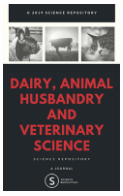

Available online at www.sciencerepository.org

Science Repository

Research Article

Replacement of Concentrate Mix with Improved Forages for Afar Goats under Semi Intensive Production System Meet to Export Market Weight

Anwar Seid Hassen[1*], Mohammed Yasin Ali[2] and Endris Feqi[2]

[1]Department of Livestock Research Directorate, Afar Pastoral and Agro Pastoral Research Institute, Semera, Ethiopia
[2]Department of Livestock Research Core Process, Dubti Pastoral Agro Pastoral Research Center, Dubti, Ethiopia

ARTICLE INFO

Article history:
Received: 23 June, 2020
Accepted: 14 July, 2020
Published: 14 August, 2020

Keywords:
Afar goats
concentrate mixture
cowpea
feed intake
weight gain
carcass

ABSTRACT

The experiment was conducted with the objective of to evaluate the comparative feeding value of improved forages as a replacement of concentrate mix with its economic benefits on feed intake, body weight gain and carcass parameters of Afar goats. Twenty-five yearling intact male Afar goats with initial mean body weight of 15.05±1.25 (mean ± SD) were used for the experiment in randomized complete block design. The experimental animals were grouped in to five blocks of five animals based on their initial body weight and each animal within each block was randomly assigned to one of the five treatment diets. Treatments were grazing (Ad libitum) + 100% concentrate mix (wheat bran and noug seed cake) (T1), grazing (Ad libitum) + 100 % mixed forage (Rhodes and cowpea) (T2), grazing (Ad libitum) + 50 % mixed forage (Rhodes and cowpea) + 50% concentrate mix (T3), grazing (Ad libitum) + 25 % mixed forage (Rhodes and cowpea) + 75% concentrate mix (T4), and grazing (Ad libitum) + 75 % mixed forage (Rhodes and cowpea) + 25% concentrate mix (T5). The experiment was consisted of feeding trial followed by carcass evaluation. The supplement given at the rate of 300gDM/head/day. Water and mineralized salt block were available free of choice. The concentrate mix was 2:1 (wheat bran and Noug seed cake. The CP content of the NSC (Noug seed cake), WB (wheat bran), cowpea and Rhodes grass were 31.3, 17.4, 16.9 and 8.6 %, respectively. Organic matter and basal intake were not significant difference (P>0.05) among the treatments, while intake of supplement was slightly higher (P<0.05) for T1, T4, T3, than T5 and T2 respectively. Average daily gain in was higher 110g/d (T4). Hot carcass weight was slightly higher (P<0.05) for T4 10.82 kg. The use of sole cowpea and Rhodes grass mix instead of concentrate mix was reduces feed cost and increase net return. Mixture of cowpea and Rhodes grass as sole supplement is relatively comparable to the supplementary value of concentrate mixture to improve Afar goat performance but forage mix was required higher (p<0.05) feed to bring the same weight to other concentrate contained treatment diets.

Introduction

Most of ruminant livestock in Ethiopia rely on local grasses for their roughage sources as well as and much of their nutrition. Many of this species have low palatability, poor productivity and inadequate nutrient to maintain animals, especially during the dry season. Improved grasses, many of them selected from other parts of Africa, have better productivity, palatability and nutrient characteristics that make them desirable for inclusion in improved forage production improvement program [1]. Improved forages would reduce the pressure on natural pastures, improve soil fertility and erosion on marginal lands, improve carbon sequestration to mitigate climate change, support system sustainability, and enhance natural assets and system resilience.

Chloris gayana, known by the common name Rhodes grass is native to Africa but it can be found throughout the tropical and subtropical world as well as naturalized species. An important feature of Rhodes grass is it appears to be drought and slat tolerant species. *Chloris gayana* can also

*Correspondence to: Anwar Seid, Department of Livestock Research Directorate, Afar Pastoral and Agro Pastoral Research Institute, P.O. Box: 16, Semera, Ethiopia; Tel: 2510911562968; E-mail: anu751751751@gmail.com

http://dx.doi.org/10.31487/j.DAHVS.2020.01.02

be mixed with legumes such as cowpea, stylo and alfalfa which also improves soil nutrient levels. The crude protein content of Rhodes grasses reaches up to 6-12% in most cultivated area of the world [2]. *Chloris gayana*, is one of the most promising pasture species among the tested species so far and recommended for areas ranging in altitude from 1,000-1,800 m.a.s.l [3]. *Chloris gayana* is drought tolerant due to its root can extract water at a depth of 4.25 meters. It makes quite good hay if cut just as it begins to flower or a little earlier.

Cowpea (*Vigna unguiculata*) is an annual herbaceous legume, due to its tolerance for sandy soil and low rainfall, it requires very few inputs, as the plant's root nodules are able to fix atmospheric nitrogen, making it a valuable crop for resource-poor farmers and well-suited to intercropping with other crops. The whole plant is used as forage for animals, and cowpea haulm addition improves nutrient supply and growth of livestock over the use of low-quality forages alone, but degree of weight change varies relative to total nutrient supply [4]. The crude protein content of cowpea reaches up to 15-19% in most cultivated area of the world [5]. Dietary nitrogen was increased by cowpea haulm addition and higher levels of cowpea feeding resulted in higher nitrogen intakes. Total feed intake increased with increasing levels of cowpea supplementation and diet digestibility was greater for diets containing cowpea haulms.

In the past two and half decade's considerable effort has been made to test the adaptability of different species of pasture and fodder crops under varying environmental conditions (agro ecological zones). As a result, quite large numbers of useful species have been selected and recommended for the different zones. The selected forages were found to be high yielding than naturally occurring swards and have proven to have higher nutritional value. Much of the generated forage technologies have been not evaluated on the performance of ruminant animals. Hence, Rhodes grasses (*Chloris gayana*) and cowpea (*Vigna unguiculata*) forage species were among the selected forage appropriate species for this experiment. Similarly, it is important to supplement yearling goats with a protein source in order to increase the efficiency of growth to the desired market weight. This study was designed to evaluate the replacement value of improved forages (cowpea *Vigna unguiculata* and Rhodes grass *Chloris gayana*) to concentrated mix (nuog seed cake and wheat bran) on growing afar goat to meet export market weight with the following specific objectives.

Objectives of the Study

i. To assess the comparative feeding value of improved forages as a replacement for concentrate mixture.
ii. To assess the economic benefits of improved forages as the main feed source.
iii. To identify the economic ration and duration required to meet market body weight 25-30 kg of Afar goats under. semi intensive feeding system

Materials and Methods

I Forage Establishment

The study was conducted at Dubti pastoral and agro pastoral research center in Afar regional state (Figure 1). Irrigated improved forages cowpea (*Vigna unguiculata*) accession 9333 and Rhodes grass (*Chloris gayana*) massaba variety were used as a feed for this study. The two forage types were established on well prepared land for the experiment under on station through irrigation. A total of 1.2 hectare of land was allocated for forage establishment. After the establishment proper management and storage condition were applied used following the recommendations for each forage species. The forages were harvested at 50% flowering.

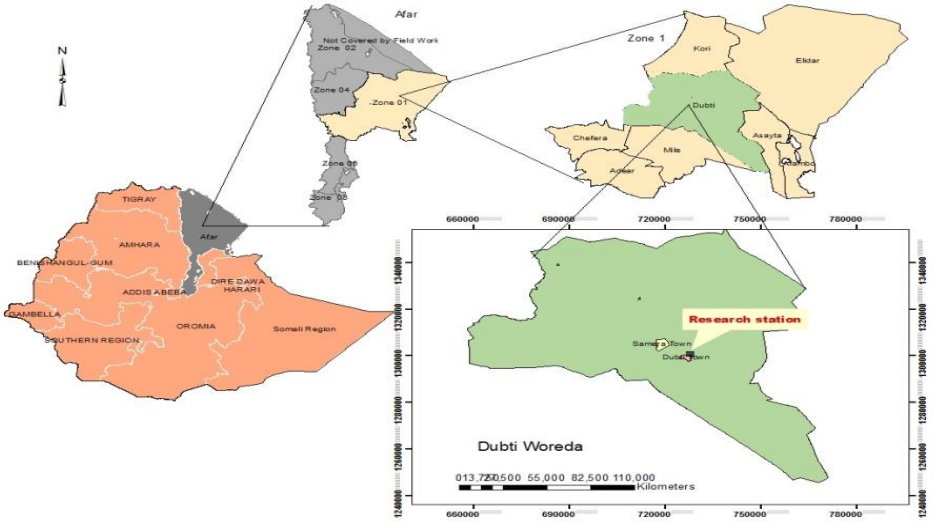

Figure 1: Description of the study area.

II Experimental Animal and Management

Twenty-five yearling intact Afar goats with average mean initial live weight of 15.05±1.25 kg (mean ± SD) were used in the experiment. The goats were housed in individual pens. All animals had free access to water and mineral salt block. Animals were quarantined for 3 weeks, and during this period, they were vaccinated to common disease in the area, dewormed and treated against external parasites. The animals were

adapted to the experimental conditions and feeds for 15 days thereafter, it was followed by 90 days feeding trial and carcass evaluation conducted at the end of the experiment.

III Experimental Design and Treatments

A randomized complete block design (RCBD) was used for the experiment. At the end of the quarantine period, animals were blocked into five blocks of five animals based on initial live weight and animals within a block were randomly assigned to one of the five treatments. Treatments were grazing (Ad libitum) + 100% concentrate mix (wheat bran and Noug seed cake) (T1), grazing (Ad libitum) + 100 % mixed forage (Rhodes and cowpea) Tx2, grazing (Ad libitum) + 50 % mixed forage (Rhodes and cowpea) + 50% concentrate mix T3, grazing (Ad libitum) + 25 % mixed forage (Rhodes and cowpea) + 75% concentrate mix T4, and grazing (Ad libitum) + 75 % mixed forage (Rhodes and cowpea) + 25% concentrate mix T5. Supplements were offered twice a day at 8:00 and 16:00 h in two equal portions. The supplement was given at the rate of 300 g DM/head/day. Water and mineralized salt block were available free of choice. Hay and mixed concentrate refusals were collected, weighed and discarded before the morning meal. Roughage was available to the Ad libitum. The feed in the experiment was offered as follows (in % of DM offered).

Table 1: Treatment arrangement of the experiment.

	% of DM offered			
Treatments	Natural Pasture Hay	Forage (g/day)	Conc. Mix (g/day)	Total Supplement(g/day)
T1	*Ad-lib*	-	300	300
T2	*Ad-lib*	300	-	300
T3	*Ad-lib*	150	150	300
T4	*Ad-lib*	75	225	300
T5	*Ad-lib*	225	75	300

T1=60% WB: 40% NSC (300g), T2= 100 (forage mix (300g); T3 = 50:50 (forage mix 150g + conc.mix 150g); T4 = 25:75 (forage mix75g+ conc.mix 225g); T5 = 75: 25 (forage mix 225g+ conc.mix75g) (Table 1). Conc. =concentrate. Forage mix= (cow pea and Rhodes grass).

IV Chemical Analysis

The samples of wheat bran, noug seed cake and mixed forages hay offered and refusals were analysed for DM, OM, Ash, CP, NDF, ADF and ADL. Samples of feed offered, and refusals were ground to pass 1 mm mesh screen size for determination of DM, ash and CP analysed according to AOAC (1990). The DM, OM, CP and ash were determined according to AOAC (2005). CP content was measured by the Kjeldahl method as N*6.25. The content of NDF, ADL and ADF was determined according to Van Soest and Robertson (1985) [6].

V Feed Intake and Digestibility

The amount of daily feed offers and refusals per head were recorded daily to determine daily feed intake. Representative samples from each treatment in the middle of each week, and composite samples, one for each feed type, were formed for the entire feeding trial for chemical analysis. Daily feed intake of individual animal was calculated as following: Feed intake (g) = Amount of feed offered (g) – Amount of feed refused (g). The metabolize energy (ME) intake of experimental animals were estimated from its digestible organic matter intake (DOMI) by using the formula, ME (MJ/kg DM) = DOMI × 0.0157, Where, DOMI = g digestible OM/ kg DM [7].

The digestibility trial was conducted after 90 days exposure of the experimental feed to the animals. It was comprised of three to five days period for animals to adapt the stress due to carrying of the fecal collecting bags followed by a seven-day feces collection period. Feces was collected and weighted every morning for each animal before offering feed or water. The daily collected feces from each animal was weighed mixed thoroughly and 20% was sampled and kept in airtight plastic containers and stored at -20°C up to the completion of the digestibility trial. At the end of the digestibility trial the fecal sample were thawed, thoroughly mixed and sub samples were taken, weighed and partially dried at 60ºC for 72 hours. The partially dried feces were ground to pass through a 1 mm sieve, stored in plastic bags until laboratory evaluation. Apparent digestibility percentage of DM, CP, Ash, NDF, ADF and ADL was determined using the following formula;

$$\text{Nutrient digestibility} = \frac{\text{Nutrient intake} - \text{Nutrient excreted in feaces}}{\text{Nutrient intake}} * 100 \quad [8]$$

VI Live Weight Gain

Live weight of the animals was measured every 14 day afterwards, after overnight fasting. Average daily gain (ADG) gain was calculated as the difference between the final and initial BW divided by the number of feeding days. Mean daily body weight change was calculated as;

$$\text{ADG (kg/d)} = \frac{\text{Final body weight(Kg)} - \text{Initial live weight (Kg)}}{\text{No. of feeding days}}$$

VII Feed Conversion Efficiency

Feed conversion efficiency is used to know how efficient the animals are converting the feed into meat. It was measured using the formula suggested by Gülten *et al.*, 2000;

$$\text{Feed conversion efficiency} = \frac{\text{Average daily live weight gain (g)}}{\text{Average daily feed intake (g)}} \quad [9]$$

VIII Carcass Parameters

At the end of the experiment, five experimental sheep from each treatment were slaughtered after overnight fasting. Weight of edible and non-edible non-carcass component yield were determined. Empty body weight and hot carcass weight of each animal were determined accordingly. Dressing percentage was calculated as proportion of hot carcass weight to slaughter and empty body weights.

$$\text{Dressing percentage based on SW} = \left(\frac{\text{Hot carcass weight(Kg)}}{\text{Slaughter weight(Kg)}}\right) * 100$$

IX Partial Budget Analysis

The partial budget analysis was made to determine cost benefit (profitability) analysis supplementation of different proportions of concentrate mix and forage mix in ration of Afar goats. The variable costs were calculated from supplementary feed and basal feed costs and from medication which were supplied for each experimental goat treatment costs. The partial budget analysis was calculated from the variable costs and benefits. At the end of the experiment, the selling price of each experimental goat was estimated by three experienced local goat dealers and the average of those three-estimation prices was taken. The variable costs were calculated from supplementary feed and basal feed costs which were supplied for each experimental goat treatment costs. The total returns (TR) were determined by calculating the difference between the estimated selling prices and purchasing price of experimental goat. Net return (NR) was calculated as;

$$NR = TR - TVC$$

The change in net return (ΔNR) was calculated as the difference between change in total return (ΔTR) and the change in total variable costs (ΔTVC).

$$\Delta NR = \Delta TR - \Delta TVC$$

X Statistical Analysis

Data were analysed using analysis of variance (ANOVA) following the general linear model procedure of SAS (SAS 2002). Treatment means were separated by least significant difference (LSD) test. The model used for data analysis was; $Yij = \mu + Ti + Bj + eij$, where Yij = the response variable (the observation in jth block and ith treatment), μ = the overall mean, Ti = the treatment effect, Bj = the block effect and eij = the random error.

Results and Discussions

I Chemical Composition of the Treatment Feeds

The chemical composition of the ingredients of experimental diets offered in the experiment is presented in (Table 2). The DM content of natural grazing pasture hay was 91.1%. Based on the results, the DM, OM, Ash, CP, NDF, ADF and ADL contents of concentrate mix (60% WB: 40% NSC) offered were 93.1%, 93.9%, 56%, 7.2%, 26.7%, 49.3%, 22.4%, and 5.1%, respectively. While the DM, OM, Ash, CP, NDF, ADF and ADL contents of forage mix (60% cowpea:40% Rhodes grass) offered were 88.3%, 84.9%, 10.8%, 11.9%, 52.4%, 23.9% and 9.0% respectively. The CP content of Rhodes grass hay in this study was 8.6% and while the CP content of natural grazing pasture was 4.9%, this figure of natural grazing pasture is below the 7% CP required for microbial protein synthesis in the rumen that can support at least the maintenance requirement of ruminants [10].

Table 2: Chemical composition of experimental feeds.

		Chemical Composition, % DM Bases					
Feeds offered	**DM (%)**	**OM**	**Ash**	**CP**	**NDF**	**ADF**	**ADL**
NPH	90.1	88.9	19.7	4.9	71.8	56.8	18.3
WB	92.1	94.2	6.8	17.3	63.1	16.9	4.1
NSC	94.2	91.0	9.5	31.4	40.2	35.1	7.9
60% WB: 40% NSC	93.1	93.9	7.2	25.8	49.3	22.4	5.1
Cow pea	90.1	91.9	12.1	16.9	25.2	21.4	14.9
Rhodes grass	89.2	80.7	11.3	8.6	77.1	48.3	5.9
60% Cow.P:40% Rhodes	88.3	84.9	10.8	11.9	52.4	23.9	9.0

DM: dry matter; OM: organic matter; CP: crude protein; NDF: neutral detergent fiber; ADF: acid detergent fiber; ADL: acid detergent liginin; NPH: natural pasture Hay; WB: wheat bran; NSC; nuge seed cake.

Table 3: Chemical composition of treatment feeds offered.

Treatments /dietary feeds	DM (%)	OM	Ash	CP	NDF	ADF	ADL
T1 (NPH+ 60% ;Nuge Cake ; 40 %WB)	92.4	80.7	11.9	17.1	53.7	25.4	6.9
T2 (NPH + 60% Cow Pea :40% Rhodes)	88.8	84.9	14.2	15.4	56.5	29.9	11.4
T3 (NPH + 50% Forage mix: 50% + concentrate mix)	90.0	86.4	10.6	16.1.	54.4	27.8	8.9
T4 (NPH + 25% Forage mix:75% concentrate mix	90.6	89.8	8.8	16.9	54.8	26.6	7.2
T5 (NPH + 75% forage mix:25% Concentrate mix	88.9	86.2	9.8	15.7	55.0	28.1	9.5

WB: wheat Bran; Mix: Mixture DM: dry matter; OM: organic matter; CP: crude protein; NDF: neutral detergent fiber; ADF: acid detergent fiber; ADL: acid detergent liginin; NPH: Natural Pasture Hay.

The CP content of Rhodes grass in this study (8.6%) was higher than 7.2 and 7.5% values reported by ElHAG *et al*., 2000 and Belay *et al*., 2014 respectively [11, 12]. Similarly, The CP content of cowpea (*Vigna unguiculata*) leaves (16.9%) was higher than the 11.05% reported by Hunegnaw and Berhan, 2016 [13]. The chemical composition of the treatment diets refused in the experiment is presented in (Table 3). The CP content of the forage mix refusals was decreased while the content of NDF, ADF and ADL were slightly increased as compared to the hay offered. Refusals mainly constituted stem parts of cowpea and Rhodes grasses than the proportion of concentrate mix feeds. This result is in line

with Van Soet (1994) who revealed that goats are very selective by nature and tend to reject the most mature or a lignified part of the forages [10].

Table 4: Chemical composition of treatment feed refused.

Feeds	Chemical composition, %DM Bases						
	DM%	OM	Ash	CP	NDF	ADF	ADL
T1 (60% WB: 40% NSC)	94.9	85.1	15.9	24.5	24.5	18.1	6.0
T1 (60% Cow.P:40% Rhodes)	90.2	88.0	8.9	6.2	65.1	34.2	14.9
T1 (50% Forage mix:50% concentrate mix)	92.9	87.2	7.1	7.5	54.1	21.8	7.8
T1 (25% Forage mix:75% concentrate mix)	93.1	82.1	13.0	17.1	31.4	23.2	12.9
T1 (75% Forage mix:25% concentrate mix)	94.6	86.5	8.0	9.0	50.5	30.8	11.9

DM: dry matter; OM: organic matter; CP: crude protein; NDF: neutral detergent fiber; ADF: acid detergent fiber; ADL: acid detergent liginin.

II Feed and Nutrient Intake

The chemical composition of treatment feeds presented in (Table 4) while the mean values of daily DM and nutrient intake of Afar goats fed on natural pasture hay and supplemented with different proportions of cowpea and Rhodes grass mix with concentrates mix are presented in (Table 5). The present study revealed that, there was no apparent difference (P>0.05) was observed in organic matter and basal intake among the treatments. Likely, intake of supplement was slightly higher (P<0.05) for T1, T4, T3 than T5 and T2 respectively. However, total dry matter intake for T1 T4 and T3 was statistically similar with T5 and T2. The result of this study revealed that supplementation of different proportions of concentrate contained forage mix instead of sole concentrates mixture had no significant effect (P>0.05) on organic matter, total DM and basal DM intake. As a result, sole concentrate feed supplementation was not superior to forage mix concentrate contained supplementation. However, intake of DM and CP of Afar goats fed the forage concentrate contained supplemented diets was indicative of good nutritive values of the feed as similar as supplemented with concentrate mix alone.

Table 5: Daily feed and nutrient intake of Afar goats fed on natural pasture hay and supplemented with different proportions of improved forage mix (cowpea + Rhodes grass) and concentrates.

DM Intake (g/d)	T1	T2	T3	T4	T5	SL	SEM
NPH DM intake	302.2	303	305	307.1	313	Ns	13.8
Supp. DM intake	297.4^{a}	262.7c	289.2^{ab}	293.3a	282.1^{ab}	*	12.2
Tot. DM intake	599.6	565.7	594.2	600.4	595.1	Ns	19.1
Tot. DM intake (% BW)	3.71	3.63	3.67^{a}	3.69	3.68	Ns	0.22
ME intake (MJ/ kg DM/d)	5.7	5.3	5.5	5.7	5.4	Ns	1.6
OM intake	595.4	566.9	579.9	582.8	571.9	Ns	18.7
CP intake	108.1^{a}	78.4c	92.1^{b}	104.3a	89.1^{b}	**	6.9
Ash intake	24.8^{b}	26.1b	28.6^{a}	25.1b	31.2^{a}	*	3.4
NDF intake	329.4^{d}	397.7a	371.7^{b}	356.7c	384.5^{a}	**	15.18
ADF intake	239.1^{a}	221.1d	231.2^{b}	235.7a	226.38^{c}	*	11.2
ADL intake	234.5^{a}	207.4c	220.5^{b}	229.9a	213.8^{b}	*	10.7

$^{a, b, c, d}$means with different superscripts in a row are significantly different.*: (p<0.05); **: (p<0.01); ME: metabolisable energy; OM: organic matter; CP: crude protein ; NDF: neutral detergent fiber; ADF: acid detergent fiber; ADF: acid detergent lignin; DM: dry matter; ns:non-significant; SEM: standard error of mean; SL: significant level; NPH: natural pasture hay.

Although, none significant differences were observed in intake of organic matter among the treatments, whereas significant difference (P<0.01) was observed among treatments in CP intake. The intake of CP was higher (P<0.01) for Afar goats in T1, T4 and T3 than goats in T5 and T2. The result of this study indicated that forage mix with a 75%, 50% and 25% concentrate contained supplementation have meaningful effect on intake of CP instead of offering sole forage mixture. The metabolizable energy intake was non-significant (P>0.05) among the treatments. However, better energy intake seems to be higher in treatment T1 and T4. Significant difference (P<0.01) was also observed among treatments in Ash intake, it was higher for T3 and T5 than T4, T1, and T2. Similarly, Significant difference (P<0.01) was also observed among treatments in NDF in take, it was higher for T2 and T5 than T1, T3 and T4. Forage mixture cowpea with Rhodes grass could be an alternative supplement as substation of concentrate mixture (nuog cake with wheat bran).

III Body Weight Gain and Feed Conversion Efficiency

The mean initial and final body weight, average daily body weight gain (ADG) and feed conversion efficiency (FCE) are presented in (Table 6). The result indicated that the effect of supplement did not significant differences (P>0.05) on average daily body weight gain, final body weight and feed conversion efficiency of among experimental animals. But numerically T1 and T4 had slightly scored higher body weight measurements than other treatments. The results of this study indicated that replacement concentrate mix with different proportion contained concentrate improved forages (cowpea and Rhodes grass) supplementation instead of concentrates mixture had positive effect on body weight gain of Afar goats. The result of average daily gain in the current study is 110 g/d (T4), which is higher than the result obtained by Abule *et al.*, 1998, who stated that indigenous goats 15-18 months old, from the middle Rift Valley area of Ethiopia, grazing natural pastures

supplemented with a concentrate (69% wheat bran and 30% noug cake) attained a higher ADG of 71.8 g/day [14]. The goats in the present study also had higher FBW than Mubende goats 23 kg at comparable ages [15].

Table 6: Effect of experimental diets on body weight change of Afar goats.

Parameters	T1	T2	T3	T4	T5	SL	SEM
Initial body weight (kg)	15.6	14.9	15.2	14.7	15.0	Ns	0.21
Final body weight (kg)	25.4	24.6	24.8	24.6	24.5	Ns	0.41
BW Change (Kg)	9.8	9.7	9.6	9.9	9.5	Ns	0.22
Daily BW gain (g/d)	108.8	107.8	106.7	110.0	105.6	Ns	0.31
FCE (g DBWG/g DDMI)	18.14	19.10	18.0	18.32	18.0	Ns	0.39

[a, b, c] Means with different superscripts in rows are significantly differ.*: (P<0.05); ns:non-significant (P>0.05); SEM: standard error of means; SL: significance level.

However, numerically T1 had slightly higher for all body weight measurements than other treatments. This might be associated with the differences in daily DM and CP intake, FCE, as well as DM and CP digestibility. This result is in line with who stated that, the low performance of local small ruminants in terms of body weight gain and carcass yield is mainly due to inadequate nutrition associated with dependence on sole natural pasture, crop residues and stubble grazing, which are inherently low in nutrients [16, 17]. According to Pond *et al.*, 1995, consumption of low-quality roughages such as straw and poor grass hay can be increased markedly by the addition of protein supplements [18]. Generally, the result of this experiment revealed that use of cowpea and Rhodes grass at different proportions instead of commercial concentrate mix result in similar body weight gain and can be used as supplement instead of concentrates mix in small ruminant feeding strategy to reduce the cost of feeding at least in smallholder production system where improved forages can be cultivated at back yard. Similarly, cowpea and Rhodes grass mixture with different levels of concentrate mix can also replace sole concentrate mix supplementation because of their similar performance effects in the experiment.

IV Carcass Characteristics

The carcass parameters of Afar goats fed on different proportion of forage mix of cowpea and Rhodes grass hay substituted for concentrates mix is presented in (Table 7). Most carcass measurements between the initial carcasses of all treatments were similar (P > 0.05). The result of this study revealed that supplementation of Afar goats with cowpea and Rhodes grass with different proportions contained concentrate and sole concentrates mixture have relatively similar effect on slaughter weight, hot carcass weight, empty body weight, dressing percentage at slaughter body weight basis and rib-eye areas. This result suggested that sole supplementation of concentrate mix (T1) in comparison with other treatments did not significantly influenced carcass parameters. The goats in the present study also had higher hot carcass weight 10.82 kg (T4) than Arsi-Bale goat 6.8 kg who reported by Hailu *et al.*, 2005 [19]. Literature reports indicated that DP in goats varies between 38 and 56% by breed, sex, age, weight and conformation, Anjaneyulu & Joshi, 1995; Getahun, 2001. Mushi *et al.*, 2009 also reported higher weights and carcass yields in goats fed higher energy levels [20-22].

Table 7: The effect of experimental diets on carcass characteristics Afar goats.

Carcass parameters	T1	T 2	T 3	T4	T5	SEM	S. L
Slaughter weight (kg)	26.7	26.3	26.4	26.6	26.4	0.4	ns
Empty body weight (kg)	17.1	18.0	17.9	18.4	18.5	0.4	ns
Hot carcass weight (kg)	10.8	10.23	10.43	10.82	10.67	0.2	ns
Dressing percentage on:							
Slaughter weight basis	40.4	38.9	39.5	40.7	40.6	0.6	ns
Empty body weight basis	53.5^{a}	52.5^{b}	52.9^{b}	53.7^{a}	52.8^{b}	0.3	*
Rib-eye area (cm^2)	10.2	10.3	10.2	10.4	10.8	0.4	ns

[a, b, c] Means with different superscripts in rows are significantly differ.*: (P<0.05); ns: non-significant (P>0.05); SEM: standard error of means; SL: significance level.

Dressing percentage of empty body weight for T4 (53.7) and T1 (53.5) had numerically slightly higher for all body weight measurements than other treatments. The result of the current study had higher dressing percentage of empty body weight than Hararghe highland goats 36.7-44.6% who reported by Freweini (2014) [23]. But the observed result is lower than 46.4-52% reported by Samson, 2010 for Short Eared Somali goats [24]. The result of this study suggested that supplementation of 75%, 50% concentrate contained forage mix had excellent dressing percentage of empty body weight as similar to sole supplementation of concentrate mixture. According to the review by Ruvuna *et al.*, 1992, dressing percent is known to be affected by breed, age, castration and it is also highly affected by feeding and degree of fattening [25]. The present study revealed that no difference (P>0.05) was observed in rib-eye muscle area among treatments. The observed result is in line with Shahjalal *et al.*, 2000 who stated that lower and higher level of protein supplementation did not affect the rib-eye area of the goats [26]. In the current study, rib-eye area ranged from 10.2-10.8 cm^2 which is higher than Hararghe highland goats 9.6-10 cm^2 reported by Ameha and Mathur, 2000 [27].

V None Edible Offal Components

The edible non-carcass component of Afar goats fed different proportions of cowpea with Rhodes grass and concentrates mix presented in (Table 8). Heart, kidney, empty gut, total fat, head and tongue, are considered as edible offal based on cultural and religious perspectives of the local community. On average, about 0.55 kg total non-carcass fat was recorded in the present study, which is comparable to 0.57 kg reported for other Ethiopian indigenous goats [28]. In the present study the total edible offal was 2.92 kg in T5. However, the

observed result is slightly lower than Hararghe highland goats 3.2 kg reported by Asnakew and Berhan, 2007 [29]. In the present study, except empty gut, total fat and tail, all edible offal components were showed significant difference (P>0.05) among treatments. The weight of empty gut was higher (P<0.05) in T5 (1362.23g) followed by T4 (1355.31g). Similarly, total fat and tail was also higher (P<0.05) in T4 and T1 153.85g, 153.18g, 24.71g and 24.83g respectively compared to other treatments. Based on the current result, replacement of cowpea with Rhodes grass supplementation with 75%, 50% concentrate contained forage mix instead of sole concentrate mixture supplementation did not affect these offal components. The present result in line with the finding of Kumar *et al*., 1991 who stated the most of non-carcass components were not affected by diet. Similarly, Dereje Worku, 2015 showed that dietary treatments significantly affect the weight of tail in Hararghe highland goats [30, 31].

Table 8: Edible non-carcass component of Afar goats fed different proportions of cowpea with Rhodes grass and concentrates mix.

Parameter	T1	T2	T3	T4	T5	S.L	SEM
Heart (g)	69.14a	68.35a	69.21a	71.50a	70.3[a]	ns	0.62
Kidney(g)	48.82a	49.36a	48.12a	50.15a	55.8[a]	ns	0.51
Empty gut(g)	1346.13b	1356.51c	1349.42b	1355.31c	1362.23[a]	*	22.9
Total fat(g)	153.18a	150.53b	151.49b	153.85a	151.11[b]	*	0.68
Head and Tongue (g)	1089.5a	1092.7a	1083.6a	1082.5a	1077[a]	ns ns	11.91
Testis(g)	175.19a	181.15a	178.25a	177.29a	180.1[a]	ns ns	0.91
Tail(g)	24.83a	23.51b	22.53b	24.71a	24.71[a]	*	1.33
TEOC (g)	2906.79[c]	2902.10[c]	2902.60[c]	2915.31[b]	2921.25[a]	ns	37.35

[a, b, c] Means with different superscripts in rows are significantly differ.*: (P<0.05) ns: non-significant (P>0.05); SEM: standard error of means; SL: significance level.

VI None Edible Offal Components

None edible component of Afar goats fed different proportions of cowpea with Rhodes grass and concentrates mix presented in (Table 9). Gut content, blood, penis, skin and feet are considered as non-edible offal. All none edible component of the parameters did not differ (P>0.05) among the treatments. Generally, the result of this study revealed that supplementation of cowpea and Rhodes grass in different proportions concentrate contained instead of concentrate mix can be used effectively without affecting the result of edible and none edible offal components that can be achieved by sole concentrate condition.

Table 9: None edible component of Afar goats fed different proportions of cowpea with Rhodes grass and concentrates mix.

Parameters	T1	T2	T3	T4	T5	SL	SEM
Blood (g)	615.29a	621.15a	610.17a	618.15a	620.20[a]	**ns**	12.23
Gut content (g)	5784a	5802a	5911a	5765a	5779a	**ns**	11.11
Penis (g)	52.17a	51.84a	52.19a	52.31a	52.41a	**ns**	0.19
Skin and feet(g)	1634a	1610a	1615a	1641a	1653a	**ns**	48.7
TNEOC (g)	8085.46	8084.99	8188.36	8076	8104	**ns**	72.23

[a, b, c] Means with different superscripts in rows are significantly differ.*: (P<0.05); ns: non-significant (P>0.05); SEM: standard error of means; SL: significance level.

VII Partial Budget Analysis

The partial budget analysis of Afar goats fed on different proportions of cowpea and Rhodes grass with concentrates mix presented in (Table 10). The partial budget analysis was executed to evaluate the economic advantages of use of cultivated improved forage of cowpea with Rhodes grass as supplemented at different proportions instead of commercial concentrate mix. The difference of net return among the treatment was the reflection of weight gain in the experimental period. In the present study, goats that have a better nutrient intake had superior average daily gain and final body weight, as a result of which they bring better sale price and earn higher net return. The current result revealed that, slight difference on net return was observed in T5, T4 T3 T2 and T1 for their body weight of 26.4 kg, 26.6 kg 26.4 kg, 26.3 kg and 26.7 kg respectively. The net return was 789, 750, 784, 788 and 792 ETB/head for T1, T2, T3, T4, and T5 respectively. This indicates that goats fed with better quality feed perform well and have better body weight gain and sold at maximum price and earn better net return.

Table 10: Partial budget analysis of Afar goats supplemented on different proportions of cowpea and Rhodes grass with concentrates mix.

Parameter	T1	T2	T3	T4	T5
Purchase price of goat (ETB/head)	610	610	610	610	610
Cow pea consumed (kg/ head)	-	16.2	8.1	4.1	12.2
Rhodes hay consumed (kg/ head)	-	10.8	5.4	2.7	8.0

Wheat bran consumed (kg/ head)	16.2	-	8.1	12.2	4.1
Noug seed cake consumed (kg/ head)	10.8	-	5.4	8.0	2.7
Total supplement consumed (kg/ head)	27	27	27	27	27
Total feed consumed (kg/ head)	54.1	54.2	54.6	55	54.4
Cost of cow pea (ETB/ head)	-	90	45	22.5	67
Cost of Rhodes grass (ETB/head)	-	60	30	15	45
Cost of wheat bran (ETB/head)	113	-	57	85.4	29
Cost of noug seed cake (ETB/head)	108	-	54	80	27
Total variable cost (ETB/ head)	221	150	186	202.9	168
Selling price of goats (ETB/ head)	1620	1570	1580	1600	1570
Total return (ETB/ head)	1010	960	970	990	960
Net return (NR) (ETB/ head)	789	750	784	788	792

TR: total return; ETB: Ethiopian birr; NR: Net Return.

Conclusion and Recommendations

There was no apparent difference (P>0.05) was observed in organic matter and basal intake among the treatments. Likely, intake of supplement was slightly higher (P<0.05) for T1, T4 and T3 than T2 and T5. The intake of CP was higher (P<0.01) for Afar goats in T1 and T4 than goats in T3, T2 and T5. Supplementation of different proportions of concentrate contained forage mix (cowpea and Rhodes grass) instead of concentrates mixture had no significant effect (P>0.05) on organic matter, total DM and basal DM intake. As a result, forage mixture with 75%, 50% and 25% concentrate contained supplementation can be an alternative potential option for small ruminant fattening considering accessibility and price since farmers can grow it at his backyard with his own labor and land. However, forage mix alone was slightly lower to bring the same weight to other treatment diets

The effect of supplement was not significant differences (P>0.05) on average daily body weight gain, final body weight, feed conversion efficiency of among experimental animals. The average daily gain in the current study was numerically higher for T4 (110 g/d). Supplementation of Afar goats with cowpea with Rhodes grass at different proportions and concentrates mixture have similar effect on slaughter weight, hot carcass weight, empty body weight, dressing percentage at slaughter body weight basis and rib-eye areas. Dressing percentage of empty body weight for T4 numerically had slightly higher (53.7) for all body weight measurements than other treatments. There were no significant (P>0.05) difference among treatments in total edible products, total edible offal and total non-edible offal components. In general, the results of body weight and carcass parameters in the current finding portray that, mixture of cowpea and Rhodes grass as sole supplement is comparable to the supplementary value of concentrate mixture to improve Afar goat performance. However, forage mix alone was scored slightly lower measurement weights to other treatment diets. Similarly, cowpea and Rhodes grass mixture with different levels of concentrate contained mix can also replace sole concentrate feeds supplementation because of their similar performance effects observed in the experiment.

The partial budget analysis showed that feed cost decrease as the proportion of cowpea and Rhodes grass levels increased. The use of sole cowpea and Rhodes grass mix instead of concentrate mix reduced feed cost and increase net return. In conclusion, from economic point of view T5 exhibited lower feed cost and increased net return than other treatments and is therefore recommended for further evaluation to verify it for on farm application. However, all supplements used in this study induced favorable average daily gain and net return and thus can be employed in feeding systems depending on their availability and relative cost.

References

1. Mengistu A (2002) Forage production in Ethiopia: A case study with implication for livestock production. *Ethiopian Soc Anim Prod Ethiop*.
2. Ponsens J, Hanson J, Schellberg J, Moeseler BM (2010) Characterization of phenotypic diversity, yield and response to drought stress in a collection of Rhodes Grass (Chloris gayana Kunth) accessions. *Field Crop Res*.
3. Gebrehiwot L, Tadesse A (1985) Pasture research and development in Ethiopia. In: Kategile, J.A. (ed.). Pasture improvement research in eastern and southern Africa. Proceedings of a workshop held in Harare, Zimbabwe, Sept. 1984. *IDRC, Ottawa, Ontario* 77-91.
4. Baloyi JJ, Ngongoni NT, Hamudikuwanda H (2008) The effect of feeding forage legumes as nitrogen supplement on growth performance of sheep. *Trop Anim Health Prod* 40: 457-462. [Crossref]
5. Anele UY, Arigbede OM, Südekum KH, Ike KA, Olanite JA et al. (2010) Effects of Processed Cowpea (Vigna unguiculata L. Walp.) haulms as a feed supplement on voluntary intake, utilization and blood profile of West Africa Dwarf sheep fed a basal diet of Pennisetum purpreum in the dry season. *Anim Feed Sci Technol* 159: 457-462.
6. Van Soest PJ, Robertsson JB (1985) Analysis of forages and fibre foods. A Laboratory Manual for Animal science 613. Department of Animal Science. *Cornell University. Ithaca, New York*.
7. Melaku S, Peters KJ, Tegegne A (2004) Effects of supplementation with foliages of selected multipurpose trees, their mixtures or wheat bran on feed intake, plasma enzyme activities, live weight and scrotal circumference gains in Menz Sheep. *J Livest Prod Sci* 89: 253-264.
8. McDonald P, Edward RA, Green JFD, Morgan GA (2002) Animal Nutrition. 6th ed. Pearson Educational Limited. Edinburgh, Great Britain 544.

9. Gülten K, Ferit R, Mevlüt K (2000) Growth performance and feed conversion efficiency of Siberian Sturgeon juveniles (Acipenserbaeri) reared in concentrate ways. *Turk J Vet Anim Sci* 24: 435-442.
10. Van Soest PJ (1994) Nutritional Ecology of Ruminants. 2nd Ed. *Cornell University Press, London* 476.
11. El Hag MG, El Shargi KM (2000) Feedlot performance and carcass characteristics of local (Dhofari) and exotic (Cashmere) goats fed on a high-fibre by-products diet supplemented with fish sardine. *Asian Aust J Anim Sci* 9: 398-396.
12. Duguma B, Eshete G, Zewdu T, Tolera A (2014) Comparison of nutritive value of alfalfa, Rhodes hay, cynodon pasture and linseed cake –maize mixture at Hawassa College of Agriculture, Ethiopia. *Acad J Nutr* 3: 19-21.
13. Hunegnaw A, Berhan T (2016) Effects of supplementation with pigeon pea (Cajanuscajun), cowpea (Vigna unguiculata) and lablab (Lablab purpureus) on feed intake, body weight gain and carcass characteristics in Wollo sheep fed grass hay. *Int J Adv Res Biol Sci* 3: 280-295.
14. Ebro A, Sisay A, Alemu T (1998) Effect of level of substituting of Lablab (Dolichos lablab) for concentrate on growth rate and efficiency in post weaning goats. In: Proc. *Ethiop Soc Anim Prod* 264-269.
15. Okello KL, Ebong C, Opuda Asibo J (1994) Effect of feed supplements on weight gain and characteristics of intact male Mubende goats fed elephant grass (P. purpureum) ad libitum in Uganda. In: Proc 3rd Biennial *Confer Afri Small Ruminant Res Network Uganda*.
16. Betsha S (2005) Supplementation of graded levels of peanut cake and wheat bran mixtures on nutrient utilization and carcass parameters of Somali goats. MSc. thesis presented to the school of graduate studies of Alemaya *University of Agriculture, Alemaya, Ethiopia* 75.
17. Bogale S, Melaku S, Yami A (2008) Potential use of crop residues as livestock feed resources under conditions of smallholder farmers in Bale highlands of Ethiopia. *Tropical Subtropical Agroecosyst* 8: 107-114.
18. Pond WG, Church DC, Pond KR (1995) Basic Animal Nutrition and Feeding. 4th (ed). *John Willy: Sons, New York* 601.
19. Dadi H, Woldu T, Lema T (2005) Comparison of carcass characteristics of Borana and Arsi-Bale goats under different durations of feedlot management. *Livest Res Rural Dev*.
20. Anjaneyulu ASR, Joshi HB (1995) Carcass characteristics and composition of goat meat in Indian breeds- an overview. In: National Symposium on Production and Marketing of Goat Meat, *CIRG ISSGPU, India*.
21. Getahun L (2001) Growth pattern and carcass characteristics of Somali and Mid-rift valley goats. MSc thesis. *Alemaya Univesity, Ethiopia*.
22. Mushi DE, Safari J, Mtenga LA, Kifaro GC, Eik LO (2009) Growth and distribution of non-carcass components of Small East African and F1 Norwegian crossbred goats under concentrate diets. *Livest Sci* 126: 80-86.
23. Freweini A (2014) Intake, digestibility, body weight change and carcass characteristics of Hararghe Highland goats fed a basal diet of urea treated sorghum stover supplemented with dried leaves of Erythrina burana, Casimiroa edulis, concentrate mix and their mixtures. *Doctoral Dissertation, Haramaya University, Haramaya, Ethiopia*.
24. SAS (2002) Guide to personal computers, version 9. Statistical analysis system institute Inc., NC. USA.
25. Ruvuna F, Taylor JF, Okeyo M, Wanyoike M, Ahuya C (1992) Effects of feed and castration on slaughter weight and carcass composition of goats. *Small Ruminant Res* 7: 175-183.
26. Shahjalal MD, Bishwas MAA, Tareque AMM, Dohi H (2000) Growth and carcass characteristics of goats given diets varying protein concentration and feeding level. *Asian Aust J Anim Sci* 13: 613-618.
27. Ameha S, Mathur MM (2000) Growth and carcass characteristics of Barbari kids as influenced by concentrate supplementation. pp. 144-150. In: R.C. Merkel, Girma Abebe and A.L. Goetsch (eds.). E (Kika) de la Garza Institute for Goat Research, Langston University, Langston, OK. The opportunities and challenges of enhancing goat production in East Africa, 70-79. *Proceedings of a Conference Held at Debub University, Awassa, Ethiopia*.
28. Ameha S, Casey NH, van Niekerk WA, Azage T, Coertze RJ (2007) Growth performance and carcass characteristics of three Ethiopian goat breeds fed grainless diets varying in concentrate to roughage ratios. *S Afr J Anim Sci* 37: 221-232.
29. Awuk A, Tamir B (2007) Feed intake, live weight gain and carcass yield characteristics of intact Hararghe highland male goats fed on different hay to concentrate ratios. *East Afr J Sci (EAJS)* 1: 45-54.
30. Kumar S, Tiwari SP, Narang MP (1991) Effect of different planes of nutrition on carcass characteristics in Gaddi goats. *Indian Vet J* 68: 953-956.
31. Dereje W (2015) Effect of substitution of concentrate mix with dried mulberry leaves on feed intake, digestibility, body weight gain and carcass characteristics of Arsi-Bale goats. MSc Thesis, *Haramaya University, Haramaya, Ethiopia*.