



## Effect of concentrate supplementation during transition period on production and reproduction of indigenous buffalo

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### Abstract

This study was to investigate the impact of concentrate supplementation on the growth, milk yield and quality, postpartum heat period and days open in transient buffalo. Hence, six selected indigenous transient buffaloes were equally divided into two groups *viz.* control (n=3) and supplemented (n=3). About 56.0 kg mixed green fodders (Para:German=3:1) and 2.0 kg concentrate mixtures were offered as a basal diet to each buffalo. Besides these, an additional amount (0.5 kg) of concentrate mixture (wheat bran-50%, mustard oil cake-40%, common salt-2% and di-calcium phosphate-8%) was supplied to each buffalo of the supplemented group. The dry matter intake of the supplemented buffalo was 2.5 and 2% higher ( $p < 0.001$ ) at pre- and post-partum period, respectively than that of the control fed buffalo. Pre- and post-partum body weight, and body condition score of buffaloes between the group were found similar ( $p > 0.05$ ). About 20% more ( $p = 0.02$ ) milk was obtained in the supplemented group compared to the control group, however, the milk composition was not different ( $p > 0.05$ ). Calf birth weight was found  $\approx 10\%$  higher ( $p = 0.51$ ) in the supplemented group than that of the control group. Postpartum heat period and days open of the supplemented buffaloes were reduced remarkably by 13 and 14 days, respectively compared to the buffaloes in control group. Overall, concentrate supplementation to the transient indigenous buffaloes has noteworthy effects on milk yield, postpartum heat period and days open.

**Keywords:** milk yield, milk composition, calf birth weight, postpartum heat period, days open

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### Introduction

The transition period is recognized as the period from three weeks before to three weeks after parturition (Grummer, 1995). This period is a crucial stage of an animal's life and has to adjust with endocrine, metabolic and other physiological conditions (Nikolic *et al.*, 2003). Proper feeding and nutritional strategies during the transition stage plays a vital role in improving the productivity and health of dairy animals (Drackley and Cardoso, 2014). Last few weeks before and after calving, concentrate feeding practiced in dairy cows by increasing amount is common in Europe and North America for many years (Broster, 1971; Shaver, 1997). Because such feeding program increases the productivity of animals and brings profitability in a dairy farm through successful reproduction *viz.* an early resumption of postpartum ovarian cyclicity, restoration of the uterus and maintenance of pregnancy (Butler, 2003). Generally, productive and reproductive responses in domestic animals are closely associated with their nutritional status (Mudgal *et al.*, 2014). Feeding of concentrates

during the transition period may prevent excessive lipid mobilization and liver glycogen depletion prior to parturition through increasing blood insulin (Kokkonen *et al.*, 2004). This, in turn may decrease fatty acid infiltration of the liver as well as the incidence of ketosis (Grummer, 1995). Feeding practices is the most critical determinant of transition management. Poor productive performance (Sasser *et al.*, 1988; Qureshi, 1995), fatty acid mobilization, fall in body condition (Grummer, 1993), extended postpartum heat period and altered reproductive parameters are the consequences of improper feeding and nutrition during the transition period (Das *et al.*, 2007). To overcome these challenges, proper feeding management should be practiced during the transition period for promoting the productive and reproductive performances of dairy animals.

Bangladesh has 1.48 million buffaloes (DLS, 2018) and most of the buffaloes are neglected with regards to feeding and husbandry activities which are responsible for low milk yield and reproduction (Uddin *et al.*, 2016). Most of the buffaloes in developing countries are fed on dry roughages, agricultural by-products and low-

quality crop residues which have naturally got poor nutritive value and digestibility (Rahman et al., 2019, Ojha et al., 2017). Beside dry roughages, lactating buffaloes are generally fed green fodder plus the minimum amount of concentrate feeds but dry and pregnant buffaloes are considered uneconomical that's why they fed only low-quality fodders (Ojha et al., 2017). Such low-quality roughage feeding with imbalanced concentrate is the prime reason for lowering the weight gains and production performances in dairy buffaloes (Qureshi et al., 2002), decreased conception rate and increased the postpartum estrus period in dairy animals (Sasser et al., 1988). Buffaloes are the neglected dairy species in our country context and most of the buffalo farmers assume that extensive system is essential for buffalo farming due to forage feeding and wallowing behaviors (Rahman et al., 2019). Farmers are not aware of their buffalo diet in their normal life even during the transition period and such a feeding system is responsible for diminishing production, impoverishing health and reproduction (Qureshi, 1995).

High producing buffaloes do not get an adequate feed at early lactation for better milk production (Goff and Horst, 1997) but nutrient demand is very high. Again, supply is not coequal with the requirement that affects the production potentiality of animal over the lactation period (Sirohi et al., 2010). Consequently, dairy animals are often forced to draw on body reserves to gratify negative energy at early lactation. This leads to a substantial loss in body weight and an inferior yield of milk (Kim et al., 1993). Elevated nutrition during the prepartum season incites ovulation and conception rates (Robinson et al., 2006). Improving nutrition by supplementary concentrate diet during the late gestation period increases birth weights of calves and milk production of buffalo cows (Sanh, 2009). There is also evidence that sudden changes to rations with relatively higher concentrate proportions immediately after calving are not detrimental (Hernandez-Urdaneta et al., 1976). Hence, proper transition nutrition is essential to improve calf birth weight, growth, body condition, milk production and early resumption of ovarian cyclicity in buffalo. Recently, several pieces of research on transitional animals regarding the concentrate supplementation in transition period has already been done including Prima et al. (2018) and Ojha et al. (2017) but limited information is available regarding the buffalo. This study was therefore designed to test the hypothesis that offering extra concentrates to the buffaloes during the transition period would have an advantageous effect on milk production and

reproductive performance. Thus, a significant effort was executed to explore the impact of pre- and post-partum concentrate supplementation on dry matter intake, growth performance, milk yield and quality, postpartum heat period and the days open of indigenous buffaloes.

## **Materials and Methods**

### **Animals and diets**

Animal handling, feeding and experimental procedures were carried out at the Research Dairy Farm (24°43'46.5''N, 90°25'22.8''E), Department of Dairy Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. Six advanced pregnant buffaloes (indigenous) with the body weights of 724.00 kg ( $\pm 60$ ), lactation length 286 days ( $\pm 7$ ), lactation milk yield 1370 kg ( $\pm 125$ ), body condition score (BCS) of 3.33 ( $\pm 0.58$ ) and in second parity (60 days before expected delivery date) were selected for this study. Buffaloes were randomly allocated into two equal groups viz. control (n=3) and supplemented (n=3). Buffaloes were kept in an individual maternity stall (10 ft. X 10 ft.) for the prepartum period to 5 days postpartum and thereafter, transferred to the stanchion barn (double rowed, face-out system). Before going to feeding trial, buffaloes were dewormed by a broad-spectrum anthelmintic (A-Mectin plus vet injection, The ACME Laboratories Limited, Veterinary Division, Dhaka, Bangladesh) as per the regular farm schedule. The feeding trial lasted for 120 days, specifically 10-day adjustment and 110-day experimental period.

This study was conducted considering the existing farm feeding practices using mixed green grass [Para grass (*Brachiaria mutica*), 42 kg/h/d; German grass (*Echinochloa crus-galli*), 14 kg/h/d=3:1], and concentrate mixture (2 kg/h/d). The concentrate mixture was composed of wheat bran, mustard oil cake, common salt and di-calcium phosphate (DCP) @82.28, 13.72, 3.70 and 0.30%, respectively. Beside this basal diet, extra 25% of total concentrate mixture (a mixture of 50.0, 40.0, 2.0 and 8.0% wheat bran, mustard oil cake, common salt and DCP, respectively) was supplied to each buffalo of the supplemented group. The required amount of green grass was supplied once daily at 12.30 PM and *ad libitum* fresh drinking water was supplied for 24 h. Concentrate mixture was fed separately twice a day in which half of the total amount of concentrate was supplied at morning and rest just prior to roughage feeding at afternoon. Proximate components of feed ingredient were analyzed as described by AOAC (2005).

## Concentrate supplementation effects on transient buffaloes

Ingredients and chemical composition of the diets are illustrated in Table 1.

**Table 1:** Ingredient and chemical composition of the ration during the transition period

	Dietary groups	
	Control	Supplemented
<b>Ingredient composition (g kg<sup>-1</sup> DM)</b>		
Para grass	710.00	691.00
German grass	184.00	180.00
Wheat bran	86.24	97.00
Mustard oil cake	15.00	24.52
Common salt	4.40	4.80
Di-calcium Phosphate (DCP)	0.36	2.68
<b>Chemical composition (g kg<sup>-1</sup> DM)</b>		
Dry matter (DM, g/kg fresh matter)	349.49	360.76
Crude protein (CP)	79.93	83.45
Crude fiber (CF)	298.89	293.57
Ether extract (EE)	33.25	34.11
Nitrogen-free-extract (NFE)	482.10	481.18
Ash	101.04	100.12
ME (MJ kg <sup>-1</sup> DM) <sup>†</sup>	8.33	8.40
NE (Mcal kg <sup>-1</sup> DM) <sup>**</sup>	1.81	1.84

<sup>†</sup>Metabolizable energy (ME) values are estimated according to the equation of Kearl (1982), ME (MJ kg<sup>-1</sup> DM) = [- 0.45 + (0.04453 × %TDN)] × 4.184; TDN is estimated according to the following equations: TDN for roughages (% of DM) = - 17.2649 + (1.2120 × %CP) + (0.8352 × %NFE) + (2.4637 × %EE) + (0.4475 × %CF); TDN for concentrate (% of DM) = 40.3227 + (0.5398 × %CP) + (0.4448 × %NFE) + (1.4218 × %EE) - (0.7007 × %CF).

<sup>\*\*</sup>Net energy (NE) = ME × 0.93 and, 1 MJ = 0.234 Mcal.

### Assessment of buffalo and calf performance

Daily dry matter intake (DMI) of buffaloes was computed from the supplied feed and feeding orts. Live weight of buffaloes was estimated fortnightly using Shaffer's formula (Sastry *et al.*, 1982) and body condition score (BCS) was recorded fortnightly through five points scale procedure as described by Edmonson *et al.*

(1989). Within half an hour of calving, calf birth weight was measured using a digital weighing balance (RFL electric weighing balance, Bangladesh). Per day milk yield from two shifts (morning and evening) were recorded for a period of 60 days postpartum. Individual buffalo milk sample (mixed of morning and evening) was analyzed weekly by automated milk analyzer (Lactoscan SLP, MILKOTONIC Ltd., Bulgaria). Postpartum heat period of each buffalo was calculated through regular observation of external sign of heat after freshening. Furthermore, days open was calculated in days from the date of calving to the date of conception.

### Statistical analysis

The impact of concentrate supplementation on DMI, body weight, BCS, milk yield and milk composition in buffaloes was analyzed by Repeated Measures Analysis of Variance (RMANOVA) in Completely Randomized Design. In this, the time period was considered as the within-subjects factor for measuring the parameters repeatedly on buffaloes and dietary groups (independent variable) were treated as the between-subjects factor. Previous lactation milk yield was considered as a covariate for examining alteration in the current milk yield of buffaloes. In addition, independent sample t-test was performed to detect the concentrate supplementation impact on calf birth weight and calf birth weight in relation to dam body weight, postpartum heat period and days open of buffaloes.

## Results and Discussion

### Dry matter intake and growth performance

The DMI and growth performance are presented in Table 2 and it was found that pre- and postpartum DMI were higher ( $p < 0.001$ ) in concentrate supplemented group compared to the control group. This increasing trend of DMI by the buffalo may be due to supplementation of extra amount of concentrate mixture in diet. In the current study, prepartum body weight of buffalo were 734.25 and 743.25 kg in control and concentrate supplemented group, respectively; and prepartum DMI of these two groups were 2.74 and 2.78% of buffalo live weight, respectively. The DMI is higher than the findings of Ojha *et al.* (2017) who found 2.37 and 2.72% DMI of buffalo live weight at the prepartum stage in farm feeding practices (concentrate mixture-0.5 to 1.0 kg/h/d) and supplemented group (concentrate mixture-2.0 to 2.5 kg/h/d), respectively. The postpartum DMI of this study were 2.82 and 2.86% of buffalo body weight in

control and supplemented group, respectively; which are slightly higher than the findings of Ojha et al. (2017), who found postpartum DMI 2.62 and 2.77% of buffalo body weight. The within-subjects test explored that time has a significant ( $p < 0.01$ ) influence on both pre- and post-partum DMI of buffaloes. Similarly, the interaction between time and diet indicated that noteworthy ( $p < 0.01$ ) impact exists on prepartum DMI only but insignificant ( $p > 0.05$ ) on postpartum DMI (Table 3). This is in similar to Kokkonen et al. (2004) who stated that the surplus concentrate supplementation improves prepartum DMI but didn't affect the postpartum DMI in dairy cows.

Body weight (BW) of the buffaloes did not differ significantly by the concentrate supplementation in both prepartum ( $p = 0.92$ ) and postpartum period ( $p = 0.96$ ) (Table 2). Probable causes of this insignificant variation might be increasing

small amounts of concentrate mixtures in diet and pregnancy stress that followed by the initiation of milk secretion results in losses of BW at an early stage of lactation or the buffaloes might have very minimum left to gain. According to Singh et al. (2003), cow's prepartum live weight did not increased significantly by the various planes of nutrition and that may be due to stress of pregnancy. The finding of the current study resembles with Kunz et al. (1985) who fed a higher amount of concentrate mixture at transition stage and found non-significant ( $p > 0.05$ ) influences on the BW of cows. The within-subjects test showed that both the time and interaction between diet x time has insignificant ( $p > 0.05$ ) effects on prepartum BW of buffaloes but time has noteworthy impacts on postpartum BW only rather than diet x time interaction (Table 3).

**Table 2:** Effect of diets on dry matter intake (DMI), body weight (BW), body condition score (BCS), milk yield, milk composition and reproductive performance of transient buffaloes

Parameters	Dietary groups (Mean $\pm$ SE)		p-value
	Control (n=3)	Supplemented (n=3)	
Prepartum DMI (kg)	20.17 $\pm$ 0.03	20.68 $\pm$ 0.03	<0.001
Postpartum DMI (kg)	19.92 $\pm$ 0.68	20.33 $\pm$ 0.68	<0.001
Prepartum BW (kg)	734.25 $\pm$ 57.65	743.25 $\pm$ 57.65	0.92
Postpartum BW (kg)	705.50 $\pm$ 59.87	710.00 $\pm$ 59.87	0.96
Prepartum BCS (5.0)	3.42 $\pm$ 0.51	3.58 $\pm$ 0.51	0.83
Postpartum BCS (5.0)	2.89 $\pm$ 0.16	2.94 $\pm$ 0.16	0.84
Overall BCS (5.0)	3.15 $\pm$ 0.25	3.25 $\pm$ 0.25	0.51
Calf birth weight (kg)	26.92 $\pm$ 2.34	29.61 $\pm$ 2.90	0.51
Calf birth weight as % of dam BW	3.85 $\pm$ 0.44	4.19 $\pm$ 0.34	0.58
Milk yield (kg d <sup>-1</sup> )	5.68 $\pm$ 0.33	6.79 $\pm$ 0.33	0.02
<b>Milk composition (g kg<sup>-1</sup>)</b>			
Total solids	159.14 $\pm$ 0.69	160.21 $\pm$ 0.69	0.33
Fat	67.10 $\pm$ 1.33	66.91 $\pm$ 1.33	0.93
Solids-not-fat	92.04 $\pm$ 1.13	93.30 $\pm$ 1.13	0.48
Protein	36.56 $\pm$ 0.85	37.60 $\pm$ 0.85	0.44
Lactose	47.76 $\pm$ 1.02	47.98 $\pm$ 1.02	0.88
Ash	7.50 $\pm$ 0.08	7.53 $\pm$ 0.08	0.84
<b>Reproductive features</b>			
Post-partum heat period (d)	94.33 $\pm$ 2.33	81.67 $\pm$ 3.18	0.03
Days open (d)	118.00 $\pm$ 2.31	104.33 $\pm$ 3.84	0.04

### Concentrate supplementation effects on transient buffaloes

Like BW, BCS at prepartum ( $p=0.83$ ) and postpartum ( $p=0.84$ ) period remains similar but numerical value was found more in the supplemented group than the control group. With the advancement of time, overall BCS of buffaloes increased significantly ( $p=0.01$ ) but time and diet interaction was insignificant (Table 3). This might be due to pregnancy stress and body tissues loss through milk production during postpartum period. This statement is supported by Khan *et al.* (2004) who reported that BCS of the postpartum cow didn't improve after allowing concentrate supplementation during late pregnancy. However, Kokkonen *et al.* (2004) found improved BCS of dairy cows by supplying a higher amount (4.7 kg/h/d) of concentrate at prepartum period.

The results on calf birth weight are mentioned in Table 2 and indicated that calf's birth weight was around 10% higher ( $p=0.51$ ) in concentrate supplemented group than the control group. Similar results were also found by Prima *et al.* (2018) in Holstein-Friesian crossbred calf birth weight and reported that prepartum concentrate supplementation (extra 0.5 kg/h/d) didn't affect the birth weight of calves. The calf's birth weight of both control and supplemented groups were 3.85 and 4.91% of the dam's BW, respectively. Mahyuddin and Praharani (2010) worked on buffalo feeding and stated that better nutrition at early stages pregnancy diet had a greater birth weight of calves from that dam than the calves born from traditional dietary dams.

**Table 3:** Tests of within-subjects effects (sphericity assumed) on dry matter intake (DMI), body weight (BW), body condition score (BCS), milk yield and composition

Parameters	Source	F-values
Prepartum DMI	Time	899.67**
	Time × diet	22.26**
Postpartum DMI	Time	432.26**
	Time × diet	1.56 <sup>NS</sup>
Prepartum BW	Time	3.90 <sup>NS</sup>
	Time × diet	1.45 <sup>NS</sup>
Postpartum BW	Time	8.17**
	Time × diet	1.34 <sup>NS</sup>
Prepartum BCS	Time	2.66 <sup>NS</sup>
	Time × diet	0.44 <sup>NS</sup>
Postpartum BCS	Time	0.28 <sup>NS</sup>
	Time × diet	0.04 <sup>NS</sup>
Overall BCS	Time	11.06**
	Time × diet	0.37 <sup>NS</sup>
<b>Milk yield and constituents</b>		
Milk yield	Time	49.73**
	Time × diet	3.13 <sup>NS</sup>
Total solids	Time	11.90**
	Time × diet	0.93 <sup>NS</sup>
Fat	Time	33.80**
	Time × diet	1.07 <sup>NS</sup>
Solids-not-fat	Time	2.48*
	Time × diet	1.05 <sup>NS</sup>
Protein	Time	0.47 <sup>NS</sup>
	Time × diet	1.13 <sup>NS</sup>
Lactose	Time	5.45**
	Time × diet	0.64 <sup>NS</sup>
Ash	Time	4.95**
	Time × diet	0.21 <sup>NS</sup>

\*\*Significant at  $p<0.01$ , \*significant at  $p<0.05$  and NS, non-significant.

### Milk yield and composition

The impact of concentrate supplementation on milk yield of buffalo is given in Table 2. The daily milk yield was significantly ( $p=0.02$ ) affected by the concentrate supplemented pre- and post-partum diet. It could be inferred from the test of within-subjects tests that time had significant ( $p<0.01$ ) influence on milk yield of buffaloes but the interaction between time and diet was found statistically similar ( $p>0.05$ ). It was observed that supplemented diet buffaloes gave 1.11 kg more milk per buffalo per day compared to the buffaloes in the control group. Such an increasing trend of milk yield in the supplemented group may be due to supplying of additional concentrate mixture (0.5 kg) at the dry period to an early stage of lactation. This finding is supported by Abdulkareem *et al.* (2012) who found 44.8% more milk daily yield in buffaloes of precalving concentrate supplemented diets. This variation might be due to the low protein (8.34%) diet used in the present study compared to the 13% crude protein diet used by Abdulkareem *et al.* (2012).

The data on milk constituents are also mentioned in Table 2. The result revealed that concentrate supplementation during transition period had no significant ( $p>0.05$ ) effect on all the components of milk. This is in similar to Keady *et al.* (2001) who offered pre- and post-calving concentrates at 5 and 7 kg/cow per day, respectively and did not found any changes of milk composition. In similar, MacRae *et al.* (1988) opined that pre- and post-partum diets have a very minute effect on milk composition especially mineral and carbohydrate fractions. In this study, time showed only significant ( $p<0.01$ ) impact upon all the constituents of milk excluding protein but the interaction of diet and time had an insignificant effect on all constituents (Table 3). Murphy (1999) also observed that cows feeding more than traditional before calving produced milk with negligible changes in milk constituents.

### Reproductive performance

The effect of concentrate supplementation during the transition stage on postpartum heat period and days open are presented in Table 2. The findings implied that concentrate supplementation had a significant impact on postpartum heat period ( $p=0.03$ ) and days open ( $p=0.04$ ) of buffaloes. It was remarkably noticed that concentrate supplemented buffaloes showed heat 13 days earlier than the control buffaloes. Also, the days required for calving to the conception was 14 days lower ( $p=0.04$ ) in the

supplemented buffaloes compared to the control. These findings are in agreement with the Ojha *et al.* (2017) who reported that higher plane of nutrition (considering 22% CP in specially formulated concentrate mixture 2.0-2.5 kg/d) meaningfully ( $p<0.05$ ) reduces (16 to 23 days) the postpartum heat period and days open of crossbred buffaloes.

Better nutrition is closely related to improving reproductive performances. In case of negative energy balance, the mobilization rate of body reserves appeared to be directly related to the postpartum interval to the first ovulation as well as lower conception rate (Butler and Smith, 1989). That's why the poor reproductive performances of control group buffaloes associated to a low BCS. However, supplementation of concentrate mixture (0.5 kg/h/d) at pre- and post-partum stage shortens  $\approx 11$  days of postpartum heat period of Holstein-Friesian crossbred (Prima *et al.*, 2018). In another study, Wongsrikeao and Taesakul (1984) also observed that improved nutrition reduced the postpartum service period in Swamp buffaloes and increased the growth rate in their calves as observed in the present study.

### Conclusion

The results of this study revealed that additional amount (0.5 kg/h/d) of concentrate mixture supplementation with existing feeding during the transition period of buffaloes brings benefit through increasing milk yield, reduction of postpartum heat period and days open. However, body weight, body condition score, calf birth weight and milk compositions remain statistically similar in both dietary groups. The findings from this study may be beneficial for tropical and sub-tropical dairy buffalo producers to manipulate their feeding strategies for a better productive and reproductive response.

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### Conflict of interest

There is no conflict of Interest neither on the results nor any part of this study.

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