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ASPECTS OF ENERGY METABOLISM OF JERSEY COWS DIFFERING IN BREEDING INDEX

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SUMMARY

Aspects of energy metabolism were compared between groups of high and low breeding index Jersey cows. Preliminary data from 44 energy balances established in the first year indicate that the large advantage in milk solids production of high breeding index relative to low breeding index cows is not due to variations in efficiency of energy utilisation.

INTRODUCTION

Information on the efficiency with which cows differing in breeding index (BI) utilise nutrients is essential to the formulation of optimum management strategies. Energy utilisation for production and maintenance, and the pattern and extent of mobilisation and accretion of body reserves are of particular importance.

The results reported here were derived during the first year of a programme designed to investigate these aspects.

MATERIALS AND METHODS

Six cows were selected from each of two herds one of high BI (HBI), the other of low BI (LBI) (Bryant and Trigg, 1981) and trained in calorimetry procedures.

Forty-four energy balances were established using open circuit calorimetry at each of two levels of feeding (*ad. lib.* and approximately 75% N.R.C. requirements) and at two stages of lactation (weeks 6-14, early; weeks 26-33, mid).

Collection of samples and their analysis were as described by Trigg *et al.* (1980). During balance periods the sole diet was fresh pasture, cut twice daily. At all other times cows were offered good pasture, grazing as one group.

BIOMETRICAL ANALYSIS

Analysis of energy balance data was by regression on a within-cow basis (Trigg *et al.* 1980). Regressions calculated for each animal were pooled within BI and stage of lactation, and differences between BI were tested for significance.

RESULTS

The average BI of the HBI and LBI animals was 127 and 100 respectively. Total production of milk and milk solids, lactation length and condition score at the start and end of lactation followed closely those of the herds from which the cows were derived.

The remainder of the data refers to balance periods only. During *ad lib.* feeding, HBI cows produced more milk solids, and ate more dry matter (DM) than LBI animals (Table 1).

TABLE 1: MILKFAT PRODUCTION, DM INTAKE AND LIVELWEIGHT DURING BALANCE PERIODS WHERE INTAKE WAS *AD LIBITUM*

	<i>Early</i>		<i>Mid</i>	
	<i>HBI</i>	<i>LBI</i>	<i>HBI</i>	<i>LBI</i>
Milkfat (kg/d)	0.86	0.74	0.61	0.41
DMI (kg/d)	11.5	9.8	13.0	11.4
LW (kg)	325	304	330	318

Metabolised energy (ME) intake per unit metabolic liveweight was higher for HBI than LBI cows at early and mid stages of lactation (12 and 10% respectively).

Within-cow regression analysis of the energy balance data obtained in early lactation (Table 3) indicate that rate of change of partitioning of energy (represented by the regression coefficient) was not affected by BI and a pooled coefficient was calculated. On

TABLE 2: REGRESSION ANALYSIS OF ENERGY PARTITIONING IN EARLY LACTATION $Y = bX + c^1$

<i>Y</i>	<i>X</i>	$b(\pm SE)$	$c(H)^3$	$c(H-L)^4$	<i>SE</i>
GE	DE	0.699 ± 0.036	200	34	12
DE	UE	0.021 ± 0.021	129	13	10
	CH ₄ E	0.062 ± 0.023	46	5	6
ME	ME	0.917 ± 0.013	-175	-18	11
	HEAT E	0.324 ± 0.057	502	3	20
	BAL ² E	0.675 ± 0.058	-500	-3	20
	MILK E	0.193 ± 0.119	436	42	40
	TISSUE E	0.482 ± 0.153	-936	44	42

¹KJ/kgLW^{0.75}

²Milk + tissue

³Intercept for HBI

⁴Difference in intercepts between genotypes

testing intercepts (c) between BI groups, the only significant difference was the partition of gross energy (GE) to digested energy (DE). For this variate, HBI cows partitioned 34 kJ/kgLW^{.75} more GE to DE ($P < 0.05$) than LBI animals at the same intake. No such effect was found in mid-lactation.

Differences in efficiency of utilisation of metabolised energy for milk + tissue (energy balance) between genotypes were not significant both in early (Table 2) and mid lactation. Insufficient data exist to enable meaningful comparisons to be made between stages of lactation.

In early lactation during *ad lib.* feeding periods, specific energy¹ (kJ/g) of tissue loss from HBI animals was less than that of LBI cows (Table 3). In contrast, gains in tissue of LBI animals in mid lactation were of higher specific energy than those of HBI cows. In both instances these differences were not statistically significant.

TABLE 3: CHANGE IN TISSUE FAT (g/d) AND SPECIFIC ENERGY (kJ/kgLW^{.75}) OF TISSUE IN COWS DIFFERING IN BI AND FED *AD LIBITUM* IN EARLY AND MID LACTATION

	Early			Mid		
	HBI	LBI	SE(d)	HBI	LBI	SE(d)
Tissue fat	-123	-257	180	244	271	257
Specific energy ¹	-56	-121	88	91	122	61

¹See text

DISCUSSION

The data presented indicate that the difference between H and L cows in production of milk solids is not a result of differences in efficiency of energy utilisation, rather it is associated with differences in intake.

Data presented by Bryant and Trigg (1981) showed that LBI cows gained more weight and condition than HBI cows as lactation progressed. The calorimetric data support this in that the gains of tissue in LBI cows were of both greater magnitude and higher specific energy, but not significantly so, than those of HBI cows.

The advantage to HBI cows in the partitioning of GE to DE in early lactation is supported by apparent digestibility of GE data collected at the same time (77.4 and 76.9% for HBI and LBI cows

¹Calorific value of tissue (fat + protein) change

respectively). In effect, the result means that at the same GE intake, the average HBI cow in our herd has a 1.2% (2.6 MJDE/d) advantage in DE. Whether the difference can be attributed to an effect on the gut of higher levels of production, higher intakes of HBI animals, or other factors is unknown. Effects of lactation and intake on digestive efficiency of ruminants have been well reviewed by Fell (1972). That the difference has disappeared in mid lactation suggests the former is more likely. Relative to LBI cows, the smaller tissue fat loss by HBI cows in early lactation does not agree with overseas data (Broster *et al.*, (1969).

CONCLUSIONS

Clearly, the effects of differing efficiencies in energy utilisation cannot account for the large differences noted in milk production between HBI and LBI cows.

Further definitive data are required, on tissue composition changes and energy utilisation at different stages of lactation and late pregnancy. Such data may indicate where specific management strategies will allow the maximum expression of genetic potential.

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