Bangladesh Journal of Animal Science
Journal homepage: http://www.banglajol.info/index.php/BJAS

# Growth and blood parameters of soybean based milk replacer fed and naturally suckled Black Bengal kids

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## Abstract

The present study was aimed to determine growth and blood parameters of soybean based milk replacer fed kids and naturally suckled counterparts in three villages of Mymensingh Sadar, Bangladesh. Twelve Black Bengal kids were allocated into two treatment groups; one group (n=6) was reared with milk replacer while the other (as control; n=6) was reared naturally keeping with their dam. Live weight and body measurement of kids were recorded weekly. Blood samples were collected from 8 weeks old kids to determine their red blood cell (RBC), white blood cell (WBC), haemoglobin (Hb), packed cell volume (PCV) and differential leukocyte count (DLC). The average initial live weight of the suckled and replacer fed kids did not show significant difference ($p<0.05$). The average final live weight was significantly ($p<0.05$) higher in artificially fed males (7.7±0.18 kg) than naturally suckled male (6.89±0.24 kg) kids. Body length, wither height and heart girth were significantly ($p<0.05$) higher in milk replacer fed male kids than naturally suckled counterparts. RBC count was significantly ($p<0.05$) higher in artificially fed group than naturally suckled kids. Hb, PCV and DLC did not differ significantly ($p>0.05$) between treatment groups. In conclusion, feeding with soybean based milk replacer enhanced growth of kids comparing naturally reared counterparts.

**Keywords:** blood parameters, growth, kids, milk replacer, soymilk

 

## Introduction

Goat (*Capra hircus*) is an economically promising domestic animal. Goat can be used to alleviate poverty as they owned by poor farmers (Owen *et al.,* 2005; Hassan *et al.,* 2007). Black Bengal goat is a dwarf meat type goat usually distributed in Bangladesh and its surrounding areas in India. Black Bengal goat comprises more than 90% of the total goat population in Bangladesh. Black Bengal does often kid twice a year. They are popular for their adaptability in hot and humid environments, high prolificacy, delicious meat and skin softness. Chevon (goat meat) is famous due to its tenderness, flavour, and leanness. Their skin is superior in quality for leather goods and has great demand both in domestic and foreign markets.

A high level of kid mortality is a significant barrier to increase goat production in tropical and subtropical countries. Insufficient milk produced by the dam is a major cause of high kid mortality in Black Bengal goats. Higher litter size of Black Bengal goat is advantageous but the problem is raised when dam milk production is lower which is not sufficient to nourish their kids. In this regard, artificial (bottle) feeding of newborn is essential. Due to the high cost and demand for cow milk, the artificial rearing of kids with milk replacers has been considered an economic and alternate way to save the kids. Artificial rearing involves feeding of young kids from a bottle with a rubber nipple on the ends as a substitute for or supplement to natural suckling. Artificial rearing of kids is important for large scale goat production. The success in artificial rearing depends on many factors like breed, milk quality, access to feed and pasture environment and system of milk feeding (Havrevoll *et al*., 1991).

The first milk replacer was formulated by Kellner (1926). Lambs can be successfully reared on milk replacer at a lower cost than with ewe rearing, thus offers a potential increase in economic returns for sheep producers (Frederiksen *et al.,* 1981). Milk replacer is 11.39% cheaper than natural milk (Khan *et al*., 2011). Milk replacers are usually made up of ingredients like skim milk powder, animal fat, buttermilk powder, whey protein, soy lecithin, and vitamin-mineral premix. Glucose, cereal flower, non-milk protein can also be used in little amount. The basic composition of milk and its physical form, milk replacers should contain such ingredients to supply all nutrients such as protein, fat, lactose, minerals and vitamins and dissolve readily in water to facilitate

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feeding in a physical form similar to milk. 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).

It is difficult to find an acceptable alternative to milk protein, the major costly ingredient of milk replacer. Soybean is a source of high quality, relatively inexpensive protein that has the potential for use in a milk replacer (Colvin and Ramsey, 1968). Soy protein sources such as soy protein concentrate and soy protein isolate have partly been used in milk replacers (Silva *et al.,* 1986). Partially replacement of whole milk with soymilk on pre-weaning calf performance and weaning costs, results soymilk as an economic partial substitute for whole milk in calf-raising (Ghorbani *et al.,* 2007). Soy flour could contribute one-third of the total protein in milk replacer for *ad-libitum* fed, artificially reared lambs with little, if any, reduction in lamb performance (Heaney and Shrestha, 1987). Effects of soy flour in milk replacer on the performance of artificially reared lambs were studied by Heany and Shrestha (1987). They reported that there were no significant differences in daily gains from birth to weaning and post-weaning feed conversions among lambs fed standard milk replacer with all the protein provided by milk products and those fed milk replacer containing soy protein. Sarker *et al.* (2015) suggested that soybean-based milk replacer could be supplied to kids up to 50% without any detrimental effects on their growth and organ development. However, the effect of that feeding of soybean-based milk replacer was not compared with the naturally reared kids. Therefore, this study was aimed to know the growth and blood parameters of soybean based milk replacer fed and naturally suckled kids in on-farm conditions.

## Materials and Methods

### Kids and their management

The experiment was conducted at Charsottrapur, Boira and Kewatkhali in Mymensingh Sadar, Mymensingh, Bangladesh. Twelve Black Bengal kids of 2 weeks old were divided into two groups considering their initial weight, litter size of their dam, parity, and dam weight. Each group consisted of 6 kids (3 male, 3 female). The initial weight of kids ranged from 1.16 to 1.65 kg and they were identified with tags. Separate rooms were used for housing of natural (suckling with mother) and replacer fed group (50% powder milk + 50% soymilk). The milk feeding schedule of artificially fed kids are shown in Table 1. Kids were fed three times daily up to 8 weeks old and received a total quantity of milk replacer equal to 10% of their live weight per day. Kids were fed twice daily during 9-11 weeks and the amount of milk replacer was 2% of their body weight. Thereafter, the kids were fed once daily and the amount of milk replacer reduced to zero by the end of 16 weeks. Concentrate mixture (24% crude protein) and green grasses were supplied *ad-libitum*.

**Table 1:** Feeding schedule of kids

| Age (wks) | Milk replacer (g/d) | Concentrate mixture (g/d) | Green Grass | Feeding of milk replacer |
|---|---|---|---|---|
| First 3 days | Feeding colostrum with their dam | | | |
| 2-3 | 180 | _ | _ | 3 times daily |
| 3-4 | 220 | _ | _ | 3 times daily |
| 4-5 | 250 | _ | *Ad-libitum* | 3 times daily |
| 5-6 | 290 | 15 | *Ad-libitum* | 3 times daily |
| 6-7 | 330 | 30 | *Ad-libitum* | 3 times daily |
| 7-8 | 380 | 70 | *Ad-libitum* | 3 times daily |
| 8-9 | 270 | 80 | *Ad-libitum* | 2 times daily |
| 9-10 | 230 | 110 | *Ad-libitum* | 2 times daily |
| 10-11 | 180 | 125 | *Ad-libitum* | 2 times daily |
| 11-12 | 120 | 130 | *Ad-libitum* | 1 time daily |
| 12-13 | _ | 135 | *Ad-libitum* | 1 time daily |
| 13-14 | _ | 140 | *Ad-libitum* | 1 time daily |
| 14-15 | _ | 145 | *Ad-libitum* | 1 time daily |
| 15-16 | _ | 150 | *Ad-libitum* | 1 time daily |

Kids were fed milk individually using a bottle with soft rubber nipple. After each feeding, the bottles and other milk feeding utensils were washed with hot water containing detergent, dried and kept in a safe place. Kids were provided free access to water from a bowl drinker. After five weeks, small amounts of concentrates were supplied to the kids. Then after 6 weeks the amount of concentrates were increased gradually up to the end of 16 weeks (Table 1).

**Preparation of soymilk**

Whole soybeans free from immature field damage and black spot were grinded in a flour mill. An amount of 62.5g soyflour was dissolved in 1000 ml water and boiled at 100º C for 10 minutes with constant stirring. After cooling, an equal amount of powder milk was mixed (1:1) and supplied to the kids.

**Live weight and body measurements of kids**

Each kid was weighed weekly at 9.00 am using a digital balance. The kids were kept off feed overnight (16 hours) before weighing. Body length, heart girth, withers height and neck circumferences were measured with the help of a measuring tape.

**Collection and processing of blood**

Blood samples were collected at 8 weeks of experimental period *via* jugular vein puncture into evacuated tubes containing EDTA (ethylene diamino tetra acetate) for examination of red blood cell (RBC), white blood cell (WBC), haemoglobin (Hb), erythrocyte sedimentation rate (ESR) and packed cell volume (PCV). For haematological test, blood was stored in test tube or vial containing anticoagulant (3.8% sodium citrate). One drop of blood was put on a slide for differential leukocytes count (DLC).

**Statistical analysis**

Data were presented as the mean ± SD (standard deviation). All data were subjected to one-way ANOVA, and the significance of difference among means was determined using Tukey's HSD test. All analyses were conducted in "SAS/STAT version 9.1.3" for Windows Service Pack 4, 2004 SAS Institute, Cary NC USA for Windows. Differences at $p<0.05$ were considered statistically significant.

## Results

**Live weight gain of kids**

The live weights of the male kids during the experimental period are shown in Figure 1. The final live weight of milk replacer fed and natural suckled male kids was 7.70 ± 0.18 and 6.89 ± 0.24 kg, respectively. Total live weight gain from 2 to 20 weeks of age were significantly ($p<0.05$) higher in milk replacer fed kids than naturally suckled group. Figure 2 showed the live weight changes of the female kids. Live weights of females during 2-10 weeks did not differ significantly between two groups. During 11-20 weeks average live weight of females was higher in artificially fed kids than the naturally suckled group although the differences were not statistically significant.

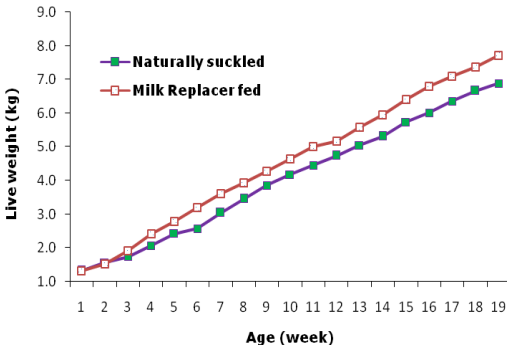


**Figure 1:** Cumulative growth curve of male kids

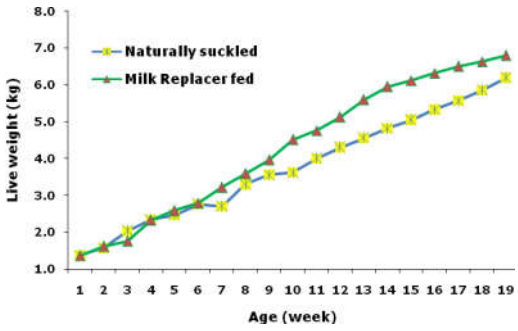


**Figure 2:** Cumulative growth curve of Female kids

**Body measurements of kids**

Body length, wither height and heart girth were significantly higher ($p<0.05$) in milk replacer fed male kids than naturally reared counterparts (Table 2). Circumferences of necks (middle) of milk replacer fed female kids were higher than naturally suckled group.

**Table 2:** Body measurements of naturally suckled and milk replacer fed Black Bengal kids

| Parameters | | Male | | Female | |
|---|---|---|---|---|---|
| | | **Natural Suckling** | **Milk Replacer Feeding** | **Natural Suckling** | **Milk Replacer Feeding** |
| Body length (cm) | | 37.64$^{b}$ ± 0.34 | 41.17$^{a}$ ± 0.99 | 37.84± 0.47 | 40.31± 1.83 |
| Wither height (cm) | | 37.59$^{b}$ ± 1.23 | 39.80$^{a}$ ± 0.62 | 37.15 ± 0.78 | 37.07± 1.11 |
| Heart girth (cm) | | 38.13$^{b}$ ± 0.36 | 40.61$^{a}$ ± 0.64 | 40.14 ± 1.61 | 40.74± 2.00 |
| Circumference of neck (cm) | Apex | 18.74 ± 1.49 | 20.85 ± 0.23 | 16.81 ± 0.62 | 18.97± 1.27 |
| | Middle | 18.87 ± 1.86 | 20.51 ± 0.36 | 17.19$^{b}$ ± 0.37 | 20.32$^{a}$ ± 1.82 |
| | Base | 20.69 ± 2.43 | 20.97 ± 0.69 | 20.21 ± 0.82 | 21.37 ± 1.77 |
| Neck length (cm) | | 11.6 ± 2.60 | 13.12 ± 1.18 | 10.74 ± 1.67 | 11.23 ± 1.45 |

*Data were represented as mean ± SD. Within a row, means with different superscripts are significantly different (p< 0.05).*

**Table 3:** Blood parameters of naturally suckled and milk replacer fed Black Bengal kids

| Parameters | | Male | | Female | |
|---|---|---|---|---|---|
| | | **Natural Suckling** | **Milk Replacer Feeding** | **Natural Suckling** | **Milk Replacer Feeding** |
| RBC (m/mm$^3$) | | 7.60$^{b}$ ± 0.35 | 8.54$^{a}$ ± 0.14 | 6.55$^{b}$ ± 0.26 | 7.69$^{a}$ ± 0.51 |
| WBC (th./mm$^3$) | | 7.3 ± 0.48 | 7.95 ± 0.23 | 6.37$^{b}$ ± 0.27 | 8.02$^{a}$ ± 0.23 |
| Hb (g) | | 7.25 ± 0.053 | 6.95 ± 0.34 | 6.63 ± 0.61 | 7.41 ± 0.40 |
| PCV (%) | | 24.0 ± 2.65 | 26.0 ± 1.0 | 19.67 ± 2.08 | 24.0 ± 3.61 |
| Differencial leucocyte count | Neutrofil (%) | 30.67 ± 2.89 | 31.0 ± 1.73 | 32.67 ± 2.08 | 33.33 ± 2.08 |
| | Eosinophil (%) | 3.0 ± 1.0 | 3.33 ± 0.58 | 3.33 ± 0.58 | 2.00 ± 1.0 |
| | Lymphocyte (%) | 64.33 ± 4.04 | 63.67 ± 2.52 | 62.33 ± 1.53 | 61.67 ± 1.53 |
| | Monocyte (%) | 2.63 ± 0.72 | 2.78 ± 0.68 | 2.67 ± 0.58 | 3.0 ± 1.0 |
| | Basophil (%) | 0 | 0 | 0 | 0 |

*RBC, Red blood cell; WBC, White blood cell; Hb, Haemoglobin; PCV, packed cell volume. Data were represented as mean ± SD. Within a row, means with different superscripts are significantly different (p < 0.05).*

**Changes in blood components**

Table 3 showed that the total numbers of red blood cell (RBC) in both male and female of artificially fed group were significantly higher (*p<0.05*) than that of naturally suckled counterparts. The number of white blood cell (WBC) was significantly (*p<0.05*) higher in milk replacer fed female kids than the natural suckling group. The other haematological parameters did not differ significantly between milk replacer fed and natural suckling male and female kids.

## Discussion

In the present study, Black Bengal goat kids were reared with soybean based milk replacers to examine their growth and blood parameters in 98 comparison with the naturally suckled kids. Growth in terms of live weight gain was significantly higher in milk replacer fed male kids than naturally suckled group. It is well known that the milk yield of Black Bengal does is low and that's why the kids suffer from malnutrition due to insufficiency of milk intake. In the present study, in case of naturally suckled group, requirement was not fulfilled by the milk produced by their dams. Artificially reared kids were fed according to their requirement based on their live weight. So, lower weight gain was recorded in naturally suckled kids than artificially reared ones.

These results were inconsistent with previous reports of Delgado-Pertíñez *et al*. (2009). They examined different kid-rearing systems where weight at the 4th week did not differ significantly, although the naturally suckled kids weighed slightly more than those of the artificially reared kids. Vacca *et al*. (2014) found that growth rate of the naturally fed group showed a steady pattern, whereas during the first two weeks artificially reared kids had lower gains in comparison with naturally milk fed kids. Lama *et al*. (2013) studied growth performance of Criollo kids under two different rearing systems (naturally reared with their mothers and artificially reared on milk replacer) where they did not find any significant differences between the growth performances of kids under rearing systems.

In the current study, higher body length, wither height, neck circumference and heart girth were found in artificially fed male kids than naturally reared counterparts. These results were inconsistent with results of Kaiwu *et al*. (2015). They did not find significant differences in wither height, body length and heart girth between the artificially feeding group and the naturally suckled kids. Masum *et al.* (2011) found that body length, wither height and heart girth did not differ significantly between whole milk fed and milk replacer fed calves.

In the present study, RBC and WBC contents of male and female kids were significantly higher in the artificially reared group than the naturally suckled kids. It is known that males have higher RBC values than females (Addas *et al*., 2010). The high RBC values in the young ruminants may be due to excitement or strenuous exercise during handling (Gartner *et al*., 1969). This leads to the release of adrenaline and hence spleen contracts and this causes the release of more RBC into circulation. It is only psychological tranquillisation that can reduce the splenic influence (Schlam *et al*., 1975). Dukes (1955) revealed that haematological values of farm animals are influenced by age, sex, breed, climate, season, nutritional status, health status and husbandry practices of animals. Sarker *et al*. (2015) reported that red blood cell count (RBC) and level of haemoglobin (Hb) increased with the increase of soymilk in the diet. These results were consistent with the present study.

## Conclusion

Feeding of soybean based milk replacer enhanced weight gain of kids compared with naturally reared counterparts. Soybean based milk replacer feeding should be popularized to improve the performance of Black Bengal kids at village level.

## Acknowledgements

This research was funded by the Bangladesh Agricultural University Research System (BAURES).

## Conflict of interest

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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