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Energy requirements for growing Kedah-Kelantan (KK) and Brahman-KK heifers in Malaysia

J.B. Liang*, M.N. Samiyah* and H. Hirooka**

Key words: Kedah-Kelantan, Brahman-KK, metabolisable energy, maintenance, growth, efficiency

Abstrak

Sebanyak 12 ekor lembu dara Kedah-Kelantan (KK) dan 11 ekor lembu dara Brahman-KK telah diberi makanan sama ada bertenaga rendah, sederhana atau tinggi untuk menentukan keperluan tenaga untuk saraan dan pembesaran. Kaitan di antara pengambilan tenaga metabolisme (PTM) bagi setiap berat badan metabolik (kg $W^{0.75}$) dan penambahan purata berat harian (PPH) bagi lembu-lembu dara ini telah dianalisis menggunakan regresi linear yang mudah. Persamaan regresi untuk KK dara ialah PTM/kg $W^{0.75}$ = 0.662 + 0.668 PPH (r = 0.64) dan untuk Brahman-KK dara pula, PTM/kg $W^{0.75}$ = 0.494 + 0.564 PPH (r = 0.86).

Keperluan tenaga metabolisme untuk saraan (TM_s) bagi KK dara ialah 662 kJ/kg $W^{0.75}$ dengan kecekapan penggunaan tenaga sebanyak 48.2% dan 34.5% masing-masing untuk saraan (K_s) dan tumbesaran (K_t). Nilai TM_s bagi KK adalah 30% lebih tinggi daripada yang dianggarkan untuk Brahman-KK (494 kJ/kg $W^{0.75}$). Nilai-nilai K_s dan K_t untuk Brahman-KK masing-masing ialah 64.6% dan 48.0%. Nilai TM_s untuk Brahman-KK adalah sama seperti yang disyorkan untuk lembu yang tidak mengeluarkan susu dari negara-negara membangun. Keperluan tenaga bagi lembu dara yang sedang membesar telah dianggarkan mengikut berat badan iaitu sehingga 250 kg bagi lembu KK dan sehingga 300 kg bagi lembu Brahman-KK.

Abstract

Twelve Kedah-Kelantan (KK) and 11 Brahman-KK heifers were fed either with low, medium or high energy intake to determine their energy requirements for maintenance and growth. The relationship between metabolisable energy intake (MEI) per metabolic body weight (kg $W^{0.75}$) and average daily gain (ADG) of the cattle were analysed using simple linear regression. It was found that for KK heifers, MEI/kg $W^{0.75}$ = 0.662 + 0.668 ADG (r = 0.64) and for Brahman-KK heifers, MEI/kg $W^{0.75}$ = 0.494 + 0.564 ADG (r = 0.86).

The ME requirement of KK heifers for maintenance (ME_m) was 662 kJ/kg $W^{0.75}$ with a 48.2% and 34.5% efficiency of energy use for maintenance (K_m) and growth (K_g) respectively. The ME_m value for KK was about 30% higher than that estimated for Brahman-KK (494 kJ/kg $W^{0.75}$). The K_m and K_g value for the latter being 64.6% and 48.0% respectively. The ME_m value

*Livestock Research Division, MARDI, P.O. Box 12301, 50774 Kuala Lumpur, Malaysia
**Division of Tropical Agriculture, Kyoto University, Kyoto 606, Japan
Authors' full names: Liang Juan Boo, Samiyah Mohd. Nasir and Hirooka Hiroyuki

for Brahman KK was similar to that suggested for non-lactating cattle of developing countries. Energy requirements for growing KK and Brahman-KK heifers were estimated for body weights up to 250 kg and 300 kg respectively.

Introduction

Nutrition is the major input in the animal industry: in many instances it is the sole economic factor which determines the success or failure of a particular livestock enterprise. It is important to know the nutritional requirements of the animals so that feed resources can be efficiently used to maximise output. Information on the nutritional requirements for beef cattle under local conditions is lacking. The recommendations on nutrient requiremets for cattle by the Agriculture Research Council (ARC) of the United Kingdom and the National Research Council (NRC) of the USA are commonly referred to by local workers when formulating feed programme.

As breed, age, sex and environment affect growth rate, feed conversion and carcass composition, these factors also influence nutrient requirements. Therefore, the relevance of information derived from overseas to the local situation needs to be examined. A programme was initiated in MARDI to establish the energy and protein requirements for the Kedah-Kelantan (KK) and its crossbreds. Initial information has been reported by Devendra (1981, 1984). This study further examines the energy requirements for growing KK and its Brahman crossbred (Brahman-KK) heifers under similar conditions.

Materials and methods

Twelve KK (average weight 141.2±14.1 kg) and 11 Brahman-KK (average weight 182.0±23.4kg), about 18 months old were used in this study. The experiment consisted of four feeding periods which lasted between 6 weeks and 8 weeks each. The heifers within each breed were grouped into three groups of similar weights and allocated at random to either low, medium or high energy intake. The low-level feeding was feeding the animal near maintenance requirements. The high level was ad lib. feeding while the medium level was intermediate of the two.

In the first two feeding periods, the animals were fed with chopped setaria grass *(Setaria sphacelata)* cut at about 8 weeks old. The animals were fed twice daily at approximately 1000 h and 1500 h. While still maintaining the three levels of feeding, the experimental diet in the latter two feeding periods was changed to consist of 70% chopped grass and 30% concentrates. During the experiment, the animals had access to mineral blocks and ample clean drinking water. The stalls were cleaned and washed every morning during which the animals were also bathed. All the animals were weighed on two consecutive days: at the beginning and at the end of each feeding period. The means of the paired reading were taken as the starting and final weights for the period.

Four digestibility trials, one for each of the four feeding periods, were conducted using the experimental animals during the experiment. In each of the digestibility trial, intake and total faecal output were collected for 7 days to determine dry matter digestibility and digestibility of energy content of the diet for the three feeding levels following the procedure similar to that described by Devendra (1981).

Digestible energy intake (DEI) was calculated by multiplying dry matter intake (DMI), gross energy (GE) content of the diet and digestibility of the energy

Table 1. Daily dry matter intake (DMI), daily metabolisable energy intake (MEI) and average daily weight gain (ADG) of Kedah-Kelantan and Brahman-KK heifers

Breed	Feeding period	Feeding level	No. of animals	Body wt. (kg)	DMI (kg)	MEI (MJ)	DMI/kg $W^{0.75}$ (g)	MEI/kg $W^{0.75}$ (kJ)	ADG (g)
Kedah-Kelantan	1	Low	4	141	2.8	24.8	68.3	606.0	15
		Medium	4	143	2.9	26.1	70.0	634.0	52
		High	4	139	2.9	25.5	71.6	625.3	−27
	2	Low	4	138	2.2	20.2	54.8	499.5	−152
		Medium	4	140	2.6	26.9	64.0	667.0	−83
		High	4	140	3.4	37.7	83.6	929.3	27
	3	Low	3	188	2.4	22.7	48.3	457.5	−142
		Medium	4	186	3.0	28.6	59.6	568.1	40
		High	4	188	3.8	34.8	74.8	685.3	175
	4	Low	3	188	4.1	38.1	80.8	747.3	248
		Medium	4	195	4.4	44.6	84.4	855.5	283
		High	4	200	5.3	56.0	97.9	1 055.8	344
Brahman-KK	1	Low	4	183	2.5	15.8	50.0	318.3	−155
		Medium	3	179	3.0	19.1	61.3	393.0	−49
		High	4	184	3.3	22.0	66.2	446.8	30
	2	Low	4	178	3.1	24.4	63.6	500.1	3
		Medium	3	177	3.4	28.6	70.1	594.8	−12
		High	4	186	3.5	28.3	69.6	566.6	18
	3	Low	3	219	3.4	30.7	59.8	541.9	48
		Medium	3	223	4.0	32.4	69.4	562.7	184
		High	4	229	5.2	45.9	88.3	784.4	431
	4	Low	3	231	4.6	39.2	77.6	664.5	396
		Medium	3	242	5.3	50.3	86.4	819.9	492
		High	4	257	5.8	52.9	90.5	826.7	546

Table 2. Chemical composition and energy content of the experimental diets

Period	Chemical composition (% DM)				Energy content⁺		
	CP	ADF	NDF	Ash	GE	ME	q
1 & 2	6.64	43.08	84.13	5.35	17.25	8.83	0.51
3 & 4	8.52	36.46	72.37	5.00	17.30	9.26	0.54

Period 1 and Period 2 consisted of 100% grass
Period 3 and Period 4 consisted of 70% grass and 30% concentrate
⁺GE = Gross energy (MJ/kg DM)
ME = Metabolisable Energy (MJ/kg DM)
q = Metabolisability (ME/GE)

content. Metabolisable energy intake (MEI) was taken to be 0.82 DEI.

The data were then analysed using the regression procedure of Statistical Analysis System (SAS) program applying the linear regression equation MEI/kg $W^{0.75} = a + b \times ADG$. Where kg $W^{0.75}$ is the metabolic body weight and ADG is the average daily weight change of the cattle. The coefficients a and b provide estimates of the quantities of ME used for maintenance and for each unit of ADG respectively. ME requirements for maintenance (ME_m) and for growth (ME_g) were calculated as (McDonald et al. 1981):

$$ME_m = a \times \text{kg } W^{0.75}$$
$$ME_g = (a + b \times ADG) \text{ kg } W^{0.75}$$

The efficiency of utilization of ME for maintenance (K_m) was calculated by dividing fasting heat production by ME_m (Ferrell et al. 1976) while that for growth (K_g) was calculated as the ratio of ADG/MEI.

Results and discussion

Energy intake and average liveweight change

The average liveweight change data of the cattle in Period 1 and Period 2 were lower than expected *(Table 1)*. In fact many of the values showed negative liveweight changes. This was due to low protein intake for the growing animals because of the poor quality grass used (crude protein = 6.64%) during these periods *(Table 2)*.

When the diet was changed to include 30% concentrates in Period 3 and Period 4, the liveweight change data improved. Nevertheless, the liveweight gains for KK heifers were low, with the individual maximum value of 420 g/day. The Brahman-KK on the other hand attained slightly higher values, with the individual maximum of 650 g/day on the high energy intake treatment *(Figure 1)*.

Since intake varied extensively between individual heifers, a continuum of energy levels rather than three discrete levels resulted. While this presents a problem in categorization into low, medium or high energy planes, it provides the opportunity to investigate the response to energy levels in considerably more depth over an expanded range in growth rate *(Figure 1)*. The regression analysis between MEI and the average liveweight change of KK and Brahman-KK indicated that for KK heifers, MEI/kg $W^{0.75} = 0.662 + 0.668$ ADG ($r = 0.64$) while for Brahman-KK, MEI/kg $W^{0.75} = 0.494 + 0.564$ ADG ($r = 0.86$).

Maintenance requirements

From the above equations, the ME_m for KK heifers was estimated as 662 kJ/kg $W^{0.75}$ while that for Brahman-KK was 494 kJ/kg $W^{0.75}$. The ME_m requirement of KK as estimated in this study was comparable to that for KK bulls, 616 kJ/

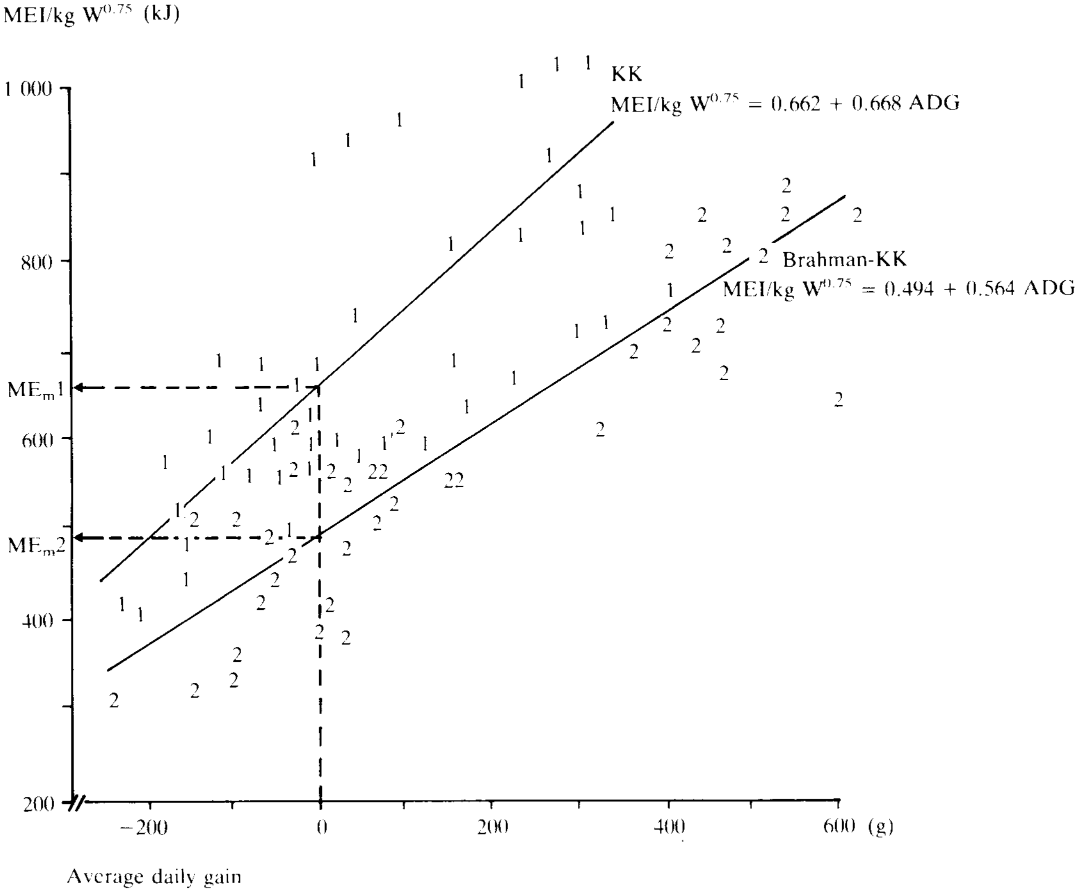

Figure 1. Relationship between metabolisable energy intake and average daily gain of growing KK (1) and Brahman-KK (2) heifers. ME_m1 and ME_m2 denote metabolisable energy for maintenance of KK and Brahman-KK respectively.

kg $W^{0.75}$ reported by Devendra (1981). The marginal difference in the two values could be due to differences in age and sex of the animals and feeding level in the two experiments used (Van Es 1980). These values however were about 30% higher than that estimated for Brahman-KK. The latter was identical to that recommended for non-lactating cattle of developing countries, 494 kJ/kg $W^{0.75}$ (Kearl 1982) and comparable to 508 kJ/kg $W^{0.75}$ of ARC (Anon. 1980).

The higher maintenance requirement per unit metabolic body weight for KK than that for its crossbreds is somewhat intriguing. Assuming that the fasting heat production for cattle was 319 kJ/kg $W^{0.75}$ (Anon. 1980), K_m for KK and Brahman-KK was estimated as 48.2% and 64.6% respectively. These values thus suggested that KK used ME less efficiently than its crossbreds. The differences could be due to breed differences in the rate of protein deposition. Animal which has a higher rate of protein growth has a higher requirement for maintenance (Byers and Rompala 1979). The higher ME_m for KK than its crossbred therefore could be justified as KK contained higher carcass lean meat and lower carcass fat than its crossbreds (Dahlan et al. 1988).

Energy requirements for growth

The estimated K_g for KK and Brahman-KK was 34.5% and 48.0% respectively. These values again suggest that KK used ME less efficiently than its crossbred for growth. The low growth rate of KK is consistent with that reported by Devendra and Lee (1975) who found that KK heifers (6–8 months old) could only achieve the highest daily gain of 0.34 kg when given good quality diet consisting of 50% cut grass and 50% concentrates. Dahlan (1986), in another experiment, reported that when fed with the same feedlot ration (metabolisability = 0.6), the average daily gain for KK yearling bulls was 0.35 kg while that for its crossbreds were 0.53 kg (Hereford-KK), 0.55 kg (Friesian-KK) and 0.61 kg (Brahman-KK).

Table 3. Metabolisable energy requirement* for growing Kedah-Kelantan heifers

Liveweight (kg)	Metabolisable energy requirement (MJ/day)					
	0⁺	0.1	0.2	0.3	0.4	0.5
100	21	23	25	27	29	32
150	28	31	34	37	40	43
200	35	39	42	46	49	53
250	41	46	50	54	59	63

*MEI = (0.662 + 0.668 ADG) kg $W^{0.75}$
⁺Average daily weight gain (kg/day)

The estimated ME requirements for maintenance and growth for KK and Brahman-KK heifers are shown in *Table 3* and *Table 4*. The recommendations were made based on the available information that when fed on diet similar to that of this experiment (metabolisability q = 0.5), growing KK and Brahman-KK heifers could only achieve a maximum daily average weight gain of about 0.5 kg and 0.7 kg respectively. The mature weight of KK females was 222 kg (Mohd. Mahyuddin, D., Univ. Pertanian Malaysia, pers. comm. 1987), therefore the estimates were made to cover body weights of up to 250 kg and 300 kg for KK and Brahman-KK respectively.

The estimates of energy requirements for maintenance and growth were compared with published data *(Table 5)*. The estimated values for Brahman-KK were identical to those of Kearl (1982). These values are 5–10% lower than those recommended by MAFF (Anon. 1975) and ARC (Anon. 1980). Direct comparisons with NRC (Anon. 1984) could not be made because the latter's recommendations were for animals of larger body size (300 kg and above). These results therefore suggest that in the absence of local data for the other classes of cattle (bulls, pregnancy lactation), the recommendations by Kearl (1982), MAFF (Anon. 1975) and ARC (Anon. 1980) may be used for the different crossbreds of KK with little

Table 4. Metabolisable energy requirement* for growing Brahman-KK heifers

Liveweight (kg)	Metabolisable energy requirement (MJ/day)							
	0⁺	0.1	0.2	0.3	0.4	0.5	0.6	0.7
100	16	17	19	21	23	25	27	28
150	21	24	26	28	31	34	36	38
200	26	29	33	35	38	42	44	47
250	31	35	38	42	45	49	52	56
300	36	40	44	48	52	56	60	64

*MEI = (0.494 + 0.564 ADG) kg $W^{.075}$
⁺Average daily weight gain (kg/day)

Table 5. Comparison of present estimates of energy requirements for maintenance and growth of cattle with published data

Source		Estimated energy requirement (MJ/day)					
		Liveweight 100 kg			Liveweight 200 kg		
		0[+]	0.25	0.50	0	0.25	0.50
Present Study	Kedah-Kelantan heifers	21	26	32	35	44	53
	KK crossbred heifers	16	20	25	26	34	42
Kearl (1982)	Growing heifers	16	20	25	27	35	43
MAFF (Anon. 1975)	Growing cattle, M/D = 10 MJ/kg	17	22	29	27	34	41
ARC (Anon. 1980)	Heifers of small mature size, q = 0.5	17	22	29	27	34	44

[+]Average daily weight gain (kg/day)

adjustments under local conditions. However, these values when used for KK should be raised by 25% to 30%.

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