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Replacing concentrate with dried moringa leaves and studying its effect on growth performance and parasitic load in goat kids

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ABSTRACT

A three-months feeding trial was conducted to investigate the effect of feeding *Moringa oliefera* dried leaves as replacement to concentrate in the ration of growing goat. Twenty female Barbari goat kids of uniform age and conformation (initial mean body weight of 11.25 ± 1.43 kg; 8 to 12 months) were selected from the herd and divided randomly into four homogenous groups using completely randomized block design. The animals in control group were fed basal diet consisting of roughage and concentrate in equal proportion, whereas in treatment groups $T_{1,}$ T_2 and $T_{3,}$ the concentrate mixture was partially replaced with dried *M. oleifera* leaves at 20, 30 and 40 percent, respectively. Significantly higher average daily body weight gain was recorded in T_3 group compared to T_1, T_2 and control groups. The mean feed conversion efficiency significantly improved in all the treatment groups. The faecal examination showed significant reduction in egg count of *Hemonchus* sp., *Trichuris* sp., *Moniezia* sp., *Eimeria* sp. parasites. It was concluded that dried *M. oleifera* leaves could be possible alternative to feed the growing goats and may replace the concentrate up to 40 percent in growing goat and also act as an effective anthelminthic agent.

Keywords: Anthelminthic, Barbari goats, Growth performance, *Moringa oleifera* leaves

In India, goats are considered as one of the most versatile domestic animal species due to their large population size and immense contribution to support the life and livelihood of rural poor (Hegde 2019). The productivity of goats in most of these subtropical regions is often limited because of the poor-quality forages or inadequacy of prominent feeds (Damor *et al.* 2017). Generally, farmers feed their animals on poor quality roughages containing not only low level of nitrogen, vitamins, and other minerals but also have high concentration of lignin and cellulose (Sultana *et al.* 2014). The poor digestibility and lower feed intake is responsible for reduced average daily gain in growing goats (Gebregiorgis *et al.* 2012).

On the other hand, these regions also have high prevalence of gastro-intestinal parasites which causes enormous losses in the productivity of goats. The frequent usage of conventional anthelminthic drugs such as albendazole, fenbendazole, levamisol, morantel, doramectin, ivermectin, etc. are leading factor for the emergence of drug-resistant nematodes (Hafiz *et al.* 2009). Therefore, it is imperative to search for feeding strategies which not only reduce the cost of production under farmer's situation but also serve as natural feed additives in improving growth and health of animals.

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MATERIALS AND METHODS

Ethical approval: The study was approved by Institutional Animal ethics committee (IAEC), constituted under Committee for the Control and Supervision of Experiments on Animals (CCSEA) rules laid down by the Government of India. (Approval no. V-11011(13)/3/2022-CPCSEA-DADF).

Experimental design and animal management: For the study, twenty yearling female Barbari goat kids (initial mean body weight of 11.25 ± 1.43 kg; 8 to 12 months) of uniform age and conformation were selected from herd. They were allocated into four groups with five animals per treatment using completely randomized block design. The animals selected were apparently healthy and free from any kind of anatomical defects but were naturally infected from pastures. A feeding trial of 3 months was conducted to study the effect of feeding *Moringa oleifera* leaves in replacement to concentrate feed at 0, 20, 30 and 40% in control, T1, T2 and T3 group, respectively. During the trial period, measured quantity of experimental feed was offered to each group as per feeding regimen based on NRC guidelines. The leftover was weighed next morning to assess daily consumption of feed. The chemical composition of different experimental feeds was recorded and presented in Table 1.

The animals were weighed before morning feeding and subsequently at every fortnightly interval to assess the

Table 1. Chemical composition (% DM basis) of experimental diet

Attribute	Green fodder	Dry fodder	Concentrate	Dried moringa
Dry matter	35.67±0.41	90.48±0.12	87.68±1.00	88.75±0.35
Organic matter	88.98±0.77	87.50±0.50	91.60±0.30	87.70±0.40
Crude protein	9.48±0.79	3.03±0.13	21.04±0.83	29.15±0.55
Ether extract	3.30±0.20	0.54±0.07	3.57±0.32	9.90±0.30
Crude fibre	24.62±0.78	37.17±1.18	8.92±1.34	10.10±0.30
NFE	51.59±2.54	45.02±0.02	58.06±1.13	38.55±0.15
NDF	60.00±1.00	85.50±2.50	35.50±0.50	16.00±0.10
ADF	50.50±1.50	52.79±0.79	15.00±1.00	9.35±0.15
Hemicellulose	9.50±0.50	32.71±3.29	20.50±1.50	6.65±0.05
ADL	2.40±0.20	3.85±0.15	1.35±0.05	2.45±0.25
Cellulose	48.10±1.30	48.94±0.64	13.65±0.95	6.90±0.40
Ash	11.03±0.77	13.50±0.50	8.40±0.30	12.30±0.40

change in body weight. The average daily live weight gain was calculated by regression of body weight of each animal on number of days of feeding during experimental period. Faecal samples were collected every fortnight directly from the rectum of each goat during morning hours, put in a sterile container and immediately taken to Veterinary Parasitology Laboratory, SVPUAT, Meerut. The analysis of faecal samples was carried out by flotation technique. The egg count was done in Mc Master slide and observed under microscope. The no. of eggs per gram was then calculated using formulae and multiplying with dilution factor. Proximate composition of feed samples offered to the animals and left over was carried out by AOAC procedure (2005) in Department of Animal Nutrition, SVPUAT, Meerut.

Statistical analyses: Generated data on growth performance, feed efficiency and parasitic egg count was measured on days 0, 15, 30, 45, 60, 75, and 90 were analyzed using ANOVA in statistical package tool (SPSS version 20.0; SPSS Inc., Chicago, IL, USA). The model used in the study was

$$Y_{ij} = \mu + T_i + e_j$$

Where Y_{ij} is dependent variable, μ is he overall mean of the population, T_i is the effect of treatments, e_j is the random error. Duncan multiple range test was applied to treatment means which showed a statistically significant variation in samples.

RESULTS AND DISCUSSION

Growth performance: The effect of substitution of concentrate mixture with different levels of dried moringa leaves is presented in Table 2. There was no significant effect on body weight of experimental goat kids till the end of study period. However, the mean change in body weight was significantly (p<0.01) higher in T3 followed by T2, T1 and control groups, respectively. The average daily gain (g/day) was highest in T3 group with significant difference (p<0.01) at higher levels of replacement during experimental duration. The results of dry matter intake (DMI) of experimental goat kids (g/day) revealed that dry matter intake was similar in all groups. The DMI was numerically higher in T3 group with significant (p<0.01) improvement in feed conversion efficiency. FCR improved significantly (p<0.01) at higher level of supplementation which was nearly 30% higher in T3 group compared to control. The present outcomes of the study were in line with the previous works of Ahmed *et al*. 2013, Ahmed and Shaarawy (2019), Choudhary *et al.* (2018), Damor *et al.* (2017), Sultana *et al.* (2015), Babeker and Bdalbagi (2015) and Melesse *et al.* (2015) who reported that feeding of moringa leaves significantly affected body weight changes in growing goat kids. In the present study, the body weight changes in Barbari goat kids were higher at upper levels of inclusion (40% > 30% > 20%) of dried moringa leaves in daily diet. Higher protein quality, more palatability, and a higher proportion of bypass protein in treatment groups that consumed *M. oleifera* leaf may be responsible for the variance in body weight gain in the animals fed the experimental diets. The superior body weight gains showed by animals in T3, T2 and T1 over control may also be accredited to the higher feed intake and feed utilization of the animals on moringa based diet, since feed intake of an animal is directly related to the body weight changes. Su and Chen (2020) reported that *M. oleifera* leaves are rich in amino acids, vitamins and minerals like iron, calcium, phosphorus etc. which may be reason for greater increase in the body weight of the goats in the current study.

Anthelmintic activity: The anthelmintic characteristics of *M. oleifera* leaves against the eggs of *Hemonchus* sp., *Trichuris* sp., *Moniezia* sp., *Eimeria* sp. revealed a significant (p<0.01) effect with reduced numbers of eggs/g of faeces (Table 3). The eggs of *Hemonchus contortus* was prevalent among the animals under study which reduced in subsequent fortnights significantly (p<0.01) in all the treatment groups (Fig 1). *Trichuris* sp. found in many naturally infected goat kids started decreasing after 3rd fortnight and the reduction in egg count was highly significant (p<0.01) higher level of feeding dried moringa leaves. The mean egg count per goat for *Moniezia expansa* in control, T1, T2 and T3 group before feeding of *M. oleifera* reduced significantly (p<0.01) in treatment groups.

Table 2. Effect of feeding dried moringa leaves on weight gain, feed intake, and feed conversion efficiency of Barbari goats (n=20)

Parameters	Treatment				SEM	*p*-value
	C	T1	T2	T3		
BW, kg (Initial)	11.34	11.23	11.18	11.26	1.43	0.99
BW, kg (Final)	15.26	17.00	17.56	17.84	1.82	0.75
BW, kg (Overall)	13.21	14.01	14.16	14.38	1.63	0.96
Δ BW, kg	3.92[a]	5.77[b]	6.38[c]	6.58[c]	0.44	0.00
ADG, g/day	43.56[a]	64.11[b]	70.87[c]	73.07[c]	4.93	0.00
DMI, g/day	397.81	450.15	459.12	464.90	344.33	0.83
FCR	9.25[a]	7.08[b]	6.51[c]	6.42[c]	0.46	0.00
FCE	0.11[a]	0.15[ab]	0.16[b]	0.16[b]	0.01	0.01

Means within row having different superscripts differ significantly ($p<0.01$). BW: body weight, ADG: average daily gain, DMI: dry matter intake, FCR: feed conversion ratio, FCE: feed conversion efficiency, SEM: standard error of mean.

Table 3. Effect of feeding *Moringa oleifera* leaves on egg/oocyst count of common goat parasites per gram of faeces (eggs per gram of faeces) in growing goats (n = 20)

Parasite		C	T1	T2	T3	SE	*p*- value
	Initial	935	930	915	945	10.93	0.31
Haemonchus sp..	Final	875[a]	300[b]	200[bc]	145[c]	25.13	<0.00
	Mean	908.57[a]	672.14[b]	623.57[b]	648.57[b]	14.88	<0.00
	Initial	970	965	965	965	5.86	0.91
Trichuris sp.	Final	915[a]	805[b]	690[c]	590[d]	19.04	<0.00
	Mean	952.14[a]	909.99[b]	893.57[bc]	873.57[c]	5.23	<0.00
	Initial	965	940	950	955	7.50	0.17
Moniezia sp.	Final	940[a]	750[b]	545[c]	480[d]	14.47	<0.00
	Mean	954.28[a]	887.14[b]	841.43[c]	831.43[c]	3.99	<0.00
	Initial	1270	1260	1265	1265	5.86	0.69
Eimeria sp.	Final	1200[a]	1095[b]	780[c]	675[d]	16.20	<0.00
	Mean	1240.72[a]	1210.71[b]	1147.86[c]	1099.29[d]	4.39	<0.00

Means within row having different superscripts differ significantly ($p<0.01$).

Similarly, significant ($p<0.01$) results were observed for mean oocysts count of *Eimeria* sp. comparing start of the experiment and end of experiment in treatment groups. The overall OPG/goat decreased significantly ($p<0.01$) with increasing level of *M. oleifera* substitution. Plants-based anthelmintics are considered as sustainable and unique strategy for controlling gastro-intestinal nematodes in ruminants (Hernandez *et al.* 2021, Ketzis *et al.* 2002). In this study, *M. oleifera* leaves showed a significant effect against parasite eggs and oocysts. The present findings were in agreement to similar investigations reported for anthelmintic activities of moringa extract obtained from leaves and seeds against different nematodes of ruminants (Asaolu *et al.* 2012, Salles *et al.* 2014). Adding *M. oleifera* depicted potent anthelmintic activity by reducing feacal egg count of different parasite in goat (Tayo *et al.* 2014, Tona *et al*. 2014, Korsor *et al.* 2017). Yusuf *et al.* (2016) reported decreasing oocysts count of *Eimeria sp*. in rams after inclusion of *M. oleifera* in their diets. It was suggested that *M. oleifera* contained plant bioactive compound with anthelminthic properties which inhibit larval formation inside the egg and reduces parasitic load in animals as reported by Cabardo *et al.* (2017). The use of *M. oliefera* in the form of dried leaves is easily adoptable practice under farmer's situation.

The results indicated that feeding the growing goats on concentrate with *Moringa oleifera* dried leaves significantly improved feed utilization and body weight gain. Further, the anthelminthic activity of moringa leaves make it potential feed additive either as supplement or replacement at goat farms having persistent gastro-intestinal parasitic load.

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