Poultry, Fisheries & Wildlife Sciences

Abraham, et al., Poult Fish Wildl Sci 2016, 4:1
http://dx.doi.org/10.4172/2375-446X.1000149

Research Article | Open access

Evaluating Production Performance of Tigray Highland Sheep Supplemented with Air Dried Foliages of African Wild Olive and Red Thorn: A Case Study of Carcass Production

Hagos Abraham[1*], Mengistu Urge[1] and Getachew Animut[2]

[1]*Department of Animal Sciences, Haramaya University, School of Animal and Range Sciences, Ethiopia*

[2]*Department of Animal Sciences, Bule Hora University, Department of Animal and Range Sciences and Ethiopian Institute of Research Organization, Ethiopia*

[*]**Corresponding author:** Hagos Abraham, Department of Animal Sciences, Haramaya University School of Animal and Range Sciences, Ethiopia, Tel: 51255530051/53; E-mail: hagsabr@gmail.com

Received date: April 12, 2016, **Accepted date:** April 25, 2016, **Published date:** April 29, 2016

Abstract

An experiment was conducted at Wukro St. Mary Agricultural, Technical, Vocational Education and Training College to determine effect of feeding foliages from African wild olive and Red thorn on growth performance and carcass production of Tigray Highland sheep and to assess their economic benefits. Chemical composition and supplementation effect of foliages of these indigenous multipurpose tree species on growth performance of Tigray Highland sheep is available on line www.globalacademicresearchjournals.org . Including air dried foliages of the multipurpose trees as protein supplement to grass hay improved carcass production. Supplemented sheep had significantly ($P < 0.05$) higher slaughter weight, empty body weight, hot carcass weight and dressing percentage on slaughter weight basis than the control treatment. It was economically feasible to poor smallholder sheep owners in the area, but supplementing T4 (mixed air dried foliages) was found as cost-effective with its high net income. The results obtained indicate that feeding foliages from the multipurpose trees alone or mixing at different proportions had potential as a protein supplement with less expense.

Keywords: Carcass; Economic benefits; Foliages; Sheep

Introduction

In Ethiopia, sheep are the second most important and numerous species next to cattle. They are dominantly kept by smallholders in the highlands and lowlands for immediate cash income, food (milk and meat) and non-food products such as manure, skin and wool. Besides, sheep are used as savings, and have social and economic importance to the producers. However, their production and productivity potential is very low. Tsige-Yohannes et al. [1] reported that inadequate and low quality feed is one of the major limiting factors to animal production in Ethiopia. Furthermore, it has been emphasized that most tropical forage species have low dry matter digestibility and intake [2]. Supplementation of concentrates is known to improve intake and digestibility of roughages [3], though the high cost and sometimes, the lack of availability of commercial protein supplements is one of the main limitations to efficient animal production by smallholders [4].

There is, therefore, a need to look for alternative protein sources that livestock owners can easily obtain from their surroundings. Pezo et al. [5] indicate that a potential strategy for increasing the quality and availability of feeds for smallholder ruminant animals in the dry season may be through the use of fodder trees and shrub forages. The aim of this study was thus to evaluate the supplementary value of two locally available multipurpose trees namely African wild olive (Olea Africana) and Red thorn (Acacia lahai) as animal feed in the study area. Thus, the specific objectives of the present study were to:

- Evaluate effect of supplementation with air dried foliages from African wild olive, Red thorn and their mixtures on carcass production of Tigray Highland sheep and
- Assess economic benefits of supplementation with air dried foliages from the multipurpose trees.

Materials and Methods

Description of the study area

The study was conducted at Wukro St. Marry ATVET College which is located at North East of Ethiopia. The area is found at a distance of 823 km from Addis Ababa. Geographically the study area lies at 13047'N latitude and 39035'E longitude at 2075 meters above sea level. The area receives 400 mm annual rainfall, which occurs between Mid-June and September of the year. Annual temperature of the study site ranges from 17 to 23.

Feed collection and preparation

Leaves of African wild olive (*Olea Africana*) and Red thorn (*Acacia lahai*) were collected and dried under shade. Leave meals, required for the whole experimental period, were thoroughly mixed and stored in well prepared sacks. Grass hay and nouge seed cake were purchased from local markets. In order to avoid malnutrition in controlled animals, sixty gram nouge seed cake (NSC) was provided to all experimental animals equally.

Feeding and sampling procedure

All animals were offered grass hay ad libitum plus sixty g NSC as a basal diet. Grass hay was offered three times per day at 8:30 am just after leave meals are offered; at 12:00 am and 5:00 pm. Grass hay offered was adjusted every ten days ensuring a refusal of twenty per cent based on previous days intake of an individual animal. NSC was weighed and offered to individual animal once a day, in the early morning. At each feeding, the proportion of leave meals required daily as per the treatment were weighed separately, mixed and offered at 0800 and 1600 hours at equal portions to animals accordingly. Samples for chemical analysis were taken from each sack during the experiment at the time when a new sack was opened for feeding from leave meals and NSC. Samples from the offered grass hay and its refusals were also taken during the experimental period. After samples were thoroughly mixed, subsamples were taken for chemical analysis.

Chemical analysis

Chemical analysis was carried out in order to determine dry matter (DM), crude protein (CP), ash, neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL). Feed samples and partially dried fecal samples (60 for 72 hours) were milled to pass through 1mm screen for chemical analysis. DM of feeds and feces was determined after oven drying (105 for 12 hours). Feed offered, refusals and feces were analyzed for DM, Ash and CP following [6]. CP was estimated as N×6.25 and organic matter (OM) by subtracting ash from 100. NDF and ADF contents for feed and feces, and ADL for feed only were analyzed according to Van Soest et al. [7] procedure.

Animals and experimental design

The study was conducted on twenty five yearling intact Tigray Highland sheep weighing 16.70 ± 2.10 kg (mean ± standard deviation) initial body weight. Age of experimental animals was determined by dentition and information from owners. Experimental animals were quarantined for 15 days and vaccinated against internal and external parasites using broad spectrum antihelmentic (albendazol bolus) and diazole, respectively. Randomized Complete Block Design (RCBD) was used. Just after quarantine period, animals were grouped in to five blocks depending on their initial body weight and randomly assigned to five treatment feeds viz. T1 (control): grass hay ad libitum + 60 gram NSC + 0 gram olive leaves and acacia lahai leaves; T2: T1 + 300 gram olive leaves + 0 gram acacia lahai leaves; T3: T1 + 195 gram olive leave + 105 gram acacia lahai leaves; T4: 105 gram olive leaves + 195 gram acacia lahai leaves; T5: T1 + 0 gram olive leaves + 300 gram acacia lahai leaves. All animals were under close observation for health problems until the end of the experimental period.

Carcass characteristics and slaughtering procedure

After the completion of feeding period (ninety days), four animals as per treatment that is twenty sheep were fasted overnight, weighed and slaughtered. On slaughtering, the animals were killed by severing the jugular vein and the carotid artery with sharp knife. Blood of all animals was drained in to different thin plastic bags and weighed for each animal separately. After the processes of slaughtering and flaying skin were completed; skin (with ears and by removing legs below the fetlock joints), head, tongue and feet were weighed independently. This was followed by weighing the components of the entire alimentary canal (esophagus, reticulo-rumen, omaso-abomasum, small and large intestines) with and without contents individually. Internal main organs (lung with trachea, heart, liver with gall bladder, spleen and kidney) and other parts such as total fat (omental and kidney), penis, testicles, tail and empty body weight were weighed and recorded separately for each animal.

Non-carcass offal components which represent additional protein and energy sources for human consumption [6], due to differences in taste and eating habit, saleable and edible proportions of the carcass in one area of a country may not be acceptable in other parts of the country. By considering this fact, categorization of non-carcass offal components as edible and/or non-edible was done based on the eating habit and culture of the people in the surrounding area where this study was conducted. The total edible offal components were taken as the sum total weight of blood, head, tongue, heart, liver with gall bladder, kidney, small and large intestines, reticulo-rumen, omaso-abomasum, tail and fat (omental and kidney), while usable products were taken as the sum total weight of hot carcass weight, total edible offal components and skin. On the other hand, non-edible offal components were considered as the sum total of the weight of lung with trachea, skin, penis, testicles, spleen, feet and gut fill.

After the completion of all measurements, carcass weight was recorded to assess dressing percentage on slaughter weight and empty body weight bases. Empty body weight was determined by subtracting weight of gut fill from the slaughter weight. The hot carcass weight was measured after removing weight of skin, head, thoracic, abdominal and pelvic cavity contents as well as legs below the hook and knee joints.

The rib-eye (longissmus dorsi) muscle area of each animal was determined by tracing the cross sectional area between the 11^{th} and 12^{th} ribs [8,9], after cutting perpendicular to the back bone. The left and right rib-eye muscle area was traced on a transparent waterproof paper and the area was calculated by using planimeter. The mean of the right and left cross sectional areas was taken as a rib-eye muscle area.

Partial budget analysis

Partial budget analysis was carried out for determination of the potential profitability of the new technology. Purchasing and selling prices of sheep, purchasing price of whole basal diet (grass hay + NSC) and labor cost for supplementary feed (feed collectors of leaves of native browses) were recorded. Other expenses such as transport (animals and feed), labor (feeder) and veterinary services were not considered since they remain common for all treatments.

Three well experienced sheep market dealers in the surrounding area were invited in order to estimate selling price of individual sheep. The difference of sheep price in each treatment, before (purchasing price) and after (selling price) the experiment was considered as total return (TR) in the partial budget analysis. The net income (NI) was calculated by subtracting total variable cost (TVC), which includes the cost of all recorded inputs that change due to the change in production technology, from the total return (TR): NI =TR – TVC.

Change in net income is the most important criterion in deciding acceptance of new technology and therefore, the change in net income (ΔNI) was calculated as the difference between the change in total return (ΔTR) and the change in total variable cost (ΔTVC), and calculated as;

$$\Delta NI = \Delta TR - \Delta TVC$$

The marginal rate of return (MRR), in order to measure the increase in net income with each additional unit -expenditure was calculated as:

$$MRR=\Delta NI/\Delta TCV \times 100$$

Citation: Abraham H, Urge M, Animut G (2016) Evaluating Production Performance of Tigray Highland Sheep Supplemented with Air Dried Foliages of African Wild Olive and Red Thorn: A Case Study of Carcass Production. Poult Fish Wildl Sci 4: 149. doi: 10.4172/2375-446X.1000149

Statistical analysis

The one way analysis of variance (ANOVA) of data on carcass characteristics was run using the general linear model procedure (GLM) of SAS [10]. Differences between the treatments were tested using least significant difference (LSD) test.

Carcass parameters were analyzed using the ANOVA model for RCBD given below;

Yij = µ+ Ti +Bj+ Eij. Where; Yij= the response variable, µ = the overall mean, Ti = the ith treatment effect, Bj = the jth block effect and Eij= the random error.

Ethical approve

This experiment was part of An M.Sc. Thesis of Hagos Abraham, which was checked and approved by the academic commission of Haramaya University following the University's guideline before the commencement of the experiment.

Result and Discussion

Chemical composition of treat feeds

The chemical analysis of the experimental diets offered and refusals is available online @ www.globalacademicresearchjournals.org. The CP content of natural pasture grass hay (basal diet) was sufficient to meet the maintenance requirement, but it was relatively low to meet the growth demands of experimental animals, which demonstrates the need for supplementation for production.

Feed intake and growth performance

Significantly (P < 0.05) higher DM intake of grass hay (basal feed) and significantly (P < 0.05) lower total dry matter intake were obtained in control treatment. However, significantly (P > 0.05) higher total DM intake was recorded in supplemented sheep without significant (P > 0.05) difference among supplemented animals. In agreement with the present study, Reyes Sa´nchez et al. [10] reported that the inclusion of Moringa as a protein supplement to low quality diets improved DM intake and digestibility of the diet and increased milk production but did not affect milk composition. Provided NSC was readily consumed by all animals with no refusals.

The average daily body weight gain for the supplemented sheep was 39.25 g/day/head and 7.4 g/day/head in control group. The weight gain results observed in the present study were similar to the values reported by Asaolu et al. [11]. The positive average daily body weight gain observed in T1 supplemented sheep is attributed to the good quality of basal diet and the inclusion of sixty gram NSC (available online @ www.globalacademicresearchjournals.org).

Slaughter weight, hot carcass weight and dressing percentage

Values for slaughter weight, empty body weight, hot carcass weight, dressing percentage (slaughter and empty body weights bases) and rib eye muscle area of the experimental sheep are given in Table 1. Animals supplemented with air dried leaves of sole or mixtures of the multipurpose trees had higher slaughter weight and hot carcass weight (P < 0.01), and empty body weight (P < 0.001) over non-supplemented ones, but the supplemented treatments were not statistically (P > 0.05) different among themselves.

Carcass characteristics	Treatment feeds					SEM	SL
	T1	T2	T3	T4	T5		
Slaughter weight (kg)	17.0^b	19.0^a	19.9^a	20.0^a	19.1^a	0.3	**
Empty body weight (kg)	12.2^b	15.1^a	15.9^a	16.3^a	15.0^a	0.4	***
Hot carcass weight (kg)	6.8^b	8.5^a	9.0^a	9.1^a	8.5^a	0.24	**
Dressing percentage							
Slaughter weight basis (%)	39.7^b	44.5^a	45.0^a	45.2^a	44.3^a	0.74	***
Empty body weight basis (%)	55.4	56.0	56.4	55.7	56.4	0.71	ns
Rib eye muscle area (cm2)	3.9^b	6.2^a	6.4^a	6.3^a	5.7^a	0.24	***

a,b= means within a row not bearing a common superscript letter different significantly; ns = not significant; **= P < 0.01; *** = P < 0.001; SEM=standard error of mean; SL=significance level

Table 1: Carcass characteristics of Tigray Highland sheep fed grass hay and supplemented with air dried leaves of African wild olive, Red thorn and their mixtures at different proportions.

Dressing percentage is both a yield and value determining factor. In the present study, supplementation significantly (P < 0.001) improved dressing percentage as calculated on slaughter weight basis; without significant (P > 0.05) difference among the supplemented groups. However, there was no significant (P > 0.05) difference between supplemented and non-supplemented groups for dressing percentage as calculated on empty body weight basis. The lack of significant difference in dressing percentage on empty body weight basis might be due to the exclusion of the contribution of gut fill, which was significantly heavier in non-supplemented animals. In line with the present study, previous studies [12-15] revealed that dressing percentage calculated on empty body weight basis did not differ significantly between supplemented and non-supplemented individuals.

Rib eye muscle area

Rib-eye (longissmus dorsi) muscle area, which is an indirect estimate of body musculature, or lean meat of the body, indicates the musculature development of the animal [9]. Results the present study revealed that supplemented sheep had significantly (P < 0.001) higher rib-eye muscle area as compared to the non-supplemented sheep, indicating the development of more lean flesh in the supplemented groups. However, there was no statistically significant (P > 0.05) difference among the supplemented groups. This is consistent with previous findings of Alemu et al. [16].

Edible and non-edible offal components

Data on edible and non-edible offal components are presented in Tables 2 and 3. The results of the present study indicated that supplementation has a positive effect on most of the edible offal components (Table 2). This is in agreement with the findings of [10,17,18]. Among the edible offal components namely: tongue (P < 0.001), liver with gall bladder and tail (P < 0.01), total fat (omental and kidney) and omaso-abomasum (P < 0.05) were significantly heavier in the supplemented sheep as compared to the non-supplemented sheep. However, heart was heavier (P < 0.5) in T3 and T4 whereas heavier omaso-abomasum was recorded in T3. The remaining edible offal components such as blood, head, kidney, esophagus, reticulo-rumen, small and large intestines were not affected by supplementation.

Parameters	Treatments					SEM	SL
	T1	T2	T3	T4	T5		
Blood (g)	714.0	745.0	735.0	770.0	710.0	7.74	ns
Head (kg)	1.2	1.3	1.2	1.4	1.3	0.03	ns
Tongue (g)	54.8^{b}	67.0^{a}	73.0^{a}	72.0^{a}	68.0^{a}	1.65	***
Heart (g)	66.0^{ab}	61.0^{b}	68.0^{a}	75.0^{a}	64.0^{b}	1.33	*
Liver + bile (g)	217.0^{b}	271.0^{a}	286.0^{a}	293.0^{a}	271.0^{a}	7.53	**
Kidney (g)	50.0	51.0	50.0	55.0	49.0	0.91	ns
Total fat (g)	45.0^{b}	51.0^{a}	54.0^{a}	55.0^{a}	52.0^{a}	1.01	*
Esophagus (g)	29.0	31.0	33.0	33.0	30.0	0.67	ns
Reticulo-rumen (g)	390.0	425.0	435.0	440.0	420.0	5.82	ns
Omaso-abomasum (g)	130.0^{b}	142.0^{ab}	178.0^{a}	168.0^{ab}	161.0^{ab}	5.22	*
Small + large intestines (g)	423.0	470.0	488.0	532.0	473.0	11.85	ns
Tail (g)	61.0^{b}	86.0^{a}	92.0^{a}	94.0^{a}	88.0^{a}	3.23	**
TEOC (kg)	3.2^{b}	3.7^{a}	3.7^{a}	3.9^{a}	3.7^{a}	0.10	**
TEOC (% SW)	19.0	19.3	19.1	19.4	19.2	0.39	Ns

a,b= means within a row not bearing a common superscript letter significantly different; *= P < 0.05; **= P < 0.01; ***= P < 0.001; ns= not significant; SEM= standard error of mean; SL= significance level; SW= slaughter weight; TEOC= total edible offal components.

Table 2: Edible offal components of Tigray Highland sheep fed grass hay and supplemented with air dried leaves of African wild olive, Red thorn and their mixtures at different proportions.

The non-edible offal components, such as feet, lung with trachea, spleen and penis did not differ significantly (P > 0.05) between the control and supplemented sheep. But, statistically (P < 0.01) heavier skin and testicles were recorded for sheep in T3 and T4 than the non-supplemented group. Gut fill was heavier in un-supplemented sheep, but significant difference was not recorded among the supplemented groups. The significantly (P < 0.01) heavier gut fill in the control group could be attributed to the higher consumption of roughage feed (grass hay), which is characterized by low digestibility and increased amount of digesta in the rumen. Van et al. [19,20] noted that non supplemented animals fill their gut with less digestible roughage which is retained in the gut for long time to be degraded by rumen microorganisms. Apart from this, supplemented sheep had statistically higher (P < 0.01) total edible offal components (TEOC) and (P < 0.001) total usable products (TUP), because of the positive effect of supplementation on the weight of most organs [21-24].

Parameters	Treatments					SEM	SL
	T1	T2	T3	T4	T5		
Skin (kg)	1.5^{b}	1.9^{ab}	2.0^{a}	2.2^{a}	1.9^{ab}	0.06	**
Feet (g)	413	420	460	483	417	10.1	ns

Citation: Abraham H, Urge M, Animut G (2016) Evaluating Production Performance of Tigray Highland Sheep Supplemented with Air Dried Foliages of African Wild Olive and Red Thorn: A Case Study of Carcass Production. Poult Fish Wildl Sci 4: 149. doi: 10.4172/2375-446X.1000149

Lung + trachea (g)	180	200	215	203	195	3.93	ns
Spleen (g)	20	25	25	25	25	0.7	ns
Penis (g)	55	55	60	60	55	1.12	ns
Testicles (g)	135.0^{b}	150.0^{ab}	175.0^{a}	175.0^{a}	150.0^{ab}	4.95	**
Gut fill (kg)	4.6^{a}	3.8^{b}	3.8^{b}	3.9^{b}	3.6^{b}	0.12	**
TNEOC (kg)	6.9	6.6	6.8	6.9	6.7	0.1	ns
TUP (kg)	10.8^{b}	14.0^{a}	14.7^{a}	15.1^{a}	14.1^{a}	0.36	***
TUP (%SW)	62.1^{b}	73.3^{a}	73.6^{a}	74.2^{a}	73.6^{a}	1.13	*

a,b = means within a row not bearing a common superscript letter significantly different; *= significant at P < 0.05; **= significant at P < 0.01; ***= significant at P < 0.001; ns= not significant; SEM= standard error of mean; SL= significance level; TEOC= total edible offal components; TUP= total usable products; SW= slaughter weight

Table 3: Non- edible offal components of Tigray Highland sheep fed grass hay and supplemented with air dried leaves of African wild olive, Red thorn and their mixtures at different proportions.

Partial budget analysis

Partial budget analysis was done in order to determine the economic importance of supplementing Tigray Highland sheep with air dried leaves of African wild olive, Red thorn and their mixtures at different proportions (Table 4). Partial budget analysis measures profit or loss, which is the net benefit obtained by difference between gains and losses for the proposed change. The result of partial budget analysis of the present study revealed that supplementing Tigray Highland sheep with air dried leaves of the multipurpose trees resulted relatively to higher profit margin as compared to the un-supplemented sheep. The gross financial margin or total return obtained by calculating differences between gross income and purchasing price of sheep in the present study was 35, 95, 100, 102 and 96 Ethiopian birr currency (ETB) per animal for sheep fed T1, T2, T3, T4 and T5, respectively. The net income of supplemented sheep (T2, T3, T4 and T5), obtained by subtracting the total feed cost from the gross financial margin or total return, was 35.04, 40.10, 41.07 and 36.82 ETB per head, respectively (Table 4). However, sheep fed basal diet (grass hay on ad libitum basis plus 60 g NSC) had a loss of net income (11.14 ETB/head), and it was the lowest compared to the other groups. Sheep supplemented with T4 had higher net income (41.07ETB) as compared to the other supplemented sheep groups (T2, T3 and T5).

Variables	**Treatments**				
	T1	**T2**	**T3**	**T4**	**T5**
Number of animals	5	5	5	5	5
Purchasing price (ETB/sheep)	230.0	230.0	230.0	230.0	230.0
Total hay consumption (kg/sheep)	48.56	33.65	33.57	34.95	32.61
Total NSC consumption (kg/sheep)	5.40	5.40	5.40	5.40	5.40
Total OTL consumption (kg/sheep)	0.00	27.00	17.55	9.45	0.00
Total AL consumption (kg/sheep)	0.00	0.00	9.45	17.55	27.00
Total cost for hay (ETB/sheep)	36.42	25.24	25.18	26.21	24.46
Total cost for NSC (ETB/sheep)	9.72	9.72	9.72	9.72	9.72
Additional cost for feed collection (ETB)	0.00	25.00	25.00	25.00	25.00
Total variable cost (ETB/sheep)	46.14	59.96	59.90	60.93	59.18
Gross income, sale of sheep (ETB/sheep)	265.00	325.00	330.00	332.00	326.00
Total return (ETB/sheep)	35.00	95.00	100.00	102.00	96.00
Net income (ETB/sheep)	-11.14	35.04	40.10	41.07	36.82
ΔNI (ETB)	0.00	46.18	51.24	52.21	47.96
ΔTVC (ETB)	0.00	13.82	13.76	14.79	13.04
MRR (%)	-	334.10	372.30	353.00	367.7

ETB= Ethiopian Birr; NSC= noug seed cake; OTL=olive tree leaves; AL= acacia lahai; NI= Net income; ΔNI= change in net income; ΔTVC= change in total variable cost; MRR= marginal rate of return.

Table 4: Partial budget analysis of Tigray Highland sheep fed grass hay plus 60 g of NSC and supplemented with air dried leaves of African wild olive, Red thorn and their mixtures at different proportions.

The change in net income (ΔNI) obtained from sheep fed T2, T3, T4 and T5 were 46.18, 51.24, 52.21 and 47.96 ETB, respectively with the corresponding marginal rate of return (MRR) of 334.1, 372.3, 353.0 and 367.7%. This showed that per unit of ETB increment to prepare supplement feed in order to attain the required gain by supplement feed could afford profit of 3.34, 3.72, 3.53 and 3.67 ETB per animal for T2, T3, T4 and T5, respectively. As a result, supplementation with leaves of the locally available browse species as sole or mixture is economical to use and this is very important particularly in arid and semi-arid areas, where these tree species are available on open grazing lands and enclosures.

From the economic analysis point of view, supplementing T4 mixed air dried leaves was found to be more profitable with its high net income. Foliages of the multipurpose trees can be acquired by farmers by using family labor, thus capital is not a problem. Therefore, T4 that is treatment with relatively better net income is recommended (Table 4) for pastoralists and agro-pastoralists as a supplementary feed to small ruminants.

Summary and Conclusion

Results of the present study indicate supplementation of African wild olive and Red thorn can help sheep keepers to attain better sheep productivity mainly during dry season with inexpensive cost. The inclusion of foliages from the selected multipurpose trees in the diet of sheep has significantly improved slaughter weight, empty body weight, hot carcass weight and dressing percentage on slaughter weight basis. Therefore, the browse leaves can potentially be used as a natural promoter in sheep for better growth performance and carcass characteristics. Nevertheless, further studies should be carried out to characterize their effects on sheep milk yield and composition in the area.

References

1. Tsige-Yohannes H (1998) Nutrition of ruminant animals in the thermal environment: conditions and prospects in Ethiopia. Proceedings of the Sixth Annual conference of the Ethiopian Society of Animal Production (ESAP) pp: 165-172.
2. Aregheore EM (2001) Nutritive value and utilization of three grass species by crossbred Anglo–Nubian goats in Samoa. Asian-Austrialian Journal of Animal Science 14: 1389-1393.
3. Nurfeta A (2010) Feed intake, digestibility, nitrogen utilization and body weight change of sheep consuming wheat straw supplemented with local agricultural and agro-industrial by- products. Trop Anim Health Prod 42: 815-824.
4. Martens SD, Tiemann TT, Bindelle J, Peters M, Lascano CE (2012) Alternative plant protein sources for pigs and chickens in the tropics-nutritional value and constraints: a review. Journal of Agriculture and Rural Development in the Tropics and Subtropics 113: 101-123.
5. Pezo D (1991) The nutritional quality of forages. Utilizacio'n Produccio'n and forage in the tro' peak. Compendium. Materials Series Ensen-anza pp: 15.
6. AOAC (1990) Official Method of Analysis, (5thedn) Washington DC.
7. Van Soest PJ, Robertston JB (1985) Analysis of forage and fibrous foods. A laboratory manual for animal science p: 613.
8. Getahun L (2001) Growth pattern and carcass characteristics of Somali and Mid-rift valley goats. An MSc. Thesis Presented to School of Graduate Studies of Alemaya University pp: 1-106.
9. Galal ESE, Afework T, Kassahun A (1979) A study on fattening Ethiopian sheep II. Performance of Adal lambs on supplemented grazing. Ethiopian Journal of Agricultural Science 1: 99-107.
10. SAS (2002/03) SAS Institute Inc cary, North Carolina, USA.
11. Sánchez NR, Spörndly E, Ledin I (2005) Effect of feeding different levels of foliage of Moringa oleifera to creole dairy cows on intake, digestibility, milk production and composition 101: 24-31.
12. Asaolu V, Binuomote R, Akinlade J, Aderinola O, Oyelami O (2012) Intake and growth performance of west african dwarf goats fed Moringa oleifera, Gliricidia sepium and Leucaena leucocephala dried leaves as supplements to cassava peels. Biology, Agriculture and Healthcare.
13. Sebsibe A, Mathur MM (2000) Growth and carcass characteristics of Barbari kids as influenced by concentrate supplementation. In: Merkel RC, Abebe G, Goetsch AL (eds.) The opportunities and challenges of enhancing goat production in East Africa. Proceedings of a conference held in Debub University, Awassa, Ethiopia from November 10 to 12, 2000. E (Kika) de la Garza Institute for Goat Research, Langston University, Langston pp: 144-150.
14. Bruh W (2008) Supplementation with dried foliages of selected indigenous browses: Effects on feed intake, digestibility, body weight gain and carcass characteristics of Abergelle goats offered hay. An MSc Thesis presented to the School of Graduate Studies of Haramaya University, Ethiopia pp: 1-73.
15. Emebet L (2008) Supplementation of blackhead ogaden sheep fed haricot bean (Phaseolus vulgaris) haulms with mixtures of wheat bran and brewers dried grain: effects on feed utilization, live weight gain and carcass parameters. An MSc Thesis Presented to the School of Graduate Studies of Haramaya University pp: 1-69.
16. Hirut Y, Solomon M, Mengistu U (2011) Effect of concentrate supplementation on live weight change and carcass characteristics of Hararghe highland sheep fed a basal diet of urea-treated maize stover. Livestock Research for Rural Development 23: 12.
17. Alemu B, Animut G, Tolera A (2014) Effect of Millettia ferruginea (Birbra) foliage supplementation on feed intake, digestibility, body weight change and carcass characterstics of Washera sheep fed natural pasture grass hay basal diet. Springer Plus 3: 50.
18. Tesfaye H (2007) Supplementation of Afar rams with graded levels of mixture of protein and energy sources: Effects on feed intake, digestibility, live weight gain and carcass parameters. An MSc Thesis presented to the School of Graduate Studies of Haramaya University pp: 1-59.
19. Tesfaye W, Mengistu U (2014) Bodyweight change and carcass yield performance of somali goats fed with groundnut pod hulls and a mixture of wheat branand mustard seed cake. Science, Technology and Arts Research Journal 3: 57-63.
20. Van Soest PJ (1994) Nutritional ecology of ruminants (2ndedn.). Cornell University Press, London pp: 1-476.
21. Pond WG, Church DC, Pond KR (1995) Basic animal nutrition and feeding (4thedn.). John Willey and Sons, New York pp: 54-615.
22. Burley J (1980) Selection of species for fuel wood plantations. The Commonwealth Forestry Review 59: 133-147.
23. Burley J, Von Carlowitz P (1984) Multipurpose Tree Germplasm. ICRAF, Nairobi.
24. Gintzburger G, Bounejmate M, Agola C, Mossi K (2000) Production and utilization of multi-purpose fodder shrubs and trees in West Asia. North Africa and the Sahel p: 60.