Vol. 10(3), pp. 70-76, March 2019
DOI: 10.5897/IJLP2018.0549
Article Number: 4CC1B0A60115
ISSN 2141-2448

http://www.academicjournals.org/IJLP

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International Journal of Livestock Production

Full Length Research Paper

The effect of using either soybean or groundnut straw as part of basal diet on body weight gain, and carcass characteristics of Gumuz Sheep

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Received 10 November, 2018; Accepted 3 January, 2019

The study was conducted to evaluate the effect of soybean or groundnut straw replacement for hay on live weight change and carcass characteristics of Gumuz sheep at Pawe Agricultural Research Centre. Thirty yearling male intact Gumuz sheep with initial body weight of 18.91 ± 2.6 kg (mean ± SD) were used in the experiment. The study consists of 90 days of feeding trial period after acclimatization of 15 days for the treatment feed, followed by evaluation of carcass characteristics at the end. The experimental design used was randomized complete block design. The experimental animals were grouped in to six blocks based on their initial body weight and each animal was randomly assigned to one of the five treatment diets; namely, Hay alone basal diet (control treatment; (T1), 50% Hay + 50% soybean straw (T2), 50% Hay + 50% groundnut straw (T3), 25% Hay + 75% groundnut straw (T4), and 25% Hay + 75% soybean straw (T5). Toasted soybean grain of 172 g and 5% molasses (of daily feed offered) were supplemented for each treatment group equally throughout the experiment period. Water and salt lick were available free choice. Natural pasture hay, soybean straw and groundnut straw contained 7.12, 4.39, and 8.08% CP, respectively. The daily body weight gains of T3 (91.48 g/d) was higher (P<0.01) than other treatment groups, whereas T2 (58.5) exhibited lower daily body weight gain. There was no difference in feed conversion efficiency (FCE) among treatments. The hot carcass weight of sheep in T3 and T4 were higher (P<0.01). The mixture of natural pasture hay with groundnut straw 50:50 or 25:75, respectively, resulted in heavier carcass yield showing the priority basal feed, but use of all combinations of the basal feed resulted in good performance of the Gumuz sheep breed.

Key words: Metekel, natural pasture hay, replacement.

INTRODUCTION

Ethiopia has diverse agro-ecologies and diverse livestock breeds/types which have different adaptations, productivity and utilization in the farming system. Sheep is kept across the agro-ecology and its population is

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estimated to be about 30.70 million. The sheep population is dominated by the indigenous breeds (99.72%) and only exotic breeds like Dorper and Awassi nowadays are used for crossbreeding of the indigenous breeds. The offtake rate of sheep in Ethiopia is about 35% and among the sheep flock two years and older (52.01% of the total sheep), 48.54% are kept for breeding; about 2.60% for mutton and less than one percent of them are kept for wool production (CSA, 2017). The short generation interval, ability to give multiple births and their small size make sheep adaptable to smallholder and mixed crop-livestock production system (FAO, 2000). There are about 17 breeds of sheep in Ethiopia and the Gumuz sheep is the one among these breeds.

Extensive sheep production under traditional communal grazing or browsing system is widely practiced. Sheep from this system provide large amount of domestic meat consumption and generate cash income from exports of mostly live animals and small proportion of meat, and skins. However, the productivity level of sheep is very low. The yield per animal slaughtered is estimated to be 10 kg of mutton (FAO, 2000). Although, there are various and complex constraints, which contributes to these reduced productivities of sheep, the most important limiting factor is feed scarcity.

Soybean [*Glycine max* (L.) Merrill] and Groundnut (*Arachis hypogaea* L.) are among the food /feed crops widely cultivated in the lowland areas of Ethiopia for various uses including raw materials for oil production, cash income, animal feed, increases soil fertility, serve as good intercrop (Geleta et al., 2007; Wijnands et al., 2009; Hailegiorgis, 2010; Jagwe and Owuor, 2014). Soybean production during the last 10 years has increased by 10 fold; while the total volume of production during the same period increased by 21 fold (Mekonnen and Kaleb, 2014). The nutritive value of soybean straw is higher than rice straw but lower than pod husk (Gupta et al., 1973; Krieder, 1979). In localities where these crops are dominant, the crop residues can be well used as alternative basal roughage for animals especially during the dry season. Treated residues have an advantage of efficient utilization of these resources as the quality specially the crude protein content is low as compared to the general roughages. This study therefore was initiated to evaluate the alternative use of soybean or groundnut straw with standard concentrate supplements on live weight change and carcass characteristics, of Gumuz sheep.

MATERIALS AND METHODS

Description of Study Site

The experiment was conducted at Pawe Agricultural Research Center, Metekel Zone of Benishangul Gumuz, Ethiopia. It is located at a distance of 572 km North West of Addis Ababa at a latitude/longitude of 11°19'N and 36°24'E. Pawe Agricultural Research Center is located at an elevation of 1100 masl with annual minimum and maximum temperature of 16.3 and 32.6°C, respectively. It receives an annual rainfall ranging from 900 to 1587 mm. It is characterized by hot to warm moist agro-ecological zone and it is known by soybean and groundnut production.

Feed production and management

Soybean and groundnut straw were collected from Pawe Agricultural Research Center (PARC) after harvesting of grain. The variety of soybean was Bellesa 95 and groundnut Manipiter. These varieties were produced as part of the centers seed multiplication activity with all the recommended production practice in which recommended (100 kg phosphorous) amount of fertilizer was applied at planting. Care was taken during harvesting the residues with leaves and pods. Soybean was trashed by tractor on the ground covered with plastic sheet and groundnut with hand picking. The crops were harvested at the grain maturity and threshed in few days period and the residues were collected and stored in a ventilated shade immediately after threshing. The natural pasture hay, which was dominated by *Cynodon dactylon* harvested manually with sickle from the natural pasture field in the research center at the stage of blooming of grasses (about 50% flowering). The harvested forage was dried for 3 to 4 days, transported to experimental sites and piled in a ventilated shade.

Experimental animals and their management

Thirty intact male yearling Gumuz sheep (with full milk teeth) and similar body conditions and sizes were purchased from a local market (Pawe, Gilgel Beless and Manbuk). Upon arrival to the research station, the animals were acclimatized to the environment and treatment feed for 15 days. During this period, the animals were grazing around the experiment station in day time and housed during the night in a group. Animals were ear tagged for identification purpose. At the end of the acclimatization, the animals were drenched with anthelminthic (Albendazole 300 mg bolus) and sprayed with Amitraz 12.5% at a dose of 1.6 ml per 1liter of water against internal and external parasites, respectively and vaccinated against common diseases of the area (Peste Des Petits Ruminants (PPR)) before the beginning of the experiment.

Hay and replacement soybean or groundnut straws were weighed and offered three times a day as basal diet after proper mixing. Basal diet was offered *ad libitum* at a rate of 20% refusal. All animals were supplemented with 5% of daily feed intake molasses and 172 g of toasted soybean grain on dry matter basis. The molasses was added to the straw and hay mixture weighed for each animal based on their *ad libitum* intake. The grain which considered as concentrate supplement was offered separately twice a day at 8:00 AM and 4:00 PM in equal proportions. The animals had free access to water and common salt lick throughout the experimental period. The refusal was measured daily in the morning before offering the daily ration.

Experimental design and dietary treatments

The design of the experiment used was randomized complete block design (RCBD). The experimental animals were grouped into six blocks each with five animals based on their initial body weight. The five experimental feed treatments were randomly assigned to animals in a block. The randomization was made using Microsoft excel 2013. The treatments of the experiment were: Hay alone (control treatment) (T1), 50% Hay + 50% soybean straw(T2), 50% Hay + 50% groundnut straw (T3), 25% Hay + 75% groundnut straw (T4), and 25% Hay + 75% soybean straw (T5). The animals were

kept in individual pens furnished with feeding troughs and water buckets. Cleaning of the pens was done daily before placement of the morning ration. The feeding trial lasted for 90 days.

Measurements and analyses

Daily feed offered to the experimental animals and the corresponding refusals were recorded and measured during the experimentation period to determine daily feed intake in dry matter basis. This was determined by multiplying the average daily feed offered by the dry matter percentage of the feed and less the average daily feed refusal in dry matter basis. Samples of feed offered were taken from batches of feeds and refusals were collected from each animal across the experimental period for each animal and finally pooled for each treatment and sub-sampled. Feed conversion efficiency was calculated by dividing the average daily body weight gain to average daily feed intake. The partially dried samples of feeds were ground using laboratory mill to pass through a 1 mm sieve screen size and taken to Holotta Agricultural Research Centre nutrition laboratory for chemical analysis.

Data on live weight of sheep were measured at the beginning of the experiment and at every 15 days interval in the morning before provision of feed and water using suspended weighing scale with sensitivity of 100 g. Average daily body weight gain for each sheep was calculated as a difference between the final and initial body weight divided by the total number of actual feeding days. Carcass characteristics of experimental animals were evaluated by slaughtering all animals in the experiment after overnight fasting. Slaughter weight (SW) has been taken right before slaughter. The animals were slaughtered by severing the jugular vein and carotid artery with knife. The blood was drained into bucket and weighed. After the animals were killed, the skin was flayed carefully to avoid adherence of fat and muscle tissue to the skin. The skin was weighed and next the entire gastro intestinal tract without esophagus was removed and divided into two sections as stomach and intestine and were weighed with gut fill. During removal of gastro intestinal tract mesenteric fat and internal organs were separated carefully and weighed. The weight of hot carcass was taken after all the offal's were removed from the carcass. Edible and non-edible offals were identified and recorded. Total usable product was taken as the sum of hot carcass weight, skin and total edible offal component.

In order to measure rib eye-area of the carcass loin part was partitioned into fore and hind quarters between the 11^{th} and 12^{th} ribs. The cut ribs were chilled for 12 hours in deep refrigerator and the rib eye area (in cm^2) was measured after cutting at the 12^{th} and 13^{th} rib site. The cross- section of the rib eye muscle was traced first on transparency plastic paper and then the traced transparency paper was positioned on graph paper squares each having an area of 1 mm × 1 mm size. The number of squares included within the mark was counted for left and right sides and area was computed as the average of the two. The empty body weight was determined by deducting the gut fill from slaughter body weight and dressing percentage was calculated based on slaughter and empty body weights.

Chemical analysis

Dry matter, Organic Matter (OM) and ash were assayed on the offered and refused feeds and feces samples using the methods described by AOAC (1990). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were analyzed according to the procedures of Van Soest and Robertson (1985). Hemicellulose and cellulose contents were calculated from the difference between NDF and ADF, and ADF and ADL, respectively. Analysis for Kjeldhal nitrogen was run according to AOAC (1990) procedures. The crude protein (CP) content was determined by multiplying nitrogen value by 6.25.

Statistical analysis

Collected data were subjected to the analysis of variance (ANOVA) using the GLM procedure of SAS (Version 9.0). Significant treatment means were separated using Tukey HSD (Tukey Honestly Significant Difference Test). The statistical model was:

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

Where: Y_{ij} = the response variable, μ = Overall mean, T_i = i^{th} treatment (test diets) effect, β_j = j^{th} block effect, εij = the random error.

RESULTS AND DISCUSSION

Chemical composition of experimental feeds

The chemical composition of the treatment feed ingredients is given in Table 1. The roughages included to make the basal diets in this experiment; natural pasture hay, soybean straw and groundnut straw had different contents of crude protein which denotes their relative contribution as source of nutrients in the diet. The CP content of groundnut straw was 8.08%. This is a good indication that this oil crop straw could serve as a good source of roughage feed that can provide adequate CP content >7% for proper function of rumen microbes and to meet maintenance requirement of animals (Van Soest 1994), given other factors such as lignification does not limit feed digestibility and nutrient utilization. Soybean straw, however, contains lower CP (4.39%). The CP content of groundnut straw is lower than haricot bean haulms (9.1%) reported by Emebet (2008) but higher (6.8) than that reported by Dejene (2010). The value of CP content of groundnut straw in the current study is higher than that of widely used cereal crop residues such as maize stover (3.5%) reported by Dejene (2010).

The higher NDF content of soybean straw (86.37) and groundnut straw (70.70) categorize these roughage feed sources as low-quality feed, since roughage with NDF content greater than 65% is categorized as low-quality feed (Singh and Oosting, 1992). This might be due to the inherent characteristics of the species, the relative stage of maturity at harvest for the grain, the length of time stayed in the field after the grain matures, the residues management after harvest and threshing could remarkably affect the quality of the residues. As plants mature the cell wall constituent increase and therefore, the structural carbohydrates (cellulose and hemicelluloses) along with lignin increase and the percent of protein normally decrease (McDonald et al., 2002). Having high value of fiber component is the characteristics of most crop residues because of the high proportion of cell wall constituents and low level of proteins and rapidly degradable components. This

Table 1. Chemical composition (% on DM basis) of feed ingredients used for the feeding experiment.

Chemical composition	Feed ingredients			
	Natural pasture Hay	Soybean Straw	Groundnut. Straw	Toasted soybean grain
Dry Matter (DM)	93.99	93.34	93.39	95.57
Ash (DM)	9.77	8.46	5.33	6.69
Organic Matter (OM)	90.23	91.54	94.67	93.31
Crude Protein (CP)	7.12	4.39	8.08	41.27
Neutral Detergent Fiber (NDF)	79.53	86.37	70.70	43.67
Acid Detergent Fiber (ADF)	52.66	73.94	64.33	22.01
Acid detergent Lignin (ADL)	10.06	13.87	11.62	4.77

indicates poor nutritive value not capable of meeting microbial requirements in the rumen of animals (Van Soest, 1994).

Feed intake

The mean daily DM and nutrient intake of treatment diets is presented in Table 2. The mean total dry matter intake (TDMI) was higher (P<0.0008) in T3 than T2 and T5. This might be due to the higher CP content of the roughage feed in T3. Tegene et al (2001) confirmed an increase in total dry matter intake as the level of crude protein increases in the diet. The result of the DM intake in the current study was within the range of 2.5 to 3.9% of BW reported for various breeds of sheep and goats in the tropics (Devendra and Burns 1983), which was 2.93 to 3.69%. The higher and lower total DM intake in proportion to body weight (3.69%) and (2.93%) was recorded in T2 and T4, respectively. The higher intake in T2 is because of the low protein content of the soybean straw. Therefore, the sheep consumed the feed as much as the gut size could hold in an attempt to fulfill their nutrient requirements. Dry matter intake is considered as an important factor in the utilization of roughage by ruminant livestock and is a critical determinant of nutrient intake and performance in small ruminants (Devendra and Burns, 1983). The total roughage DM intake in the present study is higher than values reported for Arsi-Bale sheep fed with a basal diet of faba bean haulms (Ermiyas, 2008). The CP intake was significantly higher for T3 and T4. This is because of relatively higher level of CP content of groundnut straw as compared to other roughage feed. There was no significant difference between T1, T2 and T5.

Live weight change and feed conversion efficiency

Average initial body weight, final body weight and mean daily body weight gain are presented in Table 3. One to one ratio mixed natural pasture hay and ground nut basal diet (T3) showed improved (P<0.01) average daily body weight gain than when natural pasture hay mixed with soybean haulms in a similar ratio (T2). This may be due to the high DM and CP intake of the treatment group. There was, however, no statistically significant differences in final body eight between T1, T2, T4 and T5. Similarly, the FCE of the different treatment basal diets did not show differences (P<0.05).

In the current study the higher body weight gains in T3 than T2 and numerically higher gain in T4 compared to T1, T2 and T5 can be attributed to the basal diet consumed. This implies that the higher CP content of groundnut straw, digestibility and higher DM intake of this roughage feed resulted better daily gain than other treatment groups. The result indicates the best combination of natural pasture hay with groundnut straw as a basal diet could be one to one ratio. Mixing natural pasture hay with soybean straw in 50 and 75% proportion (T2 and T5) resulted in similar body weight as group consumed only hay basal diet. In general, body weight gain displayed by all treatment groups in the current study is similar to body weight gain reported for sheep consumed roughage basal diet and supplemented with different types of concentrate mixtures. Ermiyas (2008) found 55 to 87.8 g/day from Arsi-Bale sheep fed faba bean haulms and supplemented with linseed meal, barley bran and their mixtures. Similarly, Almaz (2008) found 51 to 63 g/day from local sheep fed finger millet supplemented with mixture of '*atella'* (by product of traditional brewery in Ethiopia) and noug seed cake in different proportions. The good body weight gain recorded for all treatments regardless of the difference that existed between groups consumed different types of basal diet could be related to the low level of supplemental soybean grain and molasses, which might have created favorable condition for rumen micro flora to grow both in population and types and degrade the fibrous feed efficiently. The type of microorganisms present in the rumen depends on the type of feed consumed, whereas the level of intake influences the number of microorganism present (Kellems and Church, 2002). Thus, higher intake will increase the population but lower intake declines their number, eventually affects digestibility of feeds and animal performance

Table 2. Daily dry matter and nutrient intakes of Gumuz sheep fed hay replaced with soybean or groundnut straw as a basal feed.

Parameter	Treatments						
	T1	T2	T3	T4	T5	SL	SEM
Feed DMI (g/day)							
TSG DMI	172.00	172.00	172.00	172.00	172.00	-	-
Roughage DMI	586.39^{abc}	492.20^{c}	744.44^{a}	714.09^{ab}	580.29^{bc}	**	38.36
TDMI	758.39^{abc}	664.20^{c}	916.44^{a}	886.09^{ab}	752.29^{bc}	**	38.34
TDMI (g/kg $W^{0.75}$)	67.32^{ab}	60.35^{b}	76.94^{a}	77.18^{a}	70.15^{ab}	**	2.68
TDMI (%BW)	3.34^{ab}	3.69^{a}	2.98^{b}	2.93^{b}	3.23^{ab}	**	0.14
Nutrient intake (g/day)							
CPI	104.84^{b}	105.89^{b}	127.69^{a}	126.98^{a}	98.07^{b}	**	2.63
OMI	743.45^{ab}	648.58^{b}	890.84^{a}	871.14^{a}	751.19^{ab}	**	37.51
NDFI	577.09^{ab}	494.67^{b}	688.96^{a}	620.14^{ab}	603.84^{ab}	**	30.85
ADFI	370.35^{b}	354.98^{b}	513.36^{a}	492.34^{a}	479.34^{a}	**	23.77
ADLI	75.77^{c}	74.53^{c}	108.25^{a}	104.37^{ab}	85.03^{bc}	**	4.78

** significant at alpha 0.01; TGS: toasted soybean grain; TDMI: total dry matter intake; OMI: organic matter intake; CPI: crud protein intake; NDFI: neutral detergent fiber intake; ADFI: acid detergent fiber intake; ADLI: acid detergent lignin intake; SL: significance level; SEM: standard error of mean; T1: Natural pasture hay alone (control treatment); T2: 50% Natural pasture hay + 50% soybean straw; T3: 50% Natural pasture hay + 50% groundnut straw; T4: 25% Natural pasture hay + 75% groundnut straw;T5:25% Natural pasture hay + 75% soybean straw; BW: body weight. Figures with different superscripts with in a row are significantly different.

Table 3. Body weight change of Gumuz sheep fed natural pasture hay replaced with soybean or groundnut straw as a basal feed.

Body weight change	Treatments						
	T1	T2	T3	T4	T5	SL	SEM
Initial body weight (kg)	19.66^{a}	19.30^{ab}	19.00^{abc}	18.23^{c}	18.36^{b}	**	0.24
Final body weight (kg)	25.23^{ab}	24.57^{ab}	27.23^{a}	25.98^{ab}	23.87^{b}	**	0.73
ADG (g/day)	61.85^{ab}	58.52^{b}	91.48^{a}	86.11^{ab}	61.11^{ab}	**	7.77
FCE (ADG/g DMI)	0.08	0.09	0.10	0.10	0.08	ns	0.008

** significant (p<0.01); ns: non-significant; ADG: average daily gain; FCE: feed conversion efficiency; SL: significance level; SEM: standard error of means; T1: Natural pasture hay alone (control treatment); T2: 50% Natural pasture hay + 50% soybean straw; T3: 50% Natural pasture hay + 50% groundnut straw; T4: 25% Natural pasture hay + 75% groundnut straw; T5:25% Natural pasture hay + 75% soybean straw. Figures with different superscripts with in a row are significantly different.

(McDonald et al., 2002).

Carcass characteristics

Slaughter weight, hot carcass and dressing percentage

Slaughter weight, hot carcass weight, and dressing percentage of the experimental animal are presented in Table 4. In this study there was a significant difference (p<0.005) in slaughter body weight among treatment groups. The higher slaughter body weight was recorded in T3 (26.5 kg) as compared to T2 and T5. This may be due to the higher DM and CP intake of the treatment group. The higher hot carcass weight was observed in T3 and T4. In this study no significance difference was observed in both slaughter and empty body weight basis.

Edible and non-edible carcass offals

The edible and non-edible offals content is presented in Table 5. In this study, there was significance difference (p<0.02) in total edible offal content (TEOC) between treatment groups, but there was no difference in total none edible offal contents (TNEOC).

SUMMARY AND CONCLUSION

A feeding study was conducted to evaluate the effect of replacing natural pasture hay with soybean or groundnut straw on feed intake, nutrient utilization, body weight change and carcass characteristics of Gumuz sheep at Pawe Agricultural Research Centre using thirty yearling intact male Gumuz sheep with initial BW of 18.91 ± 2.6 kg (mean ± SD). Toasted soybean grain (172 g DM) and

Table 4. Carcass characteristics of Gumuz sheep fed soybean or groundnut straw as a replacement for hay as a basal feed.

Variable	Treatments						
	T1	T2	T3	T4	T5	SL	SEM
Slaughter weight (kg)	24.75^{ab}	23.93^{b}	26.50^{a}	25.13^{ab}	22.93^{b}	**	0.59
Empty body weight (kg)	24.17^{ab}	23.47^{b}	25.95^{a}	24.66^{ab}	22.38^{b}	**	0.58
Hot carcass weight (kg)	9.72^{ab}	9.20^{ab}	10.30^{a}	10.23^{a}	8.57^{b}	**	0.33
Dressing percentage							
Slaughter weight base	39.10	38.41	38.83	40.69	37.30	ns	0.85
Empty body weight base	51.18	50.43	50.59	51.35	49.53	ns	0.87
Rib-eye area (cm^2)	7.33	7.65	7.23	8.22	6.90	ns	0.43

** Significant at p<0.01; ns: non-significant; SL: significance level; SEM: standard error of mean; T1: Natural pasture hay alone (control treatment); T2: 50% Natural pasture hay + 50% soybean straw; T3: 50% Natural pasture hay + 50% groundnut straw; T4: 25% Natural pasture hay + 75% groundnut straw; T5:25% Natural pasture hay + 75% soybean straw. Figures with different superscripts with in a row are significantly different.

Table 5. Carcass offals of Gumuz Sheep fed soybean or groundnut straw as a replacement for hay as a basal feed.

Traits	Treatments						
	T1	T2	T3	T4	T5	SL	SEM
Total edible offals (kg)	4.5^{ab}	4.0^{ab}	4.7^{a}	4.5^{ab}	3.9^{b}	*	0.2
Edible offal (% SBW)	17.9	16.9	17.7	18.0	16.9	ns	0.5
Total non-edible offal (kg)	10.6	10.7	11.5	10.3	10.5	ns	0.3
Total usable products (kg)	16.4^{abc}	15.5^{bc}	17.5^{a}	17.2^{ab}	14.6^{c}	**	0.5
Total usable products (%)	65.8^{ab}	64.7^{b}	66.2^{ab}	68.3^{a}	63.8^{b}	**	0.8

** significant at p<0.01; * significant at alpha 0.05; ns: non-significant; SBW: slaughter body weight; SL: significance level; SEM: standard error of mean; T1: Natural pasture hay alone (control treatment); T2: 50% Natural pasture hay + 50% soybean straw; T3: 50% Natural pasture hay + 50% groundnut straw; T4: 25% Natural pasture hay + 75% groundnut straw; T5:25% Natural pasture hay + 75% soybean straw. Figures with different superscripts with in a row are significantly different.

molasses (5% of daily feed offered) were given for all experimental animals. Randomized complete block design with five treatments consisting of six replications were used for the experiment. The experiment was conducted for ninety days after 15 days of acclimatization period. Data on feed quality, feed intake, growth performance were recorded. Animals were slaughtered at the end of experiments for carcass evaluation. The daily body weight gain of animals feed basal diets feed with 1:1 ratio mixed natural pasture hay and ground nut haulms (T3) (91.48 g/d) was the highest (p<0.014). Whereas T2 (58.5 g/d) exhibited lower daily body weight gain. There was no difference in FCE between treatments.

The hot carcass weight of sheep in T3 (10.30 kg) and T4 (10.23 kg) were higher (p<0.007) than sheep in the rest of the treatments. Dressing percentage expressed on slaughter weight and empty BW basis was not different (p>0.05) among treatments. There was no difference (p>0.05) in total non-edible offal components and rib eye area between treatments. Based on the results obtained mixture of natural pasture hay with groundnut straw in 1:1 and 1:3 ratio respectively, were found to be promising basal feeds in terms of body weight gain of Gumuz sheep under the situation of the current study.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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