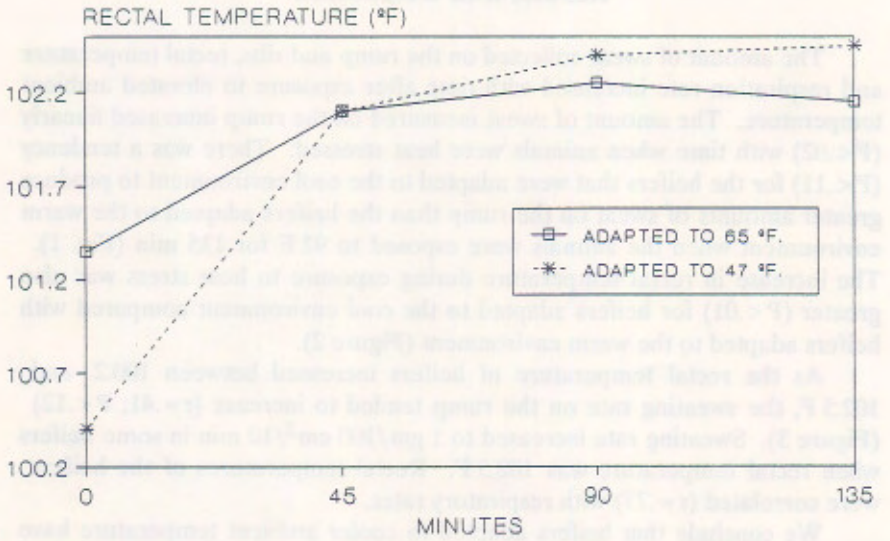

Figure 2. Rectal temperature of heifers adapted to a cool or warm environment and exposed to 92°F.

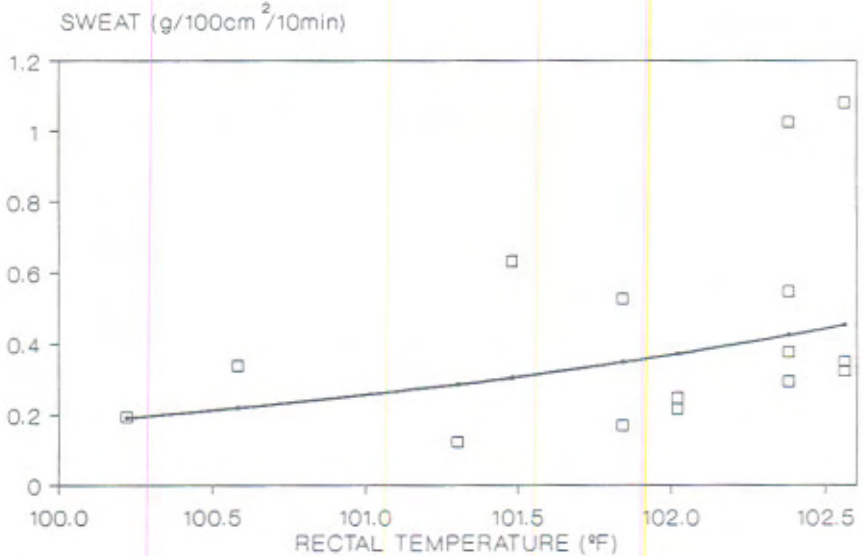

Figure 3. Relation between sweating rate and rectal temperature.

Literature Cited

Amakiri, S.F. et al. 1984. Sweat gland measurement in some tropical and temperate breeds of cattle in Nigeria. Anim. Prod. 18:285.

Berman, A. et al. 1957. Influence of some factors on the relative evaporation rate from the skin of cattle. Nature London 179:1256.

Finch, V.A. et al. 1982. Sweating response in cattle and its relation to rectal temperature, tolerance of sun and metabolic rate. J. Agric. Sci. Camb. 99:479.

McDowell, R.E. et al. 1971. Rate of surface evaporation from the normal body surface and with sweat glands inactivated under hot conditions. J. Anim. Sci. 20:380.