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Effect of calf rearing management on milk yield and live weight performance of crossbred dairy cattle in Thailand

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Abstract

Forty crossbred dairy cows (75-87.5% HF) and their calves were studied in a factorial experiment with three factors. The milking treatments were: hand milking (HM) and machine milking (MM); the calf rearing management; artificial rearing (AR) and restricted suckling (RS) and the parity number: primiparous (PP) and multiparous (MP). Calves in all of the groups were weaned at 84 days of age. Milking treatment was continued for 252 days postpartum. Average total milk production (TMP) of MM cows were significantly higher than HM in all periods. It was found that MM cows produced significantly more ($P<0.01$) saleable milk production (SMP) than HM cows in the period 4-84 days, but not significant in the other periods. Throughout the study period, the RS cows produced significantly ($P<0.001$) more TMP and SMP than the AR cows. The MP cows produced significantly ($P<0.01$) more TMP and SMP than PP cows throughout the study period. Cow body weight was not affected any treatments effect. There were no significant effect of interaction between treatments on milk production and cow body weight in any period of the study. Calves reared by RS consumed significantly ($P<0.001$) more milk per day in the period 4-84 days than did AR calves. The average daily gain of calves under RS treatment was significantly higher ($P<0.01$) than AR calves. The heart-girth measurement of the calves was not significantly different at birth, 28 days of age and at 56 days of age, but the RS calves was significantly ($P<0.05$) greater heart-girth measurement than AR calves at weaning.

Keywords: Restricted suckling, Artificial rearing, Saleable milk yield, Total milk yield, Live weight , Crossbred

Introduction

In 1982, the Thai government implemented a program to increase self sufficiency in milk production and restrict the importation of fresh milk and milk products. Eventhough, domestic production meets only about 30 % of the demand (Chantalakkhana, 1995). Milk production in Thailand is based on crossbred dairy cattle using methods developed in industrialized countries. Furthermore, the performances of calves are low and mortality rates are above 25% in small scale farms. Therefore, dairy enterprises in Thailand require appropriate calf rearing management and milking systems.

The rearing of calves in many developing countries is based on suckling of calves until they are weaned. Suckling is known to be a major stimulus for lactation milk yield in Zebu and crossbred cows (Ugarte, 1989; Orihuela, 1990). This practice has been reported to allow a greater economic effectiveness since it exploits the maximum milk potential of the cows through the consumption by the calf of the residual milk, achieves high milk yield at milking, good calf growth and results in low calf mortality (Preston and Leng, 1987; Mejia, 1994). Artificial rearing system are known to be labour intensive to require a large capital outlays for the construction of specialised calf pens and may be associated with a high incidence of mastitis (Knowles and Edwards, 1983). The aim of the present study was to evaluate the effect of milking methods and calf rearing management on milk production and calf rearing efficiency testing the hypothesis that milking methods and calf rearing management affect dairy efficiency.

Materials and methods

Cows and management of the cows

The study was conducted from February 1997 to September 1998. The animals belonged to the Department of Animal Science, Ubon

Ratchathani University, Ubon Ratchathani province, in the north-eastern region of Thailand. Forty crossbred dairy cows (75-87.5 % Holstein Friesian) and their calves were used in the study. Cows were kept in open walled sheds during first 84 days postpartum and fed ad libitum of roughage which contained ruzi grass (*Brachiaria ruziziensis*) and hamata legume (*Stylosanthes hamata*). Thereafter, they grazed from 6.30 to 15.30 on paddocks of ruzi grass and hamata legume mixed pasture, and they were maintained in open walled sheds at night time. During the study, the cows were supplemented with concentrate calculated to meet their requirements as recommended by NRC (1989). The ruzi grass had a range of crude protein (CP) contents of 7.3-10.2% and the CP content was 15.0-18.8% for hamata legume. Rotational grazing of cows was practised. All cows had access to drinking water and mineral blocks. Chemical analysis of the concentrate mixture showed that the mean crude protein percentage was 14.7 and the total digestible nutrient (TDN) was 75 %.

All cows were allotted to one group of the 2 x 2 x 2 factorial experiment with three factors. Sixteen primiparous (PP) cows and 24 multiparous (MP) cows were distributed into the following treatments. Milking treatments were (1) hand milking (HM) and (2) machine milking (MM). Calf rearing treatments were (1) artificial rearing (AR) : bucket feeding of whole milk and (2) restricted suckling (RS) twice daily for 15 minutes after milking until 84 days of lactation. During 85-252 days of lactation, all cows were continually milked without calf suckling.

Calves and rearing of calves

All calves remained with their dams for the first three days after birth. Calves in the artificial rearing (AR) groups were bucket-fed with whole milk daily at 7.30 and at 16.30. The bucket-milk feeding schedule during 4-84 days of age for AR calf is presented in Table 1. The restricted suckling (RS) groups of calves were allowed to suckle their dams twice daily for 15 minutes after milking during 4-84 days of age.

Table 1 Whole milk feeding schedule for bucket-fed calves

Age of the calf (days)	Amount of milk fed (kg)			
	Morning	Evening	Whole day	Over each period
4-28	1.5	1.5	3.0	75
29-56	2.0	1.5	3.5	98
57-70	1.5	1.5	3.0	42
71-77	1	1	2	14
78-84	0.5	0.5	1.0	7
Total				236

The amount of milk consumed by suckled calves was measured every second day by weighing the calves before and immediately at the end of each suckling session. Both AR calves and RS calves were provided with a concentrate mixture from day 57 until weaning. The amount of concentrate supplementation was calculated based on requirement of growing calves as recommended by NRC (1989). Chemical analysis of the calf concentrate showed a mean crude protein percentage of 17.0 % and 80 % of TDN. They had also free access to drinking water and mineral blocks. All calves were given anti-helmintic doses at one month of age. Clinical treatments were similar for both AR and RS calves. All calves were weighed and were measured for their heart-girth weekly for three consecutive months.

Three calves in the AR group died during experiment due to diarrhoea so the results at weaning age were therefore obtained from 37 calves.

Milk performance recording

The daily milk yield was obtained by averaging milk yield data from the 4th day postpartum to the 252nd day postpartum. The saleable milk production (SMP) and total milk production (TMP) were evaluated with the following equations :

SMP = amount of milk from milking process – amount of milk bucket fed to calf

TMP = amount of milk from milking process + amount of milk fed bucket or milk suckled by calf

Statistical analysis of data

The daily saleable milk production, daily total milk production, cow live weight change, milk consumed by calves, average daily gain of calves and heart-girth measurements were analysed as dependent variables using least squares analysis of variance according to the general linear model (GLM) procedure in the Statistical Analysis System (SAS, 1987). When the results were significant, mean comparisons were made using Duncan's multiple range test procedure in the SAS package.

Results

Milk production and live weight change of the cows

The overall mean daily total milk production was 8.27±0.14 kg/day, with a range from 6.27 to 11.05 kg/day. The cows in the MM group had significantly higher average daily TMP than the HM group throughout the study period (Table 2). The MM cows had also significantly ($p<0.01$) higher average daily SMP than the HM cows in the period 4-84 days, but no significant differences in other periods.

As results indicated in Table 2, cows in RS group produced significantly ($p<0.001$) more average daily TMP and SMP compared to the AR cows throughout the study period.

Table 2 Least squares means for the effect milking method, calf rearing system and parity number on total milk production (TMP)[1/] and saleable milk production (SMP)[2/] of the cows.

Treatment	Average daily TMP (kg/day)			Average daily SMP (kg/day)			N
	4-84 day	4-168day	4-252day	4-84 day	4-168day	4-252day	
Milking method	** [3/]	*	*	**	ns	ns	
Hand	10.80	9.40	7.97	7.76	7.88	6.97	20
Machine	12.07	10.16	8.58	8.78	8.50	7.47	20
s.e.	0.27	0.24	0.20	0.26	0.24	0.19	
Calf rearing	***	***	***	***	***	***	
Artificial	9.66	8.66	7.47	6.71	7.15	6.47	20
Restricted suckling	13.21	10.90	9.08	9.83	9.23	7.97	20
s.e.	0.27	0.24	0.20	0.24	0.24	0.19	
Parity number	**	**	**	**	**	**	
First	10.86±0.30	9.24±0.26	7.79±0.21	7.65±0.29	7.65±0.26	6.74±0.21	16
Second and third	12.00±0.24	10.31±0.21	8.75±0.17	8.89±0.24	8.73±0.21	7.70±0.17	24

1/ TMP = amount of milk from milking + amount of bucket feeding milk or milk suckled by calf
2/ SMP = amount of milk from milking - amount of milk feed bucket for calf
3/ Statistical different for each parameter; ns = not significantly different, * = p<0.05, ** = p<0.01, and *** = p<0.001

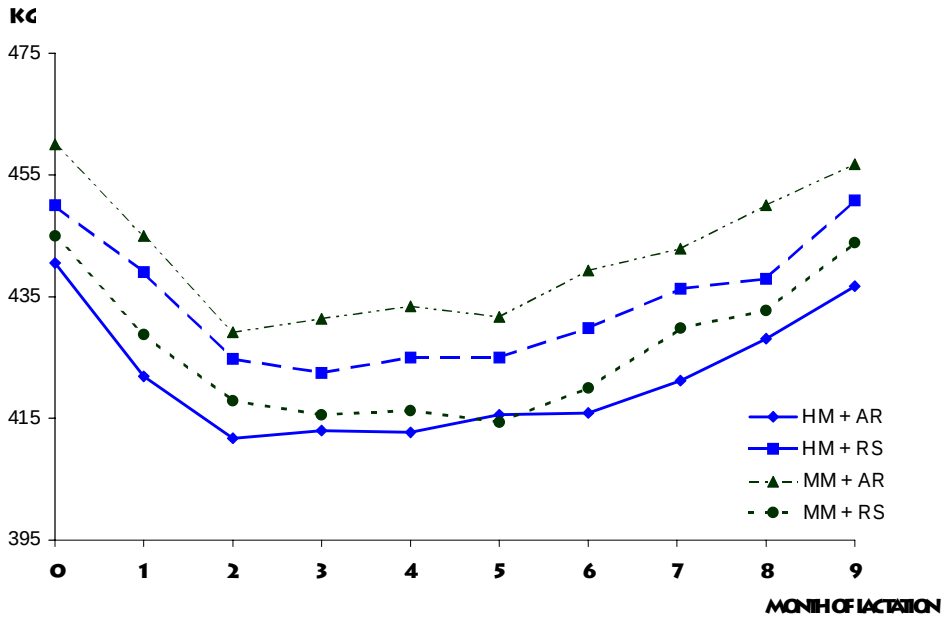

Figure 1 Cow live weight change by milking method-calf rearing management
Abbreviations : HM+AR = hand milking + calf artificial rearing, HM + RS = hand milking + restricted calf suckling, MM+AR = machine milking + calf artificial rearing, and MM + RS = machine milking + restricted calf suckling

Parity number of the cows, the MP cows produced significantly (P<0.01) more average daily TMP and SMP than PP cows throughout the period of study as results presented in Table 2.

Cow live weight was not affected either by milking, calf rearing treatments or parity number of the cows. There were also no significant interaction effect between treatments on cow live weight change (Figure 1).

Calf performances

Overall, the simple mean birth weight of all calves in the study was 29.50±0.58 kg. It was found that the RS calves had a significantly (p<0.001) higher average daily gain during 4-84 days of age than calves in AR group (Table 3).

Calves in the RS group consumed significantly (p<0.001) more milk per day during 4-84 days than did AR calves (3.35 vs. 2.88 kg/day, respectively).

Table 3 Least square means of average daily consumed milk, average daily gain and heart girth measurement of the calves

Treatment	N	Daily Consumed milk 4-84 day (kg/day)	ADG 4-84 day (kg/day)	Heart-girth (cm)			
				Day 0	Day 28	Day 56	Day 48
Calf rearing		*** [1/]	***	ns	ns	ns	*
Artificial	17	2.88±0.09	0.50±0.02	71.72±0.97	76.71±1.24	83.43±1.49	90.04±1.68
Restricted suckling	20	3.35±0.08	0.69±0.02	71.03±0.86	77.78±1.09	85.68±1.32	94.87±1.49
Overall mean		3.12±0.06	0.60±0.02	71.38±0.64	77.25±0.82	84.56±0.99	92.45±1.12

1/ Statistical different for each parameter; ns = not significantly different, * = p<0.05 and *** = p<0.001

Abbreviations : AR= artificial rearing (fed milk bucket) and RS= restricted suckling

It was found that calf rearing management, but not other treatments, influenced the heart-girth measurement of the calves at 84 days of age (Table 3). The RS calves had significantly (P<0.05) greater heart-girth measurement than AR calves at weaning.

Discussion

The TMP of RS cows was significantly higher ($p<0.001$) than that of AR cows throughout the study, which confirms the high efficiency of utilisation of the cows' milk potential when milking is combined with suckling, this results is agreed with Alvarez et al. (1980), Gaya et al. (1977), Little et al. (1991), Paredes et al (1981), Teeluck et al. (1981) and Ugarte and Preston (1975). (1983). Another reason is that suckling stimulates releasing of oxytocin which affects the milk ejection (Wagner and Oxenreider, 1972). Suckling also stimulates the release of prolactin, adrenocorticotropin and somatotropin which is thought to maintain galactopoiesis in many species (Tucker, 1985).

There were no significant differences between treatments in the change of live weight of the cows. Similar results, reported by Gaya et al. (1977), showed that there were no significant differences between RS and AR in live weight changes of the cows. Ugarte and Preston (1975) reported that live weight of dams changed from birth to weaning of calves (at 70 days), with a decrease of 17 kg for RS cows and an increase of 2.8 kg for AR cows. However, Gaya et al. (1977) showed the cows under RS management lost less body weight than cows AR system.

Milk consumed by restricted suckled calves in this study was 25.5 % of total milk. Ugarte (1977) reported that there is always residual milk left in the udder which cannot be taken out by milking but is utilised by the calf that is suckled after milking. In his study this was 21% of the total milk.

Higher rates of weight gain of the RS calves in the present study were agreed with Alvarez et al. (1980), Carias and Vaccaro (1984) and Gonzales et al. (1984). This related to the advantages for the digestive tract of young calves when they suck directly from their dam. Under restricted suckling management, the suckled milk is channeled by the reticular groove reflex directly to the abomasum, which is the true stomach and the nutrients are utilised with considerably greater efficiency than if some of the milk in passes first to the rumen as in artificial rearing system (∅skov, 1983).

Conclusion

The results of this experiment indicated that for 75-87.5 % Holstein Friesian crossbred cows with machine milking achieves a higher milk output than hand milking. Restricted suckling of calves for a limited time period increase saleable and total milk yield as well as calf growth performance.

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