International Journal of Agricultural Extension and Rural Development Studies
Vol.3, No.2, pp.34-42, May 2016
Published by European Centre for Research Training and Development UK (www.eajournals.org)

THE EFFECT OF SUBSTITUTION OF DRY BAMBOO LEAVES AT DIFFERENT PROPORTIONS WITH CONCENTRATE MIX ON FEED INTAKE, DIGESTIBILITY AND LIVE WEIGHT GAIN OF LOCAL SHEEP FED TEF STRAW

Eyob Gebreziabhear

Debre Zeit Agricultural Research Center, P.O.Box 32, Debre Zeit

ABSTRACT: *A feeding and digestibility trials were conducted at Assosa ATVET college, Benishangul-Gumuz Region, Ethiopia, using twenty five yearling local sheep weighing on average 18.7 ± 2.12 (mean ± SD) kg, to investigate the effect of substituting dry bamboo leaves in a concentrate mix on feed intake, digestibility and body weight (BW) gain of sheep. A randomized complete block design with five treatments and five replications was used to conduct the experiment. The treatments included feeding a basal diet of tef straw alone (T1, control), and supplementation with dry bamboo leaves at 100% (T2), 67% bamboo leaves hay and 33% concentrate mixture (T3), 67% concentrate mixture and 33% bamboo leaves hay (T4)and100% concentrate mixture (T5).The supplements were given at 300g DM/head/day The concentrate mixture consisted of wheat bran (WB) and noug seed cake (NSC) at the ratio of (2:1). The animals were housed in individual pens and daily offered tef straw, allowing 35% refusal. Water and salt block comprising of sodium chloride were available free choice. The results indicated that there were higher (P<0.001) total DM intake in the supplemented (775.2-798.5 g/head/day) than the control (502 g/head/day) treatment. The group that consumed tef straw alone and those supplemented with 67:33 concentrate to bamboo mix (T4) consumed more (P<0.001) basal diet than the other treatments Sheep supplemented with the dry bamboo leaves and concentrate mix at different proportions had higher (P < 0.001) CP intake than the control ones. The CP intake was 40.9, 100.9, 96.2, 93.9 and 88.5 g for T1, T2, T3, T4 and T5, respectively. Similarly, there was higher (P<0.001) daily BW gain in the supplemented sheep (14.4-36g/head/day) than in the control (-37g/ head /day) ones. The digestibility of CP (P<0.001) DM and OM (P<0.001) were higher in the supplemented than in the control treatment.*

KEYWORDS: Bamboo, Wheat Bran, Noug Seed Cake, Tef Straw

INTRODUCTION

Livestock production sector shares about 45% of the total agricultural output in Ethiopia and 16% of the total gross domestic product (CSA, 2012).The annual national mutton production is 77 metric tones and has high average off-take rate estimated to be 30%. Sheep contribute 21% of the total ruminant livestock meat output(Ameha, 2010).Sheep contribute a substantial amount to the farm household as income, mutton and non mutton products such as manure, skins, and coarse wool. They are source of risk mitigation during crop failure, of property security and monetary savings and investment in addition to many other socio-economic and cultural functions. As population pressure increases and farm size decrease, the roles of large ruminants reduce and small ruminants that constitute less competition for arable land predominate (Peacock, 2005). The major feed resources in Ethiopia for sheep production are natural pasture, crop residues, aftermath, browse species and agro-industrial by-products and to a lesser extent improved pasture and forage crops (Seyoum and Zinash, 1989).

Print ISSN: ISSN 2058-9093 Online ISSN: ISSN 2058-910

To alleviate inflation price of concentrates, supplementation of bamboo grass could be an alternative to unavailable and expensive protein concentrate. Ethiopia has about 1 million ha of high- and lowland bamboos, the latter being more dominant (850,000ha). The lowland bamboo (*Oxytenanthera abyssynica*) in Ethiopia grows only in the western part of Ethiopian lowlands and emerges into the Savannah woodlands of Sudan. It occurs mainly between 1000 and 1800 m.a.s.l. It has not been planted so far.

MATERIALS AND METHODS

Description of the Experimental Site

The experiment was conducted at Assosa Agricultural Technical Vocational and Educational Training (ATVET) College. Assosa is located at latitude of 11° 83' N and longitude of 39° 68' E with an altitude of 1540 m.a.s.l. The area receives mean annual rainfall of 1270 commencing towards the end of April and ending in November. Its mean annual temperature ranges between 16.75 ºC and 27.9 ºC with mean maximum and minimum annual temperature of 26°C and 13°C, respectively.

Management of experimental animals

Twenty five intact male yearling local sheep with mean initial BW of 18.7 $\pm$ 2.12 (mean $\pm$ SD) were purchased from Bambasi open market and used in an experiment that lasted for 7 days of digestibility trial and 90 days of feeding trial. The age of the animals were determined by dentition and information obtained from the owners. The experimental animals were dewormed against common internal parasites using antihelmintics, and vaccinated against common diseases (pneumonia and trypanosomiasis) during the quarantine period of 15 days.

Then the experimental sheep were housed in an individual pens and offered tef straw, dry bamboo leaves and concentrate mix (wheat bran and noug seed cake mixtures) according to the respective treatment for 15 days to get them adapted to the feeds prior to the beginning of the experiment. The pens were equipped with feeding troughs for tef straw, dry bamboo leaves, and buckets for concentrates and water separately. The experimental sheep were identified using ear tags.

Experimental design and treatments

A completely randomized block design consisting of five treatments (Table 1) were used to conduct both the digestibility and feeding trials. The sheep were blocked into five blocks of five animals based on initial BW. The initial BW of the sheep were determined as a mean of two consecutive weighing after overnight withholding of feed at the beginning of the acclimatization period and randomly assigned to one of the five treatments.

Print ISSN: ISSN 2058-9093 Online ISSN: ISSN 2058-910

Table 1. Experimental treatments.

Treatments	(Tef straw)	Supplement feed type and ratio		Supplement (g DM /day)
		Bamboo leaves (%)	Concentrate mix (*)	
Treatment 1	*ad libitum*	0	0	-
Treatment 2	*ad libitum*	100	0	300
Treatment 3	*ad libitum*	67	33	300
Treatment 4	*ad libitum*	33	67	300
Treatment 5	*ad libitum*	0	100	300

(*) Concentrate mix is prepared from WB and NSC at 2:1ratio.

Digestibility Trial

The digestibility trial was conducted before the feeding trial using the 25 experimental sheep after the acclimatization period of 15 days. The sheep were fitted with fecal collection bags for three days before the resumption of actual collection of feces for seven consecutive days. Total feces voided and collected in the harness were weighed daily in the morning. Twenty percent of the daily fecal excretion of each sheep was sampled after thorough mixing and pooled over the experimental period in a plastic bag and stored in refrigerator at -20^{o}C.

After seven days of fecal collection period, samples taken daily from each animal were thoroughly mixed and twenty percent sub-sample for each animal was taken. These were oven dried at 60^{o}C for 72 hours at Assosa Animal Health Laboratory. The dried samples of the experimental feeds, refusals and feces were taken to Haramaya University Laboratory where they were ground to pass through 1 mm sieve for chemical analysis.

The apparent digestibility coefficients (DC) of nutrients were calculated by using the equation:

$$\text{Apparent digestibility} = \frac{\text{Nutrient intake - Nutrient in feaces}}{\text{Nutrient intake}}$$

Chemical Analysis

The DM, ash and N contents of feed offered and refusals as well as feces were analyzed according to AOAC (1990) procedure. The CP content was calculated as N x 6.25. Organic matter (OM) content was calculated as the difference between DM and ash content on DM basis. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were analyzed by using the procedures of Van Soest and Robertson (1985). Cellulose and hemicelluloses were calculated as the difference between NDF and ADF, and ADF and ADL, respectively.

Statistical Analysis

Data in the experiment, which include feed-intake BW change and digestibility, were analyzed using the analysis of variance model for completely randomized block design according to the general linear model procedure of SAS (2002). Differences between treatments means was tested using least significant difference (LSD) test. The correlation between the nutrient intake, digestibility, BW change and carcass characteristics were determined using the statistical analysis system SAS (2002).

Print ISSN: ISSN 2058-9093 Online ISSN: ISSN 2058-910

The model used for the analysis of data collected in the experiment was:

$Y_{ij} = \mu + T_i + \beta_j + \varepsilon_{ij}$ Where:

Y_{ij} = the response variable (the observation in j^{th} block and i^{th} treatment
μ = the overall mean
T_i = the treatment effect
β_j = the block effect
ε_{ij} = the random error

RESULTS

Chemical Analysis of Treatment Feeds

The chemical composition of experimental feeds offered and refused is presented in Table 2. The crud protein content of tef straw was below maintenance requirement of sheep (68.3 g/kg DM).The straw contained high NDF (810.9 g/kg DM) and ADF (504.4 g/kg DM).The crud protein content of Lowland bamboo (*Oxytenathera abyssinica)* leaves (205 g/kg DM),wheat bran(112.1 g/kg DM), noug seed cake (322.3 g/kg DM) and concentrate mixture(2WB:1NSC) (155.9 g/kg DM) can satisfy production requirement of sheep.

The chemical composition of treatment feeds is given in Table 2.

Variables	DM (g/kg)	Ash	OM	CP	NDF	ADF	ADL	Hemi-cellulose	Cellulose
		(g/kg DM)							
Tef straw	896.8	59.7	837.1	68.3	810.9	504.4	77.9	306.5	426.5
BLH	911.2	103.6	807.6	205	730.4	408	87	322.4	321
WB	884.5	46.9	837.6	112.1	452	127.9	27.3	324.1	100.6
NSC	909.8	119.7	790.1	322.3	411.5	310.1	57	101.4	253.1
2WB:1NSC	882.5	71.1	811.4	155.9	511	214.3	59.2	296.7	155.1
Tef straw refusal									
T1	887.6	51.9	835.7	28	863.7	544.7	75.5	319	469.2
T2	885.7	44	841.7	40.3	853.3	559.8	80.3	293.5	479.5
T3	896.4	54.7	841.7	42	863.4	549.2	63.6	314.2	485.6
T4	896.4	55.8	840.6	29.8	752.8	552.2	96.1	200.6	456.1
T5	889.2	64.2	825	28	848.9	534.6	77.1	314.3	457.5

ADF = Acid detergent fiber; ADL = Acid detergent lignin; BLH=bamboo leaves hay; CP = Crude protein, DM = Dry matter, NDF = Neutral detergent fiber; NSC = Noug seed cake; OM = Organic matter. WB = Wheat bran

Print ISSN: ISSN 2058-9093 Online ISSN: ISSN 2058-910

Dry Matter and Nutrient Intake

Sheep supplemented with T_4 had significant difference ($P < 0.001$) on total dry matter intake compared with T_3; T_2 andT3.Sheep supplemented with T_2, T_3, T_4 andT_5 had no significance difference on total DM intake per metabolic body weight (g/kg $W^{0.75}$)compared with T_1. There was no significant difference on organic matter intake among sheep supplemented with T_2, T_3, T_4 andT_5 Sheep supplemented with T_2 had highest CP (100.9 g/day) compared with T_3(96.2 g/day), T_4 (93.9 g/day) ,T_5(88.5 g/day) and T_1(40 g/day)

Table 3. Daily feed intake of local sheep fed basal diet of tef straw and supplemented with bamboo leaves hay and concentrate mixture at different proportions

Feed and nutrients intake (g /day)	T1	T2	T3	T4	T5	SEM	SL
Tef straw DM intake	502.0^{a}	470.4^{c}	481.0^{b}	498.5^{a}	445.2^{d}	0.84	***
Supplement DM intake	0	300	300	300	300	-	
Total DM intake	502.0^{e}	770.4^{c}	781.0^{b}	798.5^{a}	745.2^{d}	0.84	***
DM intake (% BW)	3.0^{b}	4.0^{a}	3.9^{a}	4.0^{a}	3.9^{a}	0.19	***
OM intake	465.1^{b}	680.4^{a}	691.1^{a}	707.6^{a}	684.4^{a}	5.7	***
CP intake	40.9^{d}	100.9^{a}	96.2^{b}	93.9^{b}	88.5^{c}	0.49	***
NDF intake	473.1^{c}	673.0^{a}	617.7^{ab}	663.2^{ab}	608.9^{b}	15.9	***
ADF intake	271.5^{c}	377.4^{a}	363.4^{ab}	358.9^{ab}	319.5b	9.58	***
Substitution rate		0.10^{b}	0.07^{c}	0.01^{d}	0.19^{a}	0.002	***
Digestible DM intake	270.6^{c}	430.9^{b}	478.4^{a}	481.6^{a}	462.3^{a}	6.77	***
Digestible OM intake	278.5^{d}	409.7^{c}	448^{a}	423.4^{bc}	434^{ab}	5.44	***
Digestible CP intake	21^{d}	72.3^{a}	70.7^{ab}	69.3^{bc}	67.3^{c}	1.08	***
Digestible NDF intake	298.6^{b}	406.5^{b}	434.9^{a}	422.8^{b}	385.1^{c}	6.92	***
Digestible ADF intake	272.2^{bc}	275.1^{ab}	301.1^{a}	258.9^{c}	195.6^{c}	7.58	***

$^{a, b, c}$ = means within a row not bearing a common superscript letter significantly differ. *= ($P<0.05$); ** = ($P<0.01$), ***= ($P<0.001$), ADF= acid detergent fiber. CP= crude protein; DM= dry matter; NDF= neutral detergent fiber; ns = not significant; SEM= standard error of mean; OM= organic matter; SR=substitution rate, CM= concentrate mix ; T1 (control) = Tef straw alone; T2= Tef straw + 300 g/head/d BLH; T3 = Tef straw + 300 g/head/d 2BLH:1CM; T4 = Tef straw +300 g/head/d 1BLH:2CM; T5 = Tef straw + 300 g/head/d CM

Print ISSN: ISSN 2058-9093 Online ISSN: ISSN 2058-910

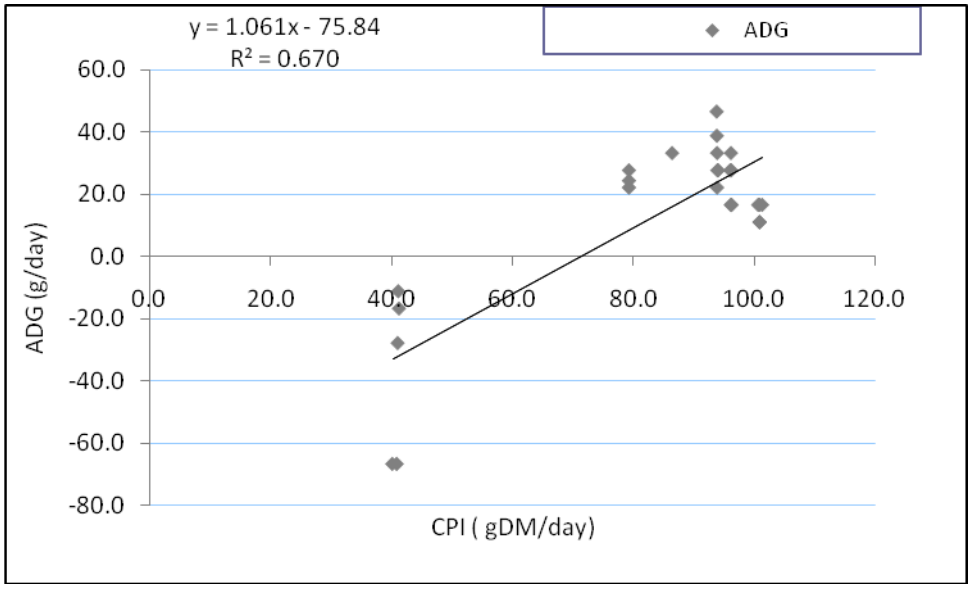

Figure 1. Regression of crude protein intake on body weight gain of local sheep fed tef straw and supplemented with bamboo leaves hay and concentrate mixture at different proportions. ADG= average daily gain; CPI= crude protein intake.

Nutrient Digestibility

Sheep supplemented with T_3 (33% bamboo leaves and 67% concentrate mix) and (0 % bamboo leaves and 100 % concentrate mix) had higher OM compared to sheep placed in (67% bamboo leaves and 33% concentrate mix), T2 (100%bamboo leaves and 0% concentrate mix) and T_1(Control).There was no significant difference in crude protein apparent digestibility among T_3 , T_4 and T_5 .The lowest NDF apparent digestibility was recorded in T2.

Table 4.Apparent digestibility of nutrients in local sheep fed tef straw and supplemented with dry bamboo leaves and concentrate mixture at different proportions

	T1	T2	T3	T4	T5	SEM	SL
Dry matter digestibility	0.56^{b}	0.57^{b}	0.62^{a}	0.62^{a}	0.63^{a}	0.003	***
Organic matter digestibility	0.62^{c}	0.62^{c}	0.66^{a}	0.64^{b}	0.66^{a}	0.005	***
Crude protein digestibility	0.53^{c}	0.73^{b}	0.75^{ab}	0.75^{ab}	0.76^{a}	0.012	***
NDF digestibility	0.65^{a}	0.62^{b}	0.67^{a}	0.66^{a}	0.66^{a}	0.003	***
ADF digestibility	0.77^{a}	0.71^{b}	0.68^{b}	0.64^{c}	0.59^{d}	0.008	***

^{a,b,c,d} =means within a row not bearing a common superscript are significantly different; * = ($P < 0.05$); ** = ($P < 0.01$); *** = ($P < 0.001$); ADF = acid detergent fiber; BLH=bamboo leaves hay; CM= concentrate mix;CP = crude protein; NDF =neutral detergent fiber; ns= not significant; SEM = standard error of mean; SL=significance level; T1=(control) = Tef straw alone; T2= Tef straw + 300 g/head/d BLH; T3 = Tef straw + 300 g/head/d 2BLH:1CM; T4 = Tef straw +300 g/head/d 1BLH:2CM; T5 = Tef straw + 300 g/head/d CM

Print ISSN: ISSN 2058-9093 Online ISSN: ISSN 2058-910

DISCUSSION

Chemical composition of treatment feeds

Tef straw used in the current experiment had low CP content but high value NDF and ADF. Feeds with fiber content exceeding 55% may be low in CP content (below 7%) or in other essential nutrients so as to induce intake limitation through deficiency of nutrients (Van Soset, 1994). Straws are generally characterized by relatively low nutrient content, high fiber content, low digestibility and low voluntary intake (limited consumption) by animals (Adugna, 2008). McDonald *et al.* (2002) which stated that as plants mature the cell wall constituents increase at the expense of other components of the organic matter. Factors such as species and variety of the crops, time of harvest, handling and storage conditions affect the nutritive value of crop residues and might have brought the difference observed between different studies.

Lowland bamboo (*Oxytenathera abyssinica)* leaves used in the current experiment had CP content of 205 g/kg DM, which is comparable to Smith (1991) and Jia-Xin (2001) who reported a CP content of 211 and 186 g/kgDM, respectively, but higher than that reported by Poudal (1991) and Yayota *et al* (2009) who reported 120-150 and 162 g/kg DM, respectively.

Dry Matter and Nutrient Intake

The group that consumed tef straw alone and those supplemented with 67:33 concentrate to bamboo mix (T4) consumed more ($P<0.001$) basal diet than the sheep in the other treatments. The basal diet DM intake was depressed ($P<0.001$) in sheep supplemented with 100% concentrate mix (T5) compared to all the other treatments. The total DM intake was significantly different ($P<0.001$) in the order of T4 > T3 >T2 >T5 >T1 indicating that inclusion of dried bamboo leaves along with the concentrate mix promoted more total DM intake compared to supplementation only with the concentrate mix or dried bamboo leaves or feeding the tef straw without supplementation. The total DM intake as percent of BW was above 3% for all the experimental treatments, however, it was higher ($P< 0.001$) for the supplemented treatments than the control. The observed total DM intake as percent of BW fall within the range of 2% to 4% suggested to be consumed by small ruminants (Schoenian, 2003).

Live Weight Gain

Due to high crude protein intake sheep supplemented with dry bamboo leaves, (wheat bran and noug seed cake mixture) and their mixture at different proportions enhanced daily BW gain of sheep fed tef straw basal diet. In agreement with the present study, Abebe (2008) reported 25-34 g/day gain for Washera sheep fed urea treated rice straw basal diet supple mented with 200-400 g DM/day of noug seed cake, wheat bran and brewery dried grain mixture. Similar to the present result, sheep fed on high protein (HP, 208 g) showed high live weight gain (36.6 g/day) as compared to those fed on low protein (106g/kg DM) which was 10.7 g/day) (Kabir *et al.*,2004). In the present study, the mean daily body weight gain has a positive and a linear correlation for the supplemented groups.

Nutrient Digestibility

Sheep supplemented with T_3, T4 and T_5 had higher CP apparent digestibility compared with sheep placed in T_1. Thus, the lower CP digestibility observed in T1 in the present study was

Print ISSN: ISSN 2058-9093 Online ISSN: ISSN 2058-910

in line with the results of Ferrell *et al.* (1999). The lower (P<0.001) NDF digestibility in T2 compared with the other treatments might be due to high NDF intake.

CONCLUSIONS

This study indicated that supplementation with dry bamboo leaves and concentrate improved feed intake, digestibility, feed conversion efficiency and body weight gain. Among all the treatments supplementation with 33% dry bamboo leaves and 67 % concentrate mix resulted in a better biological performance and profitability.

Acknowledgment

I would like to pass my thanks to ATVET for their financial support. My special thanks also go to Ato Tsdeke Demissie who is acting Dean of Assosa ATVET College for the help rendered either in the management of sheep or data collection and teachers and administrative staff

REFERECES

Abebe Hailu, 2008. Supplementation of graded levels of concentrate mix on Feed Intake, Digestibility, Live Weight Change and Carcass Characteristics of Washera Sheep Fed Urea Treated Rice Straw. An MSc Thesis Presented to the School of Graduate Studies of Alemaya University. 64p.

Adugna Tolera, 2008. Livestock feed supply situation in Ethiopia. Ethiopian Society of Animal Production proceedings: 16th Annual Conference of the Ethiopia. Ethiopian Society of Animal Production (ESAP), 8-10 oct.2008, Addis Ababa, Ethiopia.

CSA (Central Statistical Authority), 2012. Ethiopian Agricultural Sample Surevy (EASS): Report on Livestock and Livestock Characteristics Statistical bulletin Volume III Addis Ababa.

http:// www. Sheep and goat.com/index.html.

Jia-Xin, L., S.Z. Quan, W.X. Qin., 2001. Addition of rice straw or and wheat bran composition on rumenal degradability and voluntary intake of bamboo leaves shells silage fed to sheep. College of Animal Sciences, Huajiachicampus, Zhejiang University, Hangzhau 310029,China.

McDonald, P., A. Edwards J. F.D., Green halgh and C.A., Morgan. 2002. Animal nutrition, 6th.ed. prentice Hall, London. Pp. 544.

Poudyal, P.P., 1991. Utilization of bamboo in the Kathm and Valley of Nepal, In: proceeding of Fourth International Bamboo Workshop on Bamboo in Pacific Asia. Forestry Research Support program for Asia and Pacific (FORSPA) publication 6,technical document GCP/RAS/ 134/ASB,FORSPA, Chiangamai, Thailand and IDRC,Ottawa,Canada, pp259-262.

SAS, 2002. Statistical Analysis System, version 9, Institute, Inc., Cary, NC, USA.

Schoenian, S., 2003. An Introduction to Feeding Small Ruminants Western Maryland Resarch and Extension Center Mary land Cooperative Extension.

Seyoum Bediye and Zinash Seleshi, 1989. The composition of Ethiopian feedstuffs, Research Report No 6. Institute of Agriculture Research (IAR), Addis Ababa, Ethiopia.pp.33.

Print ISSN: ISSN 2058-9093 Online ISSN: ISSN 2058-910

Van Soest, P. J.1994. Nutritional Ecology of the Ruminant. 2nd ed. Cornell University Press, London. pp476.

Van Soest, P. J.1994. Nutritional Ecology of the Ruminant. 2nd ed. Cornell University Press, London. pp476

Yayota, M., J. Karashima, T. Kouketsu, M. Nakano and seasonal changes in the digestion and passage rates of fresh dwarf bamboo (Pleioblastus argenteostriatus f, glaber) in sheep. Animal Feed Science and Technology 149: 89-101

Print ISSN: ISSN 2058-9093 Online ISSN: ISSN 2058-910