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Full Length Research Paper

Effect of graded level of pigeon pea (*Cajanus cajan)* leaves on growth performance of sheep

Shumuye Belay[1]*, Guesh Godifey[1] and Minister Birhanea[2]

[1]Mekelle Agricultural Research Center, Tigray, Ethiopia.
[2]Abergelle Agricultural Research Center, Tigray, Ethiopia.

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A study was conducted with the objective to evaluate the nutritional value of pigeon pea leaves and its effect on growth performance of the Abergelle rams. It was conducted at Kola-tembein district, northern Ethiopia. It was implemented under the farmers' management practice. Eight farmers who can provide three intact male rams participated in the experiment. The four treatments (0, 200, 300 and 400 g dried leaves) were assigned randomly to the eight farmers and two farmers received the same treatment. Six rams were allocated for a treatment. Feed intake and feed left were measured daily where as daily weight gain was measured every two weeks. Both the control and supplemented rams were grazed in the field for about 10 h per day. Feed sample was collected and its nutritional content was analyzed. Dried leaves mixed with twigs had 904 g/kg DM, 236g/kg CP, 82 g/kg ash, 2.76 g/kg Mg, 6.62 g/kg Ca, 0.25 g/kg Fe and 2.3 g/kg P. DM and CP intake had significant difference (P<0.05) among the treatments. The Crude protein (CP) intake of rams assigned in T2, T3 and T4 were 44.05, 64.21 and 82.04g day^{-1}head^{-1} respectively. This CP intake excluded the CP obtained from grazing which was difficult to estimate. However, there was different browse tree and grass species used as sources of protein and energy respectively. Generally, supplemented rams had higher weight gain (P<0.05) compared to non-supplemented rams but no statistical difference was observed among the supplemented rams. Therefore, supplementing of dried leaves for rams could be an alternative feed resource, which contribute in minimizing the feed scarcity both in quality and quantity because of its accessibility to smallholder farmers.

Key words: Abergelle sheep, *Cajanus cajan*, feeding trial.

INTRODUCTION

Pigeon pea (*Cajanus cajan*) is one of the most widely grown legume crop in the tropical and subtropical countries (Purdue, 2006). Similarly, this perennial and/or annual crop is being introduced in some parts of Tigray regional state and well grown in sandy soil type both in irrigated and non-irrigated areas of the region for the purpose of feed-food. It is locally known as "*Ergbeater.*" and used as a food in a very small population in the lowland areas of the region. Hence, this crop is not widely disseminated in many parts of the region and the country as a whole. Netsanet and Yonatan (2015) also reported that in Ethiopia, pigeon pea is being produced by a very small fraction of the farming population and there is limited experience and knowhow on its utilization. However, this multipurpose crop is becoming an important subsistence crop in the whole of Africa mainly (Balogun, 2013). He also added that pigeon pea seed has a crude protein content of 278 g/kg and cow pea seed of 241 g/kg. They have similar anti-nutritional compositions like phytate (1.81 mg/100 g, 1.25 mg/100 g), cyanide (0.65 mg/100 g, 0.41 mg/100 g) tannin (1.05 mg/1000 g, 1.03 mg/100 g), saponins (1.19 mg/100 g, 1.21 mg/100 g) and oxalate (0.14 mg/100 g and 0.14 mg/100 g) respectively and can improve nutrition and food security in Nigeria though it has low human food preference (Balogun, 2013).

Pigeon pea is relatively resistant to drought, improves soil fertility and prevents soil erosion on steep land. Its

*Corresponding author. E-mail: shumuyeb@yahoo.com.

in Eastern Africa countries (Damaris, 2007). Pigeon pea seed can successfully replace cow pea in the diet of man leaf has excellent sources of crude protein content which ranges from 163 to 270 g/kg (Alexander et al., 2007). Similarly, Ajebu et al. (2013) reported that pigeon pea leaves have crude protein content of 230 g/kg. However, higher crude protein content (280-360 g/kg) of pigeon pea leaf was also reported by Phatak et al. (1993). This leaf has similar CP content with leucaena leaf and showed similar performance when goats were supplemented with pigeon pea and leucaena leaves (Karachi and Zengo, 1998). It is excellent protein forage for livestock and good sources of dietary vitamins and minerals (Sheahan, 2012).

Pigeon pea is multipurpose nitrogen fixing crop that provides the seed as human food and poultry feed, the leaves and young stems as animal fodder, fuel wood and shelter material for the subsistence farmers (Lorgyer, 2009). Introducing and familiarizing this legume crop can be used as alternative feed resources to minimize the livestock feed scarcity in the region. It can also contribute in insuring human food security in the region. Tigray region has a large number of livestock populations that significantly contribute to Ethiopia's overall economic growth. However, one of the major constraints, which strongly limit the productivity of the livestock sub-sector in the region, is unavailability of feed both in quality and quantity. Like anywhere in the country, the livestock feed in the region depend on the natural pasture and crop residues. These feedstuffs are grossly low in quantity and quality to sustain animal production. Introduction and successive utilization of improved forage crops with adaptable, high yielding ability and better nutritional values than the existing feed staff in the farming system could solve the feed shortage and increase livestock production and productivity in the region.

As a result, determining the nutritive value of the leaves and its palatability was important for further introduction and dissemination to beneficiaries. Therefore, this study was conducted with the objective to evaluate the nutritive value of pigeon pea leaves and its effect on growth performance of Abergelle yearling rams under the farmers management practice.

MATERIALS AND METHODS

Description of the study area

This on-farm experiment was conducted at Adiha irrigation schemes of the International Fund for Agricultural Development (IFAD) supported project, Kolatembien district, Tigray regional state in northern Ethiopia. The district is located at N130 37'06" latitude and E390 00'07" longitudes. Annual rainfall ranges from 500-800 mm and the annual temperature ranges from 25-30°C. Crop-livestock mixed agricultural farming system is practiced in the district.

Experimental animals and treatments

A total of 24 rams aged from 8-12 months were used to conduct the experiment. Ages of the experimental rams were estimated by asking the owners about their dentition. Farmers were selected based on their willingness to provide their own intact male rams. A farmer provided three rams and eight farmers participated in this experiment. Each farmer was given a treatment randomly and two farmers received the same treatment. The average initial weights of the experimental rams were 20.14 kg (means ± 3.9 SD). Complete randomized design (CRD) was applied and initial weight and age of the rams were taken as covariant variables. The initial body weight was taken after overnight fasting of the experimental rams at the end of adaptation period and at the beginning of the actual feeding trial. The treatments were farmers' practice (T1), T1 + 200 g of dried pigeon pea leaves (DPPL), T1 + 300 g DPPL, and T1 + 400 g DPPL. All experimental rams were grazed on the pasture land equally for about 10 h per day and the leaves for the supplemented group were provided after they return from the field.

Harvesting of the supplemental feed

Pigeon pea (*Cajanus cajan*) leaves were collected from the irrigated forage sites of Abergelle Agricultural Research Center. The research center provided dried pigeon pea leaves (DPPL) and the rams were fed for about 60 days excluding the two weeks adaptation period. Leaves including twigs and petioles were harvested and dried for four to five days until they were crushed by hand in a shadow area to minimize nutrient loss, packed in sacks, stored in air-ventilated room, and transported to farmers' house.

Animal management and feeding

Before starting the actual experiment, experimental rams were de-wormed using albendasol 7.5 mg/kg in two weeks interval to kill the adult internal parasite and the later for matured hatched eggs. They were also sprayed with diazinone against the external parasites. Rams were ear tagged for identification purpose and housed according to the farmers' management practice. The supplemented rams grazed in their grazing area for the whole day but were supplemented with half of the DPPL in the morning and half after they returned from the field, whereas the non-supplemented rams grazed/browsed in the communal grazing/browsing areas for the whole day.

Live weight change

Live weights of the experimental rams were measured in the morning time before feeding and watering and weighed with the help of spring balance every two weeks. The live weight gains were recorded every two weeks during the 60 days

Table 1. Chemical composition of different forms of pigeon pea feed given to rams.

Parameter (g/kg)	Pigeon pea		
	P1	P2	P3
Dry matter	933	904.	909
Crude protein	258	236	104
Crude fiber	208	263	450
Crude fat	64.7	44.5	27.1
Ash	110	81.8	53.3
Magnesium	3.02	2.76	2.65
Calcium	8.64	6.62	6.98
Iron	0.66	0.25	0.15
Total phosphors	2.2	2.3	1.3

P1 = Pigeon pea leaf only; P2 = Pigeon pea leaf-twig mixed; P3 = Pigeon pea twigs only.

experimental period and were calculated as follow:

$$\text{Live weight gain (LWG)} = \frac{\text{Final weight- Initial weight}}{\text{Number of days}}$$

Chemical analysis

Feed samples with triplicate were analyzed for dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash according to the methods of AOAC (2005). The major minerals such as Magnesium (Mg), Calcium (Ca), Phosphorus (P) and trace minerals such as Iron (Fe) were also determined. These minerals were analyzed using Ash-Direct Air-Acetylene Flame Method (FAAS).

Statistical model and data analysis

The collected data on feed intake and body weight change were analyzed using ANOVA techniques of SAS (2002) statistical software. The treatment means were calculated using LSD test. Initial weights and age of the rams were taken as covariance variables. The statistical model was:

$Yijk=\mu+\alpha i+Ij+Ak+\varepsilon ijk$

where:

$Yijk$ = response variable; μ = overall mean; αi = i^{th} treatment effect; Ij = initial weight effect; Ak = age effect; εijk = random error.

RESULTS

Chemical composition

The dry matter and CP value of pigeon pea leaf-twig mixed were 904 g/kg and 236 g/kg, respectively which was the main feed for the rams (Table 1). The twig of pigeon pea was palatable and its mineral content (Mg, Ca and Fe) was almost similar with pigeon pea leaves alone and mixed (twigs and leaves). However, the crude protein (CP) content of pigeon pea twigs was lower than pigeon pea leaves and the mixed one. The CP content of this leaf is above the acceptable ruminal microbial activity and the maintenance requirement (7%) of the sheep. Therefore, crude protein content of the pigeon pea leaves can be used not only for body maintenance but also for production purpose.

Supplement intake

Dry matter and crude protein intake of rams supplemented with the graded level of DPPL showed significant difference ($P<0.05$) among the treatments. The crude protein and dry matter intake presented in Table 2 were obtained from the supplemented feed only. However, crude protein and dry matter intake obtained from browsing/grazing was not known as it was difficult to estimate. However, *Zizihpus spina-christi*, *Terminalia brownie*, *Acacia tortilis, Acacia etibica*, *Dichrostachys cinerea, Sterculia africana were* some of the commonly fed browse tree species. Similarly, grass species like *Cynodon dactylon, Andropogon spp., Astragalus abyssinicus, Hyparrhenia spp., Trifolium spp., Eragrostis spp., Eleusine ficifolia, Pennisetum schimperi, and Dactyloctenium aegyptium* were some of the crude protein sources in the grazing land.

Body weight change

Average daily body weight gain of the rams supplemented with DPPL had significant difference ($P<0.05$) as compared to the rams fed on grazing land. This was mainly due to high crude intake which boosts rumen microorganisms that facilitate the digestibility. However, rams supplemented with 200, 300 and 400 g dried pigeon pea leaves had not any statistical difference though there was numerical difference (Table 3). Farmers' management including housing system, feed searching or grazing behavior of the rams, and feed availability difference from farmers to farmers affected the weight gain of the rams (Figure 1).

DISCUSSION

Pigeon pea leaf is used as fodder and valuable source of feed for farm animals (Foster et al., 2009). It is a relatively drought-resistant plant, which can thrive in a harsh environment in tropical region of the world, particularly sub-Saharan Africa (Ajebu et al., 2013). Currently, this legume crop is introduced to different agro-ecological condition of Tigray region. However, pigeon leaf is not well utilized as livestock feed due to lack of awareness and the seed as human food mainly due to low palatability as compared to chickpea and cowpea and

Table 2. Dried pigeon pea leaves supplement intake of Abergelle rams fed grazing as basal diet.

Parameter (g d^{-1} h^{-1})	Treatment					
	T1	T2	T3	T4	SE	P
DMI of DPPL	0.00	169[c]	246[b]	314[a]	2.98	0.001
CPI of DPPL	0.00	44.1[c]	64.2[b]	82[a]	0.78	0.001

[abc] Means within a row not bearing a common superscript letter differ at P<0.05; DMI of DPPL = Dry matter intake of dried pigeon pea leaves; CPI = Crude protein intake; SE = Standard error; T1 = free grazing; T2 = T1+200 g DPPL; T3 = T1+300 g DPPL; T4 = T1+400 g DPPL.

Table 3. Live weight change of Abergelle rams supplemented with dried pigeon pea leaves fed grazing as basal diet.

Parameter	Treatment					
	T1	T2	T3	T4	SE	P
IBW (kg)	20.8	20.8	19.2	19.7	1.36	0.769
FBW (kg)	21.7[b]	23.5[a]	22.1[b]	23.0[a]	0.38	0.001
ADBWG (g/d)	14.9[b]	44.4[a]	48.3[a]	54.4[a]	0.341	0.012

[ab] Means in the same row with different superscripts differ at P<0.05; SE = Standard error; IBW = Initial body weight; FBW = Final body weight; ADBWG = Average daily body weight gain.

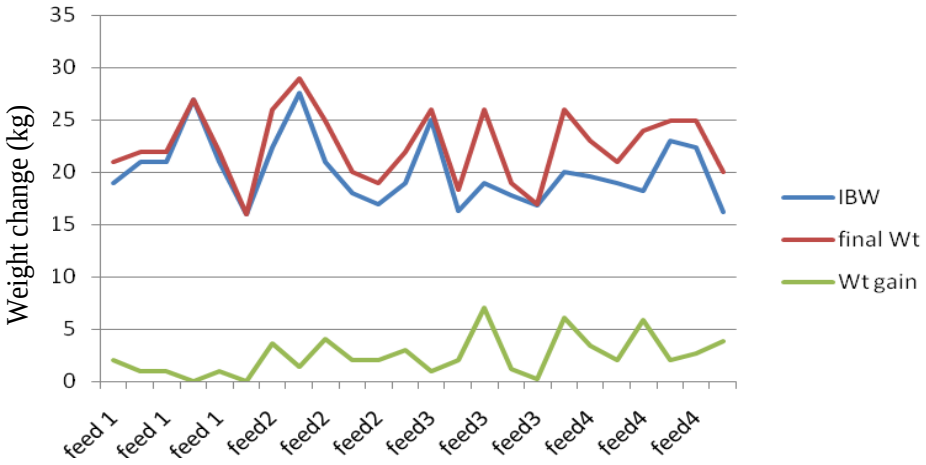

Figure 1. Graphical expression of the trend in weight change (Feed = Treatment).

the lack of know how they have. In the present study, pigeon pea leaf mixed twigs (the main feed of the rams) had a crude protein content of 236 g/kg. Similarly, Alexander et al. (2007) and Ajebu et al. (2013) also reported a crude protein content of 163-270 g/kg and 230 g/kg of the pigeon pea leaves, respectively. In this study, chemical composition of pigeon pea leaves and young stem mixed was 263 g/kg crude fiber, 44.5 g/kg crude fat, 81.8 k/kg ash, 2.76 g/kg, Mg, 6.62 g/kg Ca, 0.25 g/kg Fe and 2.3 g/kg P. Similarly, Nestanet and Yonatan (2015) also reported that pigeon leaves have a crude protein content of 216 g/kg, 305 g/kg crude fiber, 42.5 g/kg crude fat, 548 g/kg NDF and 398 g/kg ADF. Pigeon pea has also condensed tannin content of 7.9 g/kg (Nestanet and Yonatan 2015). Shumuye and Yayneshet (2011) reported that condensed tannin content ranging from 8.2-18.7 g/kg did not cause any digestion problem in goats supplemented with treated Acacia saligna leaves. Tannin levels in excess of 50 g/kg dry matter can lead to low palatability, reduce digestibility, lower intake, inhibit digestive enzymes and can be toxic to rumen micro-organisms (Kumar and Vaithiyanathan, 1990). Likewise, Silanikove et al. (1999) reported that in ruminant's diet, condensed tannin content above 30 g/kg has a negative

effect on feed intake, digestion taking place in the rumen, intestinal activity of pancreatic enzymes and finally hinders amino acid absorption from the intestine. However, Nestanet and Yonatan (2015) reported that pigeon pea leaf had low tannin content as compared to the other browse tree or shrub species. As a result, pigeon pea leaf was palatable and could not cause any negative effect in feed intake of the sheep. Industrial by-products such as wheat bran have crude protein content of 201 g/kg (Solomon and Simret, 2008) and noug (*Guizotiaabyssinica*) seed cake 318 g/kg (Ajebu et al., 2013). Therefore, this locally available and less expensive feed resource can replace the industrial concentrate feeds.

The current weight gain is higher than the weight gain (20.9 g/day) reported by Ajebu et al. (2013) for rams supplemented with sole pigeon leaves and grass hay as basal diet. The difference might be due to the additional feed intake and other management factors. However, it was lower as compared to the weight gain (70.2-92.7 g/day) of goats supplemented with pigeon pea leaves fed grazing as basal diet (Shenkute et al., 2013 cited in Ajebu et al., 2013).

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