Indian J Dairy Sci 78(4): 358-363
https://doi.org/10.33785/IJDS.2025.v78i04.009

RESEARCH ARTICLE

Effect of feeding phyto additives on colostrum, blood indices and hormonal profile in Black Bengal goats at first kidding

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Received: 23 June 2024 / Accepted: 17 November 2024 / Published online: 23 August 2025

Abstract: Present study investigated the effects of feeding phytoadditives on colostrum production, health status, blood indices and hormonal profile of Black Bengal goats at first kidding. 21 Black Bengal goat (BBG) kids of similar (3-4 months) age and body weight (4.80- 5.35 kg) were divided equally into three comparable groups viz. Control (No supplementation), T1 and T2 in this study. All the animals were fed with basal diet. Kids of T1 were supplemented with *Curcuma longa* & *Allium sativum* (1:1) (PAM-1) @15g/Kg DM conc.) while T2 were supplemented with *Curcuma longa* & *Ocimum sanctum* (1:1) (PAM-2) @15g/Kg DM conc. for a period of 10 months. Significant improvement (P<0.001) in colostrum yield was observed in T1 and T2 groups than control group without affecting (P>0.05) colostrum composition, udder health (pH, EC, MCMT, SCC) and relative immunity (Brix%) of goats at first kidding. There was significant reduction (P<0.001) in age at first kidding in T1 and T2 groups than control group. Significantly improved (P<0.001) body weight and BCS at kidding was obtained in T1 and T2 groups than control group. NEFA levels at kidding was lower (P<0.001) in T1 and T2 groups than control group goats. Blood enzymes (ALT, AST, ALP), haematology (RBC, WBC, Hb, PCV, HCR) and biochemical parameters (Glucose, Total urea, Total protein) remained unchained (P>0.05). However, a significant reduction in (P<0.001) blood lipids (total lipids, total cholesterol, triglycerides) were observed. There was higher level (P<0.001) of Prolactin and T4 hormones in T1 and T2 groups than control group goats. Whereas, levels of Cortisol and T3 were lower (P<0.001) in T1 and T2 than control group goats. Based on findings of this study, it can be concluded that supplementation of phyto additives including *Curcuma longa* & *Allium sativum* and *Curcuma longa* & *Ocimum sanctum* reduced age at first kidding, improves colostrum production, health status and hormonal profile without affecting blood attributes at first kidding.

Keywords: *Allium sativum*, *Curcuma longa,* Colostrum, Goats, Health, Hormones, *Ocimum sanctum*

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Introduction

Black Bengal goat (BBG) is considered as one of the key supporters of livelihood of farmers in tropical lower Gangetic region. BBG are small sized prolific goat breed known for its excellent quality meat and skin (Hossain, 2021). However, it is considered as slow weight gainers and poor milk producers. Slow weight gain in BBG leads to longer age at first kidding (Hasan et al. 2015; Hossain et al. 2021) which is not economical for farmers. Low colostrum and milk yields in BBG leads to under nourishment of kids as they normally produce two kids/kidding but may easily kid to triplets and quadruplets. Nonetheless, under improvement management conditions, BBG may have enhanced weight, lower age at first kidding and higher colostrum production (Hossain, 2021).

Recent era has witnessed increased interest in utilizing phyto additives in augmenting reproductive and productive performances of goats (Kholif et al. 2017; Sriranga et al. 2021). The main reason behind this increased interest is the ban in the use of antibiotics as performance enhancer in farm animals by European Union and other nations (Casewell et al. 2003) as use of antibiotics may pose risk of resistance in consumer for it (Kholif et al. 2017). Various phyto additives have been used to enhance performances of farm animals including medicinal plants, spices or other plant parts (Singh, 2021; Zhong et al. 2019; Singh et al. 2023). However, along with efficiency, their availability and economics should be considered during its utilization. These phyto additives contain essential oils, tannins, saponins, flavonoids, etc. which play vital role in natural defence mechanism of plants against invading pathogens (Kholif et al. 2017; Sriranga

et al. 2021).Phyto additives, including *Curcuma longa* (Turmeric), *Allium sativum* (Garlic) *and Ocimum sanctum* (Tulsi) have been observed to possess anti-oxidant, anti-microbial, anti-parasitic and growth promoter properties due to the presence of PSM (Hasan et al. 2015; Zhong et al. 2019; Oderinawale et al. 2020; Taj et al. 2023). These phyto additives are easily available and are low cost ingredients available in lower Gangetic region (Singh et al., 2025a; Singh et al., 2025b). These phyto additives augment secretory rhythm of digestive secretions, assimilation of nutrients and improves immune response in ruminants which may be found through increased productive and reproductive performance of goats (Hasan et al. 2015; Zhong et al. 2019; Oderinawale et al. 2020; Taj et al. 2023; Singh et al. 2023).

Little study has been conducted regarding effect of phyto additive mixtures on colostrum production, health status, blood indices and hormonal profile of goats at first kidding for formulating better management strategy for them during pre and post kidding. Given above points, this study was planned to study the effect of phyto additive mixtures containing equal amounts of *Curcuma longa* & *Allium sativum* and *Curcuma longa* & *Ocimum sanctum* @15g/Kg DM conc. for 10 months in Black Bengal goat's production, health status, blood indices and hormonal profile.

Materials and Methods

Site of the experiment

All the experimental procedures were performed at goat unit of ERS, NDRI, Kalyani, India during 2021-2022. All the activity of the goat unit is closely monitored by scientists and all the practices were as per the standard farm management practices approved by ethical committee of the institute. Typically, the year round temperature of Kalyani ranges from 12.78 °C to 38.89 °C with an average of 30.26°C. This area comes under alluvial regions of tropical lower Gangetic region. Kalyani lies 11m above mean sea level.

Experimental animals

A total of 21 post weaned female Black Bengal goat kids of 3-4 months age and body weights (4.80- 5.35 kg) were randomly distributed into 3 comparable groups each having 7 animals. Individual feeding of kids was practiced in this study. All the kids received similar housing and other management practices. *Ad libitum* feeding and watering was provided to the kids with 10kg capacity buckets however each time it was measured and recorded with the help of electronic scale with a least count of 5.0g. Good quality seasonal green and dry fodders (60:40 ratio) and fresh clean water was available to each kid all the times. Concentrate mixture contained 68% TDN and 15% DCP. Feeding was provided as per feeding standards (NRC, 2007). Concentrate mixture was admixture with phyto additives and fed to the individual kids as per standard farm management practice of the institute.

Preparation and supplementation of different phyto additive mixtures to the BBG kids

Two different phyto additive mixtures were prepared for this study. First mixture comprised of powder of *Curcuma longa* and *Allium sativum* in 1:1 ratio and second mixture was prepared using powder of *Curcuma longa* and *Ocimum sanctum* in 1:1 ratio. Good quality *Curcuma longa* rhizomes, *Allium sativum* cloves and *Ocimum sanctum* leaves were procured from local market and powdered as per the standard practice followed by Oderinwale et al. (2020). After procuring, the ingredients were cleaned and sundried followed by thin slicing and then oven dried. Hot air oven was operated at 60°C for 24 hours. Dried ingredients were separately grinded finely with the help of a mechanical grinder to pass through a screen of 1mm. After final grinding, the powders of *Curcuma longa, Allium sativum* and *Ocimum sanctum* were obtained and two phyto additive mixtures were obtained after thorough mixing followed by their storage in air tight and sterilized vessels until use. Phyto additive mixture (PAM 1) containing *Curcuma longa* and *Allium sativum* (1:1 ratio) was provided to T1 group kids @ 15g/kg of DM in concentrate mixture and Phyto additive mixture (PAM 2) containing *Curcuma longa* and *Ocimum sanctum* (1:1 ratio) was provided to T2 group kids @ 15g/kg of DM in concentrate mixture. Before providing with the experimental diets, all the goat kids were provided with 14 days of adaptation period. This experiment was conducted from first week of January, 2021 to May, 2022.

Colostrum sampling

Colostrum was collected at first day of kidding from each goat and 25ml of same was collected in sterilized vessels for estimation of its composition, pH, electrical conductivity (EC), somatic cell count (SCC), Brix % for relative immune-globulin estimation (Singh et al. 2020).

Body weight and Body condition score (BCS) of goats

Each and every BBG kid was assessed for body weight and BCS on kidding as per Ghosh et al. (2019). This BCS scaling system is scaled upon 1 to 5 points with a difference of 0.5 between two points. BCS 1 showed emaciated condition and BCS 5 indicated an obese condition in goats. A visual and palpation technique was followed in determining the BCS of goats as adopted by Singh et al. (2023) for specific skeletal points on the body of goats including spinous process of back region, tip of transverse process, level of deposition of muscle and fat between spinous and transverse position, flank region and fat over sternum part of goats (Villaquirán, 2012).

Analysis of blood samples

Under aseptic conditions, blood was collected in a sterile 10ml calibrated tube by veni-puncturing the jugular vein of individual goats at an interval of one month for 13 months of experiment

before any feeding. Metabolites such glucose, urea, total protein, albumin, globulin and NEFA, ALT, AST, ALP, Total lipids, cholesterol, and tri-glyceride, Blood haematological parameters such as WBC, RBC, Hb, PCV and hormones viz. Prolactin, Cortisol, T3 and T4 concentrations were estimated on kidding of each goat through commercial estimation kits of G-Bioscience 9800, Page Avenue, St. Louis, MO, USA using spectrophotometer.

Statistical Analysis

All the collected data underwent meticulous statistical analysis with multivariate linear model using SPSS version 26.0 (IBM Inc.). Duncan's multiple range tests were performed for determining significant difference among different treatment groups. Significant difference among the parameters were accepted when $P<0.05$.

Results and Discussion

Colostrum production, udder health of goats

Table 1 shows yield and composition of colostrum of goats under different groups. Statistical analysis of results showed that there was significant effect of supplementation of phyto additive mixtures on colostrum yield in goats. Higher ($P<0.001$) colostrum yield was reported in T1 and T2 groups than control group goats. Nutrient compositions viz. fat, solid not fat, dry matter, protein and lactose were similar ($P>0.05$) across the groups. There was no significant effect ($P>0.05$) of phyto additives on udder health status and relative immune globulins viz. pH, EC, SCC and Brix % in goats of all groups. In this study, supplementation of phyto additives mixtures (PAM-1 and PAM-2) showed an improved colostrum production without altering composition, udder health parameters and relative immune status in goats. Findings of Ghavipanje et al. (2022) is in line with this study. Ghavipanje et al. (2022) reported that dietary supplementation of Berberine (@1, 2 and 4g/day/goat), a natural isoquinoline alkaloid from various medicinal plants, in dairy goats during transition period increased colostrum production without changing colostrum composition as compared to non supplemented goats. In corroboration with findings of this study, Al-Khalaf et al. (2023) also reported that supplementation of *Curcuma longa* powder @ 5 g or 10g/ewe/day resulted in increased colostrum production (119g/ewe/day in control; 152.0g/ewe/day in 5g/day supplemented ewes and 134.0g/ewe/day in 10g/day supplemented ewes) without affecting colostrum composition. Similarly, Hendawy et al. (2019) reported no change in colostrum composition when ewes when supplemented with herbal additive @ 5g/ewe/day for 3 months post parturition. In contrary to present findings, Smeti et al. (2015) had investigated that supplementation of essential oils of *Rosemarius officinalis*L. (@ 0.6g/kg concentrate mixture) lead to no change in colostrum production but increased fat% in colostrum and reduced mortality rate in kids. However, they reported no change in immuno globulins, protein and solid not fat% in colostrum. Similar to the findings of this study, Boushehri et al. (2021) also reported no change in immune globulin levels in colostrum when supplemented with vegetable pellet feed (@ 0, 10 and 20g/cow/day) containing phyto constituent chemicals. The possible reason behind the improved colostrum production may be due to antioxidant, increased nutrient utilization ability, enhanced digestion in supplemented goats than non supplemented goats (Singh et al., 2025a).

Age, body weight and body condition of goats at first kidding

There was significant effect of supplementation of phyto additive mixtures on age, body weight and body condition in goats at first kidding. Higher ($P<0.001$) age at first kidding was observed in control group goats (418.29 days) than treatment group (T1=383.29 days; T2=380.14 days) goats. Improved ($P<0.001$) body weight (control=15.84 kg; T1=16.89 kg; T2=16.92 kg) and body condition score was observed in treatment T1 (3.79) and T2 (4.21) group goats than control group (4.21) at first kidding. This study reported reduced age at age at first kidding, improved body weight and body condition in supplemented goats with phyto additives. Findings of this study are in line with reporting of earlier studies (Chowdhury et al., 2002; Wang and Wang, 2016; Singh et al., 2023). In a study, Chowdhury et al. (2002) demonstrated that the age at which BBG first experience oestrus ranged from 131 to 338 days, while the age at which they first gave birth ranged from 273 to 500 days, consistent with the findings of this particular study. Achieving low age at first parturition may be considered as good sign of reproductive

Table 1: Yield and composition of colostrum of goats under different groups

Parameters	Control	T1	T2
Colostrum yield (g/goat)	$196.57^{a}\pm1.15$	$212.49^{b}\pm1.99$	$216.14^{b}\pm1.56$
Dry matter %	21.45 ± 0.11	21.46 ± 0.13	21.48 ± 0.10
Fat%	8.14 ± 0.04	8.17 ± 0.03	8.16 ± 0.02
SNF%	13.31 ± 0.04	13.29 ± 0.02	13.33 ± 0.03
Protein%	10.31 ± 0.01	10.32 ± 0.01	10.32 ± 0.01
Lactose%	2.34 ± 0.01	2.33 ± 0.01	2.34 ± 0.01

Means bearing different superscripts (a, b,) differ significantly ($P<0.001$) across different columns

Table 2: Blood indices and hormonal profile in different groups of Black Bengal goats at first kidding

Parameters	Control	T1	T2
	Blood hematology		
WBC (10^6/mm^3)	7.91± 0.01	7.91± 0.01	7.89± 0.02
RBC (10^6/mm^3)	8.10± 0.01	8.13± 0.02	8.08± 0.01
Hb (g %)	11.10± 0.02	11.18± 0.03	11.16± 0.02
PCV (%)	27.91± 0.03	27.95± 0.04	27.90± 0.05
	Blood metabolites		
Glucose (mg/dL)	52.58± 0.04	52.65± 0.02	52.86± 0.03
Total Protein (mg/dL)	7.12± 0.01	7.14± 0.01	7.13± 0.01
Total urea (mg/dL)	12.95± 0.01	12.96± 0.01	12.96± 0.01
ALT (IU/L)	34.78± 0.05	35.21± 0.06	35.11± 0.07
AST (IU/L)	62.77± 0.06	63.04± 0.06	62.86± 0.05
ALP (IU/L)	168.67± 0.04	168.52± 0.05	168.34± 0.06
Total lipids (mmol/L)	8.78^a± 0.01	7.23^b± 0.01	7.29^b±0.01
Cholesterol (mg/dL)	2.49^a± 0.01	1.97^b±0.01	2.02^b±0.01
Tri-glycerides (mg/dL)	2.21^a± 0.01	1.92^b±0.01	1.95^b±0.01
NEFA (mmol/L)	0.389^a± 0.01	0.314^b± 0.01	0.323^b± 0.01
	Hormonal profile (ng/ml)		
Prolactin	69.92^a± 1.21	71.88^b± 0.91	72.12^b± 0.89
Cortisol	26.64^a± 0.8	23.93^b± 0.6	25.38^b± 0.5
T3	1.49^a± 0.01	1.61^b± 0.01	1.58^b± 0.01
T4	42.00^a± 0.86	43.76^b± 0.77	42.34^b± 0.90

Means bearing different superscripts (a, b) differ significantly (P<0.05) across different columns

performance of farm animals (Hossain, 2021). The phenomenon may be attributed to the findings of Swelum et al. (2021), who suggest that phytogenic feed additives can potentially improve the reproductive capabilities of ruminants by increasing the production of FSH and LH hormones, enhancing fertility and pregnancy rates, promoting follicle development, facilitating better nutrient transport to the fetus, and enhancing granulose cell functions. Singh et al. (2023) showed that goats supplemented with fennel seed powder (@0.5 and 1.0%) in diet of Barbari goats resulted in improved final body weights and enhanced BCS in goats. The current study's findings are supported by the results of Zhong et al. (2019), which show that adding Allium sativum powder to goats afflicted with gastro intestinal worms increases their growth rate and BCS via improving nutritional digestibilities. In line with present study, some earlier studies (Kenyon et al. 2010; Hutton et al. 2011) reported a significantly improved BCS in sheep and goats supplemented with blends of herbs.

Blood indices and hormonal profile of goats

Blood metabolites viz. Glucose, total protein, total urea levels were similar (P>0.05). Whereas, blood enzymes viz. ALT, AST, ALP levels remained similar (P>0.05) (table 2). Similarly, hematological parameters viz. WBC, RBC, Hb, PCV and HCR were similar (P>0.05) at first kidding day. However, blood lipid viz. total lipids, cholesterol and tri glycerides levels and NEFA levels were lower (P<0.001) in treatment T1 and T2 groups than control group goats. In this study, higher Prolactin levels observed in treatment goats than that of control group goats. However, lower Cortisol levels were lower in treatment goats than that of control group goats. Higher T3 and T4 levels were reported in treatment goats than that of control group goats. Ingale et al. (2017) also reported reduced levels of cholesterol in Jamunapari goats when supplemented with different levels (1.5% and 2.5% in DM) of phytogenic mixture for 10months. Furthermore, Chaturvedi et al. (2013) also reported that supplementation of *Ocimum sanctum, Curcuma longa, Emblica officinalis* and *Clorodendrium phlomidis* in 1:1:1:1 to Jamunapari goats resulted in non significant effect on blood hematology and biochemical parameters. Wang and Wang (2016) reported that supplementation of Chinese herbs in goats showed non-significant change in blood tri glycerides and cholesterol levels. No change in total lipid levels may be due to shorter period of herbal supplementations in their studies. Similar to findings of this experiment, Varga-Visi et al. (2023) showed a non significant effect of phytogenic mixture on blood enzymes and blood metabolites and significantly reduced NEFA levels in Hungarian sheep. Singh et al. (2020) indicated that lower NEFA levels show lower body fat metabolization. The reason behind such reduction in levels of blood lipids may be due to the potential of phyto additives in decreasing the total lipids, cholesterol and tri glycerides through decreasing the ability of Thiol group enzymes such as HMG-CoA and Co-ASH (Hasan et al. 2015) in liver.

Hormones are crucial in controlling an animal's physiological and behavioral functions. Assessing Cortisol levels can be useful for measuring stress levels, while tri-iodothyronine and thyroxine hormones are involved in regulating body metabolism (Wang and Wang, 2016). According to this research, the treatment group animals exhibited increased levels of Prolactin. Prolactin, a hormone released from the anterior pituitary gland, plays a vital role in Galactogenesis and Galactopoiesis in goats (Hart, 1974). The influence of herbs on the adreno-hypothalamo-hypophyseal-gonadal axis can enhance the release of Prolactin by reducing the production of dopamine through neurons (Gabay, 2002; Mohanty et al. 2014). According to Ahmed and Al-Janabi (2012), supplementing crossbred Damascus goats with fenugreek seeds led to increased Prolactin levels. Similarly, Wang and Wang (2016) found that a Chinese herbal mixture led to a notable decrease in Cortisol levels in goats. They also noted that the levels of T3 and T4 remained unchanged, suggesting that herbs have the potential to modulate the hypothalamic-pituitary-thyroid axis and improve hormone release. Khan and Ludri (2002) observed that Prolactin and Cortisol concentrations increase during the peri-parturient period, while T3 and T4 levels decrease during this time. Singh and Ludri (2002) reported similar findings in crossbred goats. Additionally, Mondal et al. (2016) have also noted an increase in Prolactin and Cortisol concentrations during the peri-parturient period, along with a decrease in T3 and T4 levels (Singh et al., 2025a).

Conclusion

Present study concluded that supplementation of phyto additive mixtures containing equal amounts of *Curcuma longa* & *Allium sativum* and *Curcuma longa* & *Ocimum sanctum* @15g/Kg DM conc. for 10 months in Black Bengal goats can reduce age at first kidding, improves colostrum production, health status and hormonal profile without affecting blood attributes at first kidding.

Acknowledgement

Authors are highly thankful towards the final assistance and facilities provided by Director & Vice Chancellor, ICAR- NDRI, Karnal, India and Head, ERS, NDRI, Kalyani, India. All the working staff that supported in this study are thanked and acknowledged.

Conflict of Interest

Authors found no potential conflict of interest for this study.

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