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Effect of *Moringa stenopetala* and Pigeon Pea Supplements on Growth Performance of Short-Eared Somali Goat Breed

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Abstract

This study was conducted at Fafan Research Center, Golajo research site to evaluate the effect of *Moringa stenopetala* and pigeon pea leaf supplementation on growth performance of short-eared Somali goat breed. A total of fifteen yearling indigenous short-eared Somali goat breeds with an initial weight of 15.2 ± 0.30 kg were assigned to three treatment groups using completely randomized design. Pigeon pea (Pp) and *Moringa stenopetala* (MS) feeds were formulated using 0%, 5%, and 10% inclusion levels of MSLM and PPLM as experimental diets, respectively. The feed of the experiment was prepared in two levels (2 kg of *Moringa stenopetala* and 2 kg of pigeon pea) and was supplemented to experimental animals in treatments one and two, respectively. The average e initial body weight of selected male goats was 18.82 ± 0.37, 18.8 ± 0.37 and 17.8 ± 0.37 kg under treatment groups T1, T2 and control respectively. Data was analyzed using general linear model (GLM) procedure of SAS computer package Version 9.0 (SAS, 2002). The final weights gain (FWG) of goats on T1 and T2 of experimental group was significantly ($P < 0.05$) higher than T3 (control group) with the average mean of 26.63 ± 0.49, 26.32 ± 0.49 and 24.06 ± 0.49 kg, respectively. There was no significant difference between ($P > 0.05$) the final weight gain of goat supplemented on *Moringa stenopetala* (T1) and pigeon pea levels (T2). The mean average weight gains (AWG) obtained from the supplemented group in this study were 7.50 ± 0.37 and 7.82 ± 0.37 kg for T1 and T2, whereas mean weight gains for un-supplemented goats were found to be 6.26 ± 0.37 kg. Feeding of dried *Moringa stenopetala* and pigeon pea leaves mixture improved body weights and average daily body weight gain without affecting feed intake and overall health of Somali goat breed. As *Moringa stenopetala* and pigeon pea leaves are rich nitrogen/protein source, they can

be used effectively as substitute for conventional concentrate in the diet of growing goats at small holder farmer's level where they can be grown in abundance. Therefore, for higher quality of forage and higher total DM yield for animal feeding, moringa should be harvested at wider harvesting intervals of at least 6^{th}- to 8^{th}-week intervals. Similarly, for pigeon peas, 4- to 6-week harvesting interval can result in optimum forage as well as feed quality and resulted in better growth performances for Somali short-eared goat breeds.

Keywords

Effect, Growth Performance, Moringa, Pigeon Pea, Supplementation, Somali Goat

1. Introduction

Small ruminants play a significant role in almost all farming systems in the tropics and sub-tropics [1]. A recent report shows that Ethiopia has the largest goat population (45.76 million) among African countries [2]. Goats are primarily kept for meat production, although milk is equally important in pastoral and agro-pastoral areas. They are usually raised and finished on natural pastures, and as a result, they take a long time (over 2 years) to reach slaughter weight, not more than 20 kg [3]. The carcass weight produced is not higher than 8.5 kg per goat in the country [4]. Goats fed with low-quality roughage have satisfactory fattening performance when supplemented with concentrate having optimum contents of CP and energy [5]. It reduces age of slaughter and increases carcass quality and meat output, thereby improving access to animal protein and income to households in the subsistence production system [6]. Moreover, there is limited information on whether the growth and carcass characteristics of Ethiopian indigenous goats are differently influenced by genotype and nutritional regimes [7]. They have not been compared and characterized adequately in terms of their growth, carcass, and meat quality attributes. Regardless of their attributes, the productivity of goats in many tropical countries is low and has been related to diseases, nutrition, genotype and management [8]. The limitations of nutrition could be attributed to seasonal fluctuations in feed quantity and quality [8]. The notable effect of feed scarcity is observed particularly in dry seasons when natural pastures are mature, dry and inadequate with low nutritive value as low as 2% crude protein [9]. Supplementary feeding with high nutritive feeds could therefore be a prerequisite for viable and sustainable good goat production in such instances. Supplementing goats with nutritious feed could increase the average daily gain, carcass weight and dressing percentage, resulting in the improvement of the meat quality [10]. Usually, farmers feed their animals with crop residues and low-quality standing hay, which are low in nitrogen, high in lignocellulose, and in short supply of vitamin and mineral contents, which leads to low digestibility and reduced voluntary feed intake [11]. Moreover, some of the crop residues require expensive inputs, such as urea, to provide alternative nitrogen. Urea

is known to have toxic effects on animals, which is highly likely if feeds are improperly mixed [12]. Consequently, the energy and nitrogen intake of animals raised on these feeds can not sustain adequate levels of performance, leading to low growth, delayed animal sexual maturity, poor reproductive performance, poor meat quality, and low milk yield [11]. Therefore, the objective of this study was to evaluate the effect of moringa and pigeon pea leaf meal supplementation on performance of yearling short-earned Somali goats fed a basal diet of native grass hay.

2. Material and Methods

2.1. Study Area

The experiment was conducted in Fafan Research Center, 605 km far from Addis Ababa, 45 km west of Jijiga, lying between 9˚24'N latitude, 42˚6'E longitude, where the average annual rainfall, temperature and altitude ranges 200 - 600 mm, 24 - 450 C and 200 - 1600 m.a.s.l. respectively [13]. The region experiences erratic and insufficient rainfall, making it unsuitable for regular crop farming. It is dominated by extensive rangelands, with the population primarily engaged in pastoralism and agro-pastoralism. Communities often migrate in search of pasture and water for their livestock and themselves. The region has surface area of approximately 375,000 square kilometers which divide the area into arid and semi-arid agro ecological zone.

2.2. Collection of *Moringa stenopetala* and Pegeon Pea Leaves

Fresh mature leaves of *Moringa stenopetala* and pigeon pea were manually harvested. The leaves were air-dried under shade by spreading on clean plastic sheets for 72 hours. They were turned several times to facilitate the drying process. The grass was mowed at a frequency of 14 days, pre-dried in the sun for 24 hours by spreading on a concrete floor, and turned several times, thereafter air-dried in a shaded place and kept until use.

2.3. Preparation of Experimental Feeds

Preparation and proportion of feed supplementation levels are presented in **Table 1**. Fresh moringa and pigeon pea leaves were collected, defoliated, and dried under shade until they are crispy to the touch while retaining their greenish coloration. The leaves were then milled to obtain a product herein referred to as *Moringa stenopetala* and pigeon pea leaf meal which were stored in sacks until needed for inclusion in the concentrate diet. The two feeds of pigeon pea (Pp) and *Moringa stenopetala* (Ms) feed were used as experimental diets and formulated using 0%, 5%, and 10% inclusion levels of *Moringa stenopetala* and pigeon pea leaf meal. The goats were freely grazing during the daytime, and the experimental diets were served as supplements in the evening.

2.4. Animal Management and Experimental Design

Fifteen male yearling indigenous short-eared Somali goat breed with the initial

weight of 15.2 ± 0.30 kg was used in this study. The goats were purchased from local markets in Dhegahle kebele and transported to the Golahajo research site. All the groups of animals were ear-tagged and treated against internal and external parasites before the beginning of the experiment. The experimental animals were quarantined for 3 weeks being vaccinated for diseases such as pest des petitis ruminants (PPR), ovine pasteurellosis, and goat pox, and anthrax. After fifteen days of the adaptation period, the animals were randomly allocated to three treatment groups of five animals each in a completely randomized design (CRD). The goats were provided with individual feed and water troughs, and clean water was available all the time.

Table 1. Fodder supplementation levels.

Treatments	Number of goats	Feed types	Amount provided
Control	5	Natural pasture	Control group
T1	5	Natural pasture + MS[a]	2 kg of MS
T2	5	Natural pasture + Pp[b]	2 kg of Pp

T = Treatments, [a]*Moringa stenopetala*, [b]Pigeon pea.

2.5. Data Collection Procedure and Measurements

2.5.1. Body Weight Measurement

Body weights were recorded at the beginning of the trial and every 2 weeks. Goats were weighed in the morning hours after overnight fasting by using hanging scale. Average weight gains (ADG) were calculated as the difference between final body weight and initial body weight divided by the number of feeding days. Feed conversion efficiency was calculated by dividing ADG by daily total dry matter intake.

2.5.2. Chemical Analysis of Feed Samples

The two types of feed leaves were assessed for the value of dry matter (DM), crude protein (CP), crude fat, calcium, magnesium, potassium, zinc, copper, iron, manganese, and phosphorus using the procedures of the Association of Official Agricultural Chemists [14]. Neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), and acid detergent cellulose (ADC) were determined according to Van Soest and Robertson procedure [15].

2.6. Statistical Analysis

Data was analyzed using general linear model (GLM) procedure of SAS computer package Version 9.0 [16]. Mean comparisons were determined by using Duncan multiple range test, and significance at $P < 0.05$. The model used for the data analysis was:

$$Y_{ij} = \mu + T_i + B_j + e_{ij},$$

Where: Y_{ij} is the response variable;

μ is the overall mean;

T_i is the treatment effect;

B_j is the block effect;

e_{ij} is the random error.

3. Result and Discussion

3.1. Animal Feeding of *Moringa stenopetala* and Pigeon Pea

The effect of *Moringa stenopetala* and pigeon pea leaves on body weight gain of Somali male goat breed intake was shown in Table 2. The average initial body weight of selected male goats was 18.82 ± 0.37, 18.8 ± 0.37 and 17.8 ± 0.37 kg as T1, T2 and T3, respectively. The final weights gain of goats on experimental group of treatment one and two was shown 26.63 ± 0.49 and 26.32 ± 0.49 with average weight gains of 7.50 ± 0.37 and 7.82 ± 0.37 kg, respectively. The control group of the final weight gain was shown 24.06 ± 0.49 kg with average weight gains of 6.26 ± 0.37 kg. Hence, the present study revealed a significantly higher FWG in experimental group (T1 and T2) than the control group (T3) ($P < 0.05$). However, there was no significant difference between the final weight gain of goat supplemented on *Moringa stenopetala* (T1) and pigeon pea levels (T2) ($P > 0.05$) (Table 2). On the other hand, the average daily weight gains for goats supplemented with *Moringa stenopetala*, pigeon pea leaves and the control group were obtained, 0.042 ± 0.002, 0.043 ± 0.002 and 0.035 ± 0.002 g/day, respectively. The total weight gains of the animal supplemented with different levels of ration in general followed the trend of the daily weight gains. The highest total weight gain per animal was received for the treatment group two, which was supplemented with 2 kg of pigeon pea, while the control group exhibited the lowest weight gain. Considering the weight gain over the entire experiment there was a significant difference among the treatment group and the control group with regard to overall average live weight gains, average total weight gains and final weight gain ($P < 0.05$). The present findings are in lined with previous works of [17] [18] and [19] who were reported that feeding of moringa leaves had significantly increased the body weight gain in Sudan Nubian goat kids.

Table 2. Effect of *Moringa stenopetala* and pigeon pea supplementation on growth performance of short-eared Somali goat breed.

Treatments	Initial weight	Final weight	Monthly weight gain	Total weight gain	Daily weight gain
	Mean ± S.E.	Mean ± S.E.	Mean ± S.E.	Mean ± S.E.	Mean ± S.E.
T1	18.82 ± 0.37^{a}	26.32 ± 0.49^{a}	1.25 ± 0.06^{b}	7.50 ± 0.37^{a}	0.042 ± 0.002^{a}
T2	18.8 ± 0.37^{ab}	26.63 ± 0.49^{ab}	1.30 ± 0.06^{ba}	7.82 ± 0.37^{ab}	0.043 ± 0.37^{ab}
Control	17.8 ± 0.37^{abc}	24.06 ± 0.49^{c}	1.04 ± 0.06^{c}	6.26 ± 0.37^{c}	0.035 ± 0.37^{c}
Significance	N.S.	*	*	*	*

Mean values in a column having different superscripts differ significantly from each other; *P < 0.05; SEM: Standard error of mean, N.S.: Non-significant; T: Treatments.

3.2. Chemical Composition of Experimental Fodder

The chemical composition of *Moringa stenopetala* and pigeon pea leaves used in

this study are presented in Table 3. *Moringa stenopetala* leaves contained dry matter (89.9%), ash (12.2%), NDF (26.5%), crude protein (26.7%), ADF (16.9%) ADL (6.9%), the crude protein content of moringa foliage used in the study was in line with the fining of [20] (29.7%, 25.95% and 22.6%) obtained by [21] [22] and [23] respectively, but higher than the values (19.5% and 19.3% in DM) reported by [24] and [25] respectively. The variations in nutritive value of moringa foliage could be due to the age of harvest, soil type and fertility, proportion of leaf and stem and the agro-ecological zone where trees are growing. On the other hand, pigeon pea contained Dry matter (92.1%), NDF (50.6%), crude protein (32.9%), ADF (30.8%), ADL (12.1%) is higher than the dry matter (89.9%), NDF (26.5%), crude protein (26.7%), ADF (16.9%) ADL (6.9%) of *Moringa stenopetala*.

Table 3. Chemical composition of moringa and pigeon pea leaves fed to experimental Somali goat breed.

Diet	Chemical composition					
	DM	Ash	NDF	CP	ADF	ADL
Moringa stenopetala	89.9	12.2	26.5	26.7	16.9	6.9
Pigeon pea	92.1	8.4	50.6	32.9	30.8	12.1

DM = Dray matter; CP = Crude protein; NDF = Neutral detergent fiber; ADF = Acid detergent fiber; ADL= Acid detergent lignin; Ash= Total mineral content of forage.

4. Conclusion and Recommendations

Feeding of dried *Moringa stenopetala* and pigeon pea leaves mixture improved body weights and average daily body weight gain without affecting feed intake and overall health of Somali short-eared goat breed. *Moringa stenopetala* and pigeon pea leaves, which are rich in nitrogen and protein, can be harvested at their first cutting stage, typically around 10 weeks after planting and can be used effectively as substitute for conventional concentrate in the diet of growing goats at small holder farmer's level where it can be grown in abundance. Therefore, for higher quality of forage and higher total DM yield for animal feeding, moringa should be harvested at wider harvesting intervals of at least 6th- to 8th-week intervals. Similarly, for pigeon peas, 4- to 6-week harvesting interval can result in optimum forage as well as feed quality. Furthermore, due attention should be given while collecting, drying and storing fodder crops that produce food borne diseases. Alternative drying methods should be addressed to continue the drying of fodder crops during rainy season.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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