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THE FASTING METABOLISM OF AFRICANDER AND BRITISH CROSSBRED CATTLE AND THE EFFECT OF PREVIOUS INFESTATION WITH CATTLE TICK *(BOOPHILUS MICROPLUS* CANESTRINI)

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Summary

The fasting gas exchanges of Africander x British (AX) and Shorthorn x Hereford (SH) crossbred bulls, some of which had previously been infested with cattle tick *(Boophilus microplus,* Canestrini), were measured four weeks after dipping.

There was no breed difference in fasting gas exchange, although AX bulls had a significantly lower respiratory quotient. Prior tick infestation raised the fasting heat production in the SH bulls, but not significantly so, and animals that had been infested had a significantly higher respiratory quotient regardless of breed.

I. INTRODUCTION

It has been reported by Seebeck, Springell and O'Kelly (1971) that the compensatory gain by a group of tick infested steers was less than that of a group which had been matched with it for food intake and kept tick free. Results from other studies support the view that the tick secretes a toxin which interferes with its host's metabolism (O'Kelly, Seebeck and Springell 197 1). Efficiency of energy utilization and fasting heat production may be altered in some metabolic disorders, e.g. in cases of vitamin or mineral deficiency (Kleiber 1945; Blaxter 1962).

Fasting gas exchanges were therefore measured on Africander cross and British cross cattle, some of which had previously been infested with ticks, to determine whether a change in maintenance requirement is a component of the after effects of tick on the growth rate of cattle.

II. MATERIALS AND METHODS

Eight Africander cross (AX: nominally ½ Africander ¼ Hereford, ¼ Shorthorn) and seven Shorthorn x Hereford cross (SH: ½ Shorthorn ½ Hereford) bulls, circa 10 months old were used. Of these 4 AX and 3 SH had previously been infested with ticks (*Boophilus microplus* Canestrini) as part of another study (O'Kelly unpublished) . The previously tick infested SH bulls had an average of 740 engorged female ticks/side/day and the AX a mean of 355/side/day. Each breed carried this burden for two weeks before being dipped. All the cattle

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were dipped four weeks before the fasting metabolism measurements were made, and until the fast commenced they were fed a restricted intake of a pelleted lucerne chaff /grain diet. (Mean dry matter and nitrogen intakes for all animals were 2.21 kg/day and 67.9 g/day respectively.)

The animals were fasted for 72 h, and during the next 7 h, gas exchange was measured in confinement type respiration chambers (Turner and Thornton 1966). Three determinations of fasting gas exchange were made each lasting circa 2 h and the mean of the three determinations was used; the chamber temperature was 28°C and relative humidity was circa 60 per cent.

Urine was not collected during the fast, and methane production was usually circa 2 l/day and- never greater than 4 l/day. Heat production was therefore calculated from O_2 consumption and CO_2 production using the factors of Brouwer (1965). The effect of ignoring urinary nitrogen and methane would make the calculated values for heat production circa 0.2 MJ/24 h too high, but would not bias the results.

III. RESULTS

The liveweights, gas exchanges and heat productions for each breed are summarized in Table 1. The AX bulls were significantly heavier than the SH ($P < 0.01$), and this is reflected in the higher heat production (kJ/24 h) in the AX. However, there was no significant breed effect on the heat production per kg or per $kg^{0.75}$, and although the ticks raised the heat production per unit weight particularly in the SH, this effect failed to reach statistical significance.

There was a significant ($P < 0.05$) breed difference in respiratory quotient (SH higher than AX), and there was a significant ($P < 0.01$) treatment effect; the animals that had previously been exposed to ticks had a higher value.

IV. DISCUSSION

Fasting heat production is a measure of the net energy required for maintenance. The values obtained for the AX and SH bulls that had been kept tick-free (101.5 and 102.8 kJ/kg/24 h respectively) indicate that there was no difference in the maintenance requirements for net energy for AX and SH bulls. A similar finding was reported by Vercoe (1970) for purebred Africander and SH bulls (105.6 and 100.8 kJ/kg/24 h respectively).

Seebeck, Springell and O'Kelly (197 1) found that there was a lack of compensatory growth in Hereford cattle previously tick infested, compared with controls that had previously been pair-fed and tick-free. They stated that this indicated that ticks had "a severe effect on the metabolism of these animals with prolonged after effects". The present results for the SH bulls show that four weeks after ticks were eliminated, previously tick infested bulls had higher (although not significantly) fasting heat productions (114.9 compared with 102.8 kJ/kg/24 h). This means, amongst other things, a higher maintenance requirement and, if food intakes were similar, lower growth rates. On the other hand, tick infestation had virtually no effect on the subsequent fasting metabolism of the AX bulls (104.2 compared with 101.5 kJ/kg/24 h) . Correlations have been found between blood metabolites and tick numbers (O'Kelly, Seebeck and Springell 197 1), and it

TABLE 1

Liveweight, O_2 uptake, respiratory quotient (R.Q.) and heat production* of *Africander (AX) and British (SH) crossbred bulls

Breed and previous treatment	Liveweight[a] (kg)		O_2 uptake (1/day)		R.Q.[b]		Heat production per 24 h					
							(MJ)		(kJ/kg)		($kJ/kg^{0.75}$)	
AX												
Tick infested	181.3	± 9.8†	955	± 72	0.720	± 0.004	18.90	± 1.42	104.2	± 5.1	382.2	± 19.7
Tick free	182.5	2.1	940	67	0.703	0.003	18.53	1.33	101.5	7.1	373.0	26.2
Mean	181.8	4.7	948	46	0.712	0.004	18.72	0.90	102.8	4.1	377.6	15.3
SH												
Tick infested	151.7	2.2	876	46	0.744	0.003	17.44	0.91	114.9	5.2	403.5	18.8
Tick free	167.8	7.7	872	51	0.719	0.004	17.25	1.02	102.8	3.8	369.7	14.4
Mean	160.9	5.3	874	32	0.729	0.006	17.33	0.64	108.0	3.7	384.2	12.5

†Standard error of the mean (between animals).

[a]Significant breed differences ($P < 0.01$).

[b]Significant differences between breeds ($P < 0.05$) and due to previous treatments ($P < 0.01$).

might be expected that an effect on fasting heat production could also be related to the total number of ticks carried during treatment. Perhaps the apparently greater effect of ticks on the fasting heat production of the SH than on the AX bulls was due to this factor. Alternatively there may be a real difference between the genotypes in their reaction to ticks regardless of the level of infestation. In any event, the effect of ticks on fasting heat production failed to reach statisical significance, but the possibility that there was a real effect should not be excluded on this evidence. Further work is necessary to establish the possible relationships between tick numbers and fasting heat production in the various breeds.

Kleiber (1961) has stated that a fasting animal catabolizes mainly fat and protein, and since the respiratory quotients of "average" fat and protein are 0.71 and 0.83 respectively, a higher respiratory quotient for a fasting animal indicates a higher proportion of protein being catabolized. It is known that tick infestation affects protein metabolism (O'Kelly and Seifert 1969, 1970; O'Kelly, Seebeck and Springell 197 1; Springell, O'Kelly and Seebeck 197 1) and in the present results, the higher respiratory quotient of the previously tick infested animals suggests that some effect on protein metabolism may be still evident four weeks after dipping.

The higher respiratory quotient in the SH bulls also indicates that they derived a higher proportion of their fasting metabolism from protein oxidation, an effect that has been noted on other occasions (Vercoe unpublished). The significance of this is not understood at present.

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