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THE ENERGY METABOLISM OF YOUNG FRIESIAN CALVES FED ON A DIET OF MILK AND CONCENTRATE

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SUMMARY

Twelve Friesian calves, 6 weeks old at the start of the experiment, were allocated at random to one of two dietary treatments. These were two levels of food intake calculated to permit liveweight gains of either 0.75 or 0.25 kg/day. The total metabolizable energy fed in both treatments was derived in approximately equal proportions from milk and concentrates. Complete energy balances were carried out with all calves.

The estimated metabolizable energy (ME) required for maintenance was 0.41 MJ/kg$^{0.75}$ daily and the net efficiency with which ME was utilized above maintenance was 0.63. The requirement of ME for liveweight gain was 14.89 MJ/kg.

INTRODUCTION

The energy requirements of the pre-ruminant calf were reviewed by Davey (1974), who drew attention to the considerable variation between the various estimates of ME required for maintenance, energy costs per unit liveweight gain, and efficiencies of utilization of ME above maintenance. Holmes and Davey (1976) subsequently confirmed the much lower estimates of recent workers. The energy requirements of ruminant calves have been studied by many workers including Neergaard (1974), and Blaxter *et al.* (1966). However, for calves fed on a diet of milk and concentrate little information is available on the maintenance requirements, energy cost of liveweight gains, or net efficiencies. For this reason the following work was carried out.

EXPERIMENTAL

Twelve Friesian bull calves were reared in pairs at the rate of one pair per week from mid-March until the end of April 1976. Each calf remained on its mother for 3 days and was then fed sufficient whole milk to gain 0.5 kg/day with pelleted concentrate being available *ad lib*. Between 21 and 42 days of age, intake was adjusted so that each animal received half of its daily allowance of ME from milk and half from concentrate. During this period one calf from each pair was assigned randomly to a high level and its pair mate to a low level of feeding to produce daily liveweight gains of 0.75 and 0.25 kg, respectively. The calves received their daily ration, with milk heated to 35 to 40° C, in the morning. Energy and nitrogen balances of seven days' duration were carried out once for the earlier pairs of calves and twice for the last three pairs of calves, making a total of 18 balances.

The energy and nitrogen contents of milk, concentrate, faeces, and urine were determined and heat production was calculated from measurements of oxygen consumption, carbon dioxide production, methane production and urinary nitrogen excretion (Holmes, 1973), and energy retained calculated according to the method of Brouwer (1965).

RESULTS AND DISCUSSION

Heat produced was related to liveweight by

$$HP = 0.20\, LW^{0.98 \pm 0.11}$$

and metabolizable energy intake (MEI) to liveweight by

$$MEI = 0.34\, LW^{0.92 \pm 0.23}$$

Both equations were significant. Despite the exponent of liveweight in this experiment being close to 1.0, it was decided for comparative purposes to use the conventional exponent of 0.75 (Kleiber, 1965).

Energy Metabolism

Mean values for some measurements have been presented in Table 1.

TABLE 1: MEAN VALUES FOR ENERGY METABOLISM OF FRIESIAN CALVES RECEIVING MILK AND CONCENTRATE AT TWO LEVELS

	High	*Low*
ME intake ($MJ/kg^{0.75}/day$)	0.882	0.569
Heat produced ($MJ/kg^{0.75}/day$)	0.587	0.467
Energy retained ($MJ/kg^{0.75}/day$)	0.298	0.107
Liveweight gain (kg/day)	0.66	0.29

The metabolizability of the milk and concentrate diet was 0.78 and the gross energy contents of the milk and concentrate were 3.16 and 17.91 MJ/kg, respectively.

The relationship between ME intake and energy retained (ER) was calculated and is presented below.

$$ER = 0.634\ MEI - 0.259\ (P < 0.01, SE_b = 0.042)$$

The regression coefficient of 0.63 provides an estimate of K_g. This value is similar to that of Van Es *et al.* (1969), Vermorel *et al.* (1974), Johnson (1972) and Holmes and Davey (1976) of 0.69, 0.69, 0.63 and 0.63, respectively, for pre-ruminant calves, but higher than values presented for ruminant calves by Blaxter *et al.* (1966) and Neergaard (1974) of 0.50 and 0.52, respectively.

Using the above equation, a value of 0.408 MJ/kg$^{0.75}$ per day for ME_m can be estimated. This is similar to the values of Holmes and Davey (1976), Van Es *et al.* (1969), Vermorel *et al.* (1974), and Johnson (1972) of 0.39, 0.45, 0.40 and 0.39 MJ/kg$^{0.75}$ per day, respectively, but lower than values of earlier workers for pre-ruminant calves (see Davey, 1974). It is also lower than values reported for ruminant calves of 0.55, Blaxter *et al.* (1966), and Neergaard (1974). The only recent results widely at variance with the results discussed above are those of Webster *et al.* (1976), who obtained a value of 0.68 for ME_m.

Liveweight Gain

Mean values of 10.4 and 8.1 MJ retained per kilogram liveweight gain were calculated from the present data for the higher and lower levels of feeding, respectively. These compare with values of 9.5 (A.R.C., 1965), 8.3 (Holmes and Davey, 1976), and 11.0 (Johnson, 1972) for pre-ruminant calves; no values for ruminant calves are presented because these are dependent on diet. The ME requirement per kilogram liveweight gain (14.9 MJ) can be calculated using the pooled kilogram of 0.63 and the pooled value of 9.4 for the energy retained per kilogram liveweight gain. However, it must be remembered that, if the results in this paper are to be used in deriving practical tables of feed allowances for growing calves, then some adjustments need to be made for varying environments as the present experiment was carried out in the close confines of calorimeters under thermoneutral conditions.

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