

EFFECT OF PHYTOADDITIVE MIXTURE OF *Curcuma longa* AND *Ocimum sanctum* WITH OR WITHOUT PALM OIL ON GROWTH, INTESTINAL HEALTH AND ECONOMIC PERFORMANCE OF LOW BODY CONDITION BLACK BENGAL GOATS (BBG)

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ABSTRACT

The aim of this experiment was to study the effect of supplementation of phytoadditive mixture (PAM), *Curcuma longa* and *Ocimum sanctum* in 1:1 with or without palm oil on growth performance, gut health and economics of low body conditioned Black Bengal goats (BBG) (*Capra aegagrus hircus*). For this experiment, 21 similar body weight (BW) (7.75-8.2 kg) and age (8-10 months) female goats were randomly distributed into three comparable groups including control (no supplementation), T1 (PAM@15 g/kg dry matter [DM] conc.) and T2 (PAM with palm oil @ 0.05% BW of goat) for three months. The results of this study indicated the highest ($P<0.001$) BW, average daily gain (ADG) and body condition score (BCS) in the T2 group, followed by T1 and the control group. Improved gut health ($P<0.001$) was observed in the treatment groups than in the control group. There was ($P<0.05$) a medium to high degree of correlation between experimental goats' growth performance and gut health. Economic analysis showed the highest returns over the control group in T2, followed by the T1 group. It can be concluded that supplementation of PAM containing equal proportions of *Curcuma longa* plus *Ocimum sanctum* (15 g/kg DM conc.) with palm oil (0.05% BW) may economically improve growth performance and gut health of low body condition BBG.

Keywords: *Curcuma longa*, goat, *Ocimum sanctum*, palm oil.

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INTRODUCTION

Black Bengal goats (BBG) are considered one of the most important goat breeds of the tropical lower Gangetic region (Mandal *et al.*, 2022). It is known for its prolificacy, excellent meat and skin quality (Das *et al.*, 2024; Hossain, 2021). The Indian goat population of 16.28 million (contributes to 10.93% of total) (Department of Animal Husbandry and Dairying, 2021) consists of this breed which supports the livelihood of millions of farmers. These goats are considered a slow-growing goat breed; however, under improved nutritional management conditions, they may perform better (Hassan *et al.*, 2015; Hossain, 2021; Mandal *et al.*, 2022; Singh *et al.*, 2025a). Earlier, antibiotics were

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used as feed supplements in the diet of farm animals for promoting growth (Pettersson-Wolfe *et al.*, 2007) but, due to a ban over use of antibiotics in animal nutrition by the European Union as it may pose a risk of antibiotic resistance (Casewell *et al.*, 2003; Singh, 2022; Sriranga *et al.*, 2021). Moreover, consumers have become more health conscious, and they prefer animals that are fed with natural ingredients (Harper & Makatouni, 2002). These reasons increased utilisation of alternative growth promoters such as phytoadditives, oils containing phytochemicals among others (Singh, 2021; Singh *et al.*, 2023) as these are comparatively safer and environment friendly (Bampidis *et al.*, 2020; Barani *et al.*, 2021; Kholif *et al.*, 2017; Singh *et al.*, 2025b; Sriranga *et al.*, 2021).

These phytoadditives are obtained from various plant parts that contain secondary plant metabolites useful in natural defence mechanisms against invading pathogens (Ahmed *et al.*, 2020; Sriranga *et al.*, 2021). Recent studies have indicated that the supplementation of phytoadditives improves the growth performance, body condition and gut health of goats (Oderinwale *et al.*, 2020; Singh *et al.*, 2023). Phytoadditives have been utilised in powdered form in a concentrate mixture for convenience and efficiency in earlier studies in recommended doses to avoid adverse effects (Oderinwale *et al.*, 2020; Rabee *et al.*, 2024; Singh *et al.*, 2023). Phytoadditives such as *Curcuma longa*, *Ocimum sanctum* and oil of *Elaeis guineensis* possess anti-oxidant, anti-microbial properties, improves nutrient utilisation performances due to the presence of plant secondary metabolites such as total phenolics, tannins, saponins, flavonoids and alkaloids (Kuralkar & Kuralkar, 2021; Oderinwale *et al.*, 2020; Rabee *et al.*, 2024). Generally, due to poor nutritional status, the goats may have poor body conditions, which may lower the economic returns to the farmer. Recently, it was shown (Singh *et al.*, 2023) that the supplementation of phytoadditives may also improve the body condition of goats along with improved growth performance. Tomkins and Drackley (2010) indicated that palm oil may act as an economical feed supplement to enhance growth performance in farm animals. Additionally, palm oil supplements poly-unsaturated fatty acids to small ruminants which may further improve body condition and growth performance of small ruminants (Dutta *et al.*, 2008) through provision of high energy to farm animals to combat low energy status of animals' body (Adeyemi *et al.*, 2016; Tomkins & Drackley, 2010). Bautista-Martinez *et al.* (2023) reported an improvement in the final body weight (BW) and feed conversion of sheep supplemented with 3% palmitic oil. Interestingly, goats with improved body condition may fetch more income for farmers.

Favourably, phytoadditives such as *C. longa*, *O. sanctum* and oil of *E. guineensis* are abundantly and economically available in the lower Gangetic region (Gaonkar *et al.*, 2020; Mathews & Mandal, 2016).

To the current knowledge, very few or no studies have been conducted to understand the effect of phytoadditive mixture (PAM) with or without palm oil on growth performance, gut health, body condition and economics of low body conditioned BBG in the lower Gangetic region. Based on literature findings, we hypothesised that the PAM with or without palm oil may improve the growth performance, gut health, body condition and economics of low body-conditioned BBG. Therefore, this study was structured to study the effect of PAM with or without palm oil on the growth performance, gut health, body condition and economics of low body-conditioned BBGs in the lower Gangetic region.

MATERIALS AND METHODS

Site of the Experiment

This study was conducted in villages, namely Muratipur and Dakkhin Chandamari, which are near Kalyani City. These villages are adopted by the Eastern Regional Station of the National Dairy Research Institute, Kalyani, West Bengal, India. This study was conducted with the approval of the Institutional Animal Ethics Committee (registration: 19/P/LP/09). Kalyani lies 11 m above the mean sea level, under the tropical lower Gangetic region, which receives around annual rainfall of 96.3 mm with an average temperature of 30.26°C. This study was conducted from the first week of February to the last week of April 2024, for three months.

Experimental Design, Animals and Management Practices

A total of 21 similar age (8-10 months) and BW (7.75-8.20 kg) female BBG with low body condition (body condition score [BCS] ≤ 2.5) (Ghosh *et al.*, 2019) were randomly distributed into three comparable groups namely, control (no supplementation), T1 (supplementation of PAM containing equal proportions of *C. longa* and *O. sanctum* @ 15 g/kg DM conc.) and T2 (PAM with palm oil @ 0.05% BW of goat). The same concentrate mixture (Epic goat feed, Kalyani, India) in equal amounts was provided to each goat. Cooking grade palm oil (Sathi Gold) was procured from the local market for this experiment. PAM was mixed thoroughly in concentrate mixture and provided to the goats of treatment group T1 while PAM and palm oil were mixed thoroughly in concentrate mixture

and provided to the goats of treatment group T2. All goats were managed under semi-intensive management practices. Housing and other management practices were similar for all goats.

Preparation and Supplementation of Phytoadditives to Goats

Fresh and good quality turmeric (freshly harvested rhizomes), tulsi (middle-aged leaves) and palm oil were procured from the local market. For the preparation of the PAM, turmeric rhizomes and tulsi leaves were dried in a hot air oven operated at 60°C for 24 hr, followed by grinding in a mechanical grinder. The particle size of the PAM was obtained so that it could pass through a screen of 1 mm. This mixture was stored in air-tight containers until further usage. Supplementation of PAM was done before morning feeding (T1, supplementation of PAM containing equal proportions of *C. longa* and *O. sanctum* @ 15 g/kg dry matter (DM) conc.; T2, PAM @ 15 g/kg DM conc. along with palm oil @ 0.05% BW of goat). All the experimental animals were kept under a two week adaptation period before taking any observation. The supplementation period lasted for three months. The dose rate of the PAM was adopted from a farm experiment conducted at the same institute (Singh *et al.*, 2025a). The dose of palm oil was close to the study conducted by Dutta *et al.* (2008).

Chemical Composition of Palm Oil and Plant Secondary Metabolites (PSM) in Selected Herbs

The composition of palm oil (Sathi Gold) included saturated fatty acid (48.0%), unsaturated fatty acid (46.5%), omega-3 fatty acid (0.4%) and omega-6 fatty acid (10.5%). Herb samples were

dried in a hot air oven at 60°C for 24 hr. Dried samples were powdered to pass through a screen of 1 mm with the help of a mechanical grinder. The powdered samples were analysed for Kjeldahl-N, Ether extract and Ash content in the feed on DM basis (AOAC International, 2000). The neutral detergent fibre (NDF) and acid detergent fibre (ADF) contents were analysed using the method of Van Soest *et al.* (1991). Table 1 represents the nutritional composition of the concentrate mixture, *C. longa* (turmeric) and *O. sanctum* (tulsi) powder used in the experimental diets of BBG kids.

PSM, *viz.*, total phenolics, flavonoids, saponins and alkaloids present in the three herbs were determined as per the methods adopted by Soni and Sosa (2013) with the help of a spectrophotometer. All the samples were analysed in triplicates on every month this experiment.

Growth Parameters

Growth parameters, including BW and average daily gain (ADG), were determined every fortnight for every BBG goat with the help of an electronic weighing balance on every fortnight interval before morning feeding.

Body Condition Score (BCS)

Every BBG goat was assessed for BCS at every fortnight interval as per Ghosh *et al.* (2019). This scaling system is scaled from 1-5 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,

TABLE 1. NUTRIENT COMPOSITION OF CONCENTRATE MIXTURE AND PSM IN *Curcuma longa* AND *Ocimum sanctum*

Composition	Concentrate mixture	<i>Curcuma longa</i>	<i>Ocimum sanctum</i>
DM%	90.13 ± 0.15	22.08 ± 0.31	13.21 ± 0.02
Moisture%	9.87 ± 0.10	77.92 ± 0.09	86.79 ± 0.02
CP %DM	20.54 ± 0.11	11.17 ± 0.02	18.21 ± 0.03
CF %DM	11.91 ± 0.13	4.57 ± 0.01	9.04 ± 0.01
EE %DM	3.12 ± 0.09	12.39 ± 0.01	3.33 ± 0.01
Ash %DM	3.47 ± 0.05	7.79 ± 0.01	13.15 ± 0.02
Plant secondary metabolites (mg/100 g)			
Total phenolics	-	167.85 ± 0.08	176.24 ± 0.21
Flavonoids	-	3.78 ± 0.01	97.15 ± 0.26
Saponins	-	2.29 ± 0.01	4.79 ± 0.01
Alkaloids	-	6.60 ± 0.01	6.42 ± 0.01

Note: DM - dry matter; CP - crude protein; CF - crude fibre; EE - ether extract.

level of deposition of muscle and fat between spinous and transverse position, flank region and fat over sternum part of goats (Villaquirán, 2012).

Gut Health of Goats

The gut health of every BBG goat was monitored through faecal dry matter (FDM%), faecal consistency score (FS) and parasitic faecal egg count in per gram of faeces (EPG) on fortnight basis as the methods followed by Hasan *et al.* (2015) and Ratanapob *et al.* (2012). A representative composite sample of faeces from each BBG was assessed for determining the FDM% with the help of a hot air oven operated at 60°C for 24 hr. FS was estimated using the methods followed by Krommarin (2021). The scoring scale of faeces is based on 1-5 points wherein, (1) shows hard form of pellets; (2) symbolises soft pellets which appears to lose its form; (3) indicates completely deformed faeces; (4) shows wet faeces by non-slippery; and (5) represents runny faeces over even surfaces (Singh *et al.*, 2023).

Statistical Analysis

All the collected data underwent statistical analysis with a univariate linear model using SPSS version 26.0 (IBM Inc.) with treatment and time as fixed factors. MS Excel 2007 version was utilised for data recording and graphical representation of data. Duncan's multiple range tests (post-hoc test) were performed for determining significant differences among different treatment groups. Pearson's correlation statistics tool was utilised for estimating correlation coefficients among different parameters. Significant differences among the parameters were accepted when $P < 0.05$.

RESULTS AND DISCUSSION

Nutrient Composition of the Concentrate Mixture and PSM in *Curcuma longa* and *Ocimum sanctum*

Table 1 shows the nutrient composition of the concentrate mixture and the levels of PSM, including total phenolic compounds, flavonoids, saponins and alkaloids in different phytoadditives used in this study. As shown in Table 1, dry matter (DM%) in the concentrate mixture, *C. longa* and *O. sanctum* powder were 90.13, 22.08 and 13.21, respectively. Whereas, crude protein contents in concentrate mixture, *C. longa* and *O. sanctum* powder (of DM%) were 20.54, 11.17 and 86.79, respectively. The result showed that the mean total phenolic compounds (mg/100 g) present in *O. sanctum* powder was 4.99% higher than that of *C. longa*. The mean flavonoid content (mg/100 g)

present in *C. longa* was 96.11% lower than that of *O. sanctum* powder. The average saponin level (mg/100 g) was 52.19% lower in the powder of *C. longa* as compared to *O. sanctum*, respectively. Analysis of samples showed that the mean alkaloid (mg/100 g) present in *C. longa* was 2.73% higher than in *O. sanctum* powder. The findings of the present study are in line with other authors (Asyhar *et al.*, 2023; Kaur & Kapoor, 2002; Soni & Sosa, 2013; Udu-Ibiam *et al.*, 2014). In agreement with our findings, Asyhar *et al.* (2023) reported that the range of flavonoid content in *Curcuma* spp. was 3.47-39.54 mg QE/100 g. Also, the investigations of Chinedum *et al.* (2015) showed that flavonoids and alkaloid content in *Curcuma* spp., ranged from 0.84-4.34 mg QE/100 g and 1.03-1.80 mg/100 g. Khumaida *et al.* (2019) found that turmeric contained total phenolics to be 29.08-46.92 mg GAE/g and 21.31-33.81 mg QE/g flavonoid content, which is inconsistent with the present findings. Soni and Sosa (2013) reported similar results with this study, with total phenolics, alkaloids, saponins and flavonoids contents to be 176.5, 6.6, 5.0 and 98.5 mg/100 g, in Tulsi respectively. The reason behind this inconsistency may be the varietal difference, harvest stage and processing methods of these herbs. Earlier studies (Kholif *et al.*, 2017, 2019; Singh *et al.*, 2023) indicated that the presence of these secondary metabolites in herbs has significant potential to improve the performance of goats through antimicrobial, antioxidant, anti-parasitic and immune-modulating properties.

Effect of Phytoadditive Mixture (PAM) and Palm Oil on Growth Performance of Goats

Table 2 shows the BW of goats under different groups in field condition. There was a significant difference ($P < 0.001$) among groups for BW, ADG, and BCS in goats. Highest ($P < 0.001$) BW was observed in T2 (11.70 kg) group followed by T1 (11.28 kg) than control group (10.67 kg) animals (Figure 1). Highest ($P < 0.001$) ADG was observed in T2 (41.27 g/day/goat) group followed by T1 (37.54 g/day/goat) than control group (29.21 g/day/goat) animals. Highest ($P < 0.001$) BCS (Table 2) was observed in T2 (3.86) group followed by T1 (3.43) than control (2.71) group animals (Figure 2). The reason behind this may be due to improved body weights and enhanced muscle & fat deposition over the skeletal regions of supplemented groups than control group animals (Singh *et al.*, 2023). The reason behind the best growth in the T2 group was due to the promoting ability of supplements in the T2 group wherein, phytoadditives and palm oil improved the digestibility of nutrient, improved intake and enhanced energy density of feed consumed by goats. Pearson's correlation coefficient showed a positive correlation among

BW & BCS ($r = 0.708$; $P < 0.01$), BW & FDM ($r = 0.223$; $P < 0.05$) and a negative correlation between BW & EPG ($r = -0.314$; $P < 0.01$), BCS & EPG ($r = -0.619$; $P < 0.01$) indicating that goats which possessed higher body weight had better body condition, FDM% and reduced EPG in faecal samples. Dutta *et al.* (2008) remarked that improved energy density, polyunsaturated fatty acids (PUFA) can be provided in the diet of small ruminants through palm oil. In addition to this, Loganathan *et al.* (2010) suggested that crude palm oil is a rich source of phytonutrients such as tocopherols, polyphenols, phospholipids, carotene, squalene, polysterols. Due to these contents in the palm oil, it significantly improved DM intake, average daily gain, lactation performance, carcass traits, immunity and health status in small ruminants. Calder (1998) proposed that PUFA supplementation may enhance the working of T-lymphocytes, B-lymphocytes, natural killer cell activity and antigen-producing cells. As a result, which improved magnitude of immune response in animal body may be achieved in animals supplemented with PUFA (Hwang, 2000). Dutta *et al.* (2008) suggested 5% palm oil of concentrate mixture supplementation in small ruminants for economically improved growth performances. In line with the findings of the present study, Okoruwa *et al.* (2023) investigated higher ($P < 0.05$) final BW and ADG in phyto-genic feed-supplemented goats through improvement in the digestibility of nutrients. Further, Jiwuba *et al.* (2021) reported higher digestibility of nutrients as a result of phytoadditive plant browsing by dwarf goats, which resulted in higher BW, ADG and improved feed conversion ratio (FCR). Also, Deka (2009) showed an increased BW and ADG in Jamunapari goat kids supplemented with *O. sanctum* and *Withania somnifera* powder (2 g/goat/day for three months). Recently, Singh *et al.* (2023) also reported an increase in total dry matter intake (TDMI), BW, ADG and enhanced FCR, feed conversion efficiency (FCE) and BCS in Barbari goats supplemented with different

levels of fennel seed powder. Shipp *et al.* (2017) studied that the incorporation of peanut skin containing tannins improved final body weight and ADG in supplemented Kiko goats. Oderinwale *et al.* (2020) reported that goats supplemented with 2 g/head/day turmeric powder resulted in improved body weight, average daily gain and body condition of supplemented goats. However, Eknæs *et al.* (2017) found no significant effect on body condition in different groups on supplementing Norwegian goats with 8% palm or rapeseed oil. In contrast, Aderinboye *et al.* (2021) showed that West African dwarf goats, on being supplemented with 2.5 g/animal/day turmeric powder and 5 g/animal/day turmeric for 90 days, had a final BW and ADG that was similar across the groups. The difference in results may be due to individual phytoadditive ingredient along with different breed of goats.

Gut Health of Black Bengal Goats (BBG)

Generally, there are high levels of parasitic faecal egg loads in the gut of goats under field conditions due to poor management practices. Results of this field experimentations showed that the supplemented group showed reduced EPG counts significantly ($P < 0.001$) than control group animals following which FDM% and FS were improved ($P < 0.001$) in supplemented groups than control group goats (Table 3). There was a negative correlation between FDM & EPG ($r = -0.663$; $P < 0.01$) and a positive correlation between FS & EPG ($r = 0.433$; $P < 0.01$). The Pearson's correlation coefficient indicated that goats that had lower EPG levels showed improved FDM% and FS. Generally, the goats that are infested with parasites show higher parasitic egg loads in faeces accompanied by lower faecal consistency scores and low DM in faeces (Hasan *et al.*, 2015; Singh *et al.*, 2023). Supplementation of phyto-genic additives in the diet of animals are reported to exhibit antimicrobial and anthelmintic activities due to the presence of PSM and essential oils

TABLE 2. LSQ MEANS OF GROWTH PERFORMANCE OF LOW BODY CONDITION BLACK BENGAL GOATS (BBG) SUPPLEMENTED WITH PHYTOADDITIVE MIXTURE (PAM) WITH OR WITHOUT PALM OIL

Fortnights	Control	T1	T2
Initial BW	8.04 ^a ± 0.05	7.90 ^a ± 0.04	7.99 ^a ± 0.04
Final BW	10.67 ^a ± 0.04	11.28 ^b ± 0.06	11.70 ^c ± 0.04
Overall ADG	29.21 ^a ± 0.86	37.54 ^b ± 0.91	41.27 ^c ± 1.01
Initial BCS	2.36 ^a ± 0.11	2.21 ^a ± 0.10	2.29 ^a ± 0.11
Final BCS	2.71 ^a ± 0.09	3.43 ^b ± 0.15	3.86 ^c ± 0.09

Note: BW - body weight; ADG - average daily gain; BCS - body condition score.

Means bearing different superscripts differ significantly ($P < 0.001$) across different columns.

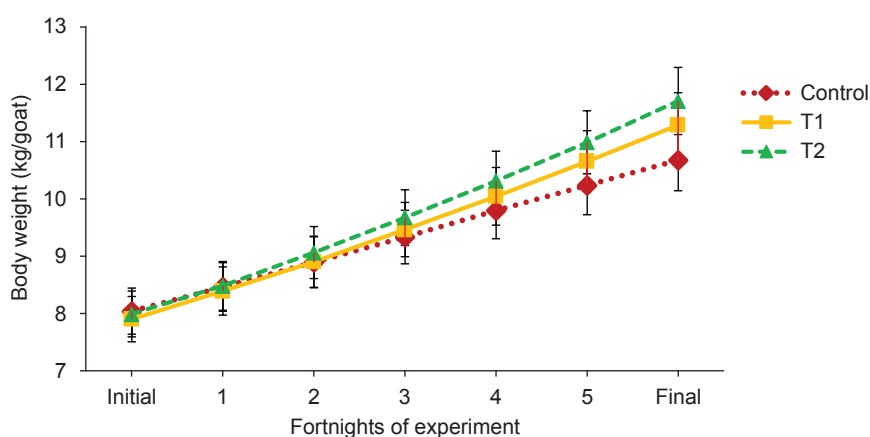


Figure 1. Body weight changes in low body condition black bengal goats (BBG) supplemented with phytoadditive mixture (PAM) with or without palm oil.

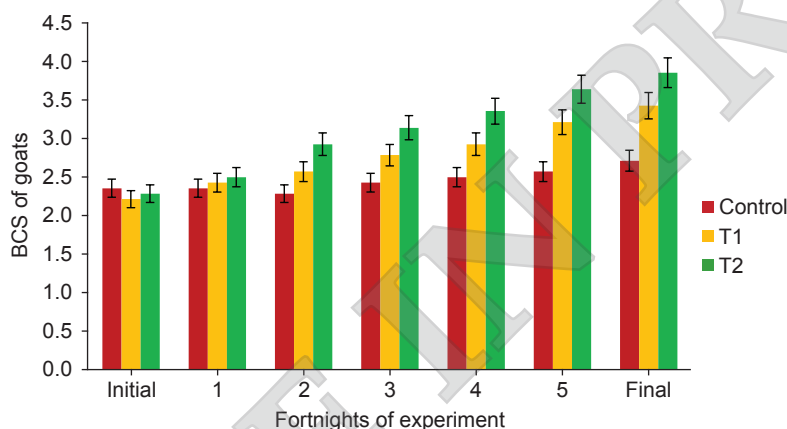


Figure 2. Body condition score (BCS) of low body condition black bengal goats (BBG) supplemented with phytoadditive mixture (PAM) with or without palm oil.

(Hasan *et al.*, 2015; Singh *et al.*, 2023; Váradyová *et al.*, 2018). In contrast, Shipp *et al.* (2017) studied the effect of incorporation of peanut skin containing tannins and investigated that faecal egg counts were higher in the control than treatment group Kiko goats. Hasan *et al.* (2015) took 18 dry does and separated them into three groups and supplemented two of them with 10% water solution of garlic at 50 mL and 100 mL/doe for 60 days and observed that the final parasitic egg count was lower in the treatment group than the control group. Váradyová *et al.* (2018) supplemented female lambs with herbal preparation (100 g DM/lamb/day) and observed significant improvement in BW and ADG through reduction in EPG as a result of the anti-parasitic effect of the herbal preparation. Possibly, the reason for improved growth performance may be attributed to a reduction in parasitic load in the gut region, which allows better utilisation of supplied nutrients to various body tissues. Chowdhury *et al.* (2016) reported a significant

effect of Curcumin powder (0.6% in DM of diet) on reducing EPG in BBG. Nath *et al.* (2019) investigated a significant reduction in EPG in goats supplemented with an ethanolic extract of turmeric powder. Bihari *et al.* (2010) showed that the methanolic extract of *Ocimum* species has anti-parasitic activities. Taj *et al.* (2023) reviewed that herbs such as *C. longa* and *O. sanctum*, among others, have anthelmintic properties.

Economics of Supplementing Phytoadditive Mixture (PAM) and Palm Oil on of Goats

Economic analysis (Table 4) showed that the cost of concentrate mixture (USD/kg) was 0.37, the cost of fodder (USD/kg) was 0.02, and the cost of PAM was USD3.56/kg; palm oil was USD1.03/kg. The cost of supplementation/goat in T1 was USD0.69 and USD1.07 in the T2 group. Return from meat at market (USD) (@45% dressing, @ USD8.02/kg meat) profit/goat in control group was USD38.50, USD40.70 in T1 and USD42.22

TABLE 3. LSQ MEANS OF GUT HEALTH OF LOW-BODY-CONDITIONED BLACK BENGAL GOATS (BBG) SUPPLEMENTED WITH PHYTOADDITIVE MIXTURE (PAM) WITH OR WITHOUT PALM OIL

Fortnights	Control	T1	T2
Initial FDM%	42.32 ^a ± 0.22	43.17 ^a ± 0.18	42.77 ^a ± 0.21
Final FDM%	42.26 ^a ± 0.20	43.21 ^b ± 0.19	43.25 ^b ± 0.16
Overall FS	1.57 ^a ± 0.15	1.10 ^b ± 0.09	1.12 ^b ± 0.11
Overall log EPG (Geometric mean of EPG)	5.54 ^a ± 0.02 (154.68)	5.07 ^b ± 0.01 (59.20)	5.07 ^b ± 0.01 (58.68)

Means bearing different superscripts differ significantly ($P < 0.001$) across different columns.

Note: FDM - faecal dry matter%; FS - faecal consistency score; EPG - parasitic eggs present in per gram of faeces.

TABLE 4: ECONOMIC ANALYSIS OF SUPPLEMENTATION OF PHYTOADDITIVE MIXTURE (PAM) WITH OR WITHOUT PALM OIL IN BLACK BENGAL GOATS (BBG)

Particulars	Control	T1	T2
Cost of concentrate mixture (USD/kg)	0.37	0.37	0.37
Cost of concentrate intake (USD/animal for 3 months)	3.30	3.30	3.30
Cost of PAM- USD3.56/kg; Palm oil- USD1.03/kg	-	0.69	1.07
Total feed cost (USD/animal for 3 months)	4.73	5.42	5.46
BW gain in 3 months (kg)	2.63	3.38	3.71
Feed cost/kg BW gain (USD)	1.80	1.60	1.47
Net profit (USD/kg gain)	-	0.20 (10.86%)	0.33 (18.20%)
Return from meat at market (USD) (@45% dressing, @USD8.02/kg meat)	38.50	40.70	42.22
Cost of labour & misc. (USD/animal for 3 months)	2.86	2.86	2.86
Total cost (USD) (feed + labour + misc.)	7.59	8.28	8.32
Profit/goat (USD)	30.91	32.42	33.90
Profit/goat over the control group (USD1 = Rs. 87.03)	-	1.51	2.99

in T2 group. Therefore, after calculating all the costs, the profit/goat in the control group was USD30.91, USD32.42 in T1 and USD33.90 in the T2 group. The reason behind the enhanced profit/goat was due to increased body weights in the T2 group followed by T1 than the control group. Allam and El-Elaim (2020) took 15 Zaraibi goats of around 4 years old from the 8th week of gestation till 3 months suckling time and separated those goats into three comparable groups, viz. Control, T1 (50% replacement of yellow maize with 50% dried orange peel) and T2 (50% replacement of yellow maize with 50% dried citrus peel) and observed that improved economic efficiency was investigated in treatment groups than control group. Khattab *et al.* (2021) supplemented 30 male Farafra lambs (8 weeks age) at 0, 5 and 10 g dried Chamomile flower/ 100 kg BW/day and observed that highest economic returns were reported in 10 g dried Chamomile flower/ 100 kg BW/day followed by 5 g dried Chamomile flower/ 100 kg BW/day as compared to control group lambs due to increase in final BW of supplemented goats. Ahmed and Shaarawy (2019) replaced the

concentrate mixture with 20%-25% *Moringa olifera* meal for 5 months and investigated that relative economic efficiency was higher in the treatment than control group animals. Abdelhamid *et al.* (2011) took 21 Zaraibi does, at ages of between 3-6 years and distributed them into groups, namely, control, *Rosemary officinalis*, *Artemisia* spp., *Pimpinella anisum* at 3-6 g/100 kg BW/day for 5 months, and they found that the mortality rate was reduced in the treatment group than in the control group, which improved economics. Hussein *et al.* (2018) showed that the supplementation of Zaraibi goats with 0.25% Chamomile flower, 2.00% tannins, 0.25% + 2.00% Chamomile flower and Tannins with soybean meals and investigated higher economical returns in 0.25% + 2.00% Chamomile flower and Tannins supplemented goats than other group goats. Dillo *et al.* (2024) took 20 local uncastrated male lambs for 90 days and separated them into 4 comparable groups, viz., control, 30.00% or 50.00% or 70.00% *Dawri damaa* leaf meal and observed that 30% *D. damaa* leaf meal incorporation was considered as economical.

CONCLUSION

Based on the findings of this study, it may be concluded that the supplementation of PAM containing equal proportions of *C. longa* and *O. sanctum* (15 g/kg DM of concentrate mixture) along with palm oil (0.05% of body weight) economically improves growth, gut health and body condition in low body conditioned BBG. This relatively newer approach of nutritional management may be recommended in other livestock species for evaluating the effect on their performance.

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