GENETIC AND GENOTYPE X ENVIRONMENT EFFECTS ON BLOOD ELECTROLYTE CONCENTRATIONS AND HAEMATOCRITS OF HEIFERS

R.M. Seebeck and Jayne A. Seebeck

CSIRO Tropical Cattle Research Centre, Rockhampton, Qld. 4700.

Evans and Turner (1965) found that there were distinct differences between various breeds of cattle in erythrocyte sodium (Na_e +) and potassium (K_e +) levels. We considered that these differences may be associated with subsequently reported differences in basal metabolism, acting through different activities of the sodium-potassium pump in cell membranes. Possible interactions with plasma levels and haematocrits also needed to be considered.

Blood samples were taken from a group of heifers at one year of age and (Na_e +), (K_e +), plasma sodium (Na_p +) and potassium (K_p^+), and haematocrits measured. The breeds sampled were Brahman x (Hereford x Shorthorn) of F_n generation (BX) (33 animals), selected Hereford-Shorthorn (HSS) (21 animals) and random-bred Hereford-Shorthorn (HSR) (13 animals). The HSS/HSR comparison was particularly interesting because, starting from the same base stock, the HSS have become more adapted to the environment and have lower fasting heat production (Frisch and Vercoe, 1979), i.e. approaching the BX. The heifers were run together and approximately half of them were treated for endoparasites by injecting an anthelmintic (tetramizole) monthly, while the remainder were untreated. Helminth eggs per gram of faeces (e.p.g.) were assessed for the three months prior to blood sampling on the untreated animals. There was no control of cattle ticks (*Boophilus microplus*), which were counted one month before blood sampling.

The data were analysed using general least squares principles, the implementation being the computer package SYSNOVA (Seebeck, 1980). Tick counts and e.p.g.'s were transformed to logarithms (after incrementing by 1), and means, within breed for tick counts, and within treatment for e.p.g., were subtracted from the values so that their use as covariates would not bias breed or treatment effects, respectively.

There were significant differences (Table 1) between breeds in both (Na_e^+) and (K_e^+), with the BX having low (K_e^+) and high (Na_e^+), the HSR having high (K_e^+) and low (Na_e^+), and the HSS between the other breeds in both (Na_e^+) and (K_e^+) but towards the higher value in each case. The ranking is in accordance with low (K_e^+) being associated with low metabolic rate. There were no significant differences between treatment groups in the (Na_e^+) and (K_e^+), nor was there any relationship of these parameters with any of the other parameters recorded.

TABLE 1. Least squares means for Na^+ and K^+ concentrations (meq/l) in erythrocytes.

Parameter	BREED		
	BX	HSS	HSR
Na_e^+ (meq/l)	69.9^a	68.0^a	62.2^b
K_e^+ (meq/l)	17.7^a	21.1^b	21.9^b

a,b Values with different superscripts in the same line are significantly different.

While there were no significant overall differences between breeds in (Na_p^+) and (K_p^+), there were significant treatment effects within breeds. The anthelmintic increased (Na_p^+) significantly ($P<0.05$) in all three breeds, and had a differential effect between the breeds on (K_p^+) (interaction significant:- $P<0.01$), (K_p^+) being decreased in the HSS, increased in the HSR and not changed in the BX (Table 2). The tick number was negatively related to (Na_p^+) in the BX, but positively related to the HSS and HSR, the difference being significant ($P<0.05$). Tick number was positively related ($P<0.01$) to (K_p^+) within the three breeds.

TABLE 2. Least squares means for Na^+ and K^+ concentrations (meq/l) in plasma, and haematocrits*.

Parameter	BREED					
	BX		HSS		HSR	
	T[1]	NT[2]	T[1]	NT[2]	T[1]	NT[2]
Na_p^+ (meq/l)	142.1	141.4	142.7	140.4	143.3	140.8
K_p^+ (meq/l)	4.4	4.5	4.0	4.4	4.5	4.1
Haematocrit (%)	33.4	31.0	30.3	29.3	34.9	30.5

* See text for significance of differences

[1] Treated with tetramizole

[2] Not treated with tetramizole

There were significant breed and treatment differences in haematocrits. Treatment with anthelmintic significantly ($P<0.01$) increased haematocrits but this was only slight in the HSS. The mean e.p.g., and the e.p.g. for the last month, were positively related to haematocrit ($P<0.05$), instead of the negative relationship one would expect from the anthelmintic response. The tick number was negatively related to haematocrits in the BX, but positively related in the HSS and HSR, the difference being significant ($P<0.05$). Between breeds, HSR and BX had the highest haematocrit and the HSS the lowest ($P<0.01$). This finding was unexpected, because stresses in a sub-tropical environment depress haematocrit, and HSS are more tolerant to those stresses than the HSR as discussed above.

We wish to acknowledge R. Bryan and G.W. Seifert for the provision of egg count, tick number and body weight data.

REFERENCES

EVANS, J.V. and TURNER, H.G. (1965) *Aust. J. Biol. Sci.* 18: 124-39

FRISCH, J.E. and VERCOE, J.E. (1979) *Tropical Animal Production* 4: 214-22

SEEBECK, R.M. (1980) Sysnova Version 9 Reference Manual. CSIRO Division of Animal Production (in press).