Improvement of Raising Method of Dairy Calves in Malaysia

1. Utilization of local agricultural products and by-products as energy sources for calf starter rations

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Expansion of dairy herd in Malaysia mostly depends on Local Indian Dairy (LID) cattle[13] as well as a large number of imported crossbred cattle (*Bos taurus* × *Bos indicus*) and their offsprings (F_2, F^3, ·, ·), mainly Friesian crossbreds, which were born locally from their exotic cross bred parents (F_1). Under the hot and humid climate in tropical area like Malaysia, crossbreeding between local and exotic breeds is considered very efficient in achieving rapid and reliable improvement of native dairy cattle as to their efficiency of dairy production.[12]

Calf raising for herd replacement is a neglected phase in dairy operation in Malaysia.[10] Farmers are not quite interested in rearing replacing calves necessary to maintain and increase the size of dairy herd. In addition, it is very difficult for farmers, who are not experienced in dairy calf raising, to forsake their traditional methods of feeding buffalo and local draft cattle. Consequently, calf mortality before weaning is very high, showing about 40%.[2] It slows down the speed of herd replacement, as farmers lose a calf in every two or three parturitions.

On the other hand, LID cattle possess an inherent characteristic that dam's milk is secreted only by a stimulus of sucking by her own calf. The calf continues to suck milk until the end of lactation period.[12] Milk yields of LID are very low; about 700 to 900 kg per lactation,[13] and farmers have to share quite a large portion of the milk with the calf.

Milk yield higher than that of ordinary native dairy cows and milk secretion by hand milking or machine milking are urgently required in Malaysia. Crossbreeding with *Bos taurus* cattle showed that the crossbred cattle can meet the two requirements. They give the milk yield more than twice that of native cattle.[12] The calves can be separated from their dams just after birth,[10] and can be artificially nursed and weaned by an appropriate raising method recently established, i.e., the early weaning method of dairy calves by using milk replacer (or whole milk) and calf starter ration.

However, the new calf raising method is hardly adopted by farmers due to lack of knowledge and experience. In addition, milk replacers composed of local materials alone are not available in the market, while most smallholders can not afford to purchase imported milk replacer.

Among published 21 Malaysian Standard Specifications on Animal Feeds and Feedstuffs, 8 have been prescribed. They are on coconut cake, tapioka chips, soybean meal, groundnut meal, rice bran, (wheat bran, wheat pollard, wheat germ), maize and palm kernel meal.[1]

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Table 1. Breed, sex, weeks of age and weight of calves used

Group	No.	Sex	Weight at birth (kg)	Age at the beginning of experiment (week)	Breed
A	1	M	26.0	6	S F(F) × L F(M)
	2	F	28.0	6	× L F
	3	F	30.0	4	× L F
	4	F	20.5	2	× L J
	5	M	24.5	1	× L J
Average			25.8±3.6		
B	6	M	30.0	6	× L F
	7	F	26.0	4	× L F
	8	M	29.0	2	× L F
	9	F	21.5	1	× L J
	10	M	23.0	2	× L J
Average			25.9±3.7		
C	11	M	26.0	5	× L F
	12	F	23.0	4	× L F
	13	M	32.0	4	× L F
	14	F	24.0	1	× L J
	15	M	22.0	1	× L J
Average			25.4±4.0		

SF: Sahiwal cross Friesian
LF: Local Indian Dairy (LID) cross Friesian
LJ: LID cross Jersey
Average ± S.D.

Use of easily available and cheap agricultural products and by-products as calf starter rations for early weaning can help reduce high calf mortality caused by mal-nutrition in the early growth stage. A large amount of milk which otherwise is consumed for calf suckling can be saved by early weaning, which accustoms calves to solid feeds from the early growth stage. The calves develop their gastro-intestinal tract to accept more solid feeds.

A series of experiments was, therefore, carried out to examine the use of local agricultural products and by-products as the main feed resources for calf starter rations.

Experimental procedure

Fifteen European and Indian cross-bred calves were divided into three groups, A, B and C. Characteristics of each calf are shown in Table 1. Group A was fed Calf Starter Ration A (R-A), Group B was fed Ration B (R-B) and Group C was fed Ration C (R-C) from the beginning of the experiment. The three groups were equally fed with whole milk for 12 weeks from the beginning and Napier grass (*Pennisetum purpureum*) after about six weeks. The milk-feeding period, 12 weeks, is very short as compared with that in Malaysia, which lasts until dam milking dries up (6 months),[10] but it is longer than that in temperate countries (3, 5 or 7 weeks).

Ration A was entirely composed of imported feed ingredients, while R-B and R-C were composed of feed ingredients locally available in Malaysia except soybean meal (imported), and they used cassava chips as the main energy source (Table 2).

Digestible crude proteins (DCP) in R-A, R-B and R-C were estimated at 19.1%, 19.4% and 20.7%, and total digestible nutrients (TDN) at 75.2%, 76.6% and 75.9%, respec-

Table 2. Ingredients, those percentages, TDN, DCP and crude fibre contents in three starter rations

Ration	Ingredients	Percent	TDN	DCP	Crude fiber
			%	%	%
A	Corn	40	35.2	4.0	0.8
	Wheat bran	15	10.5	1.2	1.7
	Soybean meal	20	16.2	10.0	1.2
	Alfalfa meal	5	3.1	0.9	1.5
	Brewer's grain	10	6.6	2.6	1.6
	Molasses	5	3.6	0.4	—
	Minerals, vitamins & salt*	5	—	—	—
	Total	100	75·2	19.1	6.8
B	Cassava chips	45	38.3	1.7	0.1
	Fish meal	5	3.7	3.4	—
	Soybean meal	20	16.2	10.0	1.2
	Coconut meal	15	12.0	3.3	1.8
	Palm kernel cake	5	2.8	0.6	0.8
	Molasses	5	3.6	0.4	—
	Minerals, vitamins & salt*	5	—	—	—
	Total	100	76.6	19.4	3.9
C	Cassava chips	30	25.5	1.1	0.1
	Coconut meal	30	24.0	6.6	3.6
	Soybean meal	20	16.2	10.0	1.2
	Brewer's grain	10	6.6	2.6	1.6
	Molasses	5	3.6	0.4	—
	Minerals, vitamins & salt*	5	—	—	—
	Total	100	75.9	20.7	6.5

* Mineral, vitamin and salt premix composed of 45 g of TM-50 (Terramysin feed supplement), 150 g of Tri-mix (mineral and vitamin supplement), and 1,000 g each of limestone, tricalcium phosphate and common salt.

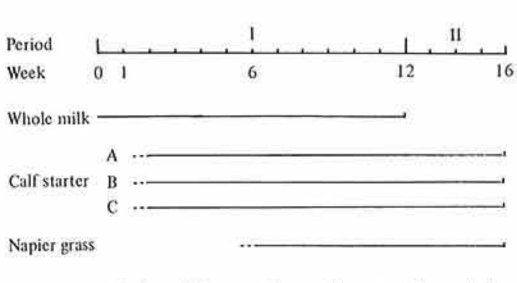

Fig. 1. Brief illustration of experimental scheme

tively.

As given in Fig. 1, the experimental period was divided into the period I (nursing) from 1 to 12 weeks of age, and the period II (after weaning) from 12 to 16 weeks of age. The feeding scheme was planned to gain 0.3 kg per day according to the U.S. NRC feeding standard (1978).[11] In the period II, the amount of starter rations was reduced to promote the intake of Napier grass.

Experimental results

1) Body weight gain

Average weekly body weight gain is shown in Fig. 2. Average daily gain for A, B and C groups was 0.478, 0.408 and 0.467 kg respectively, in the period I, 0.314, 0.349 and 0.400 kg, respectively in the period II, and 0.420, 0.386 and 0.444 kg, respectively, for

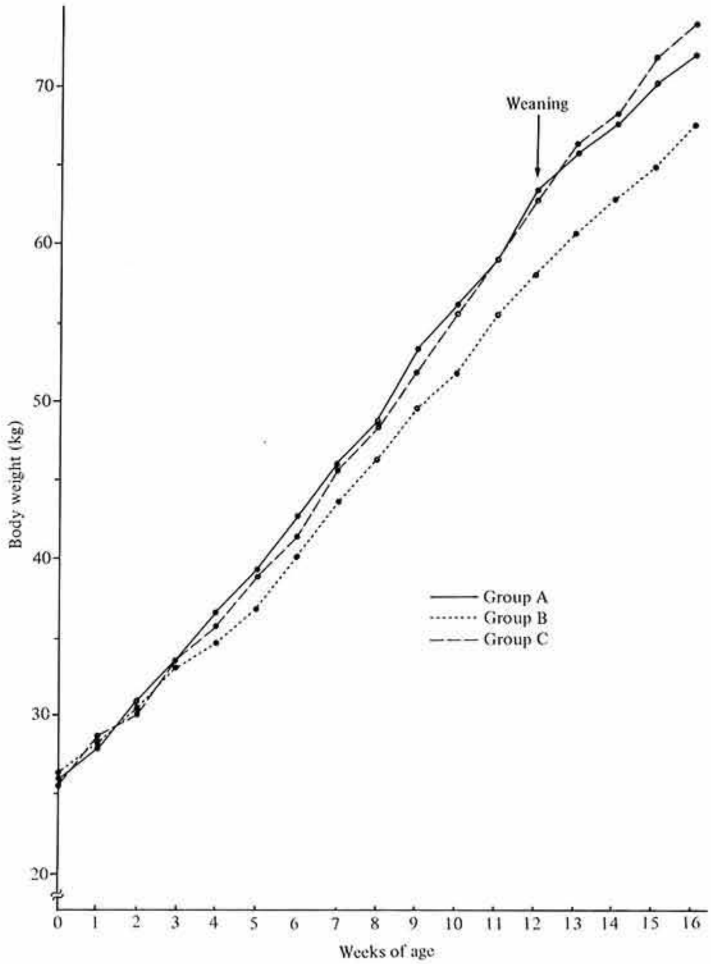

Fig. 2. Growth curves of three groups of calves

the whole period (Table 3). Statistically significant differences were not found among three groups in any period due to the shortage in the number of calves used in each group and a wide variation of individual live weight within a group.

2) *Body weight gain and body measurements at 16 weeks of age*

Average body weight and body measurements at the end of experiment are shown in Table 4, together with standard growth data of female Japanese Holstein Friesian cattle of the same age.[6] Average body weight and body measurements in Group B were smaller than those in Groups A and C, though not significant. On an average of the three groups, the body weight and height at withers are 54.1 and 90.4% of the standard female Japanese Holstein Friesian cattle. Other measurements are also less than those of Japanese standard. However, percentage values of body height and depth are higher than those of width and length. It suggests that Malaysian calves have a characteristic body conformations; relatively smaller in size, shorter in length and narrower in width than those breeds of European origin. Even calves which are half-bred or quarter-bred with Holstein blood, slower growth rate and smaller

Table 3-1. Body weight gain and daily gain of each group in the period I

Group	No.	Weight at the beginning of experiment (kg)	Weight at the end of nursing (kg)	Period (day)	Weight gain (kg)	Daily gain (kg)
A	1	41.0	61.4	42	20.4	0.486
	2	45.5	68.2	42	22.7	0.540
	3	42.0	64.1	56	22.1	0.395
	4	25.5	60.2	70	34.7	0.496
	5	26.5	63.0	77	36.5	0.474
Average			63.4±3.1			0.478±0.053
B	6	39.0	55.9	42	16.9	0.402
	7	36 5	55.7	49	19.2	0.392
	8	39.0	65.2	63	26.2	0.416
	9	25.5	60.5	77	35.0	0.455
	10	26.5	52.8	70	26.3	0.376
Average			58.0±4.9			0.408±0.030
C	11	42.0	68.0	49	26.0	0.531
	12	35.0	63.2	56	28.2	0.504
	13	39.5	66.6	56	27.1	0.484
	14	27.5	58.9	77	31.4	0.408
	15	26.5	57.8	77	31.3	0.406
Average			62.9±4.5			0.467±0.057

Average ± S.D.

Table 3-2. Body weight gain and daily gain of each group in the period II

Group	No.	Weight at the begining of weaning (kg)	Weight at the end of experiment (kg)	Period (day)	Weight gain (kg)	Daily gain (kg)
A	1	61.4	70.4	28	9.0	0.321
	2	68.2	75.0	28	6.8	0.243
	3	64.1	70.7	28	6.6	0.235
	4	60.2	71.8	28	11.6	0.414
	5	63.0	73.0	28	10.0	0.357
Average		63.4±3.1	72.2±1.9	28	8.8±2.1	0.314±0.076
B	6	55.9	62.3	28	6.4	0.229
	7	55.7	64.6	28	8.9	0.318
	8	65.2	77.0	28	11.8	0.421
	9	60.5	72.7	28	12.2	0.436
	10	52.8	62.3	28	9.5	0.339
Average		58.0±4.9	67.8±6.7	28	9.8±2.4	0.349±0.084
C	11	68.0	80.4	28	12.4	0.443
	12	63.2	74.7	28	11.5	0.411
	13	66.6	77.0	28	10.4	0.371
	14	58.9	69.1	28	10.2	0.364
	15	57.8	69.3	28	11.5	0.411
Average		62.9±4.5	74.1±4.9	28	11.2±0.9	0.400±0.032

Average ± S.D.

Table 3–3. Body weight gain and daily gain of each group during the whole experimental period

Group	No.	Weight at the beginning of experiment (kg)	Weight at the end of experiment (kg)	Period (day)	Weight gain (kg)	Daily gain (kg)
A	1	41.0	70.4	70	29.4	0.420
	2	45.5	75.0	70	29.5	0.421
	3	42.0	70.7	84	28.7	0.342
	4	25.5	71.8	98	46.3	0.472
	5	26.5	73.0	105	46.5	0.443
Average			72.2±1.9			0.420±0.048
B	6	39.0	62.3	70	23.3	0.333
	7	36.5	64.6	77	28.1	0.365
	8	39.0	77.0	91	38.0	0.418
	9	25.5	72.7	105	47.2	0.450
	10	26.5	62.3	98	35.8	0.365
Average			67.8±6.7			0.386±0.047
C	11	42.0	80.4	77	38.4	0.499
	12	35.0	74.7	84	39.7	0.473
	13	39.5	77.0	84	37.5	0.447
	14	27.5	69.1	105	41.6	0.396
	15	26.5	69.3	105	42.8	0.408
Average			74.1±4.9			0.444±0.043

Average ± S.D.

Table 4. Body weight and body measurements at sixteen weeks of age

Group	Body weight	Height at withers	Height at hip	Body length	Chest depth	Chest width	Hip width	Thurl width	Rump length	Chest girth	Belly girth	Thin circum
	kg	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm
A	72.2	84.6	88.3	83.2	36.5	21.0	20.6	23.7	27.2	92.6	108.2	10.8
B	67.8	83.2	85.4	80.3	35.5	20.6	20.3	23.2	26.7	89.6	108.4	10.7
C	74.1	85.2	87.7	83.5	36.8	21.2	20.5	23.7	27.3	94.4	109.8	10.9
Av.(1)	71.4	84.3	87.1	82.3	36.3	20.9	20.5	23.5	27.1	93.4	108.8	10.8
N.H.(2)	131.8	93.3	98.6	98.6	41.6	26.7	26.7	30.4	32.2	112.8	—	13.2
(1)/(2)%	54.1	90.4	88.4	83.5	97.2	78.4	76.7	77.4	84.1	82.8	—	81.8

N.H. refers to the growth standard of Japanese Holstein-Friesian Cattle.

size can be observed by the cross-breeding with Indian blood in it under tropical condition. For instance, birth weight of Holstein female calf is 43.4 kg[6] as compared to those of SF × LF and SF × LJ calves which were 27.5 kg and 22.6 kg, respectively (Table 1).

3) Digestibility of feed; DCP, TDN and DE (digestible energy)

After the end of the period II, three calves in each group were daily fed 0.5 kg of each calf starter ration and 2.0 kg of napier grass. A digestion trial conducted under this feeding condition gave results shown in Table 5. No statistically significant differences in digestion coefficients as well as DCP, TDN and DE utilizations were found among the groups.

4) Feed intake

Feed intake, TDN and DCP intakes of the

Table 5. Digestibilities, DCP, TDN and DE of three calf starter rations

Ration	Digestion coefficient (%)						DCP (%)	TDN (%)	DE (cal/g)
	DM	Energy	CP	EE	CF	NFE			
A	63.2	65.2	59.6	59.7	65.8	77.5	9.5	71.1	2,192
B	63.9	69.9	60.9	55.3	61.6	78.3	9.9	69.3	2,147
C	61.7	67.7	60.3	60.3	63.0	78.0	10.3	70.6	2,101

Calves in each group were fed 0.5 kg of calf starter ration and 2.0 kg of cut Napier grass daily.

three groups during the whole experimental period are shown in Table 6. Daily TDN and DCP intakes of each group by week are shown in Figs. 3 and 4, in which the amounts of TDN and DCP required for maintaining 0.3 kg of daily gain of dairy calves according to U.S. NRC feeding standard[11] are indicated by straight lines. Average daily TDN and DCP intakes in each week of age did not show any significant differences among groups. As a whole, the three groups could take approximately the same amounts of TDN and DCP. However, the increase of Napier grass intake associated with the decrease in feeding calf starter rations after the weaning could not be accomplished as scheduled due to bulkiness of the grass.

Discussion

Under the feeding conditions adopted in this experiment, calves demonstrated their ability to grow at the rate of around 0.4 kg per day. Daily weight gain rate of dairy

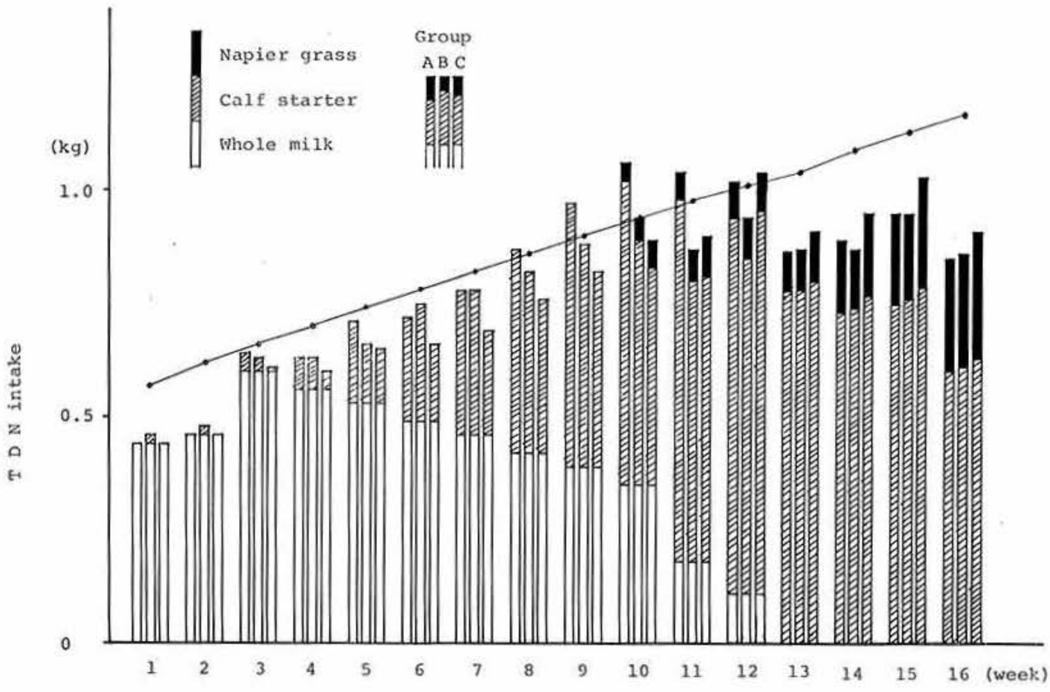

Fig. 3. Average daily TDN intakes of three groups per week during experimental period

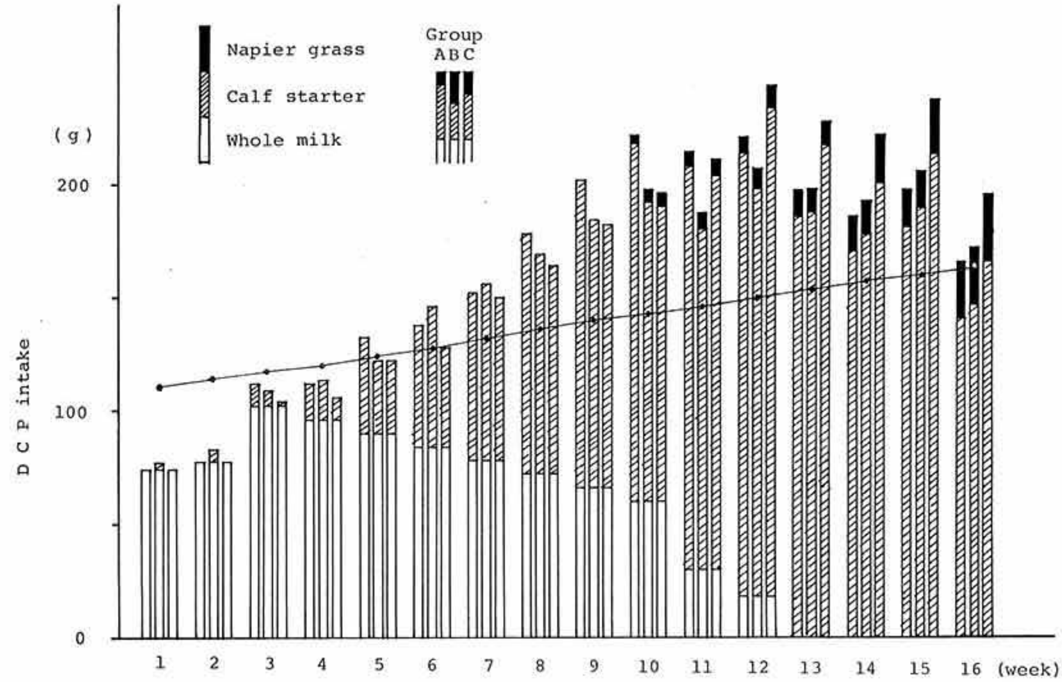

Fig. 4. Average daily DCP intakes of three groups per week during experimental period

calves in Malaysia was reported to be less than 0.2 kg under smallholders' condition,[2] although no reliable information is available on calf management by smallholders. Abu Bakar Chik et al.[3] reported that calves fed on locally-made milk replacer gained only 0.25 kg per day during a period up to 8 weeks of age, and 0.32 kg and 0.30 kg per day for calves fed on imported milk replacer and whole milk, respectively.

On the other hand, average daily gain for Japanese male Holstein Friesian calves is around 0.7 kg and their birth weight around 45 kg. In the present experiment, average daily gain for the three groups was 0.42 kg and their average birth weight was only 25.7 kg. When daily gain is divided by birth weight, the above two cases give a same value, 0.016. This result seems to indicate that the calves used in this experiment exhibited normal rate of daily gain, which is comparable with that of European breed in Japan.

The total weight gain and daily weight gain of the group B, fed with the ration B, were less than those of the group A and C, fed with the ration A and C, respectively, although the difference is not statistically significant. Digestion coefficients (%) of DM, energy, CP, EE, CF, and NFE also showed no statistically significant difference among the three rations.

It seems that lack of uniformity of calves used in the present experiment as to the initial body weight, age, sex and parental breed might have caused a difficulty in obtaining statistically significant differences among the three groups.

Average TDN intake was the lowest in Group C, because of the lowest intake in calf starter ration, but this group consumed the largest amount of bulky roughage from Napier grass (Table 6). This is why the Group C could achieve the highest weight gain among the three groups at the end of experiment. The body weight gain of this group was also attributed to the heavier weight of gut which was filled up with a large amount of Napier grass.

The calf starter rations used in this study contained 4–7% of crude fiber, 19% of DCP,

Table 6. Average feed intake (kg) of three groups during the whole experimental period

Group	Whole milk	Calf starter	Napier grass	TDN	DCP
A	198.8	65.6	68.3	90.9	18.1
B	198.6	60.2	64.1	86.6	17.6
C	198.6	56.7	84.2	86.0	18.4

and 75% of TDN, and are comparable with the recommended (official) standard of calf starter ration in Japan,[8] composed of less than 6% of crude fiber, more than 15% of DCP and more than 70% of TDN. However, the Napier grass contained less than 10% of TDN and less than 1% of DCP (on green weight basis).[5] To compensate such a poor nutritional quality of the roughage, nutritional density of calf starter rations has to be increased. On the other hand a further study will be needed to reduce the level of DCP in calf starter rations by combined use of other suitable tropical roughage, with the aim of lowering cost. Furthermore, to obtain daily gain of more than 0.3 kg, a good quality supplement in the form of a balanced concentration mixture is needed.

Soft feces were observed several times with few calves in Groups B and C, and bloat-like symptom occurred twice in Group B and once in Group C at the late stage of the experimental period, when calves already had the ability to consume more than 1 kg of calf starter ration.

It is known that acute bloat often occurs when animals ingest at one time a large amount of concentrate containing high levels of protein and carbohydrate. Rations B and C contained low levels of crude fiber, high levels of crude protein, and a large amount of carbohydrate derived from cassava chips. On the other hand, cassava contains cyanogenic glucoside (mainly Linamarin), which releases HCN. Dried cassava chips were reported to contain cyanogenic glucoside equivalent to 23–133 ppm (averaged 55 ppm)[9] or 69 to 108 ppm[7] of HCN. The cyanogenic glucoside is thought to cause the bloat in ruminants.[4] Cattle and sheep are more susceptible to HCN than horse and swine.[9] The minimum lethal dose of cyanogenic glycoside for cattle and sheep is about 2 mg/kg body weight.[4]

Feed millers in Thailand have the regulation of using cassava chips containing less than 60 ppm of HCN, and of mixing them by less than 5% in broiler ration and 10 to 15% in swine ration.[9]

Because symptoms specific to HCN toxicity were not observed in this experiment, it was not clear whether or not the soft feces and bloat-like symptom observed in cattle of the Groups B and C are certainly attributed to the HCN toxicity of the Rations B and C used. However, in view of the fact that both the Rations B and C contained a relatively large amount of cassava chips, it is suggested that the content of cassava chip in calf starter rations less than 30% would be desirable.

In conclusion, the locally available feed resources, including cassava chips, can be used as a good material for calf starter ration for weaning.

Summary

To reduce the length of nursing period and calf mortality before weaning by the use of calf starter rations, 15 pre-weaning calves composed of offsprings of Sahiwal-Friesian (female) × LID-Friesian (9 calves) and Sahiwal-Friesian × LID-Jersey (6 calves), were divided into three Groups A, B and C, and fed three different calf starter rations, A, B and C, respectively. Rations B and C were prepared by using locally-available agricultural products and by-products except imported soybean meal. Rations B and C contained 45% and 30% cassava chips, respectively, as a main energy source replacing maize. Ration A was entirely composed of imported feed ingredients. The calf starter rations were given from the first to the 16th week of age. At the initial period, whole milk was also given at the rate of about 10% of body weight twice a day, but its amount was decreased gradually, and its supply was stopped at 12 weeks of age. From 6 weeks of age to the end of the experiment Napier

grass was supplied. Water was provided individually *ad libitum* from a pail.

The results indicated that total weight gain and daily gain of Group B were lower than those of Groups A and C, but there was no statistically significant difference among groups. The daily gains for Groups A, B and C during the whole experimental period were 0.420, 0.386 and 0.444 kg, respectively.

Body weight and 11 items of body measurements of the calves at 16 weeks of age were compared with data of Holstein Friesian cattle of the same age in Japan. The body weight was about one-half of the latter, while body measurements ranged from 77 to 90%. The percentages of height and depth were generally larger than those of length and width.

There was no statistically significant difference in digestibility of feed, and TDN, DCP and DE utilization among groups. A large amount of calf starter intake in Group A depressed the intake of Napier grass as compared with Group C, but TDN and DCP intake were relatively equal among the three groups. There was no statistically significant difference in total feed intake among groups.

Few cases of bloat-like symptom and soft feces were observed in a few calves in Groups B and C.

In conclusion, cassava chips and other locally produced feed resources can be utilized as an effective calf starter ration comparable to the one entirely composed of imported feed ingredients. However, the result of this experiment suggests that the content of cassava chip less than 30% in the calf starter ration is desirable.

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