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# Utilization of *Acacia nilotica* Pod Meal as a Protein Supplement in Growing Goats

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## ABSTRACT

A 75-day growth trial was conducted to evaluate the effect of feeding babul pods (*Acacia nilotica*) meal on the growth performance of Black Bengal male goat kids. Eighteen goats (average body weight 10.3 kg, aged 7–8 months) were randomly assigned to three dietary treatments (T1, T2, T3) with six animals per group. All goats received roughage and a homemade concentrate mixture (20% crushed maize, 15% mustard cake, 10% groundnut cake, 15% chana besan, 10% rice polish, 25% wheat bran, 2% mineral mixture, 1% salt, 2% calcite) formulated to meet nutrient requirements as per ICAR, 2013. In T1, the standard concentrate was fed; in T2 and T3, 10% and 20% babul pods replaced mustard cake and wheat bran to maintain isonitrogenous diets. Babul pods contained CP 17.34%, EE 4.15%, CF 15.32%, NDF 34.56%, ADF 28.25% and ADL 2.32%. Average daily gains were 40.72 g (T1), 46.82 g (T2), and 52.04 g (T3), with no significant differences ($P > 0.05$). Feed conversion ratios (DM and CP basis) were also similar. However, parasitic load was significantly reduced ($P < 0.05$) in T2 and T3. Feed cost was highest in T1, while net profit was highest in T3, indicating economic and health benefits of babul pod inclusion.

**KEYWORDS**: Anti-haemonchus, Babul pods meal, Goats, Performance, Tannin

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Goats are vital to the Indian economy, providing meat, milk, fibre, and skin. India has 148.88 million goats (20th Livestock Census, 2019), mostly reared on poor-quality roughages such as crop residues, tree foliage, and agro-industrial by-products. Seasonal shortages and low nutritive value of feeds limit livestock productivity in arid and semi-arid regions (Gerbu et al., 2018). To address this, alternative feed resources, including tree-based and agro-industrial by-products, are gaining importance (Srihitha et al., 2025). Among these, babul (*Acacia nilotica*), introduced in 1876 for its drought, submergence, and salinity tolerance, now covers ~2 million hectares in India, with mature trees yielding 20–40 kg pods/year (Shukla et al., 1984). While tannins (>5%) can reduce digestibility and nitrogen balance (Kumar et al., 2014), babul pods are protein-rich and abundant in tropical areas, though underutilized for small ruminants. They can serve as an energy source in concentrate mixtures, improving energy utilization, and contain essential amino acids comparable to egg protein (Barman et al., 2006). Studies show *Prosopis juliflora* pods can replace up to 40% of sheep concentrates without adverse effects (Chaturvedi & Sahoo, 2013). Against this backdrop, the present study was designed to evaluate babul pods as a protein source in growing goat rations for growth performance and anti-haemonchus effects.

## Animals, feeding, management and dietary treatments

The study evaluated babul pods as a protein replacement in the concentrate mixture of growing Black Bengal male goats. Eighteen goats (average 10.3 kg) were assigned to three treatments (T1, T2, T3; six animals each). All received roughage and a homemade concentrate meeting ICAR (2013) nutrient requirements. T1 contained maize, mustard cake, groundnut cake, chana besan, rice polish, wheat bran, mineral mixture, salt, and calcite (Table 1). In T2 and T3, 10% and 20% babul pods replaced mustard cake and wheat bran to maintain iso-nitrogenous diets. Goats were stall-fed under hygienic conditions, exercised in a confined area, and provided free access to fresh drinking water.

Table 1. Ingredient composition (%) of concentrate

| Attributes | T1 | T2 | T3 |
|---|---|---|---|
| Maize crushed | 20.0 | 20.0 | 20.0 |
| Mustard Cake | 15.0 | 12.0 | 11.0 |
| Babul pods | 0.0 | 10.0 | 20.0 |
| Ground nut cake | 10.0 | 10.0 | 10.0 |
| Chickpea flour | 15.0 | 15.0 | 15.0 |
| Rice polish | 10.0 | 8.0 | 6.0 |
| Wheat bran | 25.0 | 20.0 | 13.0 |
| Mineral mixture* | 2.0 | 2.0 | 2.0 |
| Common salt | 1.0 | 1.0 | 1.0 |
| Calcite | 2.0 | 2.0 | 2.0 |

*Composition of mineral mixture (% on DM basis): Calcium (20%), Phosphorus (12%), Cobalt (0.012%), Copper (0.10%), Iodine (0.026%), Iron (0.4%), Magnesium (5%), Manganese (0.12%), Sulfur (2.0%), Zinc (0.80%) and Fluorine (0.07%).

**Data collection and statistics**

During the 75-day experiment, daily feed intake and body weights (recorded every 15 days) were monitored, with weights taken on two consecutive days before feeding and watering. At the end of the trial, three goats per group were selected for faecal examination. Samples were collected directly from the rectum, stored in labeled polythene bags, and examined using the McMaster technique (Coles et al., 1992) to determine eggs per gram (EPG) and oocysts per gram (OPG), indicating infection severity. Dry matter content was determined by oven drying at 100 °C overnight. Pooled feed and refusal samples were dried, ground (2 mm sieve), and analyzed for nitrogen via the Micro Kjeldahl method. Proximate composition followed AOAC (1999) procedures, fibre fractions were determined as per Van Soest et al. (1991), and calcium and phosphorus were estimated using Talpatra et al. (1940) method. All analyses were performed in the Animal Nutrition Laboratory, Bihar Veterinary College, Patna, India.

Data were analyzed using SPSS (Version 20.0, 2011) with one-way ANOVA and Duncan's multiple range test, and means were separated using LSD, following Snedecor and Cochran (1994) to assess significance between control and experimental groups.

The DM content of *Acacia nilotica* pod meal was 94.18 % and it contained CP 17.40, EE 4.15, CF 15.2, respectively (Table 2). The total phenolics (%, DM) of *Acacia nilotica* pod meal were 22.60 comprising of TTPh 19.3, CT 1.94, HT 17.15 and NTPh 3.36, respectively. The concentration of tannin in the diet was 0, 1.93 and 3.86 percent for T1, T2 and T3, respectively. The concentrate mixture prepared was iso- nitrogenous and iso-caloric among the groups. Similarly, Paswan et al. (2017) Reported CP 17.3% and total tannin phenolics 19.1% in *Acacia nilotica* pod meal.

Table 2. Chemical composition (%, DM) of feed stuffs offered to goats

| Attributes | Concentrate mixture | *Acacia nilotica* pod meal | Sorghum (green) |
|---|---|---|---|
| Dry matter | 93.80 | 95.20 | 24.80 |
| Organic matter | 90.50 | 94.38 | 86.80 |
| Crude protein | 19.60 | 17.40 | 7.58 |
| Ether extract | 3.40 | 4.15 | 3.64 |
| Crude fibre | 5.60 | 15.20 | 28.90 |
| Total ash | 9.50 | 5.62 | 13.20 |
| Nitrogen free extract | 61.90 | 57.65 | 46.68 |
| Phenolic constituents (%, DM) | | | |
| Total phenolics | - | 22.64 | - |
| Total tannin phenolics | - | 19.30 | - |
| Non- tannin phenolics | - | 3.34 | - |
| Condensed tannin | - | 1.92 | - |
| Hydrolysable tannins | - | 17.38 | - |

Dry matter intake (DMI, kg/100 kg BW) ranged from 2.93 to 3.27 across treatments, with no significant differences, indicating that inclusion of *Acacia nilotica* pod meal did not affect palatability (Table 3). Similar findings were reported by Paswan et al. (2017), where 30% pod meal in goat concentrates had no effect on DMI, and Kushwah et al. (2012), who observed no reduction in intake with up to 33% inclusion in lactating goats. Hidosa et al. (2020) also noted no palatability issues with up to 38% *Acacia tortilis* pods. Lalhariatpuii et al. (2022) and Balaji et al. (2025) reported DMI in Black Bengal goats at 2.7–3.0% of body weight. Min et al. (2003) found that condensed tannin (CT) levels >55 g/kg DM reduced intake, while 20–45 g/kg had no effect. In this study, 20% *Acacia nilotica* pod meal (3.86% tannin of TDMI) did not reduce voluntary intake, supporting earlier reports. For a 9.98 kg goat, NRC (2007) recommends 23 g protein/day for maintenance plus 14 g for 50 g/day growth, while ICAR (2013) suggests 55 g/day for a 10 kg goat at the same growth rate. In this study, average protein intake met ICAR standards and exceeded NRC values, ensuring optimal growth. Protein intake, as a percentage of requirement, was statistically similar across groups (92.5–102.5%). However, nutrient utilization efficiency for DM and CP was 25.12% and 24.42% lower, respectively, in the 20% *Acacia nilotica* pod meal group compared to control (Table 3). Paswan et al. (2017) also observed 22.60% lower FCR at 20% inclusion, while Hidosa et al. (2020) reported improved efficiency at higher (38%) *Acacia tortilis* inclusion.

Table 3. Effect of feeding *Acacia nilotica* pod meal on growth performance, feed intake and feed conversion efficiency in goats

| Attributes | T1 | T2 | T3 | SEM | P-value |
|---|---|---|---|---|---|
| Initial body weight (kg) | 10.49 | 10.39 | 9.99 | 3.17 | 0.987 |
| Final body weight (kg) | 13.54 | 13.90 | 13.90 | 2.98 | 0.990 |
| Body weight gain (kg) | 3.06 | 3.51 | 3.90 | 0.51 | 0.296 |
| Average daily gain (g) | 40.72 | 46.82 | 52.04 | 6.75 | 0.294 |
| DMI (g/day) | 308.75 | 303.13 | 307.63 | 23.39 | 0.968 |
| DMI (% body weight) | 3.27 | 2.93 | 3.20 | 0.79 | 0.901 |
| Concentrate: Roughage | 2.13 | 2.13 | 2.07 | 0.65 | 0.452 |
| Total protein intake (g/day) | 51.2 | 50.3 | 50.7 | 12.44 | 0.683 |
| Protein intake (% requirement) | 102.5 | 92.5 | 101.8 | 0.48 | 0.991 |
| DMI (kg/kg gain) | 8.00 | 6.75 | 5.99 | 1.35 | 0.368 |
| CPI (kg/kg gain) | 1.31 | 1.12 | 0.99 | 0.18 | 0.255 |
| Feed cost (Rs./day) | 3.92 | 3.91 | 3.92 | 0.05 | 0.977 |
| Gross profit (Rs.) | 1222 | 1405 | 1561 | 202.54 | 0.294 |
| Net profit (Rs.) | 928 | 1111 | 1267 | 203.16 | 0.295 |

DMI- Dry matter intake; CPI- Crude protein intake

The growth rate (g/day) of goats was non-significantly higher in T3 (52.04 ±3.8) compared to T2 (46.8±6.0) and T1 (40.7±4.2), respectively (Table 3). The ADG was 14.98 and 25.48% higher in T2 and T3 as compared to control group. Hidosa et al. (2020) reported higher weight gain in 38% inclusion of *Acacia tortilis* in concentrate mixture of goat. Change in weight of animals at 15 days' interval (fortnightly) up to 75 days has been presented in Figure 1. Hence, supplementation of Babool pods to black Bengal growing goats had no adverse effect on their body growth rate.

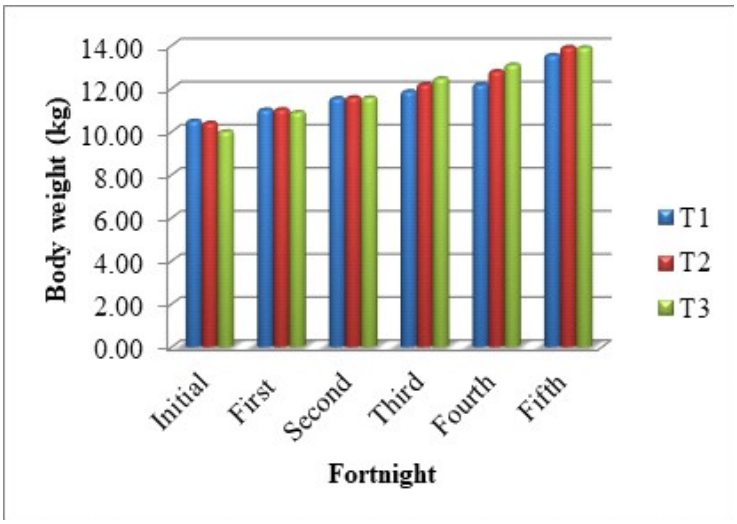


Fig.1. Effect of feeding *Acacia nilotica* pod meal on fortnight body weight of goats

The EPG count was significantly higher in T1 (762.50) than T2 (400.00) and T3 (337.50) group represent anti haemonchus activity of babool pods (Table 4). The maximum EPG was noted in control group and minimum in 20% babul pod meal supplemented group followed with 10% supplemented group. Similarly, Paswan et al. (2016) reported significantly reduced (P<0.05) EPG after 20% supplementation of babul pod meal in goat ration. This study showed that babul pod of this region had antiparasitic effect. This might be possible due to the presence of tannin in babul pod.

Table 4. Effect of feeding *Acacia nilotica* pod meal on eggs per gram (EPG) in faeces of goats

| Attributes | T1 | T2 | T3 | SEM | P-value |
|---|---|---|---|---|---|
| Initial EPG | 562.50 | 500.00 | 775.00 | 246.57 | 0.529 |
| Final EPG | $762.50^{c}$ | $400.00^{ab}$ | $337.50^{a}$ | 173.00 | 0.074 |

Feed cost was highest in the T1 group, whereas net profit was maximized in the T3 group (Table 3). Inclusion of babul pods at 10% and 20% of the ration for growing Black Bengal goats resulted in an additional weight gain of 458–849 g and an increase in average daily gain by 6–11 g/day. In the present study, the cost of production ranged from Rs.98 to Rs.75 per kg body weight gain in Black Bengal goats, which is considerably lower than the Rs.169–176 per kg body weight gain reported by Meetu et al. (2025) for Beetal goats.

## CONCLUSION

The study demonstrated that babul (*Acacia nilotica)* pods can be included in the concentrate mixture of growing Black Bengal goats at levels up to 20% without affecting feed intake or growth performance. Supplementation significantly reduced parasitic load, indicating strong antiparasitic potential, and improved economic returns by lowering feed cost per unit weight gain.

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