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Effect of Polyherbal Feed Supplementation on Growth Performances of Assam Hill Goat

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

In the current investigation, 36 nos of Assam Hill goat were selected and divided randomly into three groups. Polyherbal feed was supplemented in treatment groups @ 1 and 2 g/Kg body weight from 4 month of age till 12month of age, respectively. Data on various parameters were analysed at fortnightly interval for a period up to 9 months**.** The average body weight at 19th fortnight *i.e*., at 12months of age were 13.84± 0.032, 14.47±0.021 and 16.24±0.040 kg in control and the two treatment groups, T_1 and T_2 respectively. The overall body weight (kg) of two treatment groups were significant higher (p<0.01) than that of control group. In respect of sex, the male animals attained

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higher bodyweight than that of female animals at all the stages of experiment. Significant differences (p<0.01) among control and two treatment groups were observed for body length and chest girth of the animals. The study indicated that polyherbal feed supplementation improve the overall growth of the Assam Hill goats.

Keywords: Polyherbal; body weight; growth; Assam Hill goat.

1. INTRODUCTION

Currently, India has a total livestock population of 536.76 million out of which 148.88 million are genetically diverse goats, accounting for approximately 27.8% of the total livestock. The goat population has seen a growth of 10.14 % compared to the previous livestock census conducted in 2012. India recognizes 34 officially registered goat breeds as per National Bureau of Animal Genetic Resources (NBAGR) including one from Assam namely the Assam Hill goat. All the goats are well adapted to their respective home tract. According to the 20th livestock census by Department of Animal Husbandry and Dairying (DAHD), Government of India., the goat population in Assam is 4.315 million. i.e., 24% of the Assam's total livestock population of 18.092 million.

Goat farming is a crucial livelihood activity in rural Assam and across the nation, playing a key role in supporting the national and rural economy. It serves as a crucial source of income for farming families, particularly for those without land. Goats also offer essential dietary protein through their meat and milk. However, many Indian farmers, especially those living below the poverty lines struggle to adequately feed their goats and other animals under traditional, low-input systems. This results in poor nutritional intake and reduced productivity. There is a need to improve goat production system in the villages as it was usually the poorest farmers who own goats. The supply of quality feed together with proper hygiene, potable water and management can ensure the production of nutritious animal products with desired organoleptic properties (Saxena, 2008).

Studies on animals have shown that many herbal supplements help in improving growth and production in goats and supporting their overall health and well-being (Langeroudi et al., 2008; Sanchez et al., 2009). In developing countries, including India, medicinal plants are easily accessible to get than manufactured drugs. Some of these herbs are known to have positive effects on the animals' growth, breeding, and health (Mirzaei and Venkatesh, 2012). Many herbs and plant extracts have antimicrobial activities against a wide range of bacteria, yeasts, and molds (Thompson, 1986; Voda et al., 2003). In the current study, it was hypothesized that herbal feed supplement may greatly enhance these performances of the goat population in Assam. The present research work was taken to investigate the effect of feeding Assam Hill goat with a polyherbal feed supplement consist of Shatavari, Methi and Ajwain on their growth performance.

2. MATERIALS AND METHODS

2.1 Place of Experiment

The experiment was carried out in Goat Research Station, Assam Agricultural University, Burnihat, Assam. The geographical location of Goat Research Station, Burnihat is $20^0\,1^/$ to $26^0\,5^/\,1^{//}$ N latitude and $85^0\,4^/\,9^{//}$ to $92^0\,5^/\,2^{//}$ E longitude.

2.2 Experimental Design

A total of 36 healthy weaned Assam Hill kids (18 male and 18 female) of similar body weight were taken from the farm flock of GRS, Burnihat and were utilised for the experiment. The kids were divided randomly into three equal groups with 12 kids each (6 male and 6 female) and constituted the three experimental groups, viz. Group- I (control group-C0), Group-II (treatment group-T1) and Group-III (treatment group-T2). The kids of all the three groups were raised on similar feeding regimes under semi-intensive management system while the two treatment groups were fed polyherbal feed supplement daily at the rate of 1 g/kg Body weight (bwt) and 2 g/kg bwt. respectively T1 and T2 (Table 1). The polyherbal supplement was constituted of Shatavari root (*Asparagus racemosus*), Fenugreek seed (*Trigonella foenum-graecum*) and Ajwain seed (*Trachyspernum ammi*) powder mixed at 1:1:1 ratio (Fig. 1).

Table 1. Experimental groups and feeding schedule

Experimental group	No. of animal	Feeding treatment
Group I (C_0)	12 (6 male + 6 female)	Routine feeding and managemental regime
Group II (T_1)	12 (6 male + 6 female)	Routine feeding and managemental regime plus poly herbal feed supplement @1g/kg bwt.
Group III (T_2)	12 (6 male + 6 female)	Routine feeding and managemental regime plus poly herbal feed supplement @2g/kg bwt.

Fig. 1. Shatavari root powder, fenugreek seed powder and ajwain seed powder

2.3 Pre-Conditioning of Experimental Animals

After selection of the healthy kids, 10-day adjustment period was given to help them adjust to the new environment. Each goat was weighed, checked for health, and given identification to each animal by ear tagging. Thereafter, all the experimental kids were dewormed by an oral dewormer (Panacur suspension 2.5 % (Fenbendazole) @ 5 mg/kg) to eliminate endo parasitic infestation before the onset of experiment. The experimental kids were reared in semi-intensive system in elevated conventional slatted wooden floor shed which had provision of natural cross ventilation with proper feeding amenities.

2.4 Feeding Managenent of Experimental Animals

The routine ration was prepared with roughage and concentrate mixture (Table 2), where 1/3rd was concentrate ration and 2/3rd was roughage on a DM basis to fulfil the nutrient requirement of kids as per ICAR, (2013). The grasses fed to the animal were constituted of Para (*Bracharia mutica*) and Napier (*Pennisetum purpureum*) grass in a ratio of 50:50 on a DM basis. The control group (C_0) received only the concentrate, while the two treatment groups were given a polyherbal supplement along with the concentrate. Fresh, clean water was also provided to all the goats in the experiment.

Table 2. Feeding ingredients of concentrate ration

Ingredients	Parts
Maize crush	40
Wheat bran	12
Rice polish	10
Ground nut cake	35
Mineral mixture	2
Salt	1
Total	100

2.5 Parameters for Growth Performance

2.5.1 Body weight at fortnightly interval

Individual body weights of the kids were measured initially and then at fortnightly intervals. The weighing was done in the morning before feeding, using a 25 kg capacity spring balance and expressed in kilogram (kg).

2.5.2 Body length

Body length was measured between point of shoulder and point of hip.

2.5.3 Chest girth

The measurement was taken as the circumference of the chest immediately behind the shoulder joint.

2.5.4 Neck girth

Circumference of neck was measured at the middle position of neck.

3. RESULTS AND DISCUUSION

3.1 Growth Performance

3.1.1 Body weight

The means of the overall body weight at 12 months (i.e., 19th fortnight of the experiment) was 13.84± 0.032, 14.47±0.021 and 16.24±0.040 kg for control (C_0), treatment T_1, and T_2 groups respectively. During initiation of the experiment, the mean value of initial body weight of kids in different treatment groups were almost similar. The results showed significant difference (P<0.01) in overall average values of body weight (kg) of treatment groups than that of control group. The highest body weight was found in T_2 group, followed by T_1 than that of C_0 throughout the period of this study. In respect of sex, the male animals were found to have higher bodyweight than that of female animals at all the stages of experiment (Table 3).

A noticeable gain in body weight (kg) was seen from the fourth fortnight and continued until the nineteenth fortnight. Both treatment groups grew faster than the control group. The graph (Fig. 2) showed that by the end of the study, the difference in average body weight among the three groups (C_0, T_1, and T_2) became clearer, likely due to different levels of polyherbal supplements (0g, 1g, and 2g per kg body weight). This increase in weight agrees with findings by Mirzaei and Prasad (2011), who also saw higher weaning weights in goats with polyherbal supplements. Similarly, Muralidhar et al. (1993) found that rats fed a Shatavari-based herbal mix gained more weight than those in the control group. Mader et al. (1987) also reported better weight gain in pigs and steers fed saponin, a part of Shatavari. On the other hand, Kumar (2018) found no effect on buffalo growth from feeding Ajwain, and noted that weight changes over time could also be due to environmental factors like temperature, fodder quality, and nutrient use.

Table 3. Fortnightly body weight (Mean±Se) of Assam Hill goat of different treatment groups

Fortnight	Body weight (kg)				
	C_0	T_1	T_2	M	F
Initial	4.79 ± 0.022	4.78 ± 0.022	4.79 ± 0.021	4.80 ± 0.022	4.78 ± 0.021
1	5.26 ± 0.022	5.26 ± 0.022	5.27 ± 0.021	5.29 ± 0.023	5.24 ± 0.021
2	5.73 ± 0.021	5.74 ± 0.021	5.77 ± 0.020	5.79 ± 0.022	5.71 ± 0.019
3	6.22 ± 0.023	6.23 ± 0.024	6.29 ± 0.021	6.31 ± 0.022^a	6.19 ± 0.023^b
4	6.72 ± 0.022^a	6.74 ± 0.024^a	6.88± 0.022^b	6.86 ± 0.022^a	6.71 ± 0.023^b
5	7.23 ± 0.024^a	7.25 ± 0.025^a	7.50± 0.020^b	7.42 ± 0.024^a	7.23 ± 0.023^b
6	7.74 ± 0.025^a	7.77 ± 0.022^a	8.14± 0.020^b	8.00 ± 0.022^a	7.77 ± 0.023^b
7	8.24 ± 0.024^a	8.29 ± 0.022^a	8.82± 0.025^b	8.60 ± 0.021^a	8.30 ± 0.026^b
8	8.73 ± 0.021^a	8.82 ± 0.022^a	9.53± 0.026^b	9.22 ± 0.021^a	8.84 ± 0.024^b
9	9.21 ± 0.022^a	9.36 ± 0.021^b	10.26±0.030^c	9.84 ± 0.023^a	9.38 ± 0.026^b
10	9.68 ± 0.023^a	9.90 ± 0.022^b	10.95±0.029^c	10.44± 0.022^a	9.91 ± 0.027^b
11	10.15± 0.023^a	10.44±0.024^b	11.62±0.028^c	11.04± 0.022^a	10.44±0.028^b
12	10.62± 0.023^a	10.97±0.024^b	12.29±0.026^c	11.63± 0.022^a	10.96±0.027^b
13	11.08± 0.024^a	11.49±0.022^b	12.95±0.025^c	12.21± 0.020^a	11.48±0.028^b
14	11.55± 0.024^a	12.01±0.022^b	13.59±0.023^c	12.79± 0.020^a	11.98±0.026^b
15	12.01± 0.026^a	12.52±0.023^b	14.19±0.019^c	13.34± 0.019^a	12.48±0.027^b
16	12.47± 0.027^a	13.02±0.021^b	14.74±0.022^c	13.86± 0.020^a	12.97±0.027^b
17	12.93± 0.028^a	13.51±0.023^b	15.26±0.027^c	14.37± 0.022^a	13.43±0.030^b
18	13.39± 0.031^a	14.00±0.022^b	15.76±0.032^c	14.88± 0.022^a	13.88±0.034^b
19	13.84± 0.032^a	14.47±0.021^b	16.24±0.040^c	15.37± 0.023^a	14.33±0.039^b
Overall	9.05 ± 0.024^a	9.69 ±0.022^b	11.45±0.025^c	10.57± 0.022^a	9.55 ± 0.026^b

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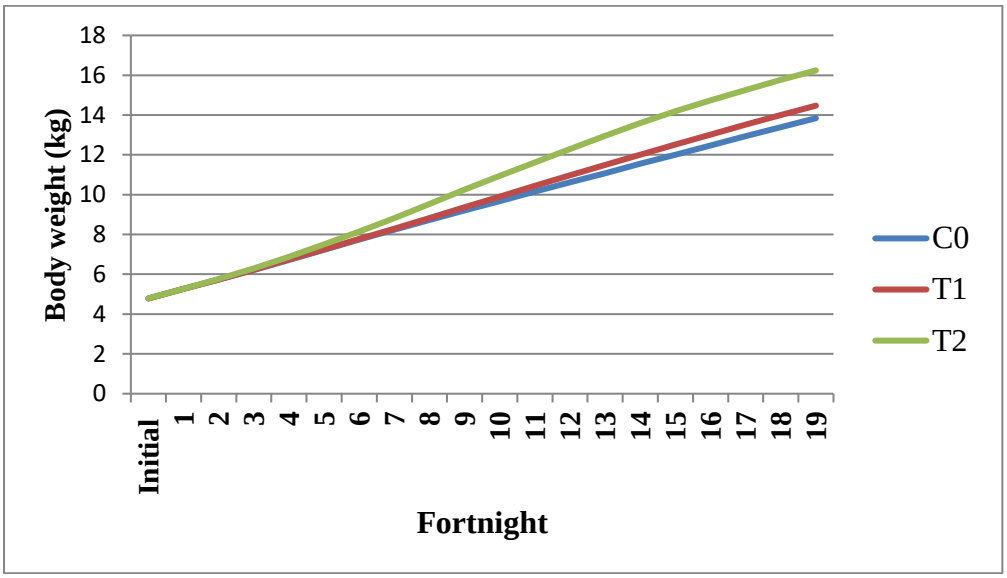

Fig. 2. Fortnightly body weight of Assam hill goat of different treatment groups

Table 4. Average (Mean±SE) Fortnightly body length of Assam hill goat of different treatment groups

Fortnight	Body length(cm)				
	C_0	T_1	T_2	M	F
Initial	30.43 ± 0.194	30.56 ± 0.212	30.62 ± 0.196	30.57 ± 0.193	30.50 ± 0.208
1	31.4 0± 0.185	31.65 ± 0.204	31.71 ± 0.194	31.60 ± 0.179	31.55 ± 0.209
2	32.36 ± 0.182	32.40 ± 0.190	32.50 ± 0.192	32.43 ± 0.163	32.41 ± 0.213
3	33.35 ± 0.167	33.43 ± 0.182	33.52 ± 0.195	33.46 ± 0.148	33.42 ± 0.214
4	34.33 ± 0.161	34.52 ± 0.171	34.62 ± 0.196	35.50 ± 0.134	35.48 ± 0.218
5	35.30 ± 0.176	35.41 ± 0.159	35.62 ± 0.201	35.45 ± 0.132	35.43 ± 0.225
6	36.28 ± 0.181	36.30 ± 0.153	36.41 ± 0.201	36.33 ± 0.131	36.31 ± 0.226
7	37.32 ± 0.177	37.62 ± 0.177	37.70 ± 0.239	37.55 ± 0.155	37.55 ± 0.241
8	37.83 ± 0.176	38.15 ± 0.170	38.20 ± 0.229	38.05 ± 0.152	38.04 ± 0.231
9	38.32 ± 0.179	38.56 ± 0.170	38.70 ± 0.218	38.55 ± 0.151	38.49 ± 0.227
10	38.83 ± 0.179	39.00 ± 0.172	39.20 ± 0.214	39.10 ± 0.150	38.94 ± 0.227
11	39.33 ± 0.189	39.70 ± 0.171	39.73 ± 0.219	39.60 ± 0.159	39.55 ± 0.227
12	39.84 ± 0.199^a	40.19 ± 0.173^a	40.20 ± 0.223^a	40.50 ± 0.164^a	39.65 ± 0.233^b
13	40.37 ± 0.209^a	40.71 ± 0.172^a	40.75 ± 0.239^a	41.00 ± 0.176^a	40.19 ± 0.237^b
14	41.03 ± 0.214^a	41.38 ± 0.180^a	41.40 ± 0.243^a	42.00 ± 0.187^a	40.56 ± 0.238^b
15	41.68 ± 0.218^a	42.00 ± 0.186^a	42.00 ± 0.249^a	42.50 ± 0.199^a	41.27 ± 0.236^b
16	42.33 ± 0.220^a	42.7 0± 0.205^a	42.71 ± 0.247^a	42.91 ± 0.209^a	42.24 ± 0.239^b
17	42.99 ± 0.225^a	43.50 ± 0.219^b	43.80 ± 0.256^b	44.21 ± 0.220^a	42.65 ± 0.246^b
18	43.66 ± 0.227^a	44.12 ± 0.236^b	44.90 ± 0.259^c	45.26 ± 0.236^a	43.20 ± 0.246^b
19	42.56 ± 0.222^a	45.10 ± 0.259^b	45.77 ± 0.259^c	45.55 ± 0.253^a	43.40 ± 0.240^b
Overall	37.98 ± 0.194^a	40.09 ± 0.188^b	40.18 ± 0.223^c	38.61 ± 0.175^a	38.04 ± 0.229^b

Means with similar superscript in a row or column do not differ significantly among themselves

In this study, the better growth rate was found in group T_2, followed by T_1 with supplementation of polyherbal preparation (Shatavari root powder, Fenugreek seed powder, Ajwain seed powder at ratio 1:1:1) in basal ration at the dose rate of 2gm and 1gm per kg bodyweight for 9 months was responsible for better growth due to digestive, hepatoprotective, antibacterial, antistressor, antioxidant, anthelmintic and immunomodulatory property of the supplement. These findings were in close conformity with Puri et al. (1993), Sethi et al. (2004), Ankita and Handique (2010), Mondal et al. (2011) and Pandit et al. (2013).

3.2 Body Length

During initiation of the experiment, the mean body length of animals in different treatment groups was almost similar. At the end of experiment (19th fortnight) group T_2 (45.77 ±0.259) showed significantly highest (P<0.01) body length (cm) followed by groups T_1 (45.10 ±0.259) than C_0 (42.56 ±0.222). Similarly, the male goat has higher body length than female animals. Similar findings were observed by Park et al. (2000) who reported a positive effect of herb mixture on growth performance in weaned pigs (Hashemi, & Davoodi, 2010).

3.3 Chest Girth

The average mean value of fortnightly measurement of chest girth of the goats (cm) showed that there were significant differences among C_0, T_1 and T_2 were observed from 10th fortnight. During early fortnights of the experiment, the mean chest girth of all the animals in different treatment groups were almost similar. At the end of experiment (19th fortnight) group T_2 (58.47 ± 0.283) showed significantly highest (P<0.01) chest girth followed by groups T_1 (58.31 ± 0.347) and C_0 (53.68 ± 0.334) which may be due to different growth rates in the different treatment groups. These results were in agreement with the result of (Chowdhury and Faruque, 2001) who shown that chest girth of male and female above 12 months of age is 73.2±1.33 and 71.0±1.13 cm, respectively. Similar findings were observed by Park et al. (2000) in weaned pigs.

3.4 Neck Girth

The average mean value of fortnightly measurement of neck girth of goats (cm) were calculated and significant differences among

Table 5. Average (MEAN±SE) fortnightly chest girth of Assam hill goat of different treatment groups

Fortnight	Chest Girth (cm)				
	C_0	T_1	T_2	M	F
Initial	36.61 ± 0.275	36.43 ± 0.260	36.55 ± 0.242	36.70 ± 0.274	36.36 ± 0.254
1	37.75 ± 0.268	37.57 ± 0.276	37.70 ± 0.246	37.84 ± 0.271	37.50 ± 0.254
2	38.88 ± 0.271	38.72 ± 0.274	38.84 ± 0.243	38.99 ± 0.272	38.64 ± 0.257
3	40.02 ± 0.264	39.87 ± 0.263	39.99 ± 0.234	40.13 ± 0.268	39.78 ± 0.255
4	41.15 ± 0.273	41.01 ± 0.256	41.14 ± 0.238	41.28 ± 0.268	40.92 ± 0.257
5	42.29 ± 0.282	42.16 ± 0.278	42.29 ± 0.247	42.42 ± 0.270	42.07 ± 0.259
6	43.42 ± 0.276	43.30 ± 0.265	43.44 ± 0.254	43.57 ± 0.269	43.21 ± 0.259
7	44.58 ± 0.284	44.45 ± 0.263	44.59 ± 0.258	44.72 ± 0.274	44.35 ± 0.263
8	45.51 ± 0.272	45.59 ± 0.268	45.74 ± 0.264	45.82 ± 0.272	45.41 ± 0.263
9	46.44 ± 0.254	46.74 ± 0.276	46.89 ± 0.257	46.91 ± 0.253	46.47 ± 0.273
10	47.37 ± 0.237^{a}	47.89 ± 0.291^{ab}	48.04 ± 0.253^{b}	48.00 ± 0.272^{a}	47.53 ± 0.254^{a}
11	48.30 ± 0.228^{a}	49.03 ± 0.293^{b}	49.19 ± 0.268^{b}	49.10 ± 0.270^{a}	48.58 ± 0.246^{b}
12	49.23 ± 0.214^{a}	50.18 ± 0.302^{b}	50.34 ± 0.262^{b}	50.19 ± 0.269^{a}	49.64 ± 0.255^{b}
13	50.18 ± 0.213^{a}	51.32 ± 0.314^{b}	51.49 ± 0.259^{b}	51.29 ± 0.265^{a}	50.70 ± 0.252^{b}
14	50.76 ± 0.234^{a}	52.47 ± 0.323^{b}	52.63 ± 0.274^{b}	52.25 ± 0.273^{a}	51.66 ± 0.264^{b}
15	51.34 ± 0.239^{a}	53.62 ± 0.326^{b}	53.78 ± 0.279^{b}	53.21 ± 0.273^{a}	52.61 ± 0.273^{b}
16	51.92 ± 0.258^{a}	54.76 ± 0.325^{b}	54.93 ± 0.268^{b}	54.17 ± 0.274^{a}	53.57 ± 0.288^{b}
17	52.49 ± 0.286^{a}	55.91 ± 0.336^{b}	56.08 ± 0.284^{b}	55.13 ± 0.285^{a}	54.52 ± 0.303^{b}
18	53.07 ± 0.312^{a}	57.05 ± 0.341^{b}	57.23 ± 0.287^{b}	56.09 ± 0.289^{a}	55.48 ± 0.313^{b}
19	53.68 ± 0.334^{a}	58.31 ± 0.347^{b}	58.47 ± 0.283^{b}	57.13 ± 0.292^{a}	56.50 ± 0.328^{b}
Overall	46.25 ± 0.274^{a}	47.32 ± 0.294^{b}	47.47 ± 0.261^{c}	47.25 ± 0.278^{a}	46.77 ± 0.271^{b}

Means with similar superscript in a row or column do not differ significantly among themselves

Table 6. Average (MEAN±SE) fortnightly neck girth of Assam hill goat of different treatment groups

Fortnight	Neck girth (cm)				
	C_0	T_1	T_2	M	F
Initial	20.09 ± 0.047	20.22 ± 0.057	20.13 ± 0.037	20.28 ± 0.048	20.01 ± 0.047
1	20.54 ± 0.046	20.79 ± 0.056	20.76 ± 0.035	20.85 ± 0.046	20.54 ± 0.045
2	20.98 ± 0.045	21.36 ± 0.053	21.39 ± 0.033	21.42 ± 0.045	21.07 ± 0.043
3	21.44 ± 0.047	21.94 ± 0.051	22.01 ± 0.031	22 ± 0.045	21.6 ± 0.041
4	21.88 ± 0.050	22.51 ± 0.050	22.64 ± 0.029	22.57 ± 0.046	22.13 ± 0.039
5	22.33 ± 0.053	23.09 ± 0.049	23.27 ± 0.027	23.14 ± 0.048	22.66 ± 0.038
6	22.79 ± 0.056	23.66 ± 0.047	23.8 ± 0.025	23.71 ± 0.049	23.19 ± 0.036
7	23.23 ± 0.060	23.84 ± 0.045	24.13 ± 0.023	24.28 ± 0.051	23.72 ± 0.035
8	23.69 ± 0.064	24.31 ± 0.047	24.56 ± 0.022	24.86 ± 0.054	24.25 ± 0.034
9	24.14 ± 0.068	24.79 ± 0.046	25.19 ± 0.021	25.43 ± 0.057	24.78 ± 0.033
10	24.59 ± 0.074	25.26 ± 0.048	25.42 ± 0.024	26 ± 0.060	25.31 ± 0.036
11	25.04 ± 0.080	25.74 ± 0.043	26.05 ± 0.020	26.57 ± 0.064	25.84 ± 0.032
12	25.49 ± 0.084	25.8 ± 0.046	26.38 ± 0.019	27.15 ± 0.066	26.37 ± 0.037
13	25.94 ± 0.088	25.99 ± 0.047	27.01 ± 0.020	27.72 ± 0.069	26.91 ± 0.033
14	26.39 ± 0.095	26.56 ± 0.046	27.24 ± 0.021	28.3 ± 0.074[a]	27.44 ± 0.034 [b]
15	26.84 ± 0.101	27.14 ± 0.047	27.87 ± 0.022	28.87 ± 0.078 [a]	27.97 ± 0.036 [b]
16	27.29 ± 0.108	27.72 ± 0.049	28.2 ± 0.024	29.44 ± 0.084 [a]	28.50 ± 0.037 [b]
17	27.74 ± 0.114	28.29 ± 0.050	28.83 ± 0.026	30.01 ± 0.088 [a]	29.03 ± 0.039 [b]
18	28.19 ± 0.120	28.87 ± 0.051	29.26 ± 0.027	30.59 ± 0.092 [a]	29.56 ± 0.040 [b]
19	28.65 ± 0.127	29.44 ± 0.053	29.69 ± 0.029	31.16 ± 0.097 [a]	30.09 ± 0.042 [b]
Overall	24.36 ±0.086[a]	25.68 ±0.047[b]	26.11 ± 0.028[c]	25.72 ± 0.056[a]	25.05±0.0324[b]

Means with similar superscript in a row or column do not differ significantly among themselves

overall values at C_o (24.36 ±0.086), T_1 (25.68 ± 0.047) and T_2 (26.11 ± 0.028) were observed.

4. CONCLUSION

In the present study 36 Assam Hill goat were selected and divided randomly into three groups. Polyherbal feed was supplemented in treatment groups @ 1 and 2 g/Kg body weight from 4 month of age till 12 months of age, respectively. Supplementation of polyherbal (Shtavari root powder, Fenugreek and Ajwain seed powder) @ 1 g/kg and 2 g/kg live body weight respectively, along with routine basal diet from weaning improved growth performances of Assam Hill goat. It may be concluded that it could serve as potential management tool to improve growth performances in goats. It is also recommended that further studies on combination of different polyherbal constituent and their effect on different glands and their hormone secretion are needed.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that no AI technologies have been used during preparation of the manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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