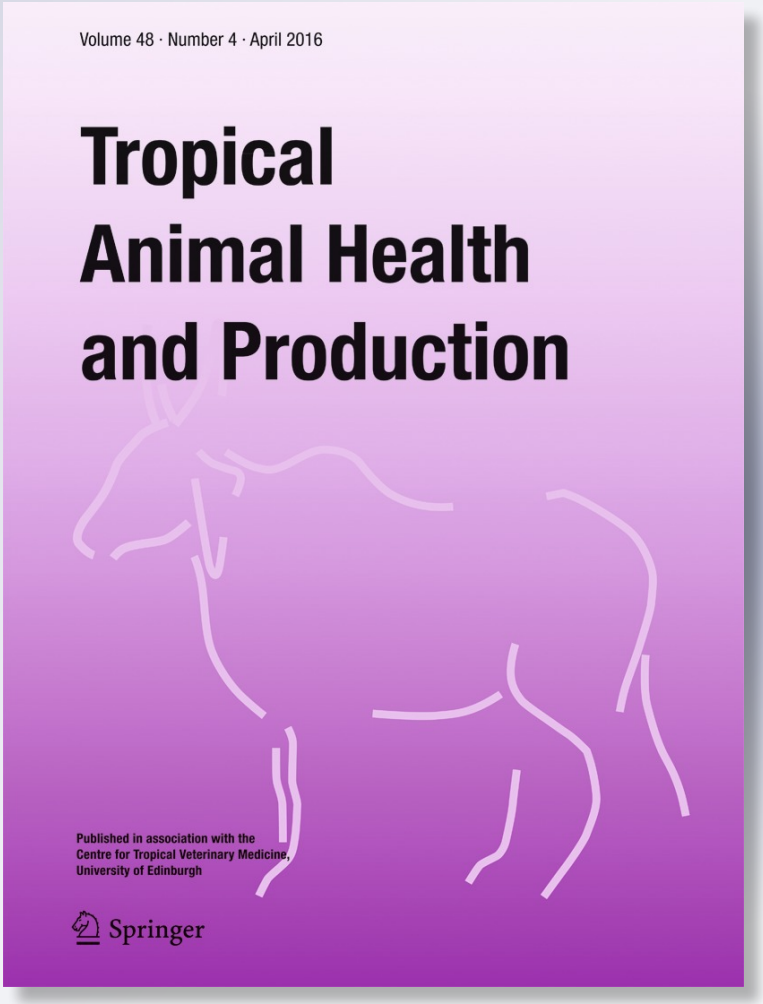
*Evaluation of desho grass (*Pennisetum pedicellatum*) hay as a basal diet for growing local sheep in Ethiopia*

Bimrew Asmare, Solomon Demeke, Taye Tolemariam, Firew Tegegne, Jane Wamatu & Barbara Rischkowsky

Tropical Animal Health and Production

ISSN 0049-4747
Volume 48
Number 4

Trop Anim Health Prod (2016)
48:801-806
DOI 10.1007/s11250-016-1031-8



Springer

Trop Anim Health Prod (2016) 48:801–806
DOI 10.1007/s11250-016-1031-8

REGULAR ARTICLES

Evaluation of desho grass (*Pennisetum pedicellatum*) hay as a basal diet for growing local sheep in Ethiopia

Bimrew Asmare[1,2] · **Solomon Demeke**[2] · **Taye Tolemariam**[2] · **Firew Tegegne**[1] · **Jane Wamatu**[3] · **Barbara Rischkowsky**[3]

Received: 17 September 2015 / Accepted: 29 February 2016 / Published online: 12 March 2016

Abstract The study was conducted to determine feed intake, digestibility, and body weight (BW) change of Washera sheep fed on desho grass and natural pasture hay as a basal diet and supplemented with concentrate mixtures. Twenty-five intact male sheeps with body weight of 19.4 ± 1.89 kg (mean ± SD) were used in randomized complete block design. The dietary treatments were 100 % natural pasture hay (NPH) (T1), 75 % NPH + 25 % desho grass hay (DGH) (T2), 50 % NPH + 50 % DGH (T3), 25 % NPH + 75 % DGH (T4), and 100 % DGH (T5). Equal amount of concentrate mixture (CM) (300 g DM/day/h) was supplemented in all of the five treatments. The result of laboratory chemical analysis revealed that the CP content of the basal diets increased with increased proportion of desho grass hay inclusion in the treatments at the expense of natural pasture hay. Total DM, OM, CP, NDF, and ADF intake and digestibility was significant ($P < 0.05$) and in the increasing order of T1 < T2 < T3 < T4 < T5. The average daily body weight gain (ADG) of experimental sheep was significantly ($P < 0.05$) higher as proportion of desho grass increased from 0 to 100 % in the basal diet. The result indicated that desho grass can be used as a basal diet for local sheep with better performance than natural pasture hay-based diets.

✉ Bimrew Asmare
limasm2009@gmail.com

[1] Department of Animal Production and Technology, College of Agriculture and Environmental Sciences, Bahir Dar University, P.O. BOX 79, Bahir Dar, Ethiopia

[2] Department of Animal Science, College of Agriculture and Veterinary Medicine, Jimma University, Jimma, Ethiopia

[3] International Center for Agricultural Research in the Dry Areas (ICARDA), Addis Ababa, Ethiopia

Keywords Basal diet · Desho grass · Digestibility · Hay · Washera sheep

Abbreviations

CM	Concentrate mixture
DGH	Desho grass hay
NPH	Natural pasture hay
SD	Standard deviation

Introduction

Though Ethiopia has large livestock population, the contribution of the sub-sector achieved so far has been inadequate (CSA 2015). The low productivity of livestock is mainly because of poor feed quality and insufficient supply (FAO 2010). To combat the livestock feed shortage, the use of indigenous forage plants as a feed source is recommended. Among such types of forage species, which has multifaceted potential, is desho grass. The grass is native to tropical and sub-tropical Africa and tropical Asia (FAO 2010). It serves for land rehabilitation and as fodder for livestock in the tropics (EPPO 2014). Desho grass is a very palatable species to cattle and sheep (Ecocrop 2010). It is currently utilized for soil conservation practices and livestock fodder in the highlands of Ethiopia (Leta et al. 2013). Despite its presence in different parts of the country, there is hardly any information on the animal evaluation of desho grass. Therefore, this study was conducted to evaluate feed intake, digestibility, and body weight change of Washera sheep fed desho grass and natural pasture hay as a basal diet.

Materials and methods

Description of the study area

The experiment was conducted at the Zenzelma Campus of Bahir Dar University located at 11° 37′ N and 37° 28′ E with an altitude of 1900 m. Annual average temperature is 29 °C and annual rain fall ranges from 1430 to 1520 mm.

Experimental sheep and their management

Twenty-five yearling intact male Washera sheeps with mean BW of 19.4 ± 1.89 kg (mean ± SD) were used in the study. The experimental animals were housed in individual pens equipped with feeding and watering troughs. They were quarantined for 15 days, vaccinated against ovine pasteurellosis, sheep pox, blackleg, and anthrax, dewormed against internal parasites, and sprayed against external parasites.

Experimental design and treatments

The experimental design was randomized complete block design with five treatments and five replications. Blocking of sheep was based on the initial BW. The treatments were 100 % NPH (T1), 75 % NPH + 25 % DGH (T2), 50 % NPH + 50 % DGH (T3), 25 % NPH + 75 % DGH (T4), and 100 % DGH (T5) with equal amount of concentrate (300 g DM/day/h) supplement in all five treatments. The concentrate mixture consisted of noug seed cake and wheat bran at equal proportion.

Feed intake and body weight change

The sheep were offered basal diet ad libitum at 25 % refusal adjustment every week throughout the experimental period. Sheep were fed in an individual feeding trough. The natural pasture hay was prepared from a natural pasture land consisting of mixed species harvested at about 50 % heading of the grass component. Desho grass was harvested at 4 months age and dried properly. Daily feed offer and refusals were recorded from each treatment. Daily feed intake of individual sheep was calculated as the difference between the amounts of feed offered and refused. Subsamples of feed offered and refusals were taken and prepared for chemical analysis. The body weight of each animal was measured every 10 days after overnight fasting. The daily body weight gain was calculated as the difference between final body weight and initial body weight divided by the number of feeding days. The feed conversion efficiency of experimental animals was determined by dividing the average daily body weight gain to the amount of feed consumed.

Digestibility trial

The digestibility trial was conducted at the end of the feeding trial. In the digestion trial, each sheep was fitted with a fecal collection bag; a 4-day acclimatization period was followed by total collection of feces for seven consecutive days. The parameters studied under the digestibility were DMD, OMD, and nutrient digestibility. Feces voided were weighed and recorded every morning, thoroughly mixed, 20 % of representative samples taken, frozen at −10 °C, and pooled over the collection period for each animal. At the end of the collection period, each sample was mixed and dried at 60 °C for 72 h. The digestibility of nutrients was determined as the difference between nutrient intake and that recovered in the feces expressed as the proportion of nutrient intake.

Chemical analysis

Samples of feeds, refusals, and feces were ground using laboratory mill to pass through a 1-mm sieve. Dry matter content was determined by oven drying samples at 105 °C. Total nitrogen (N) was determined by the Kjeldhal method (AOAC 1990). Crude protein was determined as N × 6.25. Organic matter (OM) content was calculated as the difference between DM and ash content. Neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) were determined according to Van Soest and Robertson (1985).

Statistical analysis

Dry matter intake, body weight change, DM, and nutrient digestibility coefficients were analyzed with general linear model (GLM) procedure of SAS 9.2 for least square analysis of variance. Mean separations were done using the Tukey test for variables whose *F*-values declared a significant difference. Differences were considered statistically significant at 0.5 % significance level. The statistical model for data analysis was

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

Where Y_{ij} is the response variable, μ the overall mean, t_i the treatment effect, b_j the block effect, and e_{ijk} is the random error.

Results

Chemical composition of feeds

The chemical composition of feeds and refusals of Washera sheep fed natural pasture and desho grass hay supplemented with concentrate mixture are presented in Table 1. The CP content of natural pasture hay was lower than desho grass,

Table 1 Chemical composition of experimental feeds

Feeds (g/kg DM)							
Treatment	DM	Ash	OM	CP	NDF	ADF	ADL
T1	913	115	885	35	712	464	57
T2	921	117	883	45	695	426	54
T3	925	123	877	53	677	415	45
T4	928	119	881	57	686	415	49
T5	935	121	879	54	673	381	36
Concentrate	909	87	913	225	380	239	93

DM dry matter, *OM* organic matter, *CP* crude protein, *NDF* neutral detergent fiber, *ADF* acid detergent fiber, *ADL* acid detergent lignin, *T* treatment

and increasing levels of desho grass from T1 to T4 showed an increase in total CP of basal diet except T5. The ash content of basal diet ranged from 115 to 123 g/kg DM. The concentrate mixture had a relatively high CP content (225 g/kg DM) and can be considered as quality protein supplement to support animal growth performance.

Feed intake

The daily dry matter (DM) and nutrient intake of sheep are presented in Table 2. In the current study, sheep in T5, T4, T3, and T2 consumed 22, 19, 9, and 7 %, respectively, more of the basal diet than sheep in T1. Increasing the proportion of desho grass significantly ($P<0.05$) increased the total basal DM intake of sheep and in the order T5 > T4 > T3 > T2 > T1. Total DM intake as percent of body weight of experimental sheep was 3 % while intake per metabolic body weight of experimental sheep varied from 61 to 64 %; the effects of treatment were not statistically significant ($P>0.05$). The daily nutrient intakes of experimental sheep were significantly higher ($P<0.05$) in the order T5 > T4 > T3 > T2 > T1. Organic matter (OM), CP, NDF, ADF, and ADL intakes were significant ($P<0.05$) and in the order of T5 > T4 > T3 > T2 > T1.

Body weight change and feed conversion efficiency

The body weight changes, average daily body weight gain, and feed conversion efficiency data are presented in Table 3. The average daily weight gains of treatment groups were significantly increased ($P<0.05$) as the proportion of desho grass hay increased. Final body weight and feed conversion efficiency (FCE) both increased slightly as level of desho grass increased from 25 to 100 %, but these differences were not statistically significant ($P>0.05$).

Dry matter and nutrient digestibility

Table 4 indicates the apparent digestibility coefficients of nutrients in Washera sheep fed natural pasture and desho grass hays mixture as a basal diet and supplemented with concentrate mixture. The digestion coefficients of all parameters (DM, OM, CP, NDF, and ADF) in the current study were significantly higher ($P<0.05$) and in the order of T5 > T4 > T3 > T2 > T1.

Discussion

Chemical composition of feeds

The nutrient content of natural pasture hay alone was lower than its mixture with desho grass and sole desho grass hay. The CP content of natural pasture hay was lower than previous reports (Tadele et al. 2014; Kassa 2015) in northwestern Ethiopia. The low CP content in the natural pasture hay indicates that it was harvested at late maturity, and may also result from the location, soil type, variety, and post harvest handling. The natural pasture hay used in the current study has a lower

Table 2 Daily dry matter and nutrient intake of Washera sheep natural pasture and desho grass hay as a basal diet supplemented with concentrate mixture

Parameters	Treatments						
	T1	T2	T3	T4	T5	SEM	SL
Basal DM intake (g/day)	350^{c}	375^{bc}	382^{b}	416^{a}	428^{a}	6.3	***
Concentrate DM intake (g/day)	300	300	300	300	300	0.0	Ns
Total DM intake (g/day)	650^{c}	675^{bc}	682^{b}	716^{a}	728^{a}	6.3	***
DM intake (% BW)	3	3	3	3	3	0	ns
DM intake per kg $W^{0.75}$	61	61	62	63	64	1.5	ns
OM intake (g/day)	584^{c}	605^{bc}	609^{b}	642^{a}	650^{a}	5.6	***
CP intake (g/day)	73^{d}	77^{c}	79^{b}	82^{a}	83^{a}	0.2	***
NDF intake (g/day)	325^{b}	335^{b}	335^{b}	356^{a}	357^{a}	3.9	***
ADF intake (g/day)	204^{b}	207^{b}	209^{b}	209^{b}	218^{a}	2.5	***

Superscript letters in the same row are significantly different at $P<0.05$

Table 3 Body weight parameters and feed conversion efficiency of Washera sheep fed natural pasture and desho grass hay as a basal diet supplemented with concentrate mixture

Parameters	T1	T2	T3	T4	T5	SEM	SL
Initial BW (kg)	19.5	19.1	19.0	18.9	18.3	0.9	ns
Final BW (kg)	23.6	24.5	24.6	25.7	25.8	0.8	ns
ADG (g/d/h)	52.2^{b}	59.9^{ab}	70.0^{ab}	74.4^{a}	76.4^{a}	4.9	***
FCE	0.08	0.09	0.10	0.10	0.11	0.0	ns

Superscript letters in the same row are significantly different at $P<0.05$

BW body weight, *ADG* average daily gain, *FCE* feed conversion efficiency

CP than the minimum maintenance requirement of ruminant animals (Van Soest 1982).

The mean CP content of desho grass hay was lower than reports of other researchers (Aliyu et al. 2012; Waziri et al. 2013). It has been stated that CP value ranging from 7 to 7.5 % is required to satisfy the maintenance requirement of ruminant animals (Van Soest 1982). Hence, the observed CP content of basal diet was below that demanded for maintenance requirements of sheep (Heuzé and Hassoun 2015). According to McDonald et al. (2010), NDF portion of feed is only partially digestible by any species of animals, but can be used to greater extent by ruminants, which depend on microbial digestion for utilization of most fibrous plant components. The CP content of both basal diets is an indicator that both natural pasture and desho grass hay should be provided with protein supplements to support productive and reproductive performance of the animals to their potential.

Feed intake

The significant ($P<0.05$) difference in total DM intake from T1 to T5 as the proportion of desho grass increment might be due to high the relative increase in CP content the basal diet which improved the rumen condition in sheep. Total DM intake of sheep in the current study was comparable to the results of Kassa (2015) for sheep fed hay supplemented with *Ficus sycomorous* leaf and fruit. On the other hand, total DM intake of sheep in the current study is higher than the reports of Hailu et al. (2011), but lower than the reports of Tadele et al. (2014) and Gashu et al. (2014) for the same breed of sheep. However, a significant difference ($P<0.05$) in the total DM intake was observed for the increasing levels of desho grass in the basal diet which was in contrary to the reports of Mekuriaw et al. (2012). The high intake of desho grass hay is in agreement with the reports of FAO (2010) which state that the grass was highly palatable for cattle and sheep. The mean total DM intake of sheep in the current study was 58 kg^{-1} $W^{0.75}$ which was higher than the results of Tefera et al. (2015) but lower than Gashu et al. (2014) who reported total DM intake of sheep within the range of 67.5–84.6 g DM kg^{-1} $W^{0.75}$ for the same breed of sheep. Moreover, the current result is lower than the reports of Ali et al. (2012) who reported higher (62.5–73.76) DM intake per kilogram $W^{0.75}$ for Afar sheep. The total DM intake as percent of body weight from the present result is higher than the reports of Tefera et al. (2015) for the same breed of sheep. On the other hand, the result is in agreement with workers in Ethiopia (Gashu et al. 2014; Tadele et al. 2014) and in the range of recommended dry matter intake for ruminants (2–6 %) by Susan (2003).

Table 4 Nutrient digestibility coefficients in Washera sheep fed natural pasture and desho grass hay as a basal diet supplemented with concentrate mixture

Parameters	T1	T2	T3	T4	T5	SEM	SL
DM	0.61^{d}	0.68^{c}	0.71^{bc}	0.76^{ab}	0.79^{a}	0.01	*
OM	0.66^{d}	0.71^{c}	0.74^{bc}	0.78^{ab}	0.81^{a}	0.01	*
CP	0.72^{c}	0.76^{b}	0.79^{ab}	0.81^{a}	0.82^{a}	0.01	*
NDF	0.66^{d}	0.71^{cd}	0.74^{bc}	0.79^{ab}	0.81^{a}	0.01	*
ADF	0.65^{c}	0.67^{c}	0.71^{b}	0.76^{a}	0.78^{a}	0.01	*

Superscript letters in the same row are significantly different at $P<0.05$

Nutrient digestibility

The significant increase in apparent digestibility of DM and of nutrients as level of desho grass hay increased from 0 to 100 % might be partly due to relatively higher CP content of desho grass hay as compared to natural pasture hay. High protein may increase the digestibility of the crude fiber of the feeds. McDonald et al. (2010) remarked that feed which is rich in protein promotes high microbial population which in turn facilitates rumen fermentation. The increase in digestibility of nutrients in the current study is in agreement with Tadele et al. (2014) and Kassa (2015).

The CP digestibility coefficient of the current study was significantly affected ($P<0.05$) by inclusion of desho grass and in the order T5 > T4 > T3 > T2 > T1. This indicates that the inclusion of desho grass at increasing level significantly improved ($P<0.05$) CP digestion. This is supported by the report of Asaolu et al. (2010) who indicated that combination of groundnut hay and bamboo leaf at 50:50 ratio (%DM basis) increased CP digestibility and intake compared to the sole groundnut hay. The results of this study showed increase in ADF and NDF digestibility due to increasing levels of desho grass in the basal diet which is in agreement with other studies (Degu et al. 2009). This might be associated with increased CP intake both from the natural pasture and desho grass hay mixture that might have improved rumen function and hence fermentation of the cell wall carbohydrates.

Body weight change and feed conversation efficiency

The significant increase ($P < 0.05$) in average daily gain of sheep in the present study associated with the rise in the level of desho grass hay as a basal diet might be due to the total increase in the amount of nutrients consumed. The improved feed conversion efficiency of the current result might be due to higher nutrient concentration of the basal diet and the consequent increase in body weight gain of experimental animals associated with the increment of level of desho grass. Owing to the total increment of CP intake from T1 to T5, body weight increment was observed in the current study which is in line with the reports of Worku et al. (2015). The ADG of sheep of this study is higher than the reported by other workers (Tadele et al. 2014; Tefera et al. 2015) but comparable to Gashu et al. (2014) for the same breed of sheep. The discrepancy of the results might be due to variations in the types of feeds used and the management of animals. The result of the correlation analysis indicated that daily body weight gain was positively ($P < 0.05$) correlated with DM, OM, CP, NDF, and ADF intake and digestibility which is in agreement with the reports for the same breed of sheep (Mekuriaw et al. 2012; Kassa 2015).

Conclusion

Increasing the proportion of desho grass hay from 0 to 100 % as a basal diet of Washera lambs increased DM intake, digestibility of nutrients, average daily weight gain, and feed conversion efficiency. Hence, it is concluded that desho grass can be an alternative basal diet for growing local sheep in Ethiopia. As desho grass is relatively low in CP content, it should be integrated with local protein sources like indigenous and improved leguminous fodders as well as agro-industrial byproducts.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interests regarding the publication of this paper.

References

Ali, A., Sayan, T., Sarawut, R., and Kriengki, K., 2012. Effect of Feeding *Prosopis julifl ora* Pods and Leaves on Performance and Carcass Characteristics of Afar Sheep. Kasetsart Journal (Natural Science). 46: 871–881

Aliyu, I.D., Maigandi, S.A., Muhammad, I.R. and Garba, Y., 2012. Haematological Indices and Blood Urea Nitrogen of Yankasa Ram Lambs Fed Urea, Poultry Droppings and or Urea Treated *Pennisetum pedicellatum* (Kyasuwa Grass). Nigerian Journal of Basic and Applied Science, 20(1): 39–43.

AOAC (Association of Analytical Chemists), 1990. Official methods of analysis 15th ed. AOAC Inc. Arlington, Virginia, USA. 1298p.

Asaolu, V.O., Odeyinka S.M., Akinbamijo O.O., and Sodeinde, F.G., 2010. Effects of moringa and bamboo leaf on groundnut hay utilization by West African Dwarf goats. Livestock Research for Rural Development. 22 (1).

Degu, A., Melaku, S. and Berhane, G., 2009. Supplementation of isonitrogenous oil seed cakes in cactus (Opuntia ficus-indica)-tef straw (*Eragrostis tef*) based feeding of Tigray Highland sheep. Animal Feed Science and Technology, 148, 214–226.

Ecocrop, 2010. Ecocrop database. FAO. http://ecocrop.fao.org/ecocrop/srven/home. Accessed 02 February 2015.

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm accessed on December 2, 2015.

FAO (Food and Agriculture Organization), 2010. Food and Agriculture Organization of the United Nations. Rome, Italy.

Gashu, M., Tamir, B., Urge, M., 2014. Effect of Supplementation with Non-Conventional Feeds on Feed Intake and Body Weight Change of Washera Sheep Fed Urea Treated Finger Millet Straw. Greener Journal of Agricultural Sciences 4 (2), 067–074.

Hailu, A., Melaku, S., Tamir, B., and Tassew, A., 2011. Body weight and carcass characteristics of Washera sheep fed urea treated rice straw supplemented with graded levels of concentrate mix. Livestock Research for Rural Development 23 (8) 2011

Heuzé, V. and Hassoun, P., 2015. Desho grass (Pennisetum pedicellatum). Feedipedia, a programme by INRA, CIRAD, AFZ and FAO. http://www.feedipedia.org/node/396 accessed July 1, 2015.

Kassa, A., 2015. Effects of Supplementation with *Ficus Sycomorus* (Shola) on Performances of Washera Sheep Fed Natural Pasture Hay. Global Journal of Animal Scientific Research. 3(2): 370–382.

Leta, G., Duncan, A., Asebe, A., 2013. Desho grass for livestock feed, grazing land and soil and water management on small-scale farms. ILRI, Nairobi, Kenya 2 pp.

McDonald, P., Edwards, R.A., Greenhalgh, J.F.D Morgan, C.A, Sinclair, L. A., and Wilkinson R. G., 2010. Animal Nutrition 7th ed. Longman Group UK Ltd, England. 693p.

Mekuriaw, Y., Urge, M. and Anmut, G., 2012. Intake, digestibility, live weight changes and rumen parameters of Washera Sheep fed mixture of low land bamboo (*Oxytenanthera abyssinca*) leaves and natural pasture grass hay at different ratios. Pakistan Journal of Nutrition 11 (4):322–331.

CSA (Central Statistical Authority), 2015. Agricultural sample survey agricultural sample survey livestock and livestock characteristics, Statistical Bulletin 578, Addis Ababa, Ethiopia, March 2015, Ethiopia.

Susan, S., 2003. Introduction to feeding small ruminants. Area Agent, sheep and goats. Western Maryland Research and Education Center. Maryland Cooperative Extension. Available at: http://www.asheepandgoat.com/articles/feedingsmallruminants.html. accessed on 19 December 2015.

Tadele, Y., Mekasha, Y.,Tegegne, F., 2014. Supplementation with different forms of processed Lupin (*Lupinus albus*) grain in hay based feeding of Washera sheep: effect on feed intake, digestibility body weight and carcass parameters. Journal of Biology, Agriculture and Healthcare. 4(27): 213–231.

Tefera, G., Tegegne, Mekuriaw, Y., Melaku, S., Tsunekawa, A., 2015. Effects of different forms of white lupin (*Lupinus albus*) grain supplementation on feed intake, digestibility, growth performance and carcass characteristics of Washera sheep fed Rhodes grass (*Chloris gayana*) hay-based diets. Tropical Animal Health and Production. 47(8): 1581–1590

Van Soest, P. J., 1982. Nutritional ecology of the ruminants O and B books, Corvallis, Oregon, USA. 374p.

Van Soest, P.J. and Robertson, J.B., 1985. Analysis of forage and fibrous food. A laboratory manual for animal science 613, Cornell University, USA. 202p

Waziri, A.F., Anka S.A., Bala A.Y., and Shehu H., 2013. A Comparative analysis of nutrient and mineral element content of *Andropogon gayanus* Kunth and *pennisetum pedicellatum* Trin. Nigerian Journal of Basic and Applied Science. 21(1): 60–64.

Worku, A., Animut, G., Urge, M., Gebeyew, K., 2015. Effect of Different Levels of Dried Sugar Cane Tops Inclusion on the Performance of Washera Sheep Fed Basal Diet of Grass Hay, Ethiopia. Journal of Advances in Dairy Research 3: 133.