Costs and Returns in Raising Male Calves from Smallholder Dairy Farms for Beef Production[a]

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ABSTRACT : The use of the dairy male calf for beef production has been found to be economically unprofitable during the past due to high cost of feeds and relatively low beef price. However, due to current shortage of domestic beef supply and rising beef price, this research aimed to assess feeding methods and costs and returns in raising dairy male calves for beef production under changing economic conditions. Two diets were compared: calves on an optimal feeding level were given milk replacer for 44 d and a concentrate (with *ad lib.* hay) to 150 kg bodyweight that contained 16% crude protein; those given a sub-optimal diet, more appropriate for smallholder farms, received milk replacer for 30 d and 14% CP concentrate. Twelve pairs of dairy male calves (average age 32 days) of Holstein-Friesian high grades were used, each pair having similar influencing factors such as weight, age, and genotype. Each animal was kept in a separate feeding stall until reaching the final weight of 150 kg. The results from this experiment showed that the differences of traits concerning growth performance and feed efficiency of the animals raised under the two feeding regimes were statistically nonsignificant. The optimal group was just slightly better, but the cost of production of the sub-optimal group was 24 percent lower (4,667 vs. 6,144 baht per animal) and the cost difference was highly significant. The results from this investigation showed that beef production from dairy male calves can be economically viable when sub-optimal feeding method is used and market beef price is at current level. (*Asian-Aus. J. Anim. Sci. 2000. Vol. 13, No. 10 : 1461-1466*)

Key Words : Smallholder Dairy Farming, Male Calves, Beef Production, Cost and Return, Optimal Feeding, Sub-Optimal Feeding

INTRODUCTION

Each year at least 50,000 male calves are produced on smallholder dairy farms in Thailand (Department of Livestock Development, 1997), but they have not been used for beef production since small farmers are generally constrained by the shortage of labor and feed resources on farm. Hence, practically all male calves are disposed for other purposes shortly after birth (Skunmun et al., 1999), some of them being used to make foods such as sausages or meat balls, or used for feed in crocodile farms. Few attempts to produce dairy beef commercially have been made in the past but economic viability was low due to relatively high feed costs and low beef prices (Niumsup et al., 1993; Chantalakhana, 1978). With rising demand for good-quality beef and average beef prices, as well as the availability of a relatively large supply of dairy calves at rather low cost it becomes justifiable to reassess the economic and biological feasibilities of beef production from dairy male calves. It is estimated that if these dairy calves were raised for beef at 400 kg body weight Thailand will be able to attain a supply of good quality beef which is worth approximately 800 million baht a year (US$ 20 million) at the current prices.

During the past a large number of feeding and nutritional experiments have been conducted in order to raise male dairy calves for beef, especially those being published internationally (such as that reported by Heinrichs et al., 1995). However, most of these studies usually dealt with nutritional and biological characteristics of animals and feeds; much fewer were concerned with economic and resource management aspects, especially those being directly relevant to smallholder dairy conditions. Past work such as that reported by Potikanond and Cheva-Isarakul (1984), Kanchanapruttipong (1988), Niumsup et al. (1993), and Charoensri (1996) in Thailand was aimed mainly at nutritional, feeding, and biological data on dairy calf raising. The present study was intended mainly to examine economic feasibility of dairy beef production for smallholder farms utilizing, largely, locally available resources.

MATERIALS AND METHODS

Experimental animals and design

Twenty-four male crossbred calves with at least 75 percent Holstein-Friesian and an average age of 32 days were used in this feeding trial. Two feeding regimes were used for calf rearing, these are (1) T1 : optimal feeding level, and (2) T2 : sub-optimal

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Rearing period	Feeding regimens [1]	
	T1 (Optimal level)	T2 (Sub-optimal level)
A. Start to end of milk feeding	44 days (d)	30 days (d)
- Concentrate[2]	21% protein (*ad lib.*)	21% protein (*ad lib.*)
- Milk replacer	500 gm/d (2×/d)	337 gm/d (2×/d)
- Hay[3]	*ad lib.*	*ad lib.*
A. End of milk feeding to 100 kg BW		
- Concentrate[2]	16% protein (*ad lib.*)	14% protein (*ad lib.*)
- Hay[3]	*ad lib.*	*ad lib.*
B. From 100 to 150 kg BW		
- Concentrate[2]	16% protein (*ad lib.*)	14% protein (*ad lib.*)
- Hay[3]	*ad lib.*	*ad lib.*

[1] Mineral blocks were available to all animals; [2] Commercial calf ration; [3] Para grass.

feeding level which involved feeding less milk replacer during a shorter milk-feeding period, and a ration with lower protein level from 100 kg to 150 kg body weight.

The optimal feeding level (T1) was designed to provied the animals with energy and protein close to the NRC nutrient requirements for dairy cattle (National Research Council, 1989); the expected average daily gain would be around 0.70 kg. For the sub-optimal feeding level (T2), the calves were fed levels of energy and protein less than 80% of the NRC standard in order to reduce feed costs and to obtain economic benefit. The calves in this group would be expected to grow at the rate of 0.50 kg per head per day. Paired comparison was used to assess the two feeding regimens. Calves of similar weight and age were paired (12 pairs), then T1 and T2 were randomly assigned to each member of the pair. Each animal was kept in a separate cage pen (1.4 x 1.4 m^2), pair members adjacent to one another. All animals were fed until each of them reached 150 kg in body weight. The final body weight of 150 kg was decided on the basis of a common initial body weight of feeder cattle and buffalo used for fattening operations in Thailand.

Data collection

The following data were collected.

1. Records of actual daily intakes of milk replacer, concentrate, and hay throughout the experimental period.

2. Body weight of calves weighed every 14 days.

3. Nutritional compositions of milk replacer, concentrates, and hay were measured by proximate analysis and chemical analyses (Van Soest, 1967).

4. Records of all expenses concerning calf purchase, feeds, labor, medical supplies, water, electricity, gases, and opportunity cost.

This experiment was conducted during November 1997 till August 1998 at Kamphaengsaen Campus of Kasetsart University.

Data analysis

The following traits were statistically analyzed according to the paired comparison t-test.

1. Growth and feed performances including body weight gains, feed intakes, average daily gain, and feed efficiency.

2. Costs of production : fixed and variable costs.

RESULTS

Growth and feeding performance

1) Body weight (BW) gain

During the first 28-day period the calves in group T1 and T2 attained average BW gains of 8.65 and 8.42 kg, respectively. The difference between the two groups was nonsignificant ($p>0.05$). Similarly, the differences between average BW gains of the two groups of calves at 42 days after feeding (T1 : 15.63 vs T2 : 13.50 kg) and from beginning until reaching final weight of 150 kg (T1 : 114.18 vs T2 : 113.67 kg) were nonsignificant (table 1). The trend of weekly BW gains throughout this feeding trial is shown in figure 1.

2) Feed intake

Feed intakes of the calves were calculated in terms of dry matter. For the first 28-days of feeding the two groups of calves consumed on average 1.32 (T1) and 1.25 (T2) kg/head/day, while that for the first 42-day period were 1.49 (T1) and 1.47 (T2), and for the

Table 1. Growth and feeding performances

Traits	T1	T2
Initial		
Weight (kg)	38.37± 5.25	37.83± 4.77
Age (days)	31.83±18.56	34.00±16.12
BW gains (kg)[NS]		
0-28 d	8.65	8.42
0-42 d	15.63	13.50
0-final[1]	114.18	113.67
Feed intakes (kg/d)[NS]		
0-28 d	1.32	1.25
0-42 d	1.49	1.47
0-final[1]	3.43	3.39
Intakes of concentrates (kg/d)[NS]		
0-28 d	0.49	0.56
0-42 d	0.55	0.74
0-final[1]	1.84	2.06
Intakes of roughage (kg/d)[NS]		
0-28 d	0.37	0.38
0-42 d	0.47	0.50
0-final[1]	1.52	1.50
Average daily gains (kg/d)[NS]		
0-28 d	0.31	0.30
0-42 d	0.37	0.32
0-final[1]	0.60	0.57
Feed efficiencies (kg feed/kg BW)[NS]		
0-28 d	6.86[2]	4.72
0-42 d	5.21	4.93
0-final[1]	5.54	5.95

[NS] The difference between T1 and T2 was statistically nonsignificant ($p>0.05$).

[1] Only 9 pairs remained in the experiment. One calf had digestive disorder before 28 days of feeding, one was affected by babesia, and the third calf died due to fatal accident at 120 kg BW.

[2] One animal had digestive problem.

whole experimental period 3.43 (T1) and 3.39 (T2) kg/head/day (table 1). The differences between the two groups were nonsignificant ($p>0.05$).

The intakes of concentrate dry-matter were 0.49 (T1) and 0.56 (T2) kg/head/day during the first 28 days, while those for the first 42 days were 0.55 (T1) and 0.74 (T2) kg/head/day with higher average for group 2 (T2) due to earlier termination of milk replacer at 30 days. These differences were statistically nonsignificant. Feed intakes of the two groups of calves for the whole experiment were 1.84 and 2.06 kg/head/day for T1 and T2, respectively; the difference was nonsignificant. Figure 2 shows weekly concentrate feed intakes of the two groups of calves.

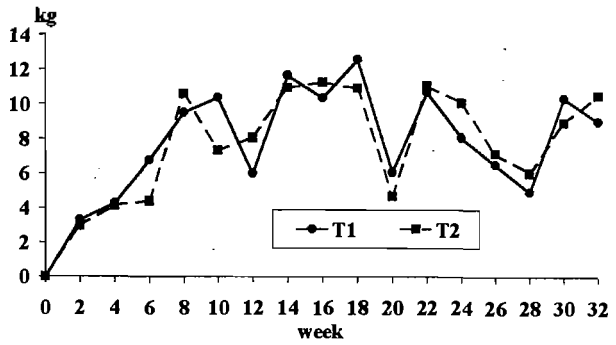

Figure 1. Body weight gains of dairy male calves during 32 weeks of feeding trial

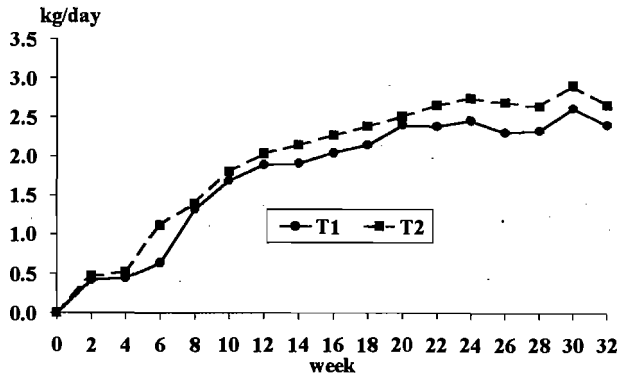

Figure 2. Weekly concentrate feed intakes of two groups of calves (T1 and T2)

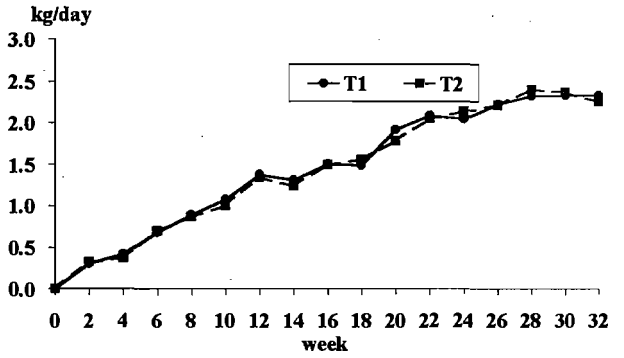

Figure 3. Weekly roughage feed intakes of two groups of calves (T1 and T2)

For roughage feed intake, hay was provided for the two groups of calves throughout this experiment. The differences in feed intakes of the two groups were nonsignificant ($p>0.05$) for all three periods. The average roughage intakes were 0.37 (T1) and 0.38 (T2) for 0-28 days, 0.47 (T1) and 0.50 (T2) for 0-42

days, and 1.52 (T1) and 1.50 (T2) kg/head/day for the whole period. Figure 3 shows weekly averages for roughage feed intakes of the two groups.

3) Growth rate

The average daily gains for the two groups of calves were 0.31 (T1) and 0.30 (T2) kg/head/day for the first 28 days, 0.37 (T1) and 0.32 (T2) kg/head/day for the first 42 days, and 0.60 (T1) and 0.57 (T2) kg/head/day for the whole period (table 1). The differences between the two groups were nonsignificant ($p>0.05$).

The average daily gains of the two groups during milk-feeding period were 0.36 kg for T1 (using milk replacer until 44 days) and 0.28 kg for T2 (using milk replacer at lower level for only 30 days).

4) Feed efficiency

The amounts of feed (dry-matter basis) required to produce one kg of body weight gain or feed efficiencies for the two groups of calves (T1 vs T2) were compared and the differences were found to be nonsignificant ($p>0.05$). For the first 28 days the averages were 6.86 (T1) and 4.72 (T2) kg of feed to 1 kg BW gain, for the first 42 days 5.21 (T1) and 4.93 (T2) kg and for the whole period 5.54 (T1) and 5.95 (T2) kg. One animal in T1 experienced digestive trouble during the first 28 days.

Costs of rearing male calves

For the first 42-day feeding period the cost of raising male calves for group T1 (terminating the use of milk replacer at 44 days) was 1,663 baht (37 baht = US$ 1) and for group T2 (terminating the use of milk replacer at 30 days) 1,053 baht ($p<0.01$). The cost of feeds accounted for 90.8 and 85.7% for T1 and T2, respectively. The cost of production during the first 42 days of calf feeding amounted to 27.1 and 22.6% of the total cost during the whole experiment for T1 and T2 accordingly. For the whole period of experiment, the comparison of the cost of production in details is shown in table 2. The total costs of raising dairy male calves from shortly after birth up to 150 kg BW for groups 1 and 2 were 6,145 and 4,667 baht, respectively, while the costs per 1 kg BW gain were 52.5 (T1) and 38.2 (T2) baht. The average length of time for the calves to reach 150 kg BW for T1 was 195 days and 201 days for T2. The costs of feeds for T1 and T2 were 73.2 and 67.0% of the total cost, respectively, while labor costs amounted to 8.6 and 11.7% accordingly. It can be seen that the total cost of production for group 2 (lower level of feeding) was 24% lower than group 1 (optimal level of feeding) while growth and feeding performances were not statistically significant.

DISCUSSION

Body weight gain

The BW gains of both groups during the first 28 days of rearing, when all calves received milk replacer, T2 were slightly smaller due to lower level of feeding of milk replacer. At 42 days of feeding, average BW gain for T1 was higher due to continuing feeding of milk replacer (until 44 days).

Average daily gains at 28 days of feeding (T1, 0.31 kg; T2 0.30 kg) were comparable to those of 0.30 to 0.36 kg/head/day reported by Limprasert (1983) and Charoensri (1996). For the period of 42 days of feeding, the average daily gain for T1 was 0.37 kg and 0.32 kg for T2. The difference was due to termination of milk replacer for T2 at 30 days but nonsignificant. The termination of milk replacer will slow down calf growth during the immediate

Table 2. Costs of raising dairy male calves up to 150 kg BW

Items[1]	T1	%	T2	%
Variable cost	6,133	99.8	4,655	99.7
Labor	530	8.6	545	11.7
Milk replacer	1,368	22.3	636	13.6
Concentrates	2,801	45.6	2,155	46.2
Roughage	327	5.3	337	7.2
Medical supplies	15		15	
Water/electricity	68		70	
Calves	350		350	
Miscellaneous	52		49	
Opportunity	622		499	
Fixed cost	12	0.2	12	0.3
Farm rent	12		12	
Total cost **	6,145		4,667	

[1] Thai currency approximately 37 baht = US$1 at the time of experiment.

** The difference (T1-T2) was highly significant ($p<0.01$).

subsequent period due to changing plane of nutrition (Charoensri, 1996). For overall period, the average daily gain of the calves in T1 was 0.60 kg as compared to 0.57 kg for T2. These averages were slightly higher than those of 0.47 to 0.50 kg reported by Charoensri (1996), owing to the fact that the experiment by Charoensri (1996) used slightly less of concentrate per animal and high proportions of calves, from the age of 0 to 4 weeks, were sick due to digestive disorder. Niumsup et al. (1993) used a longer period of milk (powdered milk) feeding (45, 60, 90, 120 days of milk feeding) obtained and average daily gains of Holstein-Friesian crossbred male calves of 0.69, 0.70, 0.63, and 0.65 kg per head, respectively. Chen (1978) who reared Holstein male calves in Taiwan using milk replacer for 28 days obtained an average daily gain of 0.34 kg, and for the period from 29 to 120 days (after termination of milk) the average gain was 0.65 kg. Chee (1978) reported the results of experiments on growing dairy male calves in Korea, in which feedings were based on 100% NRC standard, 150% of NRC, and 50% of NRC, and the respective average daily gains were 0.63, 0.65, and 0.45 kg which showed similar results to the present study.

Feed intake and efficiency

For the first 28 days the calves in T1 had higher average feed intake due to higher level of milk replacer feeding (1.32 kg/head/day) as compared to those in T2 (1.25 kg/head/day); intakes of concentrate and roughages during this initial period were small. For the period of first 42 days, the average feed intakes for both groups were similar (T1 1.49 vs. T2 1.47 kg/day), when T2 calves consumed more concentrate than T1 calves (0.74 vs 0.55 kg/day) after termination of milk replacer. These results were in line with the report by Stobo et al. (1967) who showed that calves increased concentrate intake after termination of milk feeding. The average feed intakes for both groups were similar (3.43 kg/day for T1 and 3.39 kg/day for T2) when calculated throughout the experiment.

Feed conversion efficiency during the first 28 days for group T1 was 4.74 kg of feed to one kg BW gain (when a sick animal was excluded) as compared to group T2 of 4.72 kg. However, when the sick animal was included in the calculation the average feed efficiency of T1 was 6.86 kg of feed to one kg BW gain. For a similar reason, the average of feed efficiency for T1 (5.21 kg) was slightly inferior to T2 (4.93 kg) for the first 42 days. However, for the overall the period of the experiment the calves in T1 appeared to require slightly less feed per one kg of BW gain as compared to T2 (5.54 vs 5.95 kg).

Costs of raising dairy male calves for beef

The cost of production of dairy male calves at 150 kg BW was 40.6 baht per kg BW (approximately US$ 1.10) for T1 and 31.1 baht per kg BW (US$ 0.84) for T2, with the ratio of the cost per kg BW for T1 / T2 of 1.31:1. Current prices of good-quality beef in Thailand range from 40 to 43 baht (US$ 1.08 to 1.16) per kg live weight up to 65 baht (US$ 1.76).

Raising dairy male calves for beef under present economic conditions is therefore proven to be quite profitable. Furthermore there are reasons to believe that the cost of dairy-beef production can be further decreased through formulation of cheaper rations as well as improving calf management practices. Dairy beef production with appropriate economy of scale, through integrated farming approach utilizing crop by-products and wastes, with secured link to good-quality beef market or cooperatives, can become a very viable enterprise in Southeast Asian countries in the coming decades.

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