Study on Feeding Effect of Different Levels of Protein and Energy on Production Performance of Pregnant Mother and Neo-Natal Calves

Nathu Ram Sarker, Muhammad Khairul Bashar, Sheik Mohammad Jahangir Hossain, Mohammed Khorshed Alam and Khan Shahidul Huque

Animal Production Research Division, Bangladesh Livestock Research Institute, Savar, Dhaka-1341, Bangladesh

Abstract: The present study was undertaken to assess feeding effect on productive and reproductive performances of pre-natal and post-natal Red Chittagong Cattle (RCC) cows under on-station condition. A total of 16 pregnant RCC cows having pregnancy 6-7 months and between 1-3 parities was selected for the study and was allocated randomly into four dietary treatment groups. There are four type diets, i.e., T_0 (standard diet according to National Research Council (NRC), 1995), T_1 (5% below standard diet), T_2 (5% above standard diet), T_3 (10% above standard diet) and a control treatment T_4 (maintained as farm practice). The energy and protein requirements of experimental cows were determined as per standard developed by NRC. The results revealed that crude protein (CP) and metabolizable energy (ME, MJ/day) requirements among cows of different dietary groups were not significantly different, although CP requirements between T_1 and T_3 differed significantly. Total dry mater (DM) and ME intake differed significantly ($P < 0.001$) among cows of different dietary groups, but DM intake was significantly lower for cows in farm practice group T_4 compared to the cows of other dietary groups. The total CP intake had no significant variation ($P > 0.05$) among cows of all dietary groups, but CP intake from roughage varied significantly ($P < 0.001$). Final live weight and total live weight gain had no significant variation for cows of all groups, but there were significant ($P < 0.05$) variation for daily weight gain. Daily weight gain of cows for first four dietary groups were significantly ($P < 0.05$) higher than cows of farm practice groups T_4 . Weight of calf from birth to 90 days and daily weight gain calves under different dietary groups showed that there were no significant ($P > 0.05$) variation of calf birth weights for all dietary groups, although lower birth weight was found in farm practice groups T_4 . Gestation length and postpartum heat period of cows of different dietary treatment groups revealed that there was no significant ($P > 0.05$) variation for those traits among cows of different dietary treatment groups, although there seems to be shorter postpartum heat for cows in dietary group T_2 and longer period in farm practice group T_4 . Total and daily milk yield up to 30 days and 90 days of cows had no significant ($P > 0.05$) effect for different dietary treatment groups, although there seems to be slightly better milk production performance for dietary T_2 and T_0 , respectively for 30 days and 90 days total and daily milk yield. There were no significant ($P > 0.05$) changes of total and daily weight gain of cows for all dietary groups, however cows of standard dietary group T_0 performed slightly better than those of cows of other dietary groups. Milk composition of cows of different dietary treatment groups showed that there was no significant ($P > 0.05$) variation on milk composition for cows of different dietary groups. Post-natal body condition score (BCS) for the 1st, 3rd and 4th months differed significantly ($P < 0.05$) among different dietary groups, while not found significant difference on the 2nd month. Therefore, it may be concluded that pre-natal feeding has significant effect on body weight gain, birth weight of calves and milk production of dairy cows. Hence, it is suggested that better nutrition may be provided during pre-natal period to harvest good quality of calves and higher milk yield from post-natal period.

Key words: Pre-natal, post-natal, postpartum heat period, gestation length, milk yield.

1. Introduction

Care of the dairy animal's starts with the birth of

the calf. The animals need ideal conditions to exhibit their inherent genetic capabilities. The birth weight of the calf affects the subsequent growth rate. The heavier calf gains weight at a faster rate than the calf with lower birth weight, even if both are given

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Corresponding author: Nathu Ram Sarker, Ph.D., research fields: animal nutrition and feeds and forage technology. E-mail: sarkernr62@yahoo.com.

adequate nutrition. Although the effects of nutrition, housing and health care are of much greater importance, each 1 kg difference in birth weight will expand to about 1.5 kg difference by 12 weeks of age [1]. Requirements for pregnancy represent nutrients necessary to support both growth and maintenance of fetus, placenta, uterus and mammary gland. Last two months of pregnancy needs special care in terms of higher provision of essential nutrients. Various immunological and biochemical adjustments take place in the dam to meet the metabolic needs of fetus and neonates for growth and development. During fetal life, there is maternal protection; and in the post-natal life, the neonates are protected from mother and nourished by the colostrums and milk. The influence of maternal nutrition on the early growth performance of offspring's is mainly mediated through its influence on the birth weight besides milk yield and quality. Although there are many studies that have demonstrated a positive impact of maternal nutrition on the birth weight of calves [2-4], its effects on the early growth performance of the calves is often without agreement. There are positive reports of the effect of maternal plane of nutrition on growth performance of calves. Red Chittagong Cattle (RCC) is a potential dairy cattle variety of Bangladesh and is suitable for smallholder farmers due to its small size and low feed requirements [5, 6]. They are reared under poor quality diet, unbalanced nutrients, improper feeding and poor husbandry management practice and their performances are very poor [6]. Ahmed [7] reported that the nutritional status of indigenous cows is still remaining low. RCC in farming systems are reared under traditional feeds, feeding and management practices [6]. Ahmed [7] reported the nutritional status of RCC cows remains low because they are underfed due to scarcity of feeds, fluctuated feed supply as well as absence of scientific feeding practices to improve cows performances. Ahmed [7] also reported that the nutrition is a prerequisite for the normal function of the organs

involved in productive and reproductive performances of the cows. In an experiment, Ziegler [8] reported that underfed cows are slow to return to normal heat cycles and have lower conception rates when bred. Lack of nutrient intake, i.e., energy and/or protein, is the greatest causes of poor reproductive performance. Ziegler [8] also reported that the pre-calving nutrition of the mother cow has many important implications in proper fetal growth, calf health at birth, the resistance of calf to stress and diseases when a cow produces milk and/or lactates. Maternal nutritional plane [9, 10] has been implicated in developmental programming and results pre-natal and post-natal changes that long term affect offspring's health and performance. Developmental programming is the concept that perturbations during critical pre-natal or post-natal developmental stages can have lasting impacts on growth and adult function. Maternal nutritional status [10-13] is a major factor implicated in development and function of the fetal organ systems. Effective nutritional [14-19] management during gestation has long been recognized as an important component of sound livestock production practices. Shamsuddin et al. [20] reported that imbalance feeding has been shown to be one of the factors for high incidence of reproductive disorders in the cows, which could be alleviated by supplying improved and balanced diet. Lotthammer [21] reported that the normally pregnant cows face two types of stress—firstly during pregnancy its body reserves of nutrients are reduced due to fetal development, and secondly just after the initiation of lactation period, sudden secretion of nutrients into milk is also responsible for stress to the cows. So, during this period, they need more nutrients. Jalil et al. [22] indicated that improved feeding has a positive effect on reproductive performances including milk production. Asaduzzaman et al. [23] also reported that improved feeding during pregnant and lactating of RCC cows compared to traditional feeding significantly increased live weight gain of RCC cows and their calves. Milk yield, fat-corrected

milk and milk composition were also increased. The results further indicated that there was significant ($P < 0.05$) effect of improved feedings on reproduction performances of the cows. The better reproductive performance was observed in 100% requirement group. It also showed that there was a significant ($P < 0.01$) difference in feed cost among the three dietary treatment groups. Income from sale of milk varied significantly ($P < 0.01$) among the different treatment groups, while it was higher in T_2 (213.30) group, followed by T_1 (109.20) and T_0 (74.70) groups.

However, the nutritional status of RCC cows so far has not been studied in our country. Therefore, with the above views in mind, the present study was undertaken with the following objectives:

To determine the nutritional requirement of RCC during later part of pregnancy;

To assess the feeding effect on productive and reproductive performances of pre-natal and post-natal RCC cows and their progeny.

2. Materials and Methods

2.1 Statement of the Experiment

The experiment was conducted for the period of one year from July 2012 to June 2013 to investigate the feeding effect on productive and reproductive (pre- and post-natal) performance improvement of RCC cows.

2.2 Selection of Experimental Cows

A total of 16 pregnant RCC cows are collected from the Bangladesh Livestock Research Institute (BLRI) farm and reared in shed. Four pregnant RCC cows were accommodated in a group. Four cows kept in a group are considered as an experimental unit (replication).

2.3 Weighing of the Cows

The experimental pregnant RCC cows were weighed individually at fortnightly interval by using digital cattle weighing scales from the start. The

weight was recorded in the register. The weighing of the cows was performed early in the morning before feeding, and their calves were also weighed individually at weekly interval by using digital cattle weighing scales from the start and recorded in the register.

2.4 Calculation Daily Nutrient Requirements of Pregnant RCC Cows

The daily dry matter requirements (*DMR*), crude protein requirements (*CPR*) and metabolizable energy requirements (*MER*) of the pregnant RCC cows are calculated. A nutrient requirement was calculated on the basis of National Research Council (NRC) standard. The calculations of the nutritional requirements are shown below:

$$DMR \text{ (kg/d)} = ME/MEC \quad (1)$$

where, *MEC* = metabolizable energy concentration in intake diet dry matter of feeding.

$$CPR \text{ (g/d)} = RDP + UDP \quad (2)$$

where, *RDP* = rumen degradable protein and *UDP* = undegradable dietary protein.

$$MER \text{ (MJ/d)} = ME_m + ME_f \quad (3)$$

where, ME_m = total *MER* for maintenance and ME_f = total *MER* for fetus development.

2.5 Feeding Trial with Pregnant Mother and Neo-Natal Calves

A feeding trial is conducted with selected pregnant mother as per design of the experiment. There are four type diets—standard diet (according to NRC), 5% below standard diet, 5% above standard diet and 10% above standard diet, will be used in this experiment (Table 1). A total of 16 pregnant RCC cows is divided into four equal groups and will be assigned to four dietary treatments. Four cows in each treatment are used as three replicates. Roughage (green grass and straw) are supplied to the experimental cows twice daily at 9:00-10:00 am and 3:00-4:00 pm. Green grass are supplied *ad libitum* and straw supplied 2 kg/d/cow. Concentrate mixture are supplied to the

Table 1 Lay out of the experiment.

Group (length of pregnancy)	Treatments				Total
	T ₀ (standard diet according to NRC)	T ₁ (5% below standard diet)	T ₂ (5% above standard diet)	T ₃ (10% above standard diet)	
Replication 1 (4-5 months)	1	1	1	1	4
Replication 2 (5-6 months)	1	1	1	1	4
Replication 3 (6-7 months)	2	2	2	2	8
Total	4	4	4	4	16

experimental cows twice daily at 8:00-8:30 am and 2:30-3:00 pm. Concentrate mixture is required 18.77% CP and 10.39 MJ ME per kg of feed. Management practices of the pregnant RCC cows under the experiment are all most similar. The mixture of concentrate comprises the different ingredients, such as crushed maize, wheat bran, soyabean meal, sesame oil cake, Khesari (*Lathyrus sativas*) bran, common salt and dicalcium phosphate at the ratio of 19%, 40%, 9.5%, 17%, 1.5% and 2.5%, respectively, to maintain requirement level of ME and CP for RCC pregnant cows. The live weight was taken individually at fortnightly with the help of a portable digital cattle weighing scale.

2.6 Body Condition Score (BCS)

BCS of the experimental cows were carried using visual and palpation technique according to the guidelines established by Prasad and Tomer [3]. This method grades the cow's conditioning status on a six-point scale (1-6), where 1 reflects very thin and 6 reflects very fat animal. Cows' body condition was scored on the day of their inclusion in the experiment and after 30 days interval till the end of the experiment.

2.7 Data Analysis

The collected data were analyzed by using SPSS 13.0 for Windows (SPSS Inc., 2004) statistical package and treatment means comparison were assessed by Duncan's multiple range test (DMRT) to test the significance among the treatment.

3. Results and Discussion

Feed and nutrients intake of pre-natal cows of different treatment groups are given in Table 2. Intake of straw, green grass and concentrates were significantly ($P < 0.001$) different among cows of different dietary groups. Except of cows reared in farm practices, intake of straw, green grass and concentrates of other dietary groups had no significant variation. CP and ME requirements among cows of different dietary groups were not significant, although CP requirements between T₁ and T₃ differed significantly. Total dry matter (DM) intake and ME intake differed significantly ($P < 0.001$) among cows of different dietary groups. In all cases, intake was significantly lower for cows in farm practice group (T₄) than those of cows of other dietary groups. Although total CP intake had no significant variation ($P > 0.05$) among cows of all dietary groups, but CP intake from roughage varied significantly ($P < 0.001$).

Pre-natal growth of RCC cows of different dietary treatment groups are given in Table 3, which shows initial live weight. Final live weight and total live weight gain had no significant variation for cows of all groups, but there were significant ($P < 0.05$) variation for daily weight gain. Daily weight gain of cows for first four dietary groups were significantly ($P < 0.05$) higher than cows of farm practice groups (T₄).

Weight of calf from birth to 90 days and weight gain born in different dietary dam groups are given in Table 4. Table 4 shows that there were no significant ($P > 0.05$) variation of calf birth weights for all dietary

Table 2 Feed and nutrient intake of pre-natal RCC from different diets.

Parameters	Mean ($\pm$ SE) for different treatment groups					Overall	Sig.
	T ₁ (below 5%)	T ₀ (standard)	T ₂ (above 5%)	T ₃ (above 10%)	T ₄ (farm practice)		
Straw (kg)	1.57 $\pm$ 0.05	1.63 $\pm$ 0.03	1.63 $\pm$ 0.05	1.59 $\pm$ 0.04	0.00	1.28 $\pm$ 0.15	NS
Green grass (kg)	18.49 ^a $\pm$ 0.42	19.08 ^a $\pm$ 0.30	19.55 ^a $\pm$ 0.55	19.19 ^a $\pm$ 0.44	15.64 ^b $\pm$ 0.18	18.39 $\pm$ 0.36	***
Feed concentrate (kg)	3.00 ^a $\pm$ 0.33	3.08 ^a $\pm$ 0.06	3.49 ^a $\pm$ 0.15	2.88 ^a $\pm$ 0.33	1.50 ^b $\pm$ 0.00	2.79 $\pm$ 0.18	***
CP requirements (g/d)	405.86 ^b $\pm$ 37.79	468.36 ^{ab} $\pm$ 12.36	496.21 ^{ab} $\pm$ 52.68	515.28 ^a $\pm$ 28.52	442.28 ^{ab} $\pm$ 15.21	465.59 $\pm$ 15.80	**
ME requirements (MJ/d)	46.17 $\pm$ 2.29	46.59 $\pm$ 0.89	48.39 $\pm$ 2.24	46.98 $\pm$ 0.39	50.85 $\pm$ 2.54	47.79 $\pm$ 0.84	NS
DM intake from roughage (kg/d)	4.34 ^a $\pm$ 0.10	4.49 ^a $\pm$ 0.07	4.55 ^a $\pm$ 0.13	4.46 ^a $\pm$ 0.11	2.53 ^b $\pm$ 0.03	4.07 $\pm$ 0.18	***
DM intake from concentrate (kg/d)	2.68 ^a $\pm$ 0.29	2.75 ^a $\pm$ 0.05	3.13 ^a $\pm$ 0.14	2.57 ^a $\pm$ 0.29	1.34 ^b $\pm$ 0.00	2.49 $\pm$ 0.16	***
Total DM intake (kg/d)	7.02 ^a $\pm$ 0.24	7.24 ^a $\pm$ 0.09	7.68 ^a $\pm$ 0.24	7.04 ^a $\pm$ 0.34	3.87 ^b $\pm$ 0.03	6.57 $\pm$ 0.33	***
ME intake from roughage (MJ/d)	29.77 ^a $\pm$ 0.43	30.09 ^a $\pm$ 0.06	30.69 ^a $\pm$ 0.62	30.20 ^a $\pm$ 0.48	22.79 ^b $\pm$ 0.25	28.71 $\pm$ 0.70	***
ME intake from concentrate (MJ/d)	21.00 ^a $\pm$ 2.31	21.55 ^a $\pm$ 0.039	24.48 ^a $\pm$ 1.08	20.14 ^a $\pm$ 2.28	13.15 ^b $\pm$ 0.00	20.07 $\pm$ 1.06	**
Total ME intake (MJ/d)	50.77 ^a $\pm$ 1.99	51.64 ^a $\pm$ 0.38	55.18 ^a $\pm$ 1.59	50.34 ^a $\pm$ 2.39	35.93 ^b $\pm$ 0.27	48.77 $\pm$ 1.65	***
CP intake from roughage (g/d)	271.02 ^c $\pm$ 4.18	281.38 ^c $\pm$ 4.18	309.18 ^b $\pm$ 6.98	310.05 ^b $\pm$ 8.83	341.88 ^a $\pm$ 3.75	302.70 $\pm$ 6.49	***
CP intake from concentrate (g/d)	144.56 ^b $\pm$ 19.10	162.72 ^{ab} $\pm$ 6.0	164.50 ^{ab} $\pm$ 26.55	200.36 ^a $\pm$ 18.14	121.00 ^b $\pm$ 0.00	158.69 $\pm$ 9.01	NS
Total CP intake (g/d)	415.58 $\pm$ 30.25	444.10 $\pm$ 9.55	473.68 $\pm$ 33.79	510.41 $\pm$ 24.92	384.82 $\pm$ 76.45	445.72 $\pm$ 19.31	NS

NS = $P > 0.05$; ** = $P < 0.01$; *** = $P < 0.001$. Sig.: significance level.

Table 3 Feeding effect on live weight change of prenatal RCC.

Parameters	Mean ($\pm$ SE) for different treatment groups					Overall	Sig.
	T ₁ (below 5%)	T ₀ (standard)	T ₂ (above 5%)	T ₃ (above 10%)	T ₄ (farm practice)		
Initial weight (kg)	160.25 $\pm$ 15.26	179.25 $\pm$ 9.85	197.00 $\pm$ 22.87	169.00 $\pm$ 14.95	173.75 $\pm$ 9.27	175.85 $\pm$ 6.68	NS
Final weight (kg)	199.63 $\pm$ 12.28	217.06 $\pm$ 10.67	245.25 $\pm$ 36.13	208.05 $\pm$ 16.97	203.75 $\pm$ 10.64	214.75 $\pm$ 8.73	NS
Total weight gain (kg)	39.38 $\pm$ 5.79	37.81 $\pm$ 7.38	48.25 $\pm$ 13.74	39.05 $\pm$ 2.16	30.00 $\pm$ 1.83	38.89 $\pm$ 3.28	NS
Daily weight gain (kg/d)	0.429 ^a $\pm$ 0.05	0.412 ^a $\pm$ 0.07	0.470 ^a $\pm$ 0.06	0.464 ^a $\pm$ 0.08	0.200 ^b $\pm$ 0.01	0.395 $\pm$ 0.03	*

NS = $P > 0.05$; * = $P < 0.05$. Sig.: significance level.

Table 4 Feeding effect on birth weight (kg) and average daily gain of calves.

Parameters	Mean ($\pm$ SE) for different treatment groups					Overall	Sig. level
	T ₁ (below 5%)	T ₀ (standard)	T ₂ (above 5%)	T ₃ (above 10%)	T ₄ (farm practice)		
Calf birth weight (kg)	15.43 ^{ab} $\pm$ 0.55	15.68 ^a $\pm$ 0.38	16.60 ^a $\pm$ 2.34	14.67 ^{ab} $\pm$ 1.59	11.95 ^b $\pm$ 0.36	14.78 $\pm$ 0.58	NS
15 d weight (kg)	19.00 ^{ab} $\pm$ 0.20	19.25 ^{ab} $\pm$ 0.14	21.83 ^a $\pm$ 2.33	17.83 ^b $\pm$ 1.88	14.40 ^c $\pm$ 0.52	18.31 $\pm$ 0.73	**
30 d weight (kg)	22.00 ^{ab} $\pm$ 0.58	22.63 ^{ab} $\pm$ 0.72	24.50 ^a $\pm$ 1.76	19.67 ^c $\pm$ 2.05	16.43 ^{bc} $\pm$ 0.66	20.93 $\pm$ 0.81	**
90 d weight (kg)	34.75 ^b $\pm$ 3.00	37.63 ^{ab} $\pm$ 2.89	43.17 ^a $\pm$ 0.60	31.17 ^b $\pm$ 0.88	22.50 ^c $\pm$ 0.65	33.47 $\pm$ 1.87	***
30 d weight gain (kg)	6.58 ^{ab} $\pm$ 1.09	6.95 ^{ab} $\pm$ 0.59	7.90 ^a $\pm$ 1.05	5.00 ^{ab} $\pm$ 1.15	4.48 ^b $\pm$ 0.69	6.15 $\pm$ 0.47	*
90 d weight gain (kg)	12.75 ^{ab} $\pm$ 3.14	15.00 ^a $\pm$ 2.35	18.67 ^a $\pm$ 1.74	11.50 ^{ab} $\pm$ 2.36	6.08 ^b $\pm$ 0.93	12.54 $\pm$ 1.35	*
30 d daily weight gain (kg/d)	0.285 ^{ab} $\pm$ 0.09	0.298 ^a $\pm$ 0.08	0.263 ^a $\pm$ 0.04	0.167 ^{ab} $\pm$ 0.04	0.149 ^b $\pm$ 0.02	0.234 $\pm$ 0.03	*
90 d daily weight gain (kg/d)	0.225 ^{ab} $\pm$ 0.05	0.250 ^a $\pm$ 0.05	0.333 ^a $\pm$ 0.03	0.200 ^{ab} $\pm$ 0.06	0.100 ^b $\pm$ 0.00	0.217 $\pm$ 0.02	*

NS = $P > 0.05$; * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$.

dam groups, although lower birth weight was found in farm practice groups (T_4). Live weights of calves at 15, 30 and 90 d varied significantly ($P < 0.01$; $P < 0.001$) for different dam groups. In all cases, calves in farm practice group (T_4) performed poorer than calves of other dietary dam groups, while T_2 groups performed significantly better than other groups. Although at 30 days age of calf, total and daily weight gain did not differ significantly ($P > 0.05$), but differ significantly ($P < 0.05$) for 90 days age among different dietary dam groups. At 90 days age of calf, weight and daily weight gain for T_2 dam groups performed better than other treatment groups.

The relationship between live weight gain and ME and CP intake in pre-natal RCC is shown in Figs. 1 and 2, respectively. It was observed that live weight gain increased linearly with the increase of ME and CP intake (Figs. 1 and 2, respectively). The equations revealed that the daily maintenance requirements of ME and CP of the experimental cows were 36.19 MJ ME/d and 433.5 g/d, respectively. The energy and protein requirements of the cows usually depends on stage of pregnancy, live weight and fetal development. Hence, ME and CP requirements for maintenance varies.

The relationship between birth weight of calves and CP intake is exhibited in Fig. 3. Fig. 3 shows the correlation between CP intake of pregnant cows and birth weight of calves, and it indicated there was a positive correlation between CP intake and birth weight of calves. The figure shows that per unit of CP intake by the dam the calf birth weight was increased by 1.77. Diet during pregnancy is one important modifiable factor that can have a substantial influence in the viability and body composition of newborn [24]. Protein status of the mother can also impact progeny development but has not been as well studied.

Gestation length and postpartum heat period of cows of different dietary treatment groups are given in Table 5, which shows that there were no significant

Fig. 1 Relation between ME intake and gain of pregnant cow.

Fig. 2 Relation between CP intake and body weight gain.

Fig. 3 Relation between CP intake of cow and birth weight of calf.

($P > 0.05$) variation for those traits among cows of different dietary treatment groups, although there seems to be shorter period of postpartum heat for cows in dietary group T_2 and longer period in farm practice group T_4 .

Milk production performance of RCC cows among different dietary groups are given in Table 6. Total and daily milk yield up to 30 days and 90 days of cows had no significant ($P > 0.05$) effect for different dietary treatment groups (Table 6), although there seems to be slightly better milk production performance for dietary group T_2 and T_0 , respectively for 30 days total and daily milk yield and 90 days total and daily milk yield. However, in all cases cows in farm practice group T_4 showed poorer performance.

The post-natal weight and growth changes of RCC

cows for different dietary treatment groups are illustrated in Table 7.

Table 6 illustrates that there were no significant ($P > 0.05$) changes of total and daily weight gain of cows for all dietary groups, however cows of T_0 performed slightly better than those of cows of other dietary groups. It should also be noted that except the standard dietary group (T_0), the cows of all dietary groups showed negative weight gain during post-natal period, which may be due to the higher nutrients utilization for milk production than growth.

Milk composition of cows of different dietary treatment groups are presented in Table 8, which shows that there were no significant ($P > 0.05$) variation on milk composition for cows of different dietary groups. Table 7 also indicates that fat content

Table 5 Gestation length and postpartum heat period of RCC.

Parameters	Mean ($\pm$ SE) for different treatment groups						Sig. level
	T_1 (below 5%)	T_0 (standard)	T_2 (above 5%)	T_3 (above 10%)	T_4 (farm practice)	Overall	
Gestation length (d)	283.3 $\pm$ 1.70	283.0 $\pm$ 2.12	283.7 $\pm$ 0.67	282.0 $\pm$ 0.58	282.0 $\pm$ 0.41	282.8 $\pm$ 0.58	NS
Postpartum heat period (d)	58.5 $\pm$ 4.98	75.8 $\pm$ 11.31	36.5 $\pm$ 12.20	40.3 $\pm$ 13.62	93.3 $\pm$ 33.08	60.9 $\pm$ 8.61	NS

NS = $P > 0.05$.

Table 6 Feeding effect on milk yield of pre-post RCC.

Parameters	Mean ($\pm$ SE) for different treatment groups						Sig.
	T_1 (below 5%)	T_0 (standard)	T_2 (above 5%)	T_3 (above 10%)	T_4 (farm practice)	Overall	
Total milk yield up to one month (kg)	104.2 $\pm$ 18.88	132.2 $\pm$ 17.58	143.0 $\pm$ 13.29	107.0 $\pm$ 21.30	121.2 $\pm$ 3.84	121.1 $\pm$ 7.14	NS
Daily average milk yield up to one month (kg/d)	3.54 $\pm$ 0.59	4.70 $\pm$ 0.31	4.77 $\pm$ 0.44	3.57 $\pm$ 0.71	4.04 $\pm$ 0.13	4.12 $\pm$ 0.22	NS
Total milk yield up to three months (kg)	245.5 $\pm$ 39.17	349.8 $\pm$ 34.59	278.0 $\pm$ 71.15	266.2 $\pm$ 76.63	274.7 $\pm$ 17.88	285.1 $\pm$ 19.46	NS
Daily average milk yield up to three months (kg/d)	2.73 $\pm$ 0.44	3.89 $\pm$ 0.38	3.09 $\pm$ 0.79	1.97 $\pm$ 1.10	3.05 $\pm$ 0.19	2.99 $\pm$ 0.27	NS

NS = $P > 0.05$.

Table 7 Post-natal growth of RCC.

Parameters	Mean ($\pm$ SE) for different treatment groups						Sig.
	T_1 (below 5%)	T_0 (standard)	T_2 (above 5%)	T_3 (above 10%)	T_4 (farm practice)	Overall	
Initial weight (kg)	168.13 $\pm$ 10.42	196.25 $\pm$ 8.69	141.63 $\pm$ 50.25	138.50 $\pm$ 49.13	182.00 $\pm$ 8.69	165.30 $\pm$ 13.81	NS
Final weight (kg)	167.88 $\pm$ 11.38	197.50 $\pm$ 10.87	141.00 $\pm$ 49.99	136.00 $\pm$ 47.69	176.25 $\pm$ 6.87	163.73 $\pm$ 13.69	NS
Total weight gain (kg)	-0.25 $\pm$ 1.23	1.25 $\pm$ 3.24	-0.625 $\pm$ 0.68	-2.500 $\pm$ 2.84	-5.750 $\pm$ 2.53	-1.575 $\pm$ 1.08	NS
Daily weight gain (kg/d)	-0.009 $\pm$ 0.04	0.046 $\pm$ 0.11	-0.021 $\pm$ 0.02	-0.083 $\pm$ 0.09	-0.192 $\pm$ 0.08	-0.052 $\pm$ 0.04	NS

NS = $P > 0.05$.

Table 8 Feeding effect on milk composition of RCC.

Parameters	Mean ($\pm$ SE) for different treatment groups					Overall	Sig. level
	T ₁ (below 5%)	T ₀ (standard)	T ₂ (above 5%)	T ₃ (above 10%)	T ₄ (farm practice)		
Fat content (%)	4.64 ^{ab} $\pm$ 0.76	4.79 ^{ab} $\pm$ 0.38	5.93 ^a $\pm$ 0.46	3.46 ^b $\pm$ 1.19	4.60 ^{ab} $\pm$ 0.26	4.62 $\pm$ 0.34	*
Protein content (%)	4.08 $\pm$ 0.09	4.04 $\pm$ 0.04	4.03 $\pm$ 0.11	3.03 $\pm$ 1.01	3.94 $\pm$ 0.08	3.81 $\pm$ 0.21	NS
Lactose content (%)	5.84 $\pm$ 0.17	5.68 $\pm$ 0.11	5.56 $\pm$ 0.06	4.15 $\pm$ 1.39	5.46 $\pm$ 0.14	5.33 $\pm$ 0.30	NS
SNF content (%)	8.29 $\pm$ 2.25	10.72 $\pm$ 0.07	10.31 $\pm$ 0.11	7.92 $\pm$ 2.64	10.58 $\pm$ 0.13	9.52 $\pm$ 0.71	NS
Mineral content (%)	0.20 ^a $\pm$ 0.05	0.16 ^{ab} $\pm$ 0.04	0.23 ^a $\pm$ 0.03	0.08 ^b $\pm$ 0.04	0.19 ^{ab} $\pm$ 0.01	0.17 $\pm$ 0.02	*

NS = $P > 0.05$. SNF = Solid's not-fat; * = $P < 0.05$.

Table 9 Post-natal BCS of RCC.

Parameters	Mean ($\pm$ SE) for different treatment groups					Overall	Sig. level
	T ₁ (below 5%)	T ₀ (standard)	T ₂ (above 5%)	T ₃ (above 10%)	T ₄ (farm practice)		
BCS on month one	3.90 ^a $\pm$ 0.15	3.63 ^a $\pm$ 0.30	4.06 ^a $\pm$ 0.18	3.68 ^a $\pm$ 0.29	2.98 ^b $\pm$ 0.09	3.65 $\pm$ 0.12	*
BCS on month two	3.98 ^a $\pm$ 0.23	3.75 ^{ab} $\pm$ 0.19	4.13 ^a $\pm$ 0.24	3.78 ^{ab} $\pm$ 0.27	3.18 ^b $\pm$ 0.12	3.76 $\pm$ 0.11	*
BCS on month three	3.94 ^a $\pm$ 0.21	3.78 ^{ab} $\pm$ 0.16	4.10 ^a $\pm$ 0.06	3.98 ^a $\pm$ 0.21	3.35 ^b $\pm$ 0.09	3.83 $\pm$ 0.09	*
BCS on month four	4.03 ^a $\pm$ 0.10	3.98 ^a $\pm$ 0.25	4.15 ^a $\pm$ 0.13	4.10 ^a $\pm$ 0.15	3.43 ^b $\pm$ 0.05	3.94 $\pm$ 0.09	*

* = $P < 0.05$.

found in milk of group T₂ was slightly better than those of other groups, while poorer in group T₃. Protein content was found slightly better in milk of group T₁ than those of other groups, while poorer in group T₃. Lactose content was found slightly better in milk of group T₁ than those of other groups while poorer in group T₃. Similarly solid's not-fat (SNF) and mineral contents were found slightly better in groups T₀ and T₂, respectively, than those of rests of the groups, while poorer in groups T₃ for both parameters.

Table 9 indicates the post-natal BCS of cows of different dietary treatment groups. Post-natal BCS for 1st, 3rd and 4th months differed significantly ($P < 0.05$) among different dietary groups, while not found significant difference on 2nd month (Table 8). It should be mentioned here that in all cases cows in group T₂ performed better than those of other groups, while cows in farm practice group (T₄) performed worse than those of other groups (Table 8). Banos et al. [25] observed that daughters of older dam had lower BCS, produced less milk yield and needed more days to first service. Banos et al. [25] also found that daughters from late calving first parity cows (30-36 months) had a 7% lower BCS, produced 4.5% less milk, and had their first service almost 3 days later

than daughters from early calving first parity cows (18-32 months).

4. Conclusions

In conclusion, it was observed that pre-natal feeding above 5% protein and energy in the diet of dairy cows have significantly increased the body weight gain, birth weight of calves and milk production of dairy cows; and reduced post-partum heat period. Therefore, it is suggested that better nutrition may be provided during pre-natal period to harvest good quality of calves and higher milk yield from post-natal period.

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