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Body Weight Gain and Testicular Growth of Horro Rams Supplemented Concentrate with *Lablab purpureus* Fed Grass Hay

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Abstract: The study was conducted at Ambo University using twenty five Horro sheep with initial body weight of 16.84±0.23kg (mean±SD). The objectives of the experiment was to evaluate Body weight gain and testicular growth of horro rams supplemented concentrate with *Lablab purpureus* fed grass hay. The experimental sheep were blocked into five blocks of five animals based on their initial body weight and randomly assigned to one of the five treatment diets within a block. The treatments were grass hay fed ad libitum to all treatments plus 100% CM/day (T1, control supplemented), 75%CM: 25%LP/day (T2), 50%CM: 50%LP/day (T3), 25%CM: 75%LP/day (T4), 100%LP/day (T5). The experiment consisted of 90 days feeding trials after quarantine and adaptation period to the environment and experimental feed. Feed offered and refused were recorded throughout the respective study period; while body weight change was recorded at 7 days interval. The CP contents of NSC, LP, WB, MG and GH were 31.1, 21, 18.7, 8.2 and 7.4%, respectively. Organic matter ranged from 87.8% (GH) to 98.1% (MG). The mean intake of basal DM in T5 (523.4±3.13 g/d) was greater ($p<0.001$) than in T1, T2, T3 and T4 by 86.2, 63.2, 49 and 24.6%respectively. The supplemented animals had higher ($p<0.001$) total DM intake (860.2-923.4g/d; SEM±3.07) than the control supplemented (837.2±3.07g/d) and the higher ($p<0.001$) total CP intake of 117.58, 118.79, 120.75 and 122.73 g/d (SE±0.23) for T2, T3, T4 and T5, respectively were recorded than T1 (115.7±0.23 g/d). LP Supplementation improved ($P<0.001$) final body weight (FBW) and average daily gain (ADG). Lambs fed T5 diet displayed higher ($P<0.001$) FBW (22.52±0.074kg) and ADG (63.5±0.76g/d) as compared to T1 (20.78±0.07kg) and (41.76±0.76/d) for FBW and ADG, respectively. LP Supplementation significantly increased ($P<0.001$) scrotal circumference and testicular traits than T1.

Keywords: Body Weight Gain, Concentrate, Horro Lamb, *Lablab purpureus*, Testicular Trait

1. Introduction

The livestock population of Ethiopia is estimated at 59.5 million cattle, 30.7 million sheep and 30.2 million goats [8] and they are distributed throughout a range of the wide ecology of the country. Similar to other species of livestock, sheep are also very important sources of food, hair (wool) and manure. As an integral component of theoverall farming system, livestock serve as a source of draught power for crop production, transport, minimize risk during times of crop failure, supply farm families with milk, meat, manure, serve as source of cash income, and plays significant role in the social and cultural values of the society [22, 6]. Among the livestock species, sheep and goats are widely reared in a crop-livestock farming systems and are distributed across different agro-ecological zones of Ethiopia. They provide their owners with a vast range of products and services such as immediate cash income, meat, milk, skin, manure, risk spreading and social functions [2].

The crop-livestock farming systems in the Ethiopian highlands are under stress because of shrinking cultivated areas per household, land degradation, and reduced pasture land [9]. To solve this problem, there are options like supplementing animals with agro-industrial by-products such as different oil seed cakes and brans from edible oil and flour processing industries, respectively. However, they are costly and not readily available everywhere.

Supplementation with forage legumes (herbaceous and shrubby or tree legumes) can enhance the utilization of poor quality roughages in smallholder mixed farming systems for better growth and carcass yield of sheep [12]. However, wider use of cultivated forages by livestock keepers in Ethiopia is not significant probably because of scarcity in information regarding the feeding value, lack of information regarding means of its efficient utilization, such as in combination with different non-grain and grain concentrates, and less adoption and wider cultivation practices of these feed. Therefore, the present study was conducted with the objective:

To evaluate Body weight gain and testicular growth of horro rams supplemented concentrate with *Lablab purpureus* fed grass hay.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted at Ambo University, Ambo, Oromia Region, Ethiopia which is located at 115 km West of Addis Ababa. The site was situated at 8°17'N latitude and 37°1'E longitude and at mid altitude in average 2340 meter above sea level. The mean annual rainfall was 1079 mm and the mean minimum and maximum daily temperatures of the area were 12 and 26°C, respectively.

2.2. Experimental Feeds Preparation and Feeding Management

Experimental feeds were composed of natural grass hay as a basal diet and replacement of concentrate mix with *Lablab purpureus* (LP) legume forage. The grass hay was bought from hay producer and stored in hay shade till the feeding was started. A seed of *Lablab purpureus* of 90% viability was sown at the recommended rate of 15-20 kg/ha in Ambo University campus farm site. The LP was sown in a plot with 40 cm within rows and 100 cm between rows. *Lablab purpureus* hay was prepared by cutting or harvesting at growth stage of 50% flowering and stored in hay shade. The hay was dried until it is crispy by frequently turning in order to maintain its green color. Mechanical chopping was done approximately to 4-7cm length and chopped materials were dried under shade until use for feeding. The concentrate mixtures consist of 55% wheat bran, 30% noug seed cake and 15% maize grain. The *Lablab purpureus* replaced the concentrate mixture at proportions of 0%, 25%, 50%, 75% and 100%. The *Lablab purpureus* and the concentrate were provided to the experimental animals as a mixed ration according to the treatment. Experimental feeds were offered in two equal portions twice a day at 0800 and 1600 hours. All groups were offered with hay *ad libitum* and had access to drinking water twice a day.

2.3. Experimental Animals and Their Management

Twenty five yearling male Horro sheep with average initial body weight of 16.84±0.23kg were purchased from market. Age of the animals was determined based on their dentition and information obtained from the owner.

The experimental animals were quarantined for fifteen days and vaccinated against common infectious diseases in the area. Thereafter, the experimental animals were assigned into different treatments after which the animals were randomly put into a separate well aerated pen having a feed trough. Each animal offered feeds allotted for its respective treatment. Feed offered and left was recorded. They were let to drink water twice a day, in the morning at 0900 and in the afternoon at 1500 hr. Pen cleaning was done every morning before offering feed.

2.4. Experimental Design and Treatment

Experimental treatments used in the experiments were presented in the (table 1). The experiment was conducted by using a randomized complete block design (RCBD) with five treatments and five replications. Animals were blocked based on their initial body weight (IBW) into five blocks consisting of five animals. The initial body weight was determined as a mean of two consecutive body weight measurements after overnight feed removal from the trough. Treatment diets were randomly assigned to each animal in a block. Concentrate was supplemented for control group at a rate of 400 gm/head/day and treatment groups were supplemented with four levels of *Lablab purpureus* and concentrate mix as outlined below. The supplement forage *(Lablab purpureus)* and the concentrate mixture were mixed together before offered to the animal. The experiment was conducted for 90 days of feeding trials.

Table 1. *Experimental Treatments.*

Treatments	Natural pasture hay	Supplement mixture		Daily DM offer (gm /head)
	(Basal diet)	CM (gm)	LP (gm)	
T1	*Ad libitum*	400	0	400
T2	*Ad libitum*	300	100	400
T3	*Ad libitum*	200	200	400
T4	*Ad libitum*	100	300	400
T5	*Ad libitum*	0	400	400

Concentrate Mixture (CM)=Wheat bran (55%), Noug seed cake (30%), Maize grain (15%), LP=Lablab Purpureus hay, DM=dry matter gm=gram.

2.5. Measurements

2.5.1. Feeding Trial

The feeding trial was conducted for 90 days following 14 days of adaptation period. The amount of feed offered and the corresponding refusal was weighed and recorded for each sheep to determine feed intake. Representative samples of feeds offered and refusal for each animal were collected and pooled per treatment and dried in an oven at 65°C for 72 hours. Mean daily DM and nutrients intake was determined as a difference of offered and that of refused. The daily DM intake expressed as percent of body weight and metabolic body weight of an animal was calculated by dividing the mean daily DM intake during 90 days of experimental period with respective body weight of sheep taken in the same period by employing the following formula:

Total DM intake (percent body weight)=DM intake (g)/ Body weight (kg)*100

Total DM intake (metabolic body weight (g/kgW°)=DM Intake (g)/BW° (kg)

2.5.2. BodyWeight Gain

Initial body weight of the experimental animals was measured at the beginning of the trial using weighing spring balance. Live weight of each animal was recorded ten days interval in the morning before feed was offered throughout the experiment. Average daily weight gain was estimated as the difference between final live weight and initial live weight of the experimental sheep 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 by the animal each day.

2.5.3. Testicular Measurements

Measurements on Scrotal circumference (SC), Testicular diameter (TD), Testicular length (TL) and Testicular tone (TT) were taken every two weeks by restraining the rams in the standing position. SC was measured at the widest testis circumference using tailor tape while TD was measured at the anterior-posterior position on each testis at its maximum width using a caliper. TL was also measured with a flexible measuring tape on both the left and right testes in cm. Records on left and right testes on TD and TL were averaged to produce single values at each time of measurement.

Scrotal skin thickness (SST) was measured using caliper at the tip of the testes by pushing the testes up ward with one hand while the opposite hand guide and adjust the caliper. Since the scrotal skin is folded, value at each measurement was divided by two and recorded as SST. Testicular tone (TT) was scored subjectively by palpating the testis for testicular tone as suggested for bucks (15); that ranges in scale from 1-5 (1=very soft; 2=soft; 3=moderate; 4=hard; 5=very hard).

2.6. Chemical Analysis

Samples of feed offered and feces were dried in an oven at 65°C for 72 hours and ground to pass 1 mm sieve screen size. The ground samples were kept in air-tight plastic bags pending chemical analysis. The nitrogen (N), Dry matter (DM), Organic matter (OM), and ash content were analyzed according to [3]. The crude protein (CP) content was calculated by multiplying N content with a factor of 6.25. Neutral detergent fibers (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) were analyzed based on the method of [21].

Organic matter (OM) content was calculated as:

% OM=100 - ash percentage.

2.7. Statistical Analysis

Data on feed intake, body weight gain, scrotal circumference and testicular dimensions were analyzed using the general linear model procedure of [13]. The treatment means were separated by least significant difference (LSD). The model used for data analysis was:

$$Y_{ij}=\mu + T_i + B_j + E_{ij}$$

Where; Yij=Response variable
μ=Overall mean
Ti=Treatment effect
Bj=Block effect
Eij=Random error

3. Results and Discussion

3.1. Chemical Composition of Feeds

Variations were observed in chemical compositions. For instance, CP ranged from 7.4 to 31.1%. The lowest CP was recorded for natural pasture hay while the highest CP was obtained from noug seed cake.

Table 2. *Chemical Composition of Experimental Feeds (Dry matter as %; other values expressed as % DM).*

Feed offer	DM	CP	NDF	ADF	ADL	Ash	OM
Grass hay	90.9	7.4	72.4	44.5	8.3	12.2	87.8
LP hay	91.8	21	51.3	46.3	11.7	11.9	88.1
NSC	89	31.1	38.8	28.3	9.4	9.3	90.7
WB	90.5	18.7	49	15.7	6.2	5.9	94.1
MG	90.2	8.2	5.8	2.7	__	1.9	98.1

ADF=acid detergent fiber; ADL=acid detergent lignin; CP=crude protein; DM=dry matter; LP=Lablab purpureus; MG=maize grain; NDF=neutral detergent fiber; NSC=noug seed cake; WB=wheat bran.

The variation in chemical composition of hay reported in different studies is attributed to the stage of maturity of the grass from which the hay was prepared, hay preparation and storage management differences, and species composition of the grass. As mentioned by [11] advance in maturity of grass from which the hay was prepared is usually associated with low CP and high NDF and ADF content. Faulty handling such as over drying causes shuttering of leaves, and composition of the grass in terms of grasses and legume influences its chemical content.

3.2. Dry Matter and Nutrient Intake

The result showed that the mean basal DM intake (DMI) in the CM supplemented group was significantly ($P<0.001$) lower than the *Lablab purpureus* forage supplemented groups. The total DM intake was in the order of T5>T4>T3>T2>T1, which was mainly attributable to slight differences in basal DM intake. Significant ($P<0.001$) differences were also observed in total DM intake among the LP supplemented groups.

Dietary protein supplementation is known to improve intake by increasing the supply of nitrogen to the rumen microbes. This has positive effect on increasing rumen microbial population and efficiency, thus enabling them to increase the rate of breakdown of the digesta. When the rate of breakdown of digesta increases, feed intake is accordingly increased [20]. Total NDF and ADF intake was lower ($p<0.001$) for T1 than LP supplemented groups.

This might be due to the amount of fiber fractions that existed in the treatment feed which might have increased with the increasing amount of total DM intake in the supplemented groups due to the high intake.

Among supplemented groups, T5 (sole *Lablab purpureus* hay supplement) consumed higher Total DM on the basis of metabolic body weight (g/kgW°). The CP, ADF, NDF intake were statistically different (p<0.001) among all treatments.

Table 3. *Daily dry matter and nutrient intake of Horro sheep fed basal diet of natural pasture hay and supplemented with concentrate mix, Lablab purpureus hay or their mixture.*

Intake	Treatments						
	T1	**T2**	**T3**	**T4**	**T5**	**SEM**	**SL**
Hay DM (g/d)	437.2°	460.2°	474.4°	498.8°	523.4°	3.07	***
Supp. DM (g/d)	400	400	400	400	400	0.00	-
Total DM (g/d)	837.2°	860.2°	874.4°	898.8°	923.4°	3.07	***
Total DM (%BW)	4.01°	4.05°	4.06°	4.08°	4.1°	0.01	***
Total DM (g/kg W°)	86.28°	87.24°	87.8°	88.46°	89.34°	0.16	***
OM (g/d)	758.5°	773.2°	780.1°	795.9°	811.9°	2.74	***
CP (g/d)	115.7°	117.58°	118.79°	120.75°	122.73°	0.23	***
NDF (g/d)	474.4°	502.8°	525.0°	554.5°	584.1°	2.36	***
ADF (g/d)	264.7°	303.6°	338.8°	378.4°	418.1°	1.39	***

a-e=means within a row not bearing a common superscript are significantly different; p<0.01=**, p<0.001=***; ns=non-significant; SL=significance level; ADF=acid detergent fiber; CP=crude protein; DM=dry matter; NDF=neutral detergent fiber; OM=organic matter; SEM=standard error of mean; T1=Hay adlibitum+100%CM (wheat bran 55%, noug seed cake 30%, maize grain 15%); T2=Hayadlibitum+75%CM+25%LP; T3=Hayadlibitum+50%CM+50%LP; T4=Hay adlibitum+25%CM+75%LP; T5=Hay adilibtum+100%LP; LP=Lablab purpureus.

3.3. Body Weight Change

The current finding revealed that increased level of *Lablab purpureus* hay supplementation increases average daily body weight gain and body weight change. This was in agreement with the results obtained by [12] who reported that *Lablab purpureus* and *Cajanus cajan* supplementation improved daily body weight gain. The values of ADG observed for supplemented groups in the current study were considerably higher than the highest ADG value of 47.2gm/day reported by [10] for the Ethiopian highland sheep supplemented with 300g/day leucaena to urea treated and untreated straw. Similarly, lower ADG values (ranged from 33.3 to 58.7gm/day for Horro lambs and 40.2 to 48.7gm/day for Washera lambs) were reported by [5] when consumed rations containing different roughage to concentrate ratios. In the current study, feed conversion efficiency (FCE) was significantly higher (P<0.001) for LP supplemented than the CM supplemented group (T1). Similar findings of improved FCE in supplemented groups versus non-supplemented group were reported by previous studies [7, 15, 23, 10].

Table 4. *Body weight parameter and feed conversion efficiency of Horroshee p fed a basal diet of natural pasture Hay supplemented with concentrate mix, Lablab purpureus hay or their mixture.*

Parameters	Treatments						
	T1	**T2**	**T3**	**T4**	**T5**	**SEM**	**SL**
IBW (kg)	17.06	16.92	16.68	16.76	16.8	0.103	ns
FBW (kg)	20.78°	21.22°	21.54°	22.04°	22.52°	0.074	***
BWC (kg)	3.76°	4.3°	4.86°	5.28°	5.72°	0.068	***
ADG (g/d)	41.76°	47.72°	53.96°	58.62°	63.5°	0.76	***
FCE (g ADG/g DMI)	0.049°	0.055°	0.060°	0.065°	0.068°	0.0007	***

a-e=means within a row not bearing a common superscript are significantly differ. p<0.01=**, p<0.001=***, ns-non significant, SL-significance level, BWC=body weight change; ADG=average daily body weight change; FBW=final body weight; FCE=feed conversion efficiency; IBW=initial body weight; SEM=standard error of mean.

3.4. Testicular Measurements

LP Supplementation improved (P<0.001) scrotal circumference (SC) compared to the control supplemented fed grass hay. The higher SC in the supplemented group was comparable with 23.5±0.30 cm of earlier report [14].

Although SC recorded in the current study was within the range (21 to 28cm) reported earlier [16], it was lower compared to 28.7 cm reported [17] for the same breed. The difference might be due to differences in the age of the experimental animals used since this study employed yearling rams as compared to rams of 2 to 3 years old used in the latter case. As BW significantly affects SC [17], rams of 3 years old attain higher BW and consequently higher SC would be expected. Another report indicated that the mean SC for Horro rams was found to be 27cm [4]. This high value, in comparison to the current finding, may be attributed to the fact that the author used different age classes of rams since age influences SC of the animal.

***Table 5.** Scrotal Circumference of Horro Rams fed a basal diet of grass Hay supplemented with concentrate mix, Lablab purpureus hay or their mixture.*

Parameters	Treatments						
	T1	T2	T3	T4	T5	SEM	SL
ISC (cm)	19.78°	20.2°	20.44°	20.76°	20.92°	0.116	***
FSC (cm)	21.2°	22.12°	22.82°	23.5°	24.62°	0.139	***
TCSC (mm)	14.2°	19.2°	23.8°	27.4°	37°	1.119	***
AD CSC (mm)	0.154°	0.208°	0.262°	0.3°	0.408°	0.012	***

a-e=means within a row not bearing a common superscript are significantly differ. p<0.01=**, p<0.001=***, ns-non significant, SL-significance level, ISC=Initial scrotal circumference; FSC=Final scrotal circumference; TCSC=Total change in scrotal circumference; ADCSC=Average daily change in scrotal circumference; SEM=standard error of mean.

Supplementation with LP at 100% on DM basis was found to increase SC for T5 while there observed a reduction in respective traits for T1 (Table 3). The favorable results regarding the increase in SC, with supplementation may be due to the beneficial effect of dietary nutrients on the testicular traits. This is similar to earlier report [18] which indicated that selenium supplementation favorably affects cells of testes and increased SC in Suffolk Egyptian rams.

On the other hand the decrease in SC for controlsupplemented group could partly be explained by the decrease in scrotal skin thickness (SST). Furthermore, the loss in these testicular traits in controlsupplemented rams might be attributed to the decline in protein content of that treatment which consequently resulted in the loss of testicular subcutaneous fat. Similarly [19] reported that Arsi-type rams fed on sole basal diet of chickpea haulms were found to reduce their SC by 10% due to loss of fat from scrotal tissues.

Testicular size was drastically reduced in control supplemented group and rams either gain or lose testicular size at greater rate than live weight that have associated depressed testicular growth with protein deficiency in rams [24]. Other testicular traits were also significantly (P<0.001) affected by supplementation.

Highly significant (P<0.001) differences were observed in testicular tone (TT), testicular diameter (TD); TL and SST between LP supplemented and control-supplemented groups, with the lowest value being recorded for (control supplemented) animals. Except for TD measurements, values for SST, was lower than the average values of 0.75±0.06 to 0.9±0.06 cm earlier reported [19].

The variation might be attributed to difference in the reported BW and breed differences.

***Table 6.** Testicular Dimensions of Horro Rams fed a basal diet of grass Hay supplemented with concentrate mix, Lablab purpureus hay or their mixture.*

Parameters	Treatments						
	T1	T2	T3	T4	T5	SEM	SL
TT*	2.4°	2.56°	2.78°	2.9°	3.12°	0.077	***
TD (cm)	3.32°	3.6°	3.82°	4.16°	4.24°	0.0712	***
SST (cm)	0.128°	0.152°	0.168°	0.182°	0.204°	0.0045	***
TL (cm)	7.74°	8.12°	8.48°	8.58°	9.44°	0.16	***

a-e=means within a row not bearing a common superscript are significantly differ. p<0.01=**, p<0.001=***, ns-non significant, SL-significance level, TT*=Original data of testicular tone (1-5 score); TD=testicular diameter (cm); SST=scrotal skin thickness (cm); TL=testicular length (cm); SEM=standard error of mean.

TD measurements in the current study for LP supplemented groups were comparable with values reported by [1], which were 3.82±0.08cm. As indicated by testicular measurements in the current study, testicular size was affected by nutrition, with values being lower for control supplemented than LP supplemented groups which indicated that testicular growth can be positively affected when animals are fed above their maintenance requirement. Hence supplementing Horro rams during the dry season is mandatory as lower testicular size has been associated with poor fertility and a lower libido [19]. Generally, LP supplementation was found to favorably affect all testicular traits considered in the current experiment, while there appeared a reduction in these traits across the experimental period in control-supplemented group which underline the importance of supplementing Horro rams.

4. Conclusion

The results obtained from the feeding trials revealed also that supplement of *Lablab purpureus* hay at level of 400 g DM/d/head resulted in higher (P < 0.001) total DM and CP intakes and improved (P < 0.001) the daily body weight gain compared to the concentrate substitution at 100, 200 and 300 g DM/d/head. The result of this study showed that supplementation of *Lablab purpureus* improved ADG and testicular size of Horro rams compared to the control supplemented. The Consistent with T5, T4 should be considered as an appropriate feeding strategy to improve productive and reproductive traits of Horro rams.

References

[1] Abera Seyoum and Yoseph Mekasha, 2016: Body Weight Gain and Testicular Growth of Horro Rams Supplemented with Noug Seed Cake and Wheat Bran Mix under Grazing Management in Western Ethiopia. *International Journal of Scientific Footprints;* Vol. 4 (2): PP 49–60.

[2] Adane Hirpa and Girma Abebe. 2008. Economic Significance of Sheep and Goats. In: Alemu Yami & R. C. Merkel (eds). *Ethiopian Sheep and Goat Productivity Improvement Program (ESGPIP)*, Addis Ababa, Ethiopia.

[3] AOAC (Association of Official Analytic Chemists). 1990. Official Methods of Analysis. 15th edition. AOAC. *Inc. Anc. Arlington,* Virginia, U.S.A. pp. 12-98.

[4] AOAC (Association of Official Analytical Chemists), 1990. Official methods of analysis: Association of Official Analytical Chemists (AOAC). 5th ed. Washington, DC. 69-88p.

[5] AssefuGizachew. 2012. Comparative feedlot performance of Washera and Horro sheep fed different roughage to concentrate ratio. *An MSc Thesis Presented to School of graduate studies of Haramaya University*. 68p.

[6] Azage Tegegne, Berhanu Gebremedhin and Hoekstra D. 2010. Livestock input supply and service provision in Ethiopia: Challenges and opportunities for market oriented development. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 20. *ILRI (International Livestock Research Institute*), Nairobi, Kenya. 48p.

[7] BiruKefeni. 2008: Effects of supplementation with sweet potato tuber and haricot bean screenings on feed utilization, Growth and carcass characteristics of adilo sheep. *An MSc. Thesis Presented to School of Graduate Studies of Haramaya University*. 35p.

[8] CSA (Central Statistical Agency). 2017. Agricultural Sample Survey, report on livestock and livestock characteristics (Private Peasant Holdings). Federal democratic republic of Ethiopia, Addis Ababa. *Statistical Bulletin 585*. Vol. 2, April 2017, Ethiopia.

[9] Funte Senbeto, Negesse Tegene and Legesse Getahun. 2010. Feed resources and their management systems in ethiopian highlands: The case of umbulo wacho watershed in southern Ethiopia. *Tropical and subtropical Agroecosystems*, 12: 47-56.

[10] GetahunKebede, 2014. Effect of wheat straw urea treatment and Leucaenaleucocephalafoilage hay supplementation on intake, digestibility, nitrogen balance and growth of lambs. *International Journal of Livestock Production*, 6 (4): 88-96.

[11] McDonald, P., Edwards, A. R., Greenhalgh, D. F. J. and Morgan, A. C. 2002. *Animal Nutrition.* 6th ed. Prentice Hall, London. pp. 245-477.

[12] MekonnenDiribsa. 2014. Effects of Supplementation with *Cajanuscajan, Lablab purpureus*or their Mixture on Feed utilization, Growthand Carcass characteristics of Horro sheep fed a Basal diet of Natural grass hay. *MSc Thesis, Haramaya University,* Haramaya Ethiopia. 57pp.

[13] SAS (Statistical Analysis System). 2004. Statistical Analysis System Institute Inc. User’s Guide, Version 9, SAS Institute Inc., Cary, NC, USA.

[14] TemesgenJembere, GemedaDuguma, KetamaDemisse and DiribaGeleti, 2007: Evaluation of cow pea hay (V. unguaculata) vs. nougcake supplementation of Cynodondectylon on growth performance and carcass characteristics of Horro rams. pp. 23-29. Proceeding of the 11th Annual Conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, October 4-6, 2007.

[15] TewodrosEshete, 2011: Effect of inclusion of different proportions of tossign (*thymus serrulatus*) in concentrate mix supplement on feed intake, digestibility, body weight changeand carcass parameters of Menz sheep fed grass hay. *MSc Thesis Presented to the School ofGraduate Studies of Haramaya University.* 57p.

[16] Tilley, J. M. A. and Terry, R. A. 1963. A two stage technique for in vitro digestion of forage crops. *J. of British Grassland* 18, 104-111.

[17] Toe, F., J. E. O. Rege, E. Mukasa-Mugerwa, S. Tembely, D. Anindo, R. L. Baker and A. Lahlou-Kassi, 2000: Reproductive characteristics of Ethiopian highland sheep. I. Genetic parameters of testicular measurementsin ram lambs and relationship with age at puberty in ewe lambs. *Small Rumi. Res*. 36: 227-240.

[18] UlfinaGalmessa, GemedaDuguma, Solomon Abegaz, Solomon Gizaw and V. S. Raina, 2003: Effect of plane of nutrition on age and weight at sexual maturity in Horro ram lambs. pp. 13-22. Proceeding of the 15th Annual Conference.

[19] Van Soest, P. J., Robertson, J. B. and Lewis, B. A. 1991: Methods for dietary fiber and non starch polysaccharides in relation to Animal nutrition. J. of Dairy Sci. 74, 3583-3597.

[20] Van Soest, P. J., 1982. Nutritional Ecology of theRuminant, *O and B books Corvallis,* Oregon, USA. 345-356p.

[21] Van Soest, P. J., and Robertson, J. B. 1985. Analysis of forage and fibrous foods. *A laboratory manual for Animal science.* 613 Cernell University, Ithaca, New York, USA. 127p.

[22] Wint, G. R. W. and Robinson, T. P. 2007. Gridded Livestock of the World, 2007. Rome: *Food and Agriculture Organisation of the United Nations, Animal Production and Health Division.* Pp 131.

[23] YeshambelMekuriaw, Mengistu Urge and GetachewAnimut, 2012. Intake, digestibility, live weight changes and rumen parameters of Washera sheep fed mixtures of lowland bamboo (*Oxytenantheraabyssinica*) leaves and natural pasture grass hay at different ratios. *PakistanJournal of Nutrition,* 11 (4): 322-331.

[24] Zewdu, 2008: Characterization of Bonga and horro indigenous sheep breeds of smallholders for designing community based breeding strategies in Ethiopia. MSC. The sisharamaya University.