INTAKE AND DISTRIBUTION OF ENERGY IN MILK, BODY TISSUE AND FAECES OF LACTATING WHITE FULANI (BUNAJI) ZEBU CATTLE AT IBADAN

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SUMMARY

The daily gross energy intake, milk production, faecal output and liveweight changes of two sets of 16 White Fulani (Bunaji) Zebu Cattle, designated Groups A and B sub-divided into four stages of lactation were measured in feeding trials over a period of 16 weeks. Group A received supplementary concentrates at pasture whilst Group B received no supplementation.

Relating energy output as milk, body tissue and faeces to the gross energy consumed, showed that faecal energy accounted for 37.97 to 38.61 percent of the losses for Group A and 34.76 to 37.43 percent in Group B. Energy output in milk averaged 6.89 to 10.21 percent of gross consumed for Group A and only 4.25 to 5.85 percent for Group B. Energy deposited as body tissue was low, averaging 1.18 to 1.92 percent for Group A cows and 0.14 to 0.67% for Group B.

INTRODUCTION

Considerable efforts have been made within the last two decades to assess the way in which energy consumed by the dairy cows is distributed as milk, body tissue, faeces and other losses (Hashizume, Morimoto, Masubuchi, Abe and Hamada, 1965; Flatt, Moe, Moore, Hooven, Lehmann, Orskov and Hemken, 1967).

Apart from the fact that many of the studies were conducted under controlled conditions, which often times make a direct application of the results to practical farm conditions difficult, they have been carried out almost esclusively with high-producing dairy cattle in the temperates.

This report contains an assessment of the gross energy intake and the output of energy in milk, body tissue and faeces of the inherently low-producing White Fulani (Bunaji) Zebu Cattle under the farm conditions at Ibadan.

EXPERIMENTAL

Animals:

A total of 32 White Fulani Zebu Cattle at different stages of lactation from the University dairy herd were used. These were divided into 2 groups of 16 each designated A and B, Group A received supplementary concentrates at pasture whilst Group B received none. Each group was further sub-divided into four groups of four each with average group lactation length of 5, 10, 15, and 21 weeks at the beginning of the experiment which ran for 16 weeks. The lactation groups were designated I, II, III, IV respectively.

Lactation:

The cows were grazed daily from 08.00 hour to 13.30 hours and from 15.30 to 18.30 hours in paddocks of pasture swards made up of *Cynodon nlemfuensis* var robustus, *Pennisetum Purpureum, Panicum Maxinum,* plus the legumes *Centrosema Pubescens and Stylosanthes gracilis,* on a rotational basis with a change over to fresh pastures every +& days.

In addition to the grazing, each cow in Group A received a supplementary concentrate mixture (Table 1a & b) fed at a rate of 465g/kg milk calculated to furnish energy and protein for milk production at 100% of the ARC (1965) recommendations for dairy (Table 1a & b).

Measurement of feed intake and faecal output

The total daily feed comsumption of each cow in each rotation period was determined indirectly, using the chromic oxide (Cr_2O_3) and the faecal nitrogen index methods for estimating faecal output and predicting digestibility respectively. Details of the procedure adopted were similar to those described by Olaloku and Oyenuga (1975).

TABLE 1

Composition of the production Ration

Maize (%)	70
Decorticated groundnut cake (%)	20
Palm Kernel Meal (%)	10
Plus mineral mix* (kg/ 1000kg feed)	25
Calculated energy (a) (Mcal/kg feed)	3.3
Calculated protein (b) (g/kg feed)	119.4
Rate of feeding = 465 feed/kg milk	

* 'Cattle Minsal' an I.C.I. iodized mineral mixture

a = Metabolizable energy;

b = Available protein.

TABLE 1b

Average Ration Composition (% Dry Matter)

	Concentrate	Pasture
Dry Matter	83.9	90.5
Crude Protein	15.9	12.4
Crude Fibre	2.5	35.8
Ether Extract	1.4	1.8
Gross Energy (cal/g)	4.4	4.3

The gross energy in feeds and faeces was determined in a ballistic bomb calorimeter using benzoic acid as the standard.

Milk recording and Analysis:-

Twice a day, hand milking of the cows carried out at 05.00 and 14.30 hours and yields recorded. The daily concentrate allowance for the cows in Group A was given in two equal instalments at milking times. Milk samples were obtained weekly for anyalysis of fat and solid non-fat (s.n.f.).

The energy value of milk was estimated using Overman and Gaines (1933) formula as recommended by the ARC (1965) thus:-

Energy value of milk Kcal/kg = $304.8 \pm 114.1 \times$ fat percentage in milk.

Liveweight changes:-

Each cow was weighed on the same day once a week immediately after the morning miling. The weight gains were treated as energy deposited as body tissue using Brody's (1964) average value of 0.952kg TDN per 0.45kg of gain or loss and assuming 4405 Kcals per kg TDN.

Statistical analysis was carried out using the method outlined by Federer (1963) and Duncan's (1955) multiple range tests were used to test the significance between the means.

RESULTS

Table 2 shows the mean daily milk yield, milk fat percentage. The cows in Group A produced more milk with higher

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fat content than their counterparts in Group B.

For the Group A cows, milk yield was significantly higher ($P < 0.05$) for the cows in stage of lactation group I as compared to the others. Percentage milk fat was on the other hand significantly higher (P. 0.01) for the cows in the later stages of lactation (Group III and IV) as compared to those in Group I and II.

TABLE 2

Mean Daily Milk Yield and Fat Percentage

	Stage of Lactation Groups			
Milk Yield (kg/day)	I	II	III	IV
Group A	4.75[a] ±0.65(SE)	2.92 ±0.20	3.05 ±0.19	3.35 ±0.57
Group B	2.10[b] ±0.13	2.95[a] ±0.23	1.95[b] ±0.07	1.76[b] ±0.17
Fat Percentage (%)				
Group A	5.60[a] ±0.36	5.92[a] ±0.28	6.18[b] ±0.17	6.21[b] ±0.23
Group B	5.35[a] ±0.21	5.56[a] ±0.39	6.05[b] ±0.24	6.30[b] ±0.30

** = P. 0.01
S E = Standard Error.

a,b = Means not followed by the same super-scripts in the same horizontal column are significantly different from one another.

For the Group B cows, although milk fat percentage followed a trend similar to that of Group A, milk yield was however significantly higher ($P < 0.01$) for the cows in stage of lactation group II as compared to the others.

The intake of gross energy and the output of energy in milk, body tissue and faeces are shown in Table 3a for the Group A cows. Gross energy intake was highest for the cows in group I and declined with advancing lactation from group II through to IV. The differences between the stage of lactation groups were however not significant.

TABLE 3a

Daily Gross Energy Intake and Amounts of Energy in Milk, Body Tissue and Faeces for cows in Group A

	Stage of Lactation Groups I	II	III	IV
Gross Energy (Mcals)	43.85	41.35	41.15	38.56
	±1.54 (SE)	±2.13	±2.09	±1.08
Energy in Milk (Mcals)	4.48[a]	2.85[b]	3.08[b]	3.39[b]*
	±0.16	±0.16	±0.15	±0.27
(%)	10.21	6.89	7.48	8.80
Energy in Body Tissue (Mcals)	0.52	0.73	0.74	0.74
	±0.03	±0.05	±0.01	±0.02
(%)	1.18	1.76	1.79	1.92
Energy in Faeces (Mcals)	16.65	15.72	15.82	14.89
	±0.60	±0.57	±0.83	±0.64
(%)	37.97	38.01	38.44	38.61

* = P. 0.05
SE = Standard Error
(%)a = Expressed as percentage of Gross Energy intake.

a,b = Means not followed by the same superscripts in the same horizontal column are significantly different from one another.

Energy output in milk was significantly higher ($P < 0.05$) for cows in Group I as compared to the other groups. The energy in milk represented from 6.89 to 10.21% of the gross energy consumed by the cows.

Energy deposited in body tissue (liveweight gains) which accounted for 1.18 to 1.92% of the gross energy intake, increased with advancing lactation although the differences were not significant.

Faecal energy was highest for the cows in group I and declined with advancing lactation. The differences were however not significant. It is clear from the data that faecal energy accounted for a substantial proportion of the gross energy intake of the cows.

The energy consumed from concentrates expressed as a percentage of the gross energy intake and the mean values for each stage of lactation group are shown in Table 3b. It can be seen from the table that concentrates supplied only a small percentage of the gross energy and was highest (18.19%) for the group I cows.

TABLE 3b

Energy supplied from concentrates expressed as Percentage of Gross Energy Intake (Group A Cows)

Stage of Lactation Groups	*Mean*	*Range*
I	18.19±2.09 (SE)	10.50—43.44
II	12.44±0.82	10.12—18.94
III	14.09±1.42	4.99—23.62
IV	15.25±1.35	7.08—24.84

SE = Standard Error.

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A correlation analysis relating the percentage of the gross energy intake deriving from concentrates to the faecal energy losses, showed a low positive, but non-significant r value of 0.037.

Table 4 shows the means for gross energy intake and output of energy in milk, tissue and faeces for Group B cows. Gross energy intake was higher for the stage of lactation groups II and III than for groups I and IV, although the differences were not significant.

TABLE 4

Daily Gross Energy Intake and Amounts of energy in Milk, Body tissue and Faeces for Cows in Group B

	Stage of Lactation Group			
	I	II	III	IV
Gross Energy (Mcals)	42.29	47.52	44.53	42.39
	±2.11(SE)	±2.87	±2.93	±2.80
Energy in Milk (Mcals)	1.92	2.77	1.94	1.80
	±0.11	±0.16	±0.19	±0.13
(%)a	4.54	5.85	4.35	4.25
Energy in Body tissue (Mcals)	0.26	0.06	0.30	0.26
	±0.04	±0.01	±0.05	±0.07
(%)a	0.60	0.14	0.67	0.61
Energy in Faeces (Mcals)	15.06	16.45	16.67	14.74
	±0.69	±0.00	±0.90	±0.65
(%)a	35.61	34.76	37.43	34.77

SE = Standard Error.
(%)a = Expressed as percentage of Gross Energy Intake.

The energy output in milk was much lower than for the group A cows; accounting for between 4.25 and 5.85% of the gross energy intake. It was higher for the cows in groups I and II as compared to groups III and IV. The differences were however not significant.

Energy deposits in body tissue accounted for less than 1% of the gross energy intake and was higher and almost similar for the cows in groups I, III and IV as compared to group II. The differences were not significant.

The percentage of GE intake in faeces were higher for groups I and III compared to groups II and IV. Compared to milk and body tissue, the losses were by far the highest single outlet of gross energy consumed.

DISCUSSION

The results have shown that the greater proportion of the gross energy consumed by the lactating White Fulani cows used in this study was lost as faeces, the losses being higher for the supplemented cows (Group A). Milk energy on the other hand accounted for only a very small percentage of the gross energy intake, whilst the energy in body tissue accounted for only 0.14 to about 1.92% of the gross energy consumed.

The percentages of gross energy lost as faeces are in good agreement with those reported for Japanese Holstein cattle by Hashizume *et. al.* (1965). They are however higher than the figure of 26.9% reported for high-producing American

Holsteins by Flatt *et. al.* (1967).

Coppock, Flatt and Moore (1964) had also reported a range of 28.4 to 37.7% of gross energy consumed being lost in faeces of high-producing Holstein cows.

The percentage of energy loss as faeces by the group A cows were about the same for the different stages of lactation groups. This was apparently due to the proportions of roughage: concentrates dry matter consumed by each group which were within the same range — being approximately 82.18; 87.4: 12.60; 86.5: 13.5 and 84.6: 15.4 for Groups, I, II, III and IV respectively.

The high roughage: Concentrate ratios as compared to the 40: 60, 60: 40 and 20:80 ratios in the rations used by Coppock *et. al.* (1967) together with the high crude fibre content of the herbage grazed by the animals in this experiment, may have resulted in lower digestibility values and hence greater losses of energy as faeces.

The percentage energy output in milk in relation to the gross energy consumed was generally lower than those reported by other workers. Coppock *et. al.* (1964) reported a range of 15.6 to 20.2%, Hashizume *et. al.* (1965) quoted figures of 12.9 to 18.0%, whilst Flatt *et. al.* (1967) have reported a figure as high as 22.4% for high-producing cows.

The lower level of energy secreted in milk by the White Fulani cows in this study, may be attributed in part to the milk-yielding capacity of the breed. It may also have been due to the nature of the diet, especially the pasture component which was high in crude firbre. The lower milk yields of the group B as compared to the group A cows which received supplementation, appears to confirm the suggestion that the nature of the diet may have contributed to the lower performance of the cows used in this study.

Body tissue energy was generally low in relation to the gross energy intake although the figures obtained in this study are in good agreement with others reported in the literature (Coppock *et. al.*, 1964; Flatt *et. al.*, 1967).

The pattern of energy distribution in milk in relation to the stage of lactation, especially for the Group A cows confirms the conclusions of Flatt *et. al.* (1964) that progressively less of the gross energy was used for milk production as lactation progressed.

Apart from the distribution of the gross energy consumed by the cow into faeces, milk and body tissue energy, heat production has been shown to be a major component of energy loss to the cow.

Thus Coppock *et. al.* 1964) reported that heat production accounted for as much as 34.6 to 35.9% of the gross energy intake of high producing Holstein cows, whilst Hashizume *et. al.* (1965) reported a range of 27.2 to 34.5%.

Flatt *et. al.* (1967) concluded that regardless of the ration or stage of lactation, heat production, on average, constituted 44.1% of the gross energy consumed by high-producing Holstein cows.

Even though there were no facilities for determining the heat production as well as the losses of energy as methane and urine in this study, the comparatively low energy output as milk and body tissue coupled with the fact that the losses of energy as urine and methane are generally low and relatively constant (Blaxter, 1961); Armstrong, 1964) might lead to the suggestion that a substantial proportion of the gross energy consumed by the White Fulani cows in this study was lost as heat production.

More detailed experimentation would however be required to determine the possible ways in which heat production can be reduced so as to make more energy available for production by the White Fulani cattle.

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