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Effect of Replacement for Barley grain with *Faidherbia albida* pods on Growth and Hematological Performance in Highland Sheep in Arid Areas of Tigray, Ethiopia

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Abstract

An experiment was conducted to evaluate the potentials of *Faidherbia albida* pods as replacement for barley grain on growth performance and hematological parameters of male highland sheep. Thirty highland male sheep below one year of age and average weight of 14.82 kg were used for the study. The animals were weighed and randomly allotted to five different treatments with varying level of *Faidherbia albida* ripened pods replacing barley grain as T1 (0%), T2 (25%), T3 (50%), T4 (75%) and T5 (100%) in a completely randomized design (CRD) with six animals per treatment. The sheep were supplemented with the experimental diet daily after feeding hay, which lasted for 4 months. There were no significant ($P>0.05$) difference in total daily feed intake. Significant ($P<0.05$) increase in total weight gain and weight gain per day was recorded and the male highland sheep fed T3 ration recorded the significantly ($P<0.05$) highest weight gain (8.21 kg) and weight gain per day (56.13 gm) followed by T4, T5 and T2. Significant decrease in Feed Conversion Rate (FCR) was recorded and sheep fed T3 ration recorded the significantly ($P<0.05$) lowest FCR (8.76) followed by T4 (9.42), T2 (10.03) and T5 (10.06). No significant ($P<0.05$) difference was observed in the hematological parameters recorded during beginning and end of the experiment. Conclusively, *F. albida* pods can be used to replace barley grain in the feeding of male highland sheep. Hence, it is recommended that cost of production in highland sheep can be greatly reduced by replacing barley in their diets with 50-75% *F. albida* pods.

Keywords: *Faidherbia albida, highland goads, barley grain, growth performance*

Introduction

Ruminants in the tropics are normally fed on low quality roughages, natural pasture and agricultural crop-residues, mainly straw (Wanapat, 1999). Ethiopia is reported to be endowed with the largest livestock population in Africa. According to the Central Statistical Agency, CSA, (2016/17), the population of cattle, sheep and goat was estimated to be 59.5 million, 30.7 million and 30.2 million, respectively. In spite of such a substantial potential, the economic contribution of this sector is not developed to the expected level. Inadequate animal feed resources both in terms of quality and quantity, among others, is leading livestock owners to search for availability of alternatives.

Natural grazing is the major source of small ruminant feed particularly sheep. Livestock production of dry/arid region is almost/totally dependent on grazing. However, grazing lands do not fulfill the

nutritional requirements of animals particularly in the dry season, due to poor management and their inherent low productivity and poor quality. With the rapid increase of human population and high demand for food, pastures are steadily being converted to farmlands. In the mixed crop-livestock systems of the Ethiopian highlands, the total feed resources available for livestock production come from permanent marginal pastures and transient pastures between cropping cycles, crop residues and crop aftermath grazing (Fekadu, 1996). However, these feed resources are high in fibre, with low to moderate digestibility and low levels of nitrogen (Tsige, 2000). Many types of traditional plant and its products from arid region were used in many tropical countries. In arid and semi-arid countries various alternative ruminant feed resources have been used by smallholder, such as Citrus by products (Migwi *et al.,* 2001, Barrios-Urdaneta *et al*. 2003); cactus (*Opuntiaficusindica*) (Mengistu, 2001; Tikabo, 2004), *Zizyphusmauritiana* leaf meal (Abdu *et al*. 2011); *Moringaoleifera* leaf meal (Zanu *et al*. 2011) and Neem *(Azadirachtaindica);*Seed Cake *(*Aruwayo and Maigandi, 2013).

Faidherbiaalbida is a leguminous tree species of mimosoidae sub-family and has been used for long time by the farmers throughout the arid and semi-arid zones of Africa for soil conservation and soil fertility improvement. The tree is particularly a note-worthy among the deciduous leguminous fodder trees. The tree has relatively wide ecological amplitude and unique nature of bearing leaves and flowers during the dry season and shedding leaves during the rainy season (Osman and El Atta, 1993). Owing to this phenology, the tree provides abundant pods and green fodder for nourishing animals during period of feed scarcity. Animals eat the pods, which contain an average 12.40% crude protein and 42.65 nitrogen free extract (Ibrahim and Tibin, 2003). It has been estimated that the mature tree of *F. albida* could produce 135 kg of pods with average value that twice that of a good hay or dried peanut (Jung, 2000). There is, however, a scarcity of information on the extent to which *F. albida* pods can be utilized by sheep and other animals and its effects on production performance and on blood parameters. With this background, this study was planned to evaluate the effects feeding different levels of *F. aldida* leaf/seed with pod on production performance and blood parameters on highland sheep in comparison with barley supplementation, as barley is commonly available agro-industrial by-product, which is moderately rich in protein (8.00-12.00%). It is available with cheaper price throughout the year in Northwestern Zone of Tigray (Mulugeta and Gebrehiwot, 2013).

Materials and Methods

Study Area

The study was conducted at the College of Veterinary Medicine, Mekelle University, Mekelle city of Tigray region in the semi arid highlands of northern Ethiopia. Mekelle is the capital city of Tigray region and located in the northern extremes of Ethiopia extending from $33^{0}25^{1}$ to $39^{0}\,38^{1}$ north latitude and from $36^{0}27^{'}$ to 40^{0} 18' east longitude at an average altitude of 2000 to 2200 meters above sea level. The mean annual rainfall ranges from 11.3 mm to 39.1 mm and the temperature varies from 12^{0}C (in November and December) to 27^{0}C (in January and March). Mekelle is relatively humid and hot climate and it is at a distance of 783 km from Addis Ababa (MoM, 1998).

Experimental animals: Thirty highland male sheep below one year of age and average weight of 14.82 kg were selected and purchased from local market. The animals were vaccinated against anthrax and hemorrhagic septicemia. A day after, they were ear tagged and dewormed against internal parasites and treated against the external parasites by using acaricides. They were also given prophylactic doses of oxytetracycline. The animals were given one week adaptation period, during this period they were fed standard ration.

Housing: The experimental animals were divided into five groups, each containing six animals, and housed in semi-open pens. The initial weight of each was recorded carefully. Each group was kept separately for the duration of the experiment. Each pen was provided with clean water and feed troughs.

Experimental rations: Five experimental rations were formulated to see the replacement effect of *Faidherbia albida* with barley grain at different level *i.e.* 0%, 25%, 50%, 75% and 100%. The ingredient composition of different ration is mentioned in Table 1. All the rations were iso-nitrogenous. The animals were individually penned and offered the experimental ration Acacia pods, barley grain, nug cake, maize, wheat bran and salt. Each animal received a total of 4% dry matter of their body weight as daily feed allowance consist of one-third experimental concentrate and two-third hay.

Table 1: Percentage composition of experimental diets

Feed ingredients %	**Experimental diets**				
	T1 (0%)	**T2 (25%)**	**T3 (50%)**	**T4 (75%)**	**T5 (100%)**
F. albida pods	0.00	10	20	30	40
Barley grain	40	30	20	10	0
Nug cake	25	25	25	25	25
Maize	23	23	23	23	23
Wheat bran	10	10	10	10	10
Salt	2	2	2	2	2

Experimental procedure: After the adaptation period the experimental animals were individually weighed again by using small ruminants balance (0-50 kg capacity) and randomly divided into five groups (6 animals each), with similar average body weight. Blood samples from each animal were collected for evaluation of blood parameters.

Feeding management: The rations were prepared and packed in labeled sacks as Ration T1 (control 0%), T2 (25%), T3 (50%), T4 (75%) and T5 (100%) on the basis of replacement of barley grain with *F. albida* dry pods. The rations were given to the sheep daily at 8:00 am and the refusal part was collected in the next morning at 7:00 am and weighed. Clean water was available throughout the experimental period. The experiment was conducted for a period of 120 days.

Data Collection and Analysis

Feed intake: The rations were given to sheep daily every morning at 8:00 am and the refusal part was collected in the next morning at 7:00 am, weighed and subtracted from the daily offered amount to calculate the actual feed intake.

Body weight: The experimental animals were weighed weekly by using small ruminants balance (0-50 kg capacity). Difference in weight and feed consumed was taken to calculate the daily weight gain and Feed Conversion Ratio (FCR).

Blood parameter: Blood samples were collected at the beginning and at the end of the experiment to evaluate the blood parameters like erythrocyte sedimentation rate, ESR, red blood cells, RBC and white blood cells, WBC.

The experiment was a Completely Randomized Block Design (CRBD). Data generated from the experiment were analyzed using the General Linear Model (GLM) analysis of variance procedure of Statistical Analytical System (SAS, 2005). Treatment means that were significantly different were separated using Duncan's Multiple Range Test (DMRT).

Results and Discussion

The chemical composition of experimental feed containing different levels of *Faidherbia albida* pods as replacement for barley grain are presented in Table 2. The above result showed that zero inclusion of *F. albida* pods gave better results in terms of total DM but the crude protein, ether extract and ash is increased by supplementing different levels of inclusion of *F. albida* pods. The increase in CP values of the feeds also reported by Norton (1998) and Uguru *et al.* (2014) for most tropical legumes and the range of 10 to 15% reported by Sikosana *et al*., (2002) for most browse plants. Increase of DM and decrease of CF is also reported by Uguru *et al.* (2014) due to inclusion of *Acacia Nilotica pods* in the ration. In contrary to this study, decrease in DM, CP and EE was reported due to inclusion of *F. albida* pods (Ibrahim and Tibin, 2003) which is beyond the scope of this study to deal with this difference.

Table 2: Proximate composition of experimental feed (%) based on dry matter basis

Pods as Replacement for Barley grain					
Parameters	**Treatments (Levels of *F. albida* pods) %**				
	T1 (0%)	T2	T3 (50%)	T4 (75%)	T5 (100%)
Dry matter (DM)	94.10	93.33	92.87	92.34	91.91
Crude protein (DM)	16.83	17.03	17.35	17.81	18.09
Crude fibre (CF)	13.54	13.38	14.58	14.11	15.07
Ether-extract (CF)	9.44	10.12	10.57	11.12	11.54
Ash	4.983	5.43	5.58	5.61	5.72
Nitrogen-free extract	55.21	54.04	51.92	51.35	49.58

The performance of highland male sheep fed diets containing different levels of *F. albida* pods to replace barley grain are presented in Table 3. There were no significant (P<0.5) difference in initial body weight and total daily feed intake. However, daily intake of experimental diets increased as the level of *F. albida* pods inclusion increased from 25% to 75% but it decreased at 100% replacement of barley grain. Similar trend of feed intake was reported in Sudan desert goats at different levels of F. *albida* pods inclusion in the experimental ration (Ibrahim and Tibin, 2003). The lower intake recorded in T5 may be due to high level of *F. albida* pods may attributed to low palatability with increased inclusion of tannin containing feed as reported by Zarah, (1999). This shows that an increase in level of *F. albida* pods decreased feed intake which is in line with the report of Mohammed (1989) and Abbator, (1996) who indicated an increase in level of *F. albida* pods above 20 kg in the diet decreases feed intake while Abbator, (1996) and Zarah, (1999) reported that inclusion level of *F. albida* pods above 15 kg reduces feed intake of Red Sokoto bucks. Contrary to the current finding, Bah *et al.* (2017) reported significant difference in feed intake at different level of inclusion of *F. albida* pods in Red Sokoto bucks. This variation may be due to species variation of experimental animal and inclusion of different ingredients which may increase palatability and acceptability of the diet to the animals.

Table 3: Feedlot performance of male highland sheep fed different levels of *F. albida* pods

Parameters	**Treatment groups**					
	T1 (0%)	**T2 (25%)**	**T3 (50%)**	**T4 (75%)**	**T5 (100%)**	**Sign.**
Initial body weight (kg)	14.85	15.01	14.67	14.43	15.14	NS
Final body weight (kg)	20.50^{a}	21.75^{ab}	22.88^{b}	22.00^{b}	21.98^{ab}	S*
Total weight gain (kg)	5.65^{a}	6.74^{a}	8.21^{b}	7.57^{b}	6.84^{ab}	S*
Weight gain /day (gm)	47.04^{a}	56.13^{ab}	68.37^{b}	63.11^{b}	57.03^{ab}	S*
Total daily Intake of feed (g)	548	563	599	595	574	NS
Feed Conversion Ratio	11.64^{a}	10.03^{b}	8.76^{c}	9.42^{bc}	10.06^{b}	S*

Foot note: S: Significant; NS: Non-significant*

Total weight gain and weight gain per day were significantly affected by inclusion of *F. albida.* As these two parameters are positively correlated, hence similar trends were observed among the treatment groups. There was significant increase in total weight gain and weight gain per day from T1 to T3 then gradual decrease to T5 was observed. Male highland sheep fed T3 ration recorded the significantly (P<0.05) highest daily weight gain (8.21 kg) and weight gain per day (56.13 gm) followed by T4, T5 and T2. The control group has significantly lowest daily weight gain (5.65kg) and weight gain per day (47.04 gm) (Table 3). These differences may be attributed to higher tannin (Zarah, 1999) contents and fibre accumulation as the level of *F. albida* pods increases with higher levels of inclusion (Bah *et al.,* 2017). Ibrahim and Tibin, (2003), reported similar trend of daily weight gain and weight gain per day in Sudan desert goats at different levels of F. *albida* pods inclusion in the experimental ration. These finding partly agree with the report of Zarah, (1999) and Bah *et al.* (2017). The decrease in daily weight gains as the

level of *F. albida* pods increased could partly be due to the decreased efficiency of feed utilization rather than the reduced feed intake alone. This is in conformity with finding of Ibeawuchi and Adamu (1990). Feed conversion rate (FCR) was significantly affected by inclusion of *F. albida.* There was significant decrease in FCR from T1 to T3 then gradual decrease to T5 was observed. Male highland sheep fed T3 ration recorded the significantly ($P<0.05$) lowest FCR (8.76) followed by T4 (9.42), T2 (10.03) and T5 (10.06). The control group has significantly highest FCR (11.64). Similar findings are reported by Ibrahim and Tibin, (2003) in Sudan desert goats at different levels of *F. albida* pods inclusion in the experimental ration. Findings revealed that the inclusion of *F. albida* pods from 50% to 75% will be effective in replacing barley grains as it enhances the FCR. The results of hematological parameters of male highland sheep fed different levels of *F. albida* pods as replacement for barley grain at start and end of experiment are presented in Table 4. No significant ($P<0.05$) difference was observed in the hematological parameters recorded during beginning and end of the experiment periods in sheep.

Table 4: Hematological parameters of male highland sheep fed different levels of *F. albida* pods

Treatments	ESR		Sign.	RBC Count		Sign	WBC Count		Sign.
	Initial (mm/hr)	Final (mm/hr)		Initial	Final		Initial	Final	
T1	1.00	1.00		5.28×10^6/µl	4.99×10^6/µl		8225/µl	7975/µl	
T2	1.45	1.35	NS	5.67×10^6/µl	5.68×10^6/µl	NS	7787/µl	8162/µl	NS
T3	0.85	1.00		5.65×10^6/µl	5.44×10^6/µl		8775/µl	9093/µl	
T4	1.50	1.35		5.06×10^6/µl	4.93×10^6/µl		9900/µl	9712/µl	
T5	1.65	1.55		4.96×10^6/µl	5.12×10^6/µl		9100/µl	9255/µl	

Note: Erythrocyte sedimentation rate, ESR, red blood cells, RBC and white blood cells, WBC

Conclusion and Recommendation

From the current findings, it can be concluded that *F. albida* pods can be used to replace barley grain in the feeding of male highland sheep. Hence, it is recommended that cost of production in highland sheep can be greatly reduced by replacing barley in their diets with 50%-75% *F. albida* pods.'

References

Abbator, F. I. 1996. Digestibility and voluntary feed intake of some browse plants species by sheep in the semi-arid zone of Nigeria. Pp 66-68.

Abdu, S.B, Haasan, M.R, Adamu, H.Y. &Yashim, S.M. 2011: Effect of Level of *Zizyphus mauritiana* Leaf Meal Inclusion in Concentrate Diet on Rumen Degradation Characteristics. *World Journal of Life Sciences and Medical Research*, **1**(4):117-121.

Aruwayo, A. &Maigandi, S. A. 2013: Neem (Azadirachtaindica) Seed Cake/Kernel as Protein Source in Ruminants Feed. *American Journal of Experimental Agriculture*, **3**(3): 482-494.

Bah, S. U., Ibrahim, H. &Asheik, L. G. 2017. Effect of varying levels of *Faidherbia albida* pods supplement on intake and weight gain of red sokoto goats in the semi-arid zone, Nigeria. *Journal of Animal Production Research*, **29**(1):359-364.

Barrios-Urdaneta, A., Fondevila, M. &Castrillo, C., 2003. Effect of supplementation with different proportions of barley grain or citrus pulp on the digestive utilization of ammonia-treated straw by sheep. *Animal Science*, **76**, 309–317.

CSA. 2016/17. Central Statistical Agency (CSA). Agricultural sample survey. Report on livestock and livestock characteristics. The Federal Democratic republic of Ethiopia, Statistical Bulletin 585, Addis Ababa, Ethiopia, April, 2017.

Fekadu, D. 1996. Potential of Enset *(Ensetentricosum)* in Ruminant Nutrition in Ethiopia, Part III. M.Sc. Thesis, Swedish University of Agricultural Sciences, Uppsala, Sweden.

Ibeawuchi, J. &Adamu, Y.A. 1990. Effect of various levels of A. albda pods in concentrate supplement for goats. Growth response and feed intake. *Bulletin Animal Health Production Africa*, **38**, 219 222.

Ibrahim, A. &Tibin, I.M. 2003. Feeding potential of *Faidherbia albida* ripe pods for Sudan desert goats. Scientific Journal of King Faisal University (Basic and Applied Sciences), **4** (1):1424.

Jung, G. 2000. Tannin in feed stuff for complex stomach animals *Nutr. Res. Rev*. **10**, 106-120.

Mengistu, W. 2001. Prickly pear cactus (Opuntiaficus-indica) as feed to ruminants. MSc. Thesis presented to Swedish University of Agricultural Science, Uppsala. 88p.

Migwi, P.K., Gallagher, J.R. & Van Barneveld, R.J., 2001. The nutritive value of citrus pulp ensiled with wheat straw and poultry litter for sheep. *Australian Journal of Experimental Agriculture*, **41**:1143 1148.

Mohammed, I. D. 1989. Dry Acacia albida pods as supplement to low quality feed for sheep in the semi arid zone of northern Nigeria. Pp 28.

MoM, 1998. Mekelle office of metrology. Info. Doc. Note.Mekelle, Ethiopia.

Mulugeta, F. &Gebrehiwot T. 2013. Effect of sesame cake supplementation on feed intake, body weight gain, feed conversion efficiency and carcass parameters in the ration of sheep fed on wheat bran and teff (*Eragrostisteff*) straw. *Momona Ethiopian Journal of Science* (MEJS), **5**(1):89-106, 2013.

Norton, B.W. 1998. The nutritive value of tree legumes. In: Gutteridge, R.C. Shelton, H.M. (eds). Forage tree legumes, in tropical Agriculture, Grass land society of Australia Inc. St. Lucia, Queensland.

Osman, U.E & el Atta, H.A. 1993. Rizobial cross inoculation group of *F.albida* and Acacia species. U.K.J. Agricultural Science, 1(1):93-97.

SAS, 2005. Institute Inc. SAS/STAT, Users' Guide. 6.03 edition. Cary NC, USA.

Sikosana, J.L.N., Smith, T., Mlambo,V., Owen, E., Muller-Harvey, I. &Mould, F. 2002. Acacia and other tree pods as dry season feed supplements for goats. In: (eds) smith, T., Godfrey, S.H., Buttery, P.J. and Owen. E. Helping Small Stock keepers enhance their livelihoods: Improving management of small holder owned sheep and goats by utilizing local resources: proceedings of the second DFID livestock production programme Link project (R7798) workshop for small stock keepers. SokoineUniversityof Agric. Tanzania 8-10 January, 2002 pp 69-75.

Tikabo, G. 2004. Survey on cactus pear (Opuntiaficusindica) in EndertaWereda, Southern Tigray and effect of wilting and different levels of cactus inclusion on feed utilization in sheep. An MSc Thesis Presented to the School of Graduate Studies of Alemay University. 52p.

Tsige Y. 2000. Livestock feed security and associated impacts on sustainable agricultural development. In: Proceedings of the 7th Annual Conference of Ethiopian Society of Animal Production (ESAP), Addis Ababa, Ethiopia, 26-27 May 1999. pp. 51-61.

Uguru, C., Lakpini, C.A.M., Akpa, G.N., &Bawa, G.S. 2014. Nutritional Potential of Acacia (*Acacia Nilotica* (L.) Del.) Pods for Growing Red Sokoto Goats. *IOSR Journal of Agriculture and Veterinary Science*, **7**(6) Ver. I: 43-49.

Wanapat, M. 1999. Feeding of ruminants in the tropics based on local feed resources. M Wanapat (Editor). Department of animal science, KhonKaen University, Khon Kean, Thailand.

Zanu, H.K, Asiedu, P, Tampuori, M, Abada, M., Asante, I. 2012. Possibilities of using moringa (m*oringaoleifera*) leaf meal as a partial substitute for fishmeal in broiler chickens diets. *Online Journal of Animal Feed Research*, **2**(1):70-75.

Zarah, I. A. 1999. Performance of Borno white goats fed graded level of dry *Faidherbia albida* pods. Pp 33-40.