ENERGY DIGESTIBILITY OF 16-WEEK-WEANED CALVES FROM 9 TO 25 WEEKS OF AGE

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Introduction

The feeding standard has been established in the requirement of total digestible nutrients (TDN) or digestible energy (DE) for dairy cattle in this country[6]. The standard tables have also presented amounts of DE for individual feedstuffs[6]. SEKINE *et al.*[8], however, have found the "associative effect" on energy digestibility of a mixed ration for 6-month-old calves fed hay and concentrates. The content of DE of a ration, therefore, may not be acculately calculated by the composition of ingredients and their energy values in additive fashion. So, coefficients of digestibility of energy for individual feedstuffs may not be used for the estimation of DE content of a ration. Thus, the determination of digestibility of energy is to be required to a ration as a whole. When determination of the digestibility has been done for a ration consisting of commonly used feedstuffs and with an average composition, DE content of rations for dairy calves may be estimated with the content of gross energy unless rations have too extreme composition.

Values of digestible energy for feedstuffs presented in the standard tables[6] were mainly determined on mature cattle fed at a maintenance level. The energy digestibility determined by the adult may not be applied to the growing young calves. Coefficients of digestibility of energy have been reported on 6-week-weaned calves[3,4]. Female calves for the replacement of dairy herd, however, were conventionally raised under the regime carrying much longer milk feeding period than 6 weeks.

The present study purposed to investigate the energy digestibility of young calves weaned at 16 weeks of age, from 9 to 25 weeks of age fed a ration consisting of common feedstuffs used to raise a calf.

TABLE 1. Chemical composition and gross energy content of feedstuffs used

	Dry matter	Organic matter	Crude protein	Acid detergent fiber	Gross energy
	%	% of DM			MJ/kg DM
Calf starter	84.9	95.1	19.9	5.9	18.9
Growing mixture	84.1	93.2	14.2	9.3	18.4
Grain screening pellet	86.7	91.9	13.4	24.2	19.4
Grass silage	41.9	90.7	9.2	46.0	18.9
Orchardgrass hay (2nd cut)	83.9	88.6	10.6	43.0	18.2

TABLE 2. Feeding regime for calves up to 25 weeks of age

Age	Whole milk	Calf starter	Growing mixture	GSP[a)]	Grass silage	Hay	Water
wks	kg/day						
0	4.5						
1	5.0						
2	5.5						
3	6.0	0.1				*ad lib.*	*ad lib.*
4	6.0	0.1				↓	↓
5	6.0	0.3				↓	↓
6	6.0	0.4				↓	↓
7	6.0	0.5				↓	↓
8	6.0	0.5				↓	↓
9	6.0	0.6				↓	↓
10	6.0	0.6				↓	↓
11	6.0	0.8				↓	↓
12	6.0	0.8				↓	↓
13	5.0	1.0				↓	↓
14	4.0	1.4				↓	↓
15	2.0	2.0				↓	↓
16	2.0	2.0				↓	↓
17		1.0	1.0		1.0	↓	↓
18		1.0	1.0		1.0	↓	↓
19		1.0	1.0		1.0	↓	↓
20		1.0	1.0		1.0	↓	↓
21			1.5	0.5	2.0	↓	↓
22			1.5	0.5	2.0	↓	↓
23			1.5	0.5	2.0	↓	↓
24			1.5	0.5	2.0	↓	↓
25			1.5	0.5	3.0	↓	↓

a) Grain screening pellet

Materials and Methods

Animals used were 21 Holstein female calves born in the experimental farm of Hokkaido University. Feeds used were whole milk, commercial calf starter, commercial growing mixture, grain screening pellet (GSP), grass silage and 2nd cut orchardgrass hay. Chemical compositions of individual feed were shown in table 1 together with gross energy contents.

Amounts of the ration to be fed were calculated using the requirement for growing dairy calves presented by Japanese feeding standard[5]. Table 2 shows the feeding regime for corresponding ages. Calves were weaned at 16 weeks of age. Concentrates were fed twice a day at 9 : 00 and 17 : 00 hour with an equal portion of daily allowance. Grass silage and GSP were fed once a day at 11 : 00 hour. Second cut hay and water were given at free access.

Digestion trials were conducted at the ages of 9, 13, 17, 21 and 25 weeks for seven days. Feces were collected for the last 4 days of the period using total collection method. Feeds, weighbacks of feeds and feces were dried in a forced air oven at 55°C and were ground through 1 mm screen for the further analyses.

Analyses of chemical composition were conducted using the methods by A. O. A. C.[1]. Contents of acid detergent fiber were determined using the method described by GOERING and VAN SOEST[2]. Gross energy (GE) concentrations were determined by the adiabatic bomb calorimeter (Shimadzu Co. Ltd., CA-3). Energy contents of whole milk were calculated using the composition of milk determined[7].

Results and Discussion

Table 3 shows means of live weight and dry-matter (DM) intake for calves at respective age. Means of DM intake expressed as percent of live weight were slightly lower at 9 and 13 weeks of age because of whole milk feeding. Calves, however, gained weight by 1.15±0.13 kg daily from 9 to 17 weeks of age. From 17 to 25 weeks of age, daily gain averaged 0.83±0.15 kg. The growth rate of calves was highly satisfactory in the present study.

TABLE 3. Means of live weight and dry-matter intake of calves at respective age

Age	Live weight	Dry-matter intake
wks	kg	kg/day
9	82.9± 6.1[a)]	1.68±0.22
13	113.7± 8.6	2.50±0.36
17	147.1±10.4	3.68±0.38
21	172.6±10.7	4.09±0.32
25	193.5±13.4	4.48±0.53

a) Standard deviation

TABLE 4. Means of gross energy intake and digestibility of calves at respective age

	Age (wks)				
	9	13	17	21	25
Gross energy intake (MJ/day)	35.9±4.1[a]	50.3±6.5	67.9±6.6	75.5±5.7	82.4±9.3
Gross energy supplied by					
milk (%)	50.9	30.3	—	—	—
concentrates (%)	25.9	32.8	47.4	41.7	38.4
roughages (%)	23.2	36.9	52.6	58.3	61.6
Energy digestibility (%)	87.4±3.8	80.6±3.3	70.7±3.9	67.9±4.0	67.6±3.9

a) Standard deviation

Table 4 presents GE intakes and coefficients of digestibility of energy for calves at respective age. Milk energy amounted to about 51% of GE intake at 9 weeks of age and to about 30% at 13 weeks of age. Roughages supplied 23 and 37% of total GE intake at 9 and 13 weeks of age, respectively. Coefficients of digestibility of energy were about 87% and 81% at 9 and 13 weeks of age, respectively. Milk feeding appeared to be responsible for the relatively high digestibility of energy.

After weaning, calves at 17 weeks of age showed 10% units lower digestibility of energy than those at 13 weeks of age. Roughages supplied 53% of the total GE intake at 17 weeks of age. Proportions of GE supplied by roughages to the total increased to 58% and to 62% at 21 and 25 weeks of age, respectively. Coefficients of digestibility of energy at both ages decreased by 3% units from that at 17 weeks of age. The rate of decline in digestibility of energy was similar to that calculated from the equation reported by SEKINE *et al.*[8] using the results obtained by calves fed hay and concentrates. Coefficients of digestibility of energy, however, showed slightly higher than those calculated[8] without any significant differences. In the present study, calves were simultaneously fed hay and silage. Feeding level was slightly lower in the present study than that reported by SEKINE *et al.*[8]. Thus, these differences in feeding conditions may be responsible for the slight discrepancy between the determined and the calculated.

Coefficients of digestibility of energy averaged 68% at 21 and 25 weeks of age with 6% of the coefficient of variation. The composition of the ration used in the present study was of no extremity from common feeding regimes. The results obtained may be used for the estimation of DE content of a ration with an average composition. It should be reminded, however,

that the results obtained showed relatively larger coefficient of variation. Further studies might be required on the composition and proportion of ingredients in concentrates for the estimation of DE contents of rations for 16-week-weaned calves.

Summary

The energy digestibility was determined in calves from 9 to 25 weeks of age subsisting on a ration consisting of common feedstuffs used to raise a calf. Twenty one female Holstein calves were fed whole milk which ceased at 16 weeks of age, commercial calf starter and growing mixture, grain screening pellet, grass silage and 2nd cut orchardgrass hay.

Coefficients of digestibility of energy were over 80% for calves aged up to 13 weeks and about 68% for those over 21 weeks of age. The figure may be used for the estimation of digestible energy content of a ration for young 16-week-weaned calves when detailed informations are not available.

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