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Evaluation of the effect of Pigeon pea dried leave supplementations on feed intake and live weight change on local sheep breed in Eastern Amhara, Ethiopia

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Abstract

The trial was conducted in 2014 in Sirinka Agricultural Research Center feeding trial barn. Twenty five yearling male intact local sheep were used for the experiment in a 90 day trial to evaluate the effect of pigeon pea dried leaves on feed intake and live weight change. The five treatments were (T1) Teff straw + 220g wheat bran+ 211g noug seed cake(Control); (T2) Teff straw + 110g wheat bran + 158g noug seed cake + 199 pigeon pea; (T3) Teff straw + 110g wheat bran + 105g noug seed cake + 294 pigeon pea; (T4) Teff straw + 110g Wheat bran + 53g noug seed cake + 389 pigeon pea; and (T5) Teff straw + 588 pigeon pea in dry matter basis. Pigeon pea leave were harvested from trial site of forage research unit of the center. The forage was harvested at about 50% flowering and 1m height, sun dried and stored for the feeding trial. The NDF and CP contents of Nouge seed cake were higher than the pigeon pea leave and wheat bran feeds (Table 1). However, pigeon pea leave had the highest ash content compared to the other feeds. The NDF, ADF, and ADL contents of the teff straw were higher than the contents of pigeon pea leave and concentrate feed, where as CP content of the teff straw was the lowest. The nouge seed cake had the lowest ADL content than the other three feeds. There was significant difference ($P < 0.05$) between pigeon pea supplemented and control group in total feed intakes. The average daily body weight gain for T1, T2, T3, T4 and T5 was 35.33, 49.33, 52.22, 54.67 and 32.22 g/day, respectively. However, there was no significant difference ($P > 0.05$) in daily body weight change parameters among treatments. Pigeon pea leave hay can be used as an alternative home grown supplement feed (protein source) in sheep feeding. Supplementing of pigeon pea hay up to 389g mixed with 110 g wheat bran and 53 g noug seed cake per day for growing rams can improve body weight gain without any adverse effect on the performance of sheep.

Keywords: sheep, intake, pigeon pea, body weight gain.

Introduction

Pigeon pea is importance in soil conservation along highways and mountain slopes particularly against soil erosion caused by wind and water (Saxena 2000). Pigeon pea is an interesting plant to use as animal feed due to the relative high crude protein 16.3-27 % (CP) content in leaves (Alexander *et al*., 2007). Pigeon pea produces forage quickly and can be used as a short-lived perennial forage crop. The leaves and young pods can be fed to the animals fresh or they can be harvested and conserved. The perennial habit of the

crop makes it valuable as a stand over high-protein fodder for those times of the year when protein shortage is the major limit to production.

The limitation in utilizing it as a mono gastric feed are the presence of toxic substances, trypsin and chemo trypsin inhibitors (Jumbunatha and Singh, 1981). However, the anti-nutritional factors in pigeon pea are less than they are in soybean, field pea, and common bean (Kamath and Belavady 1980). Its potential use as ruminant feed is expected to be higher, due to the presence of micro-organism in host's fore-stomach which assists the animal to rely less on amino acid pattern and/or tolerate better on high fiber content and toxic substances in feed. Positive effects on animal performance have been reported when cattle grazed on pegion pea bush pasture (Norton, 1981).

In Ethiopia, where the dry season covers over six months of the year, browsing and crop residues are the major source of nutrients consumed by sheep and goat in the dry seasons (EARO, 2000; Abule et al., 2003; Alemayehu, 2003). In these months, the existing feeds are low in protein and high in fiber content, which in turn can limit their feeding value for sheep and goat (Van Soest, 1982).

According to McDonald et al. (1988), when small ruminants depend on such low quality diet voluntary feed intake and digestibility are low. Consequently, animal performance is poor due to lack of adequate dietary protein and energy intake. In addition, lack of substantial nutrient supply from the feed to a body of the kids might increase susceptibility to disease and parasites (Markos, 2006; Getahun, 2008).

This in turn leads to stunted growth and lower market weight of the kids within a reasonable time frame. To mitigate the problem, a number of strategies have been tested in the past to improve the protein and energy nutrient supply in the rumen in order to create suitable environment for optimum fermentation and maximum microbial protein synthesis. Practically this can be achieved using agro-industrials by products such as oil seed cakes and forage legumes that can serve as a protein supplement depending on the farmer economic levels. Of this, adapted multipurpose trees can be used as cheap source of protein supplements to improve the utilization of poor quality dry pasture and crop residues. Pigeon pea has a better N-fixing ability even in its unfertilized condition (Myaka et al., 2006).

Pigeon pea is well adapted to the climate and uniquely combines optimal nutritional profiles, high tolerance to environmental stresses, high biomass productivity, most nutrient and moisture contributions to the soil. It is widely used as fodder and feed for livestock. Its foliage is an excellent fodder with high nutritional value (Onim et al., 1985). Therefore, this experiment was set up to measure the growth responses of local sheep to graded levels of pigeon pea leaves supplementation. Thus, this trial was conducted with the objective of evaluating the effect of feeding dried leaves of pigeon pea on feed intake and live weight change of local sheep fed teff straw as a basal diet.

Materials and Methods

Description of the study area

The experiment was conducted at Sirinka Agricultural Research Center, located in eastern Amhara region of Ethiopia (11˚45'00"N, 39˚36'36"E.) about 508 km north east of Addis Ababa at an altitude of 1850 m.a.s.l. The mean annual rainfall for the year 2014 was 950 mm. The rainfall pattern is bimodal. The main rainy season occurs from June to September and the short rainy season; which is usually erratic occurs from February to April. The mean maximum and minimum temperature of the area are 26˚C and 13˚C, respectively.

Experimental animals and treatments

Twenty five yearling male intact local sheep were used for the experiment. The experimental animals were purchased from local markets in the study area. Before the beginning of the experiment all animals were treated against internal and external parasites. During the experiment the experimental animals were penned individually and blocked in to five blocks of five animals based on their initial weight.

The animals within a block were randomly assigned to one of the five treatment feeds. Teff straw (chopped) was used as basal diet and it was provided ad libtum. The five experimental feeds were Teff straw + 220g wheat bran+ 211g noug seed cake(Control) (T1); Teff straw + 110g wheat bran + 158g noug seed cake + 199 pigeon pea (T2); Teff straw + 110g wheat bran + 105g noug seed cake + 294 pigeon pea (T3); Teff straw + 110g Wheat bran + 53g noug seed cake + 389 pigeon pea (T4); and Teff straw + 588 pigeon pea in dry matter basis (T5). Pigeon pea leaves were harvested from trial site of forage research unit of the center. The forage was harvested at about 50%

flowering and 1m height. Then it was sun dried and stored for the feeding trial under a shade.

The treatment diets were offered twice a day at 8:00 h and 16:00h in two equal portions. Feed offered to the experimental animals and corresponding refusals were recorded daily throughout the experimental periods to determine daily feed intake.

Body weight measurements were taken every fortnight after overnight fasting and daily body weight gain was determined as a difference between final and initial body weight divided over the feeding days. Feed conversion efficiency was calculated as the proportion of daily weight gain to daily dry matter intake.

Determination of chemical composition

Composite samples of sundried leaves, wheat bran, nouge seed cake and teff straw were taken for chemical composition. The oven dried samples were ground in a Willey Mill to pass through 1 mm sieve for the determination of chemical composition. Feed samples were analyzed for DM and ash using the method of AOAC (2000). Nitrogen was determined using the micro-Kejeldhal method (AOAC, 2000). Crude Protein (CP) was calculated as N × 6.25. The Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF) and Acid Detergent Lignin (ADL) were analyzed according to Van Soest et al. (1991).

Statistical analysis

Feed intake and body weight changes were analyzed for the treatment differences using General Linear Model procedures in SAS (2000). Mean differences were considered significant at $P<0.05$ and mean separation among treatments was done using the Duncan's Multiple Range Tests.

The model of the experiment was:

$$Y_{ij} = \mu + t_i + b_j + e_{ij}$$

Yij= the response variable (the observation in j^{th} block and i^{th} treatment), μ= overall mean, ti = treatment effect, bj = block effect and eij= random error

Results and Discussion

Chemical composition of treatment feeds

The chemical composition of leaves is shown in table 1. The NDF and CP contents of Nouge seed cake were higher than the pigeon pea leaves and wheat bran feeds (Table 1). However, pigeon pea leaves had the highest ash content compared to the other feeds. This because of Pigeon pea leave had higher mineral content than other supplements. The NDF, ADF, and ADL contents of the teff straw were higher than the contents of pigeon pea leaves and concentrate feed, where as CP content of the teff straw was the lowest. The nouge seed cake had the lowest ADL content than the other three feeds.

Table 1. Chemical composition of the different treatment feeds

	Nutrient content in percentage					
Feed type	**CP**	**DM**	**NDF**	**ADF**	**ADL**	**Ash**
Teff straw	4.73	89	84.20	62.22	30.71	8.4
Noug cake	20.31	90	64.44	15.15	6.6	5.5
Pigeon pea	17.01	89	53.33	29.29	24.4	9.1
Wheat bran	12.56	90	30.14	23.64	13.04	14

DM dry matter; *CP* crude protein; *NDF* neutral detergent fibre; *ADF* acid detergent fibre; *ADL* acid detergent lignin.

The CP content of pigeon pea in the current experiment was within the range 162.5 to 250 g/kg DM reported by Alexander *et al*. (2007) for 200 pigeon pea germ plasms. However, the CP content of pigeon pea leaves in the present study was higher than the values 213 and 200 g/kg DM reported by Shenkute*et al*. (2013) and Cheva-Isarakul (1992), respectively. Foster *et al.* (2009), Jokthan (2006) and Karbo *et al*. (1998) reported CP contents of 137, 158 and 132 g/kg DM, respectively, which is lower than the value observed in this experiment.

Feed intake

There was significant difference ($P < 0.05$) in total intake among T1 and other treatment groups (Table 2). The result of this study indicated that as the proportion of pigeon pea leave increases there was an increment in feed intake. However; this increment in the proportion of pigeon pea had no effect on teff straw intake.

Table 2. Intake of local sheep on teff straw and supplemented.

Item	T1	T2	T3	T4	T5	SL
Teff straw intake (g/day)	340.86	377.96	365.36	368.14	357.17	ns
Supplements intake (g/day)	405.77^{e}	462.17^{d}	503.05^{c}	524.48^{b}	557.16^{a}	***
Total intake (g/day)	746.63^{c}	840.13^{b}	868.41^{ab}	892.63^{ab}	914.34^{a}	*

Total intake (g/day) among treatments ranged between 746.7 and 914.34. This difference in total intake was significant ($P < 0.05$). When the amount of pigeon pea is increased total feed intake has improved. Similar study in India showed that pigeon pea has the potential to improve intake of low quality herbage (Karachi and Zengo, 1998).

According to Bonsi *et al.* (1994), the positive effects of supplementation on feed intake may have been a reflection of the increase in the intake of essential nutrients such as energy, vitamins, minerals and in particular nitrogen (N). Leguminous fodder trees, as supplements, alleviate N deficiency thereby improving the rate of degradation of the basal diet and the fractional rate of liquid matter from the rumen and hence improve feed intake.

Moreover, leguminous fodder trees increase protein supply to the host animal by increasing the supply of both degradable and un-degradable protein, and by creating a favorable rumen environment resulting in enhanced fermentation of the basal roughage and thus increased microbial protein synthesis (Osuji et al., 1995).

Body weight changes

Average daily weight gain was not significantly different among treatments (Table 3).The similarity in body weight gain among treatments reflects that the supplements are comparable in their nutrient supply. This could be due to the similar DM intake and digestibility.

The body weight gain of sheep in the current study was higher than reported by Ajebu *et al.* (2013). However; similar with reported by Karachi and Zengo (1998) and Keba (2009) which shows that increased body weight gain by increasing the amount of pigeon pea leaves.

In the current experiment high noug seed cake supplementation (T1) resulted in a weight gain of 35.33 g/day which was similar to those supplemented with high pigeon pea leave (T5) (32.22 g/day) which indicates the significance of pigeon pea leave as a CP supplement. Similarly, Ahmed and Abdalla (2005) fed different sources of protein (cotton seed cake, sesame seed cake, groundnut cake and sunflower seed cake) to sheep and observed similar weight gain among the different sources.

However, increment in the amount of pigeon pea leave to 588g per day decrease body weight gain. This is due to several anti nutritional factors, namely, protein inhibitors, amylase inhibitors, and flab causing sugar and phytic acid which cause digestion fail. Pigeon pea contains some amount of polyphenolic compounds (tannins) that inhibit the digestive enzymes—trypsin, chymotrypsin, and amylase. These compounds create problems when pigeon pea is consumed in large quantities. In addition to the above reason T5 had no any energy source which could be another factor for lower body weight gain.

Table 3. Body weight change parameters of local sheep fed teff straw and supplemented with commercial concentrate, pigeon pea leaf and their mixtures at different proportions.

Item	T1	T2	T3	T4	T5	SL
Initial BW(Kg)	23.88	24.32	23.64	24.64	24.08	ns
Final BW(Kg)	27.06	28.76	28.34	29.56	26.98	ns
ADG (g/d/head)	35.33	49.33	52.22	54.67	32.22	ns
FCE	0.047	0.059	0.060	0.061	0.035	ns

ADG (g/d/head) Average Daily Gain, FCE Feed Conversion Ratio, BW Body weight.

One of the limitations of this study is that at the end of the experiment we were not able to do nutrient composition analysis for the different feed samples we collected. Hence, we were not able to calculate the nutrient intake and digestibility of the different nutrients as planned. In addition the feed intake was not calculated in dry matter basis

Conclusion and recommendation

According to the results of this study dried pigeon pea leave can be used as a substitute for concentrate mixture in the diets of growing local ram lambs fed on teff straw as basal diet. There was no any palatability problem observed on pigeon pea hay used in this experiment. Thus pigeon pea hay can be used as an alternative home grown supplement feed (protein source) in sheep feeding. Supplementing of pigeon pea hay up to 389g mixed with 110 g wheat bran and 53 g noug seed cake per day for growing rams can improve body weight gain without any adverse effect on the performance of sheep.

Finally we recommend that this experiment was the first of its kind in our locality which was done under experimental station. Thus, further on-farm evaluations under farmers condition has to be done.

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