

Comparative Feeding of Male Dairy, Beef Cattle and Swamp Buffalo

I. Economics of Beef Production

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ABSTRACT : Due to rising trend of beef demand in Asia in the next two decades it is necessary to find additional sources of beef supply. In most Southeast Asian countries, male dairy and swamp buffalo have not yet been raised for a primary purpose of quality beef production. This study was aimed to compare growth and feeding performances as well as economic returns from feeding male dairy, beef cattle and swamp buffalo for quality beef. Thirty-six animals, 12 of each breed group, were used in feeding trial to compare the cost of beef production. Two levels of concentrate feeding, 1.75% of body weight (BW) and 1.00% of BW, were used for each breed group in order to compare feeding methods i.e. high and low levels. Within each breed group two animals of similar initial BW were randomly assigned to the two levels of feeding. The animals were fed from about 150 kg BW until reaching the final weight of about 400 kg. The results from this study showed that under the prevailing economic conditions in Thailand the cost of beef production from buffalo was lowest due to very low cost of feeder stocks, followed by dairy and beef. However, the cost of feeding per kg of BW gain was lowest in beef and highest in buffalo i.e. when disregarding the differences in cost of feeder stocks. Beef calves grew faster than dairy and buffalo, with better feed efficiencies. The results indicated that beef cattle could be more suitable for beef production for high-quality beef market, while buffalo could be more suitable for small farms where high roughage feeding is common. Male dairy calves appeared to require higher level of concentrate feeding than 1% BW in order to maintain good body conditions. (*Asian-Aust. J. Anim. Sci.* 2002, Vol 15, No. 6 : 878-883)

Key Words : Cost of Beef Production, Male Dairy, Swamp Buffalo, Growth, Carcass Traits

INTRODUCTION

The demand for beef in Asia in 2020 was predicted to be 2.6 times of that in 1993 (Delgado et al., 1999). The increasing trends of beef demand have already been evident in several Southeast Asian countries such as Indonesia, Malaysia, the Philippines, and Thailand. Additional sources of beef supply could come from male dairy calves, which have not been utilized in most countries in Asia. Good quality beef can also be produced from buffaloes. In 2020 the demand for milk in Asia will also rise to 2.7 times as compared with that in 1993 (Delgado et al., 1999), and the increase in milk supply will most likely come from increasing number of dairy animals, which means that more male dairy calves will be available for beef production. Furthermore, the use of swamp buffalo for draft power in several Southeast Asian countries showed a steadily declining trend (Chantalakhana, 2001), and these animals can also be diverted to beef production.

It is commonly believed that swamp buffalo can utilize poor quality feeds such as crop residues more efficiently than cattle and, hence, increase body weight at lower cost. However, in case where better quality feeds are used in animal feeding beef cattle could grow faster with better feed

efficiency. Pao-in (1995) obtained average daily gains (ADG) of 0.31 and 0.21 kg/day from swamp buffalo and Brahman crossbred (with Thai native), respectively, when feeding was based only on roughages; but these respective ADG's increased to 0.67 and 0.54 kg when concentrate supplement of 1% BW was given to these animals, and 0.76 and 0.76 kg for animals given concentrate supplement of 1.5% BW. Kanthapanit et al. (1972) found that European crossbred beef grew at 0.90 vs 0.40 and 0.60 kg/day for Brahman crossbred and swamp buffalo, respectively, on the same feeding level. Wanapat and Wachirapakorn (1990) reported an ADG of 0.53 kg from swamp buffalo fed with roughage and concentrate available at village level at 50:50 ratio.

Feeding of Holstein-Friesian (HF) crossbreds in different studies found the ADG from 0.92 (Nijthavorn, 1995), 0.8 to 1.0 (Ruaengsiri, 1991), and 0.51 for 75% HF and 0.40 for 50% HF (Thubcharoen, 1986). Kanthapanit (1984) found the ADG's of HF cross, Brahman cross, and Charolais cross to be non-significantly different when these animals were fed the same ration. However, so far there has been no comparative study on feeding of dairy, beef cattle, and swamp buffalo for beef production. This study was aimed firstly to make an economic comparison of beef production from beef cattle versus male dairy and swamp buffalo, and, secondly, to examine whether animals from these three breed groups respond differently to different levels of feeding.

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MATERIALS AND METHODS

Selection of experimental feeding levels

Two feeding levels were used in this experiment (1) feeding of concentrate supplement at 1.75% of BW and (2) feeding of concentrate supplement at 1.00% of BW. The first feeding level was considered an optimal level of concentrate supplement practiced by beef fattening operators, while the second level represented possible feeding practice by small-scale cattle raisers in Thailand. The experimental feeds were formulated to contain 18% crude protein (CP) for animals below 200 kg BW, while 16% CP ration was used for animals above 200 kg BW (see feed composition in table 1). Animals were fed individually twice a day at 8:00 and 13:00 o'clock, at which time each animal received concentrate feeding and then green forage grass *ad libitum*.

Experimental animals

Thirty-six male calves of dairy crossbreds (>75% HF), beef crossbreds (mostly Kamphaengsaen breed i.e. 50% Charolais, 25% Brahman, and 25% Thai indigenous cattle), and Thai swamp buffaloes, with 12 animals of each breed group, were used in this experiment. The initial weights of

the experimental animals were 167.1±10.9, 211.5±39.1 and 153.1±10.9 kg for dairy, beef and buffalo, respectively. All animals were fed to the final weight of approximately 400 kg after which they were slaughtered for carcass and meat studies. This experiment was carried out at the Buffalo and Beef Production Research and Development Center (BPRADec) of Kasetsart University at Kamphaengsaen Campus during July 1998 to November 1999.

Experimental design and data collection

Within each breed group, two animals of similar initial BW were chosen as a pair, and the two feeding levels were assigned randomly to each member of each pair. Hence, there were 6 pairs within each breed group. Paired comparison was used to analyze the data within each breed group. The combined data of three breed groups conformed that of the split-plot design. The following mathematical model was used to analyze the combined data.

$$Y_{ijk} = \mu + B_i + P_{j^i} + F_k + BF_{ik} + e_{ijk}$$

When

y_{ijk} = observation on an individual animal of i^{th} breed within j^{th} pair received k^{th} level of feeding

μ = an overall average

B_i = the difference due to breed groups

P_{j^i} = the effect of pairs (different initial body weight) for pair j^{th} of breed i^{th}

F_k = the influence of feeding level k^{th}

BF_{ik} = the interaction between the i^{th} breed and feeding level k^{th}

e_{ijk} = random variation peculiar to an individual animal

Duncan's New Multiple Range Test was used to test the significant differences of three breed groups.

As for data collection, daily measures of feed intake and cost of production for each animal were recorded. Individual animal was weighed once a month. All animals were slaughtered at about 400 kg BW at the University slaughterhouse and carcass data were recorded.

RESULTS AND DISCUSSION

Feeding and growth performances

Detailed figures in table 2 show feeding and growth performances of male dairy, beef and swamp buffalo. The initial weight of beef calves was relatively heavier (211.50 kg) as this was determined by the availability of feeder stocks at the time of experiment. The ADG of beef calves was highest (793.73 g) as compared with dairy (707.54 g) and swamp buffalo (607.04 g). These results were similar to many past reports (Kaewkong, 1983; Thubcharoen, 1986; Pao-in, 1995; Kanthapanit et al., 1972;

Table 1. Feed and nutrient composition of experimental concentrate rations

Feed ingredient, kg	Ration 1 (BW 150-200 kg)	Ration 2 (BW 200-400 kg)
Cassava chips	44.90	42.60
Dry brewery waste	20.00	20.00
Palm kernel cake	10.00	14.00
(special grade)		
Palm kernel cake	-	10.00
Corn	8.00	-
Soybean meal	4.00	-
Molasses	8.00	8.00
Urea	2.00	2.00
Bone meal	1.50	1.80
Salt	1.00	1.00
Premix ¹	0.50	0.50
Sulfur powder	0.10	0.10
Total	100.00	100.00
Nutrients (%)		
Crude protein	18.00	16.00
TDN	78.00	80.00
Calcium	1.16	1.22
Phosphorus	0.50	0.58
Price per kg. baht	5.54	4.22

¹ One kg consisted of Vitamin A 2,160,000 IU, Vitamin D 400,000 IU, Vitamin E 2,700 IU, Mn 8.5 g, Zn 6.4 g, Fe 8.0 g, Cu 1.6 g, Co 320 mg, I 800 mg, Mg 16 mg, Se 32 mg, EDTA 66 mg, and the rest was filler.

Table 2. Feeding and growth performances of three breed groups

Item	Dairy	Beef	Buffalo
No. of animals	12	12	12
Initial BW, kg	167.13±10.86	211.50±39.14	153.13±10.95
Final BW, kg	413.68±10.16	411.51±8.91	398.88±9.13
Days of feeding	354.17 ^b ±46.45	263.42 ^c ±80.42	411.00 ^a ±49.05
Total BW gain, kg	246.04 ^a ±14.26	200.01 ^b ±42.54	245.76 ^a ±10.48
Average daily gain, g	707.54 ^b ±91.69	793.73 ^a ±166.12	607.04 ^c ±86.01
Daily feed intake, kg			
Concentrate	4.09 ^a ±1.16	4.11 ^a ±1.01	3.67 ^b ±0.94
Roughage	12.65 ^a ±0.71	11.71 ^b ±1.01	11.85 ^b ±0.91
Kg of feed per 1 kg BW gain			
Concentrate	5.76 ^{ab} ±1.31	5.29 ^b ±0.92	6.08 ^a ±1.12
Roughage	18.27 ^a ±2.87	15.38 ^b ±3.50	19.97 ^a ±3.71

^{a,b,c} Different superscripts indicate significant difference ($p < 0.05$).

Wanapat and Wachirapakorn, 1990). The amount of feeds required for 1 kg BW gain appeared to be lowest in beef calves i.e. 5.29 kg for concentrate and 15.38 for roughage, while feeds per kg BW in buffalo calves were highest i.e. 6.08 kg for concentrate and 19.97 for roughage, and that in dairy calves was medium i.e. 5.76 for concentrate and 18.27 for roughage.

Figures in table 3 show the differences of animal traits resulting from two feeding levels of concentrate. The differences of average daily gain, feed conversion ratios for concentrate and roughage, and daily feed intakes were highly significant ($p < 0.01$).

Cost of production

Beef calves were raised from an average initial BW of 211.50 kg until reaching average final weight of 411.51 kg, with total BW gain of 200.01 kg; the cost per kg of final BW was 57.22 baht (table 4) which was highest ($p < 0.05$)

among the three breed groups. This is mainly due to higher cost of feeder stocks (beef calves), which was 63.14 baht per kg of initial BW as compared with 28.10 and 12.42 for dairy and buffalo, respectively. Dairy calves were fed from 167.13 kg initial BW until reaching average final BW of 413.68 kg, with total BW gain of 246.04 kg; the cost per kg of final BW was 53.23 baht. Feeding of buffalo calves started at average initial BW of 153.13 kg until the average final BW reached 398.88 kg, with total BW gain of 245.76 kg; the average cost per kg of final BW was 47.16 baht and lowest among the three breed groups ($p < 0.05$). This was mainly due to the fact that the average cost per kg of initial BW of buffalo calves was only 12.42 baht, 5 times less expensive than beef calves. However, when feeding cost per kg of BW gain (excluding the costs of initial BW) was calculated beef calves appeared to be lowest (52.87 baht) and significantly lower than buffalo (63.04 baht) but non-significantly different from dairy

Table 3. Feeding and growth performances of animals received two concentrate levels

Item	Feeding of concentrate		Significant levels
	1.75%BW	1.00%BW	
No. of animals	18	18	
Initial BW, kg	177.50±34.48	177.34±35.30	
Final BW, kg	408.70±14.23	407.62±14.23	
Days of feeding	311.83±83.51	373.89±77.12	**
Total BW gain, kg	230.93±34.01	230.28±34.75	NS
Average daily gain, g	776.74±149.39	626.82±78.59	**
Daily feed intake, kg			
Concentrate	4.92±0.40	2.99±0.21	**
Roughage	11.56±1.03	12.58±0.52	**
Kg of feed per 1 kg BW gain			
Concentrate	6.22±1.27	4.82±0.53	**
Roughage	15.35±2.92	20.39±2.78	**

** Highly significant difference ($p < 0.01$).

NS: Non-significant difference ($p > 0.05$).

Table 4. Costs of beef production from male dairy, beef cattle and swamp buffalo, Thai baht*

Item	Dairy	Beef	Buffalo
No. of animals	12	12	12
Total cost	21,975.82 ^b ±1,547.61	23,544.88 ^a ±1,406.84	18,814.16 ^c ±1,668.85
Cost per kg final BW	53.23 ^b ±3.64	57.22 ^a ±3.34	47.16 ^c ±4.01
Cost of concentrate/d	18.82 ^b ±5.33	19.45 ^a ±5.03	16.67 ^c ±4.36
Cost of roughage/d	12.65 ^a ±0.71	11.71 ^b ±1.01	11.85 ^b ±0.91
Feeding cost/kg BW gain ¹	58.53 ^b ±6.30	52.87 ^b ±6.77	63.04 ^a ±7.29

* Approximately 45 baht=US\$ 1.

¹ Not including cost of animal purchase.

^{a,b,c} Different superscripts indicate significant difference ($p < 0.05$).

(58.53 baht). This was mainly due to the fact that beef calves grew faster (ADG 793.73 g) than buffalo (607.04 g), with better feed efficiencies for both concentrate and roughage feeds (table 2) as compared with buffalo calves ($p < 0.05$).

Figures in table 5 show various cost items for beef production per kg of BW gain of dairy, beef, and buffalo, as well as the cost of feeding using two levels of concentrate (1.75% BW vs 1.00% BW). The average cost per kg BW was 58.85 baht for 1.75% BW group and 56.79 for 1.00% BW group, the difference was not significant ($p < 0.05$). It can be seen that the first group (1.75% BW) used more concentrate (6.22 kg) per kg BW gain (table 3) which resulted in higher cost for concentrate feed (table 5), but this was somewhat offset by less use of roughage feed as compared with the second group (1.00% BW). Although the ADG of the second group (626.82 g) was lower than the first group (776.74 g) but the cost of production of the second group was slightly lower though not statistically significant.

Figures in table 6 show detailed feeding performances of male dairy, beef and buffalo being fed on two feeding levels of concentrate. It should be noted that beef calves grew at 910.16 g per head per day on high level of concentrate, but only 677.31 g on low level of concentrate. The difference of 232.85 g per animal per day was highly significant ($p < 0.01$), while the same differences were only 115.74 in

dairy ($p < 0.05$) and 92.55 in buffalo ($p < 0.05$). This indicated that improved breed of beef cattle responded to higher level of feeding better than dairy or buffalo calves. However, the effect of lower feeding level was less distinct in buffalo. This could indicate that under small-farm conditions in developing countries where feed resources were usually limited in quality and quantity, buffalo might offer a better alternative for beef production from crop residues and other farm wastes and by-products, especially where farmers could not afford cash inputs such as concentrate feeds or premixes. As concerning feed efficiency, the amounts of feeds per kg of BW gain were lowest in beef calves fed with high level of concentrate, while these figures were higher in dairy and buffalo, accordingly.

Carcass traits

Warm dressing percentages of male dairy, beef and buffalo being fed two levels of concentrate were shown in table 7. Warm dressing percentage of beef cattle was significantly higher (56.20%) than that of dairy (53.78%) and buffalo (52.30%), while the difference between dairy and buffalo was non-significant. It should be noted that only the difference of dressing percentages between two levels of concentrate feeding in dairy group was significant ($p < 0.05$), but not in beef or buffalo group. It was clearly evident that male dairy calves receiving low level of concentrate feeding

Table 5. Cost of beef production per kg BW gain, Thai baht

Cost item	Breed			Concentrate level	
	Dairy	Beef	Buffalo	1.75% BW	1.00% BW
Variable cost	58.10	52.53	62.54	58.45	56.34
Labor	4.92	3.87	5.73	4.53	5.41
Concentrate	26.51	27.46	27.38	30.27	23.97
Roughage	18.27	12.67	19.97	15.35	18.59
Supplies ¹	2.89	2.53	3.29	2.75	3.04
Opportunity cost	5.51	6.00	6.17	5.55	5.33
Fixed cost	0.43	0.34	0.50	0.40	0.45
Farm rent	0.43	0.34	0.50	0.40	0.45
Total cost	58.53	52.87	63.04	58.85	56.79

¹ Veterinary supplies, electricity, water, and miscellaneous items.

Table 6. Feeding performances of dairy, beef and buffalo on two planes of nutrition

Item	Plane of concentrate feeding		Significant level
	1.75%BW	1.00%BW	
Dairy			
No. of animals	6	6	-
Initial BW, kg	168.05±9.40	167.22±13.06	-
Final BW, kg	411.17±5.95	415.98±13.38	-
Days of feeding	322.33±39.02	386.00±28.14	**
Total BW gain, kg	243.32±13.37	248.77±15.82	-
Avg. daily gain, g	762.44±86.62	646.70±54.37	*
Feed intake/d			
Concentrate	5.18±0.24	2.99±0.04	**
Roughage	12.29±0.78	13.01±0.41	NS
Kg feed/1 kg BW			
Concentrate, kg	6.87±0.83	4.65±0.34	**
Roughage, kg	16.29±2.14	20.24±2.03	**
Beef			
No. of animals	6	6	-
Initial BW, kg	211.72±40.56	211.28±41.53	-
Final BW, kg	411.15±9.67	411.87±9.00	-
Days of feeding	230.17±82.10	296.67±69.53	NS
Total BW gain, kg	199.43±43.52	200.58±45.67	-
Avg. daily gain, g	910.16±160.07	677.31±50.56	**
Feed intake/d			
Concentrate	5.03±0.34	3.18±0.22	**
Roughage	11.19±1.14	12.23±0.55	NS
Kg feed/1 kg BW			
Concentrate	5.76±0.97	4.27±0.50	*
Roughage	12.60±2.59	18.16±1.33	**
Buffalo			
No. of animals	6	6	-
Initial BW, kg	152.73±7.81	153.52±14.23	-
Final BW, kg	402.77±3.86	395.00±11.49	-
Days of feeding	383.00±35.14	439.00±46.64	*
Total BW gain, kg	250.03±6.91	241.48±12.25	-
Avg. daily gain, g	657.62±64.21	565.07±77.54	*
Feed intake / d			
Concentrate	4.55±0.30	2.79±0.11	**
Roughage	11.20±0.84	12.50±0.29	**
Kg feed/1 kg BW			
Concentrate	7.07±0.67	5.09±0.68	**
Roughage	17.15±1.93	22.78±2.75	**

* Significant difference ($p < 0.05$), ** Highly significant difference ($p < 0.01$).

NS: Non-significant difference ($p > 0.05$).

showed low body condition reflecting insufficient feeding level, while their body structure remained large. This indicated that low plane of concentrate feeding probably provided less than satisfactory level of nutritional requirements for high-grade HF crossbreds.

CONCLUSION

The results from this experiment indicated that when

high plane of nutrition was provided to bovine animals in beef production, beef cattle (Kamphaengsaen breed) grew significantly faster than buffalo by about 38% of the average daily gain of buffalo, while dairy calves outgrew buffalo by only 16%. However, at lower plane of nutrition beef calves outgrew buffalo by less than 20%, while dairy calves outgrew buffalo by only 14%. When planes of nutrition were compared the beef calves on higher plane of feeding outgained those beef calves on lower plane by more

Table 7. Warm dressing percentages of male dairy, beef and buffalo

Item	Dairy		Beef		Buffalo	
	1.75%BW	1.00%BW	1.75%BW	1.00%BW	1.75%BW	1.00%BW
Mean	54.85	52.71	56.36	56.03	52.49	52.10
SD	2.60	1.10	2.71	1.32	1.66	1.94
CV (%)	4.74	2.09	4.82	2.36	3.17	3.73
Difference between two feeding levels	*		NS		NS	
Breed mean	53.78 ^b		56.20 ^a		52.30 ^b	
CV (%)	4.10		3.72		3.32	

* Significant difference ($p < 0.05$). NS Non-significant difference ($p > 0.05$).

than 34%, while the corresponding estimates were only about 16 and 18% for buffalo and dairy, respectively. This indicated that buffalo calves were less responsive to high plane of concentrate feeding, and probably more adaptable to traditional feeding systems of roughage feeding.

When considering growing and feeding performances of dairy, beef and buffalo together with cost of production, it can be generally concluded that wherever premium prices are paid for high-quality beef high level feeding of crossbred beef cattle in tropical environment can be more profitable as compared to buffalo or dairy beef. However, for common consumer market, such as that in Thailand and Southeast Asia raising of buffalo by rural farmers utilizing locally available feed resources can be more profitable due to lower cost per kg of BW, though the time period taken for buffalo feeding to reach mature BW would be somewhat longer.

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REFERENCES

- Chantalakhana, C. 2001. Contribution of water buffaloes in rural development. In Proceedings of FAO (APHCA)/JLTA/DLD Regional Workshop on "Water Buffalo Development : Water Buffalo for Food Security and Sustainable Rural Development". FAO, Bangkok. p. 9.
- Delago, C., M. Rosegrant, H. Steinfeld, S. Ehui and C. Courbois. 1999. Livestock to 2000 : The next food revolution. IFPRI/FAO/ILRI. Food, Agriculture, and the Environment Discussion Paper 28. p. 72.
- Kaewkong, T. 1983. Body weight gain, feed efficiency and carcass quality of male dairy crossbreds of Holstein-Friesian, Brown Swiss and Red Dane. M.S. Thesis, Kasetsart University Library, Bangkok, Thailand.
- Kanthapanit, C. 1984. Production of quality beef from dairy. *Beef and Buffalo Journal* 7(2):5-10. Kasetsart University, Bangkok.
- Kanthapanit, C., U. Pisone and F. Pinkerton. 1972. Study on roughage to concentrate ratio in cattle and buffalo fattening. Annual Report, The Northeast Agricultural Center, Khon Kaen, Thailand. pp. 15-29.
- Nijthavom, C. 1995. Effects of feeding cotton seedmeal to male dairy calves on growth, carcass quality and cost of production. Kasetsart University Library, Bangkok, Thailand.
- Pao-in, T. 1995. Comparison of beef performance and economic return between swamp buffalo and Brahman crossbred. M.S. Thesis, Kasetsart University Library, Bangkok, Thailand.
- Ruaengsiri, T. 1991. Use of wastes from baby-corn production for fattening of Holstein-Friesian male crossbreds. M.S. Thesis, Kasetsart University Library, Bangkok, Thailand.
- Thubcharoen, S. 1986. Growth, puberty and semen quality of Holstein-Friesian crossbreds. M.S. Thesis, Kasetsart University Library, Bangkok, Thailand.
- Wanapat, M. and C. Wachirapakom. 1990. Utilization of roughage and concentrate by feedlot swamp buffalo. *Asian-Aus. J. Anim. Sci.* 3:195.