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# Development of milk replacer for rearing kids

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## Abstract

The present study was conducted to evaluate the effect of different milk replacers on the performance of kids. In a 60-day feeding trial, twenty kids of both sexes (15 days of age and average 1.9 ± 0.4 kg BW) were divided into four groups having five kids in each and were assigned to four treatments: milk replacer prepared using shoti (*Curcuma zedoaria*) powder ($T_1$), milk replacer prepared using fresh eggs and wheat flower ($T_2$) and milk replacer prepared from skim milk powder ($T_3$). Total DM and milk DM intake were significantly ($P<0.001$) higher in $T_1$ than $T_3$, $T_0$ and $T_2$ groups. ME and MP intake were significantly ($P<0.05$) higher in $T_1$ than the other three groups. Average daily gain was significantly ($P<0.05$) higher in $T_1$ compared to $T_2$ and $T_3$ groups, while control was intermediate. Body weight gain of $T_2$ and $T_3$ group increased up to 5$^{th}$ week and declined thereafter. Feed conversion efficiency did not differ significantly between groups. DM and OM digestibility was significantly ($P<0.05$) higher in $T_1$ group. N retention (as percentage of N-intake) was lower in $T_3$ group. Costs for $T_0$, $T_1$, $T_2$ and $T_3$ groups were 4.7, 9.0, 36.6 and 4.7 Tk/100g (or 0.054, 0.113, 0.456 and 0.054 $/100g) mixed dry milk replacer. Since the supplementation of milk replacer did not affect weight gain, FCR and nutrient utilization, milk replacer was cost-effective. Therefore, shoti and egg + wheat can be fed to goat kids as an alternative to goat milk. (*Bangl. vet*. 2014. Vol. 31, No. 1, 46 – 54)

## Introduction

Milk is an essential feed for newborn kids for 3-4 weeks or up to 5-6 months depending on breed and other factors (Sultana *et al*., 2012; Morand-Fehr, 1981 & 1982). In Bangladesh, Black Bengal goat is highly prolific, having multiple births in 70% cases (Devendra and Burns, 1983). Under traditional feeding systems in Bangladesh, the goats are raised by grazing on harvested or fallow lands (Chowdhury & Faruque, 2004). This feed cannot be relied on to produce adequate milk for kids (Sultana *et al*., 2012). Thus, it is important to supplement feeding of kids to minimize mortality (Awah, 1981; Akinsoyinu, 1985; Ayoade, 1987; Ademosun, 1988). Black Bengal goats are poor milk producers (108-135 g/day; Hussain, 1999). Dam's milk is the ideal food for newly–born kids, but due to multiple births, milk shortage of weak dams, early weaning and does producing two litters in one year, it is essential to develop milk replacer. In Bangladesh, poor mothering, feed shortage, and low milk production are common. The causes for poor mothering could be poor nutrition or genetic inability to produce milk (Shelton, M., 1981). In such cases, kids would be raised successfully by using milk replacer. Results depend on the composition and quality of the milk

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replacer, level of intake, feeding system and management (Skjevdal, 1974; Mowlem, 1982; Owen and De Pavia, 1980; Morand-Fehr *et al.*, 1982; Havrevoll *et. al.*, 1991). Most researchers have focused on the productive and reproductive performance (Sultana *et al.*, 2012; Hossain *et al.*, 2004), and nutrient requirements (Chowdhury & Faruque., 2004) of Black Bengal goats, and limited information is available on the effect of milk replacer on kids' performance. The study was undertaken to develop cost-effective milk replacer using locally available ingredients and to measure its nutritional status.

## Materials and Methods

*Animals and design*

The study was carried out at Goat and Sheep Research Farm at Bangladesh Livestock Research Institute, Savar, Dhaka from July 2008 to May 2009. Twenty Black Bengal kids of both sexes at average 15 days of age were used. The kids sucked their mothers from birth until 10 ± 2 days of age, when they were separated from their mother. They were cared under full confinement until the end of the experiment. At the beginning of the trial, average body weight was 1.91 kg ± 0.37 kgs. The kids were housed in individual pens (38.5 inch × 48.0 inch) with straw bedding. The kids were divided into four groups having five kids in a group, and given four treatments: i) kids reared based on their mother milk without any milk replacer ($T_0$), ii) reared by feeding milk replacer prepared by using shoti (*Curcuma zedoaria*) powder ($T_1$), iii) milk replacer prepared by using fresh eggs and wheat flower ($T_2$) and iv) milk replacer prepared from skim milk powder ($T_3$).

*Feed ingredients and milk replacer preparation*

Locally available ingredients were used (Table 1). Milk replacer was prepared at 100g mixture/L of warm water and boiled for at least five minutes and cooled at 35-370C , then it was fed to the kids.

*Feeding and animal management*

Kids were suckled five times in a day, 7 AM, 10 AM, 1 PM, 6 PM and 10 PM, in $T_0$. The other three feeds were fed at the same times. Milk intake (contain 89.7% DM, 3.8%CP, 4.7% fat and 0.7% ash respectively) was determined according to Sultana *et al.*, (2012). Kid starter (CP-26.5% and M/D-11.23) and soft green grass (DM-20.50; CP-11.28; ADF 24.85 and ash-16.98) were provided from 27th and 36th days, respectively thrice a day at 7 A. M., 1 P. M and 8 P. M.

Kids' weights were recorded weekly before feeding. Sample of milk replacers, kid starter, green grass and refusal were taken to determine the intake during the trial. From day 60 of the experiment, a metabolic trial was carried out for 4 days with five kids per group. The faeces and urine were collected every morning before the kids were fed. In order to minimize the loss of nitrogen, 100 ml 6N sulphuric acid was added to the bucket for urine collection. The quantity of urine collected for each

animal was measured using a graduated measuring cylinder, and 10% was taken and frozen until required for analysis.

Table 1. Feed composition of different milk replacer (g/100g)

| Ingredient (%) | Treatments | | | Kid starter |
|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | |
| Shoti | 19 | - | - | - |
| Skim milk | - | - | 70 | - |
| Fresh egg | - | 30 | - | - |
| Wheat Flour | - | 18 | - | - |
| Soybean meal | 64 | 27 | - | 57.0 |
| Maize ground | - | - | 20 | 35.0 |
| Soybean oil | 15 | 23 | 7 | 5 |
| Molasses | - | - | - | 5 |
| Salt | 1 | 1 | 1 | 1 |
| DCP | 0.5 | 0.5 | 1.5 | 1 |
| Vit-min. Premix | 0.5 | 0.5 | 0.5 | 1 |
| Total | 100 | 100 | 100 | 100 |
| Composition calculated (dry form) | | | | |
| DM (% in dry form) | 64.36 | 77.32 | 89.16 | 92.78 |
| DM (% in liquid form) | 7.36 | 4.56 | 7.77 | - |
| CP (%) | 28.44 | 26.80 | 27.91 | 26.50 |
| EE (%) | 26.87 | 33.06 | 13.52 | - |
| Ash (%) | 8.58 | 3.85 | 10.86 | 5.74 |

100 g milk replacer were mixed in a liter of worm fresh water then it was boiled for five minutes and cooled it was pour into the feeder and then fed to the kid

*Chemical analysis*

The compositions of the collected feed sample, faeces and nitrogen for the urine samples were analyzed by using the AOAC (1990).

*Feed cost analysis*

The costs of feed ingredients were recorded at current market price and costs of milk replacer were calculated from them.

*Statistical analysis*

The results of feed intake, growth and digestibility were analyzed by one-way ANOVA using computer software package General Linear Model of SPSSx (11.0 version).

## Results and Discussion

*Chemical composition of diets*

The chemical compositions of the diets are presented in Table 1. The dry matter content of dried milk replacer varied from 64.4 to 92.8 %. The crude protein and fat (EE) content of milk replacer varied from 26.0 to 28.5 and 13.5 to 26.9 % respectively of dry matter. Ash content varied from 3.85 to 70.9%. Mowlem (1981 & 1982) and Morand–Fehr (1982) recommended that the dry matter content in liquid milk replacer may vary between 12-24% for young kids, which does not support the present composition. Morand-Fehr, (1981); Morand-Fehr *et al.* (1982) reported that the fat content of the milk replacer may vary from 15 to 25% and protein from 20 to 25% on dry matter basis.

*Nutrient intake*

The nutrient intakes of different groups are presented in Table 2. The average total DM intake and milk dry matter intake were significantly ($P<0.05$) higher in $T_1$ than in $T_3$, $T_0$ and $T_2$. Total dry matter intake was significantly ($P<0.05$) affected by intake of milk replacer or goat milk. The range of protein intake was 18.2 to 24.4 g/d. Total CP intake was significantly ($P<0.05$) higher in $T_1$ than in $T_2$ but not significantly different from $T_3$ and $T_0$. Therefore, the amount of protein intake (g/d) followed NRC (1985) recommendation. DMI from concentrate (g/d), and green grass (g/d), and DMI as a percentage of live weight were not significantly ($P>0.05$) different between groups.

Table 2. Effect of different milk replacer on nutrients intake

| Parameters | Treatments (mean ± SE) | | | | SEM | Sig. level |
|---|---|---|---|---|---|---|
| | $T_0$ | $T_1$ | $T_2$ | $T_3$ | | |
| Con. DMI (g/d) | 42.3 ±1.17 | 42.2 ± 0.96 | 42.0 ± 1.33 | 42.0 ± 1.44 | 1.24 | NS |
| Green grass DMI (g/d) | 12.5 ± 0.40 | 12.0 ± 0.06 | 12.0 ± 0.38 | 12.5 ± 0.38 | 0.33 | NS |
| Milk DMI (g/d) | $34.0^{a}$ ± 2.81 | $42.1^{c}$ ± 0.78 | $25.0^{a}$ ± 0.49 | $37.0^{b}$ ± 2.13 | 1.82 | ** |
| TDMI (g/d) | $88.6^{b}$ ± 3.33 | $96.5^{a}$ ± 1.56 | $78.4^{c}$ ± 1.62 | $90.8^{ab}$ ± 2.83 | 2.46 | ** |
| DMI (% LW) | 1.5 ± 0.111 | 1.5 ± 0.08 | 1.4 ± 0.08 | 1.6 ± 0.11 | 0.1 | NS |
| TCPI (g/d) | $20.5^{ac}$ ± 0.79 | $24.4^{bc}$ ± 0.73 | $18.2^{a}$ ± 0.77 | $22.4^{c}$ ± 0.76 | 0.77 | ** |

NS Not significant; ** Significant at 1% level of probability; a, b, c Mean values having different superscripts in a row differ significantly ($P<0.05$); DMI dry matter intake; TDMI total dry matter intake; TCPI total crude protein intake; LW live weight; Con. Concentrate; g/d gram per day

Live weight gain and feed conversion efficiency are presented in Table 3. The average daily gain was significantly ($P<0.05$) higher in $T_1$ than in $T_0$ and $T_3$, which did not differ significantly from each other, but were significantly higher than T2.

Chowdhury & Faruque (2004) mentioned that the average growth rate of Black Bengal kids was 60 g, which corresponds with the present findings. Recently, Sultana *et al.*, (2012) found growth rate was 40-45 g/d. In another experiment Sahlu *et al.* (1992) mentioned that average growth rate of Angora goats is 115-125 g/d, while in Alpine goats was 153-258 g/d (Andrighetto *et al.*, 1994). The lower growth rate might be due to the genetic characteristics of Black Bengal goat.

Table 3. Effect of different milk replacer on average daily gain (ADG) and feed conversion efficiency (FCR)

| Parameters | Treatments (mean ± SE) | | | | SEM | Sig. level |
|---|---|---|---|---|---|---|
| | $T_0$ | $T_1$ | $T_2$ | $T_3$ | | |
| Initial live weight (kg) | 1.87 ± 0.17 | 1.89 ± 0.21 | 1.93 ± 0.21 | 1.92 ± 0.18 | 0.06 | NS |
| Final live weight (kg) | 6.0 ± 0.34 | 6.1 ± 0.19 | 5.7 ± 0.54 | 5.9 ± 0.42 | 0.40 | NS |
| ADG (g/d) | $68.84^{b}$ ± 4.5 | $71.2^{c}$ ± 1.8 | $62.80^{a}$ ± 0.6 | $66.33^{b}$ ± 0.4 | 4.13 | * |
| FCR | 1.29 ± 0.08 | 1.35 ± 0.04 | 1.25 ± 0.15 | 1.37 ± 0.03 | 0.09 | NS |
| Feed cost/kg (Tk) | 42.76 | 89.54 | 360.64 | 42.76 | - | - |
| Feed cost/kg ($) | 0.541 | 1.133 | 4.565 | 0.541 | - | - |
| Feed cost/100g (T) | 4.65 | 8.95 | 36.64 | 4.65 | - | - |
| Feed cost/kg ($) | 0.054 | 0.113 | 0.456 | 0.054 | - | - |

NS Not significant; SEM standard error of mean; * Significant at 5% level of probability; a, b, c Mean values having different superscripts in a row differ significantly ($P<0.05$); ADG average daily gain; g/d gram per day

The final live weight gain and feed conversion efficiency were not significantly ($P>0.05$) different between groups. The cost of three dry mixture of milk replacers $T_1$ (Shoti), $T_2$ (Egg + flour) and $T_3$ (Skim milk) were 8.95; 36.0 and 4.65 taka per 100g respectively.

The average growth rates are presented in Fig. 1. In the first week, ADG fell in $T_1$ (shoti), $T_3$ (skim milk) groups compare to $T_0$ (with mother) and $T_2$ (egg & flour) groups. The body weight of kids fed with their dam's milk increased steadily each week except 5th and 6th week (Fig. 1). The body weight gain of $T_2$ and $T_3$ group (having egg + wheat flour and skim milk) increased up to 5th week and then declined. The growth response in 1st to 2nd week of the experiment may be affected by their feeding habit. No previous reports of milk replacer effects on growth and digestibility in Black Bengal goat are available, but our results were similar to those of Abrams *et al.* (1985) in kids and Stiles *et al.* (1974) in calves. The body weight gain was reduced in $T_2$ and $T_3$ groups from 6th to 9th week which may indicate inability to utilize nutrients. The feed conversion ratio during the experimental period ranged between 1.3 : 1 to 1.4 : 1. Utilization of nutrients was higher in T0 than in the other groups. FCR depends on the energy concentration of milk and its fat content (Morand-Fehr, 1981).

The digestibility and N-utilization data are presented in Table 4. Dry matter (DM) and organic matter (OM) digestibility was significantly (P<0.05) higher (75.7 & 79.0 respectively) in $T_1$ group compared to the other three groups. CP digestibility did not differ significantly between groups. The range of acid detergent fibre (ADF) digestibility was 7 to 20%, which is consistent with the findings of Porter (1969). The digestibility of nutrients depends on the development and capacity of the digestive tract (Roy, 1980; Thivend *et al.*, 1980). In goats, milk passes through the oesophageal groove to the abomasum for the duration of continuous milk feeding. With the development of the rumen and reticulum, the capacity for fibre digestion is increased. The development of the ruminant stomachs is related to live weight, age and diet (Sanz-Sampelayo *et al.*, 1987). The nitrogen intake and output in faeces, and nitrogen retention in mg/kg W0.75 and percentage were not significantly (P>0.05) different between groups. The N-excretion (mg/kg W0.75) was significantly (P<0.05) higher in $T_3$ group and followed by $T_1$, $T_2$ and $T_0$ groups. Kids fed milk replacer based on skim milk powder increased N-excretion.

Table 4. Effect of different milk replacer on nutrients digestibility and N-balance

| Parameters | Treatment (Mean ± SE) | | | | SEM | Sig. level |
|---|---|---|---|---|---|---|
| | $T_0$ | $T_1$ | $T_2$ | $T_3$ | | |
| **Digestibility (%)** | | | | | | |
| Dry matter | 69.0 ± 2.93 | $75.7^b$ ± 1.09 | $65.7^a$ ± 3.64 | 69.0 ±1.36 | 2.5 | * |
| Crude protein | 77.6 ± 1.71 | 83.6 ± 1.24 | 77.7 ± 4.22 | 77.0 ± 2.05 | 2.58 | NS |
| Organic matter | 70.4 ± 4.16 | $79.0^b$ ± 1.63 | 71.5 ± 2.94 | $69.0^a$ ± 2.64 | 2.99 | * |
| ADF | 9.5 ± 3.73 | 19.8 ± 2.81 | 14.6 ± 6.07 | 7.0 ± 4.6 | 4.47 | NS |
| **N-balance** | | | | | | |
| N-intake (mg/kg W0.75) | 1191.5 ± 75.7 | 1250.5 ± 50.8 | 1156.4 ± 84.2 | 1309.2 ±68.8 | 70.98 | NS |
| N-output in faeces (mg/kg W0.75) | 221.5 ± 24.16 | 195.2 ± 5.46 | 240.7 ± 48.99 | 276.1 ± 27.52 | 31.7 | NS |
| N-output in urine (mg/kg W0.75) | $175.5^a$ ± 8.69 | $237.4^b$ ± 30.59 | $177.2^a$ ± 14.85 | $292.7^b$ ± 45.32 | 28.53 | * |
| Total N-output (mg/kg W0.75) | $397.0^a$ ± 31.4 | $431.1^a$ ± 27.2 | $417.9^a$ ± 49.6 | $568.8^b$ ± 71.4 | 49.27 | * |
| N-retention (mg/kg W0.75) | 749.0 ± 67.67 | 843.0 ± 68.46 | 692.0 ± 56.30 | 714.0 ± 60.0 | 63.05 | NS |
| N retention (%) | 66.4 ± 2.88 | 66.0 ± 2.89 | 64.0 ± 2.62 | 57.0 ± 3.90 | 3.13 | NS |

NS Not significant; * Significant at 5% level of probability; a, b, c Mean values having different superscripts in a row differ significantly (P<0.05); ADF acid detergent fibre; mg/kg W0.75 milligram per kilogram metabolic body weight; N nitrogen

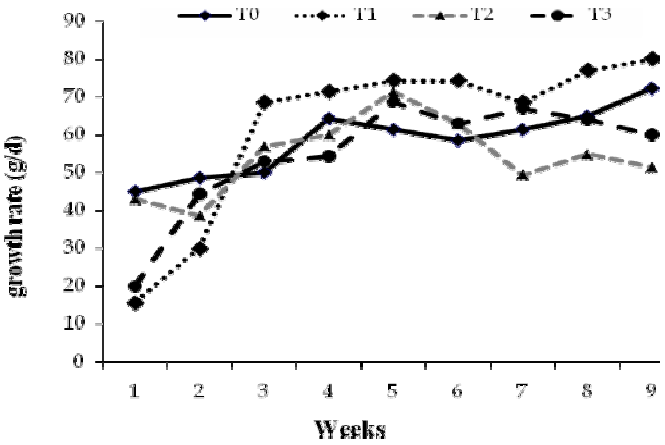


Fig. 1. Effect of different milk replacers on weekly body weight gain

## Conclusions

Based on the present results, feed intake, growth, FCR and nutrient utilization in kids fed three milk replacers were similar to those in the control suckled group. Due to high price and unavailability of skim milk in the local market, the use of shoti or egg and wheat flour to produce a milk replacer may help profitable kid rearing in Bangladesh.

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