Effects of Feeding High and Low Energy Levels during Late Pregnancy on Performance of Crossbred Dairy Cows and Their Calves

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ABSTRACT : The present research was designed to evaluate the effects of pre and post-partum energy level and feeding pattern on the performance of crossbred dairy cows and their calves under farm conditions. A total of 16 crossbred dairy cows were divided into two equal groups on the basis of their body weight and milk production. One group was given 30% less and the another was given 30% more energy than MAFF's (1984) recommendation. After calving all cows were given same *ad.libitum* diet to assess the effects of feeding during pregnancy on their performance. It was observed that just before calving cows on low energy group gained less ($p<0.05$) weight than that of the cows on high energy group (12.9±11.71 vs. 42.25±12.74 kg/cow. Birth weight of calves of low energy group was lower ($p<0.05$) than that of the calves of high energy group (17.87±1.78 vs. 20.73±2.24 kg/calf). Cows that were on low pre-calving dietary energy level produced less milk during lactation than the cows of high energy pre-calving group (3.45±0.75 vs. 4.27±0.79 lit./cow). No significant difference was noticed on calf growth rate and reproductive parameters of cow. Energy level that was 30 % less than MAFF's (1984) recommendation was found to be very low and not suitable for our crossbred cows during their last three months of pregnancy. ***(Asian-Aust. J. Anim. Sci. 2004. Vol 17, No. 7 : 947-953)***

Key Words : Pre-calving, Dairy Cow, Feed Supply, Nutrition and Lactation, Feed Intake, Reproduction

INTRODUCTION

The relationship between food intake during the pregnancy of cow, post-parteum milk production and birth weight of calves are of considerable practical importance in dairy cattle farming, since a sizeable portion of the food resources of any farm is usually devoted to the rearing of herd replacements and maintenance of dry cows. If mother is severely underfed during the last three months of pregnancy, it might affect the young causing death *in utero* or by reducing viability at birth (Mc Donald et al., 1985). After birth, the young's are still not free from the effects of nutrition of dam during pregnancy, since the latter's milk yield may be affected. Sometimes, the death of fetuses may make itself apparent through abortion or still birth. On the other hand, high levels of nutrition during pregnancy may reduce calf birth weight and appetite of the cow after calving may be poor, resulting in poor milk yield (Russel et al., 1979).

Although, feeding standards have been devised for crossbred animals in Indian subcontinent (Ranjhan, 1993), they are hardly observed by poor and illiterate farmers and underfeeding of animals is very likely under practical feeding conditions. The specific objective of this study was to monitor the effects of feeding 30% low or high level of dietary energy than recommendation of MAFF 1984 during the last trimester of pregnancy on the performance of crossbred dairy cows during pregnancy and also in subsequent lactation if they are given same diet during the lactation period.

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MATERIALS AND METHODS

Animals used

Sixteen crossbred dairy cows during their last three-month of pregnancy were selected from Bangladesh Agricultural University Dairy Farm. The cows were divided into two similar groups, having 8 cows in each group. Average body weight and body condition score of the first group was 257.66±17.37 kg and 2.46±0.19 and of the second group was 254.70±28.72 kg and 2.48±0.22, respectively. The cows of first group were given 30% less energy and the cows of second group were given 30% more energy (than the recommended level of MAFF, 1984) during the last three months of pregnancy. Chemical composition of feed ingredients, which were same during pregnancy and early lactation period except plane of nutrition, is given in Table 1.

Trial procedure

Pregnancy period : Pregnancy trial was carried out in the maternity shed of the University dairy farm. All cows were kept in individual pen and fed individually during the experimental period. They were fed two times a day. Half of the daily requirement of the ration was given in the early of the each morning (approximately 6.0 A.M) and the remaining portion was given in the after noon (at about 3.0 P.M). Any of the feed ingredients, left in the manger

Table 1. Chemical composition of feeds used in the experiment

Ingredient	DM (g/kg)	ME (MJ/kg DM)	CP (g/kg DM)
Straw	881	6.5	35
Wheat bran	834	10.7	160
Oil cake	844	11.0	270
Green grass	176	10.5	80

(mainly straw) were weighted in the next morning before offering the morning diet. Clean and fresh drinking water was always available to each cow. Other management facilities for all cows were same during the study period. The cows were weighted fortnightly on a livestock weighing scale. The weight was taken always using the same machine and approximately same time before giving the morning feed. The following parameters were measured during pregnancy period. i) Body weight changes of cows from start of the experiment to just before and after calving. ii) Changes in body condition score of cows iii) Birth weight of calves iv) Gestation length of cows.

Lactation study

After calving, cows and calves were cleaned with luke warm water and antiseptic solutions. Some assistance was given to the calves during the first few days to ensure that they obtained as much colostrums as possible. The cows were weighted after removal of placenta. The pregnancy diets were withdrawn gradually and *ad libitum* feeding was practiced during 120 days lactation study. After birth, calves of both the groups were allowed to drink as much colostrum as possible to them from their mothers. This was continued till seven days post-partum. period. During that time, calves were kept always with their mother. After one week, calves were separated from their mother and were allowed to drink milk for about half an hour just after morning and evening milking. Together with this all calves were fed whole milk at the rate of 1.0 liter per 10 kg of body weight up to 21 days. After 21 days, whole milk was reduced to half amount and was continued up to 45 days. Simultaneously high quality green grass and concentrate mixture was introduced gradually from 15th day of calving. The calf starter consisted of wheat bran, oil cake and common salt. Fresh and clean drinking water was always available to each calf. Other management facilities for all calves were same. The following parameters were measured from the lactation study.

i) Body weight changes of cows ii) Changes in body condition score iii) Voluntary intake of DM and ME of cows during early lactation iv) Milk yield of cows v) Composition of milk vi) Time required for calving to first heat vii) Time required for calving to conception viii) Conception rate ix) Number of insemination per conception x) Calving interval xi) Feed intake and growth rate of calves.

Animal weighing : During the lactation study, body weight of cows and calves were taken fortnightly with the help of a livestock weighing scale. Weight was taken every time before giving diet to the cows. Body weights of calves were taken before suckling their mother and also before offering other diets (concentrate and roughage). Using the same livestock scale during the whole lactation study.

Milk estimation : Milking was done every day manually with the help of expert milkman in the morning (at about 6.30 A.M) and afternoon (at about 4.0 P.M). Before milking cows were washed with the help of clean water to remove dust urine and manure from their body. There after their body were wiped out with dry clean cloth. Just before milking, calves were allowed suckling their mother for few minutes to stimulate milk let down. After that calves were tied near their mother and milking was completed within 7 to 8 minutes. Every day milking was done by the same milker. Milk obtained from two times milking was combined together to get the actual milk yield of the cows for that day.

Milk analysis : Milk samples were analyzed separately from each cow to determine the percentage of fat, total solids and solids-not-fat (SNF) content. After complete milking of a cow, milk was mixed thoroughly and representative amount of milk samples were taken and immediately transferred to the Dairy Technology

Table 2. Effect of low and high-energy feeding on the performance of cows during pregnancy

Parameters studied	Low-energy group	High-energy group	Level of significance
Initial body weight (kg)	257.66±17.37	254.70±28.72	NS
Initial body condition score (BCS)	2.46±0.19	2.48±0.22	NS
Weight just before calving (kg)	270.56±16.10	296.95±25.14	*
BCS before calving	2.79±0.38	3.55±0.32	**
Total weight changes from start to just before calving (kg)	12.9±11.71	42.25±12.74	**
Weight just after calving (kg)	242.09±11.33	266.23±28.52	*
BCS after calving	3.05±0.47	3.01±0.26	NS
Gestation length (days)	277.25±4.95	276.63±5.53	NS
Total weight changes (from start to post calving) kg/cow	-15.57±13.68	11.53±9.92	**
Feed intake (kg, DM/day/cow)	4.01±0.38	6.21±0.54	**
Energy intake (MJ ME/day/cow)	32.68±2.56	50.57±3.66	**
CP intake (g/day)	356.75	534.85	**

** $p<0.01$. * $p<0.05$, NS: Nonsignificant. Values are in case for 8 cows±standard deviation.

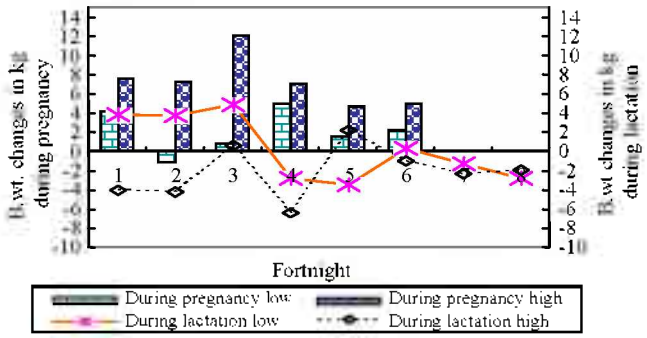

Figure 1. Fortnightly body weight (B.wt) changes per cow per day during pregnancy and early lactation.

Laboratory of the department of Dairy Science for chemical analysis. Fat percent of milk was determined by Babcock method as per procedure described by Aggarwalla and Sharma (1961). Protein was determined by using Kjeldal Method described in AOAC (1985). Oven drying method was used for determining Total Solids content of milk and specific gravity was determined by using Quevenne lactometer and cylinder as per described by Eckles et al. (1951).

Body condition score

Body condition score of the cows were performed fortnightly by using a procedure 5 points' scale. Every time same people did condition scoring in order to reduce the error as much as possible and variability.

Statistical analysis

Data collected from this experiment were statistically analyzed as per Steel and Torrie (1980) for two groups, t test is done.

RESULTS AND DISCUSSION

Nutrient intake and performance of cows during pregnancy

On an average roughage intake (DM basis) in both groups constituted 68%. of which supplied 58% of total energy. Some data on intake and performance of cows during pregnancy is given in Table 2 and Figure 5. Fortnightly body weight changes and pattern of weight changes are shown in Figure 1 and 2. On an average the cows were about one hundred and eighty days pregnant when the experiment started and they were in moderate body condition. During the pre-partum period cows on low and high-energy treatment gain about 5 and 16% of their initial weight respectively. From start to immediate post calving cows on low energy group lost about 6.04% of body weight and cows that were on high-energy group gained about 4.52% of body weight. The difference between the body weight changes of cows from initial to just before calving were highly significant ($p<0.01$) and initial to just

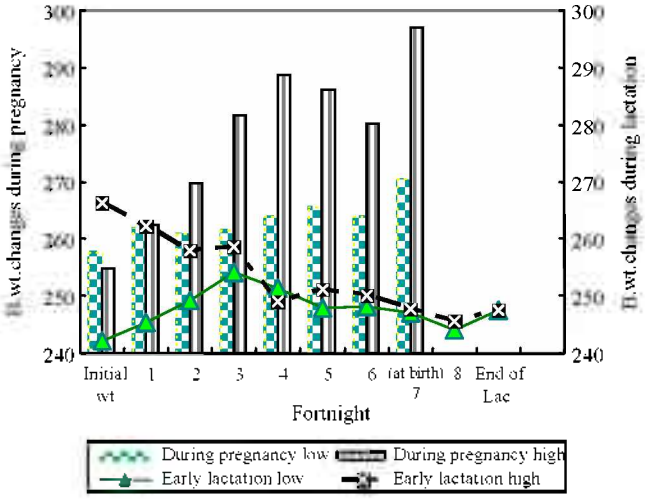

Figure 2. Pattern of body weight (B.wt.) changes of cows during pregnancy and early lactation.

after calving were also highly significant ($p<0.01$). Comparative higher ($p<0.01$) intake in high energy group corresponded to superior ($p<0.01$) physical condition. The result of body weight changes agrees with the findings of several researchers Kunz et al. (1985) observed that cows on high level diet gained more weight than the cows that were on low level of diet during last trimester of pregnancy. Anthony et al. (1986) mentioned that their low plane cows gained less weight than the high plane cows during pre-calving period. The immediate post-calving weights were also lower for the low plane cows. Similar results were also reported by Anthony et al. (1986) who found that their cows on high energy diets gained significantly ($p<0.01$) more weight than the cows on low energy diets during pregnancy period. Joubart and Bousma (1958) found that high plane animals increased in live weight by 31.2% from conception to calving, where as low plane animals by only 14.8%. Corah et al. (1973) carried out an experiment where low and high level of dietary energy were given during pre-calving period and found that from start to immediate post-calving high plane cows gained 36.4 kg and low plane cows lost 5.8 kg and the difference between the two groups was significant ($p<0.05$). The result of body weight changes of cows during pregnancy also agrees with the report of Prassad and Tomer (1996) who found that body weight was low in low level of feeding than the cows of high level feeding. Hight (1968) observed that cows on low plane of nutrition over the pre-calving period gained on an average 0.24 kg/day more than high plane cows between calving and weaning. The result also agrees with the reports of Garansworthy and Jones (1987), Islam (1988), Prassad and Tomer (1996) and Murphy (1999). According to the opinion of above author's cows, which lost more weight or gain. least weight during pregnancy had the highest weight gains during lactation. Generally lighter cows have greater appetite after birth than the fatty cows and for this reason

Table 3. Effect of low and high-energy feeding during pregnancy on lactation and reproductive traits

Parameters studied	Low-energy group	High-energy group	Level of significance
Average weight (kg) just after calving	242.09±11.33	266.23±28.52	*
Average weight (kg) at the end of lactation	247.38±19.54	247.49±32.52	*
BCS at the end of lactation	2.90± 0.47	3.01±0.26	NS
Weight changes from calving to end of lactation study i.e. 120 days (kg/cow)	5.29±13.89	-18.74±7.62	**
Milk production (Lit./cow/day)	3.45±0.75	4.27±0.79	NS
Feed intake (kg DM/cow/day)	7.05±0.24	6.97±0.28	NS
Energy intake (MJME/cow/day)	66.52±2.07	66.21±2.16	NS
Time required from calving to first heat (days)	202.00±72.00	145.00±63.00	NS
Time required for calving to conception (days)	254.00±122.00	185.00±66.00	NS
No. of service per conception	2.4	2.0	NS
Conception rate (CR) %	42.00	50.00	
Calving interval (days)	519±128	465±63	NS
CP intake (g/day) by cows	699.50	699.55	NS

Figure are mean±SD for n=8. * $p<0.05$, ** $p<0.01$, NS: Nonsignificant.

Table 4. Results of analysis of milk of two groups of cows

Parameters studied	Low-energy group	High-energy group	Level of significance
Specific gravity	1.0315±0.002	1.0302±0.002	NS
Fat (g/kg)	40.7±5.9	40.4±6.4	NS
Total solids (g/kg)	125.8±12.9	126.6±10.4	NS
Solids-not-fat (g/kg)	83.4±5.3	86.7±4.4	NS
Protein (g/kg)	35.0±2.0	36.0±2.5	NS

NS: Nonsignificant.

they consumed more food and utilized them more efficiently. This was reflected in their post-partum performance. Body condition score (BCS) for both low and high energy group increased during the pregnancy (Table 2) period but the increment was more for the cows that were on high level of energy. This difference in BCS of two groups was due to the difference in energy content of the diet of two groups. The result of BCS score agrees with the reports of Prashad and Tomer (1996) who found that BCS of cows on high level of pre-calving energy was more just before calving than the cows that were on low energy group diet.

Nutrient intake and performance of cows during lactation

During lactation also, on an average, roughage intake (DM basis) in both groups constituted 68%, which supplied 63% total energy. Some data on intake and performance of cows during lactation is given in Table 3 and Figure 5. Fortnightly body weight changes and pattern of weight changes are shown in Figure 1 and 2. Weight of the cows after calving was lower ($p<0.05$) on low energy diet. During lactation periods cows on low energy diet were able to maintain their BCS but cows that were on high level pre-calving dietary energy lost some BCS during lactation. The result of BCS reflects the result of body weight changes of cows and also agrees with the findings of Islam (1988) who found that cows that had less body condition at calving improved BCS rapidly during lactation in comparison with the cows that had more BCS at calving. Feed intake of the cows during lactation period had some relation with the feeding level of the cows during pregnancy period. Cows that were on low level pre-calving dietary energy consumed slightly more DM and ME during the lactation period than the cows of high-level pre-calving dietary energy group. The result of this experiment agrees with the report of several researchers who found that cows that had lost body weight or, gain a little during pregnancy (due to supply of low level of feeding) consumed more feed during lactation when they were given adequate or *ad libitum* feed (Islam, 1988; Murphy, 1999). Similar type of results were also obtained by Larson (2000) who reported that during the first 16 weeks post-calving, cows with higher BCS (fatty cows) at calving consumed less dry matter than the cows that had adequate body condition score at calving.

Cows that were on low dietary energy group produced slightly less milk than the cows of high-energy group. The difference between the milk yields of two groups of cows was not significant (Table 3). Usually cows that are thin at birth produce more milk during lactation (Islam, 1988). But in this trial cows that were on low pre-calving energy level, produced slightly less milk. This was due to the fact that low energy level was 30% less then the MAFF (1984) recommended dietary energy level. It seems that this level was very low for our crossbred dairy cows during late pregnancy. In this connection Patchell (1957) suggested that

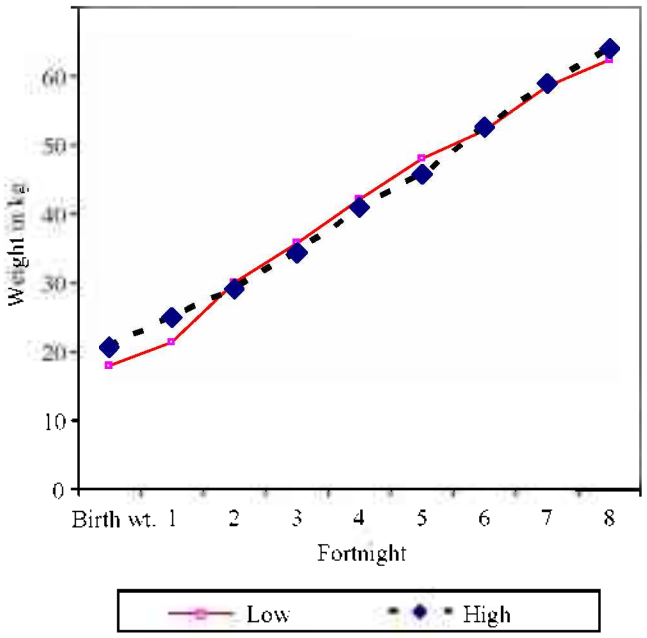

Figure 3. Growth pattern of calves.

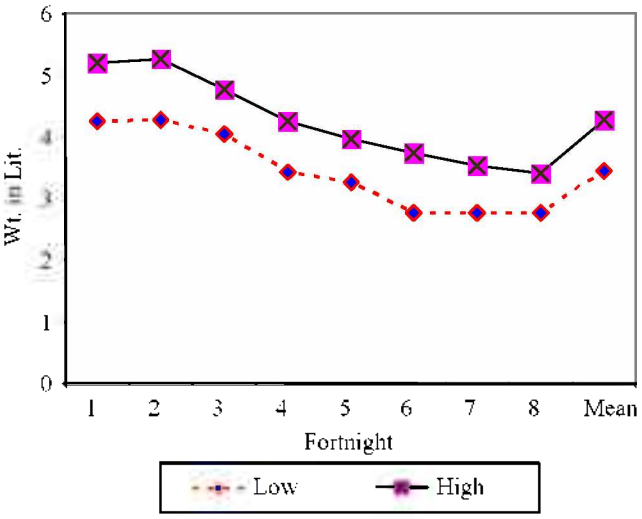

Figure 4. Fortnightly milk yield/day/cow.

underfeeding in late pregnancy, such that large losses of live weight occur, depressed milk yield. In our experiment cows on low energy group lost about 16 kg of body weight at calving which might be the cause of slightly less milk yield by this group than that of the cows of high energy group. Schmid and Scholtz (1959) obtained similar type of result.

Result on milk analysis for specific gravity, fat, total solids, solids-not-fat and protein content are given in Table 4 and fortnightly milk production of different groups are shown in Figure 4. No significant effect of pre-calving dietary energy was noticed on above milk parameters, although the values of above parameters were slightly lower in the milk of the cows of L energy group. The result of milk analysis agrees with the findings of some researchers

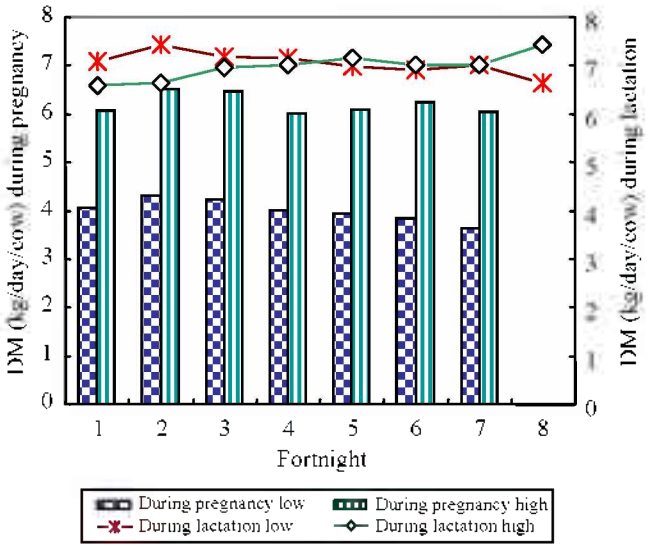

Figure 5. Fortnightly feed intake (DM kg/day/cow) during pregnancy and early lactation.

who found that *ad libitum* feeding before and after calving produces milk with slight increase in fat and solids-not-fat content (Jenness and Patton, 1959). Murphy (1999) observed that feeding cows more than normal before calving produces milk with slightly high protein content. In an experiment Islam et al. (1992) analyzed the milk samples of cows collected from rural areas of Bangladesh and found that the solids-not-fat content of milk of cows reared traditionally in village areas of Bangladesh was slightly lower than the normal SNF content (8.5%) of milk. This was mainly due to the under feeding of cows by village poor farmers. Slightly low specific gravity of the milk of low energy group was due to the variations in fat content of milk of two groups. As milk fat is the lighter constituent of milk, so milk containing more fat has slightly lower specific gravity in comparison with the milk containing low fat content (Webb and Dziuk, 1974). In this experiment fat content of milk of high-energy group was slightly higher than that of the milk of high-energy group. For this reason specific gravity of milk of low energy group was slightly lower than the specific gravity of milk of high-energy group.

Overall reproductive performances were better for the cows of high-energy group although values of different reproductive parameters did not differ significantly between two groups (Table 3). Time required (days) from calving to first heat and time required (days) for calving to conception was non-significantly lower for the cows of high energy group. Number of service per conception was also non-significantly lower for the cows of high-energy group. Conception rate after insemination was 42% in low energy group and 50% in high-energy group. Calving interval was also slightly lower in higher energy group than the cows of low energy group (Figure 5). The results of above

Table 5. Birth weight, growth rate and feed intake of calves from cows that were fed high and low energy diets during last trimester of pregnancy

Parameter	Low energy	High energy	Significance
Average birth weight	17.87±1.78	20.71±2.24	*
Growth rate			
from birth to 1 month	0.27±0.10	0.29±0.10	NS
from birth to 4 month	0.37±0.06	0.36±0.05	NS
Concentrate intake (kg/DM/day)	0.19	0.19	NS
Grass intake (kg/DM/day)	0.81	0.81	NS

NS: Nonsignificant.

reproductive parameters agree with the findings of several workers. (King, 1968: Dunn et al., 1969; Hall, 1974 and Dindorker et al., 1982). Rakha and Igbueli (1971) found that feeding zebu cows a sub-maintenance ration resulted in 55% of the animal stopping cycling with in a year where as those on a maintenance diet continue to cycle normally. McDonald et al. (1985) mentioned that if a cow is severely underfed during the last three months of pregnancy than it might have tremendous effect on the reproductive performance of dairy cows. In the present experiment dietary energy level of low energy group was 30% lower than that of the recommended level of MAFF (1984). It seems that this level is not suitable for our crossbred dairy cows for maintaining the normal reproductive performance of the cows.

Performance of calves

Birth weight, growth rate and feed intake of calves from cows that were fed high and low energy diets during late trimester of pregnancy is given in Table 5 and the growth pattern of calves are shown in Figure 3. Calves from the cows of low energy group were about 2.8 kg lighter at birth than the calves produced by cows on high level of energy. In this experiment effect of dietary energy on calf birth weight was significant ($p<0.05$). It seems that the energy level of low energy group was not adequate during the last trimester of our crossbred dairy cows. The result of this experiment regarding birth weight agrees with the findings of several researcher (Corah et al., 1973; Corah et al., 1975; Anthony et al., 1986; Goehring et al., 1987) who found that cows given low energy diet during pre-calving period produced lighter calves at birth.

There was no significant effect of pre-calving energy on growth rate of calves. Calf growth rate calculated from birth to one month of age showed that growth rate was little higher in high-energy group (0.29±0.10 kg/calf /day) than that of the calves of low energy group (0.27±0.10 kg/calf/day). This difference was influenced mainly by birth weight of calves and milk yield of cows. Initial weight of calves of high-energy group was about 2.84 kg higher than the calves of low energy group. These extra weights have helped for little faster growth rate in high-energy group. Simultaneously milk production of cows of high-energy group was higher than the milk production of low energy group. So it is expected that calves on high-energy group might have consumed some milk by suckling their mother. This was also another reason for little faster growth rate of calves of high-energy group. The result of growth rate of calves during birth to one month of age agrees with the results of Clutter and Nielsen (1987) who found that calves suckling dams with high milk yield gained more than those suckling a low yielding group. When growth rate was calculated from birth to 120 days post calving period than it was found that calves of low energy group compensate their growth and growth rate of two groups of calves become similar. Dry matter consumption of calves of low energy group was slightly higher than the calves of high energy group which might have influenced the growth rate of calves of low energy group and at about four months time growth rate of low energy group calves became same to the calves of high energy group.

CONCLUSION

From the result of this experiment it may be suggested that 30% less dietary energy level of MAFF's (1984) recommendation during the last trimester of pregnancy is not suitable for our crossbred dairy cows. Cows on 30% more then MAFF's (1984) recommended dietary energy level during last three months of pregnancy performed little better then that of the cows of low energy group.

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