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Evaluation of Different Herbaceous Legume Hays As Protein Supplements for Growing Local Lambs Fed a Basal Diet of Teff (*Eragrotis Tef*) Straw

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Abstract: **A study to evaluate the dry matter feed intake (DMI) and growth rate of local growing lambs supplemented different herbaceous forage legumes hay with teff straw (TS) *ad libitum* and sorghum crushed grain (SCG) based-diet was conducted at Sirinka Agricultural Research Center (SARC). The treatments were NCTR (TS + SCG 100 to 150 g/day head^{-1}) and NCTR with supplementary (SUPP) protein sources VET (Vetch, *Vicia dasycarpa*), STY (Stylosanthes, *Stylosanthes hamata*), LAB (Lablab, *Lablab purpureus*), SIR (Siratro, *Macroptilium atropurpureum*), DES (Desmodium, *Desmodium unicinatum*), SES (Sesbania, *Sesbania sesban*), LUC (Leucaena, *Leucaena pallida*) hay and PCTR (Noug cake, *Guizotia abyssinica*). Average initial body weight (IBW) (23.11± 0.3 kg) and feed conversion rate (FCR) 4.81 were same for all treatment groups. Final body weight (FBW) and average daily body weight gain (ADG) were different ($p<0.001$) among treatment groups. Animals fed on NCTR plus LUC and LAB supplement had better FBW, ADG and dry matter supplement (SDMI) and total feed intakes (TDMI) than other treatment groups. Moreover, animals in supplemented treatment groups' achieved a maximum ADG of 109.1 gm head^{-1} at 10th week of feeding period. The results indicated the possibility of increasing sheep production through supplementation of these forge legumes in areas while the production of these forage species are possible. Therefore, supplementation of growing lambs with LUC and LAB hay plus NCTR until 10 weeks (70 days) would give optimum body weight gain.**

Keywords: **body weight gain, DMI, Herbaceous legumes, Lablab, Leucaena, Supplementation, teff straw.**

1. INTRODUCTION

In mixed farming areas of the Ethiopian highlands, where land is intensively cultivated for crop production for human use, animals are mainly dependent on crop residues; particularly during the dry season. But the feeding values of crop residues are limited by deficiencies of crude protein, metabolizable energy, minerals and vitamins [8]. One way of improving the utilization of such crop residues is by proper supplementation with leguminous forages [4]. Forage legumes are rich in protein (both fermentable and by-pass protein, depending upon the level of tannin content) and other nutrients such as minerals [9].

Herbaceous forage legumes have been identified as potential protein supplements for ruminants since they contain CP (150-300g/kgDM), minerals and vitamins needed for the growth of ruminal microorganisms [6]. The energy and nitrogen substrates made available through digestion of legumes in the rumen result in an increased yield of microbial protein and

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thus in an increased supply of microbial N for absorption in the lower intestinal tract [5]. Moreover, supplementation with forage legumes could be a sustainable way of improving the feeding value of poor quality crop residues especially to the resource poor African smallholders [9].

In its production potential, teff straw stands second to maize among crop residues and in its nutritional quality; it is the best among cereal crop residues in Ethiopia [11]. Because of its low N and high cell wall contents and slow digestion, animals kept on sole teff straw diet cannot maintain their N balance. Especially growing animals may lose weight due to their high N requirement. Losses up to 75g/day were reported for young calves fed on a sole diet of teff straw [1]. Protein supplementation of grass diets containing less than 70 g CP / kg DM has been reported to increase DM intake, DM digestibility and animal performance [7].

To date, adaptable forage legumes that are suitable to the soils and climatic conditions of Sirinka have already been identified. However, information based on animal trials to their actual feeding value as sole rations or as supplements to poor-quality animal feeds, are still lacking. Hence, critical animal evaluation and identification of better quality forage legume (s) that can enhance the efficiency of utilizing basic feed resources deserves an urgent research attention. Therefore, this study was conducted to determine the effects of different herbaceous legumes hay supplemented with sorghum crushed grain (basal-diet) and teff straw (*ad libitum*) on dry matter intake and growth rate of local growing lambs.

2. MATERIALS AND METHODS

A. General:

The study was carried out at Sirinka Agricultural Research Center (SARC) of eastern Amhara region in Ethiopia which is located at $11^{O}30'$ - 12^{O} N latitude and $39^{O}30'$-40^{O} E longitude, with an altitude of 1850 m. above sea level.

The experimental forage legumes were grown at Jarri sub-research center which is located at an altitude of 1780 m above sea level receiving average annual rainfall of 800 mm. The experimental forages were harvested at the recommended stage at which optimum quality and yield could obtain, and air dried under shade.

B. Animals and Management:

Eighty one native growing male lambs aged approximately 9 months and having an average IBW of 20.34 ± 0.3 kg were purchased from local market. They were treated for internal and external parasites prior to the start of the study. The animals were stratified into nine weight groups; animals from each group were ear tagged, and randomly assigned to one of the nine treatment groups using completely randomized design. They were housed in an individual pens on slatted floor. To fully acquaint the animals with their experimental diets and new surroundings, the actual study period (120 days) was preceded by a preliminary 15 days acclimatization feeding period. The lambs were weighed at the start and weekly during the actual study period.

The treatments were

NCTR = (Teff straw *ad libitum* + Crushed Sorghum grain 100 to 150 g/day head^{-1}) (negative control)

LUC = (NCTR + Leucaena, *Leucaena pallida*)

LAB = (NCTR + Lablab, *Lablab purpureus*)

DES = (NCTR + Desmodium, *Desmodium unicinatum*)

VET = (NCTR + Vetch, *Vicia dasycarpa*)

STY = (NCTR + Stylosanthes, *Stylosanthes hamata*)

SES = (NCTR + Sesbania, *Sesbania sesban*)

SIR = (NCTR + Siratro, *Macroptilium atropurpureum*)

PCTR= (NCTR + Noug cake, *Guizotia abyssinica*) (positive control)

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C. Experimental diet:

Nitrogen (N) content of supplementary protein sources (Vetch, Stylosanthes, Lablab, Siratro, Desmodium, Sesbania and Leucaena hay and Noug cake) were determined using proximate analysis [14] and the crude protein (CP) content was calculated as N X 6.25 (Table 1). Equivalent N levels of the supplementary legumes hay and Noug cake (PCNT) satisfying the daily requirement of growing lambs for CP [3]were provided to the respective treatment groups based on initial and weekly body weight at the beginning and during the study period, respectively. Teff straw, water and mineral lick were given *ad libitum* for all treatment groups. To fulfill the energy requirement of the experimental animals, depending on their intake 100 to 150g/day head^{-1} sorghum crushed grain (SCG) was offered as basal diet.

TABLE 1. N (%), CP (g/kg in DM) and DM (%) content of the experimental feeds.

Experimental feeds	N content%	CP g/kg DM	DM%
Teff straw	-	-	82.6
Sorghum crushed grain	-	-	82.5
Vetch (*Vicia dasycarpa*) hay	2.39	149	79.9
Lablab (*Lablab purpureus*) hay	2.05	128	80.7
Stylosanthes (*Stylosanthes hamata*) hay	2.88	180	81.9
Siratro (*Macroptilium atropurpureum*) hay	2.55	160	81.0
Leucaena (*Leucaena pallida*) hay	2.39	149	84.0
Sesbania (*Sesbania sesban*) hay	1.42	88.7	91.5
Desmodium (*Desmodium unicinatum*) hay	2.25	141	81.7
Noug (*Guizotia abyssinica*) cake	3.94	246	82.6
Mean	**2.48**	**155**	**82.9**

N= nitrogen; CP= crud protein; DM= dry matter

The amounts of feeds offered and refused were recorded on daily bases and oven dried at 105^{o}C for 24h to determine the DM feed refusal and intake of the animals. The refusals were removed, weighed and sampled every morning (0800) before provision of each day feeds.

D. Statistical analysis:

Body weight gain (ADG and FBW) and DM intakes of basal (BDMI), supplementary (SDMI) and teff straw (TDMI) feeds were subjected to analysis of variance using the General Linear Model (GLM) procedure available in SAS [10]. IBW was used as covariate to ADG and FBW. Duncan's Multiple Range Test was employed for separation of treatment means.

3. RESULTS AND DISCUSSION

A. Body weight gain:

With similar average FCR of 4.81 and IBW of 23.11 ± 0.3 kg, ADG and FBW of growing lambs were different among treatment groups. Hence, animals supplemented with LUC and LAB hay, respectively were superior for ADG and FBW (Table 2). The ADG of this study was higher than 27.8, 55.7 and 49.27 gm/day head^{-1}, respectively reported by [12], [2] and [13].

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TABLE 2. ADG (gm head^{-1}), IBW and FBW (kg head^{-1}) and FCR (kg. DMI/kg wt gain) of growing lambs fed under different treatments.

	Treat.										p-value
	LUC	LAB	DES	STY	VET	SIR	SES	PCTR	NCTR	SEM	
Body wt.											
IBW	20.5	20.8	19.8	20.4	21.1	20.2	19.4	20.9	19.8	10.1	<.0001
FBW	27.8^{A}	27.9^{A}	26.7^{B}	26.8^{B}	26.7^{B}	25.3^{C}	24.3^{D}	23.9^{D}	22.7^{E}	9.82	<.0001
ADG	62.0^{A}	59.6^{A}	58.0^{AB}	53.9^{ABC}	47.2^{ABC}	43.4^{BC}	40.4^{CD}	24.7^{D}	24. 2^{D}	5991	<.0001
FCR	4.21	6.45	5.57	7.72	4.47	6.51	3.44	2.09	2.89	296	0.07

Mean within the row followed by different letters are significantly (P<0.001) different.
NCTR=TS + CSG; VET= NCTR + Vetch (*Vicia dasycarpa*); STY= NCTR + Stylosanthes (*Stylosanthes hamata*); LAB= NCTR + Lablab (*Lablab purpureus*); SIR= NCTR + Siratro (*Macroptilium atropurpureum*); DES= NCTR + Desmodium (*Desmodium unicinatum*); SES= NCTR + Sesbania (*Sesbania sesban*); LUC= NCTR + Leucaena (*Leucaena pallida*); PCTR= NCTR + Noug cake (*Guizotia abyssinica*).
Treat.= Treatments; TS, Teff straw; SCG, sorghum crushed grain; NCTR, Negative control; PCNT, positive control; IBW= Initial body weight, FBW= Final body weight, ADG= Average daily weight gain, FCR, Feed Conversion Rate; SEM. Standard error of means.

As can be seen in Fig. 1, the ADG of animals achieved at 10th and 2nd weeks of feeding period, respectively for supplemented treatment groups and negative control were higher than other feeding periods.

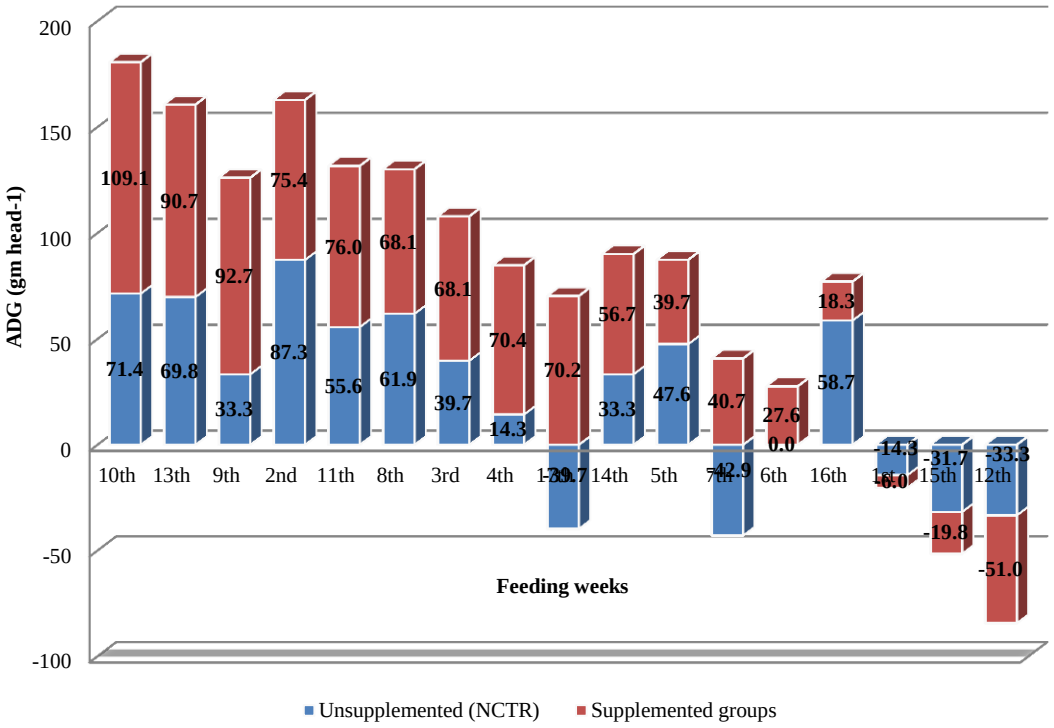

Fig. 1 ADG (gm) of supplemented and un-supplemented (NCTR) treatment groups for different feeding periods.

B. Dry matter feed intake:

The average daily BDMI, SDMI and TDMI were different among treatment groups. Due to the absence of supplementary feed, animals that were fed TS and SCG (NCTR) treatment group have resulted higher DM teff straw intake than other supplemented treatment groups. Among supplemented groups, animals supplemented with LUC and LAB hay have resulted higher SDMI and TDMI than other treatment groups.

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TABLE 3. Daily average BDMI (TS + SCG), SDMI and TDMI (kg/day head^{-1}) of animals under different treatment groups.

	Treat.										p-value
	LUC	LAB	DES	VET	STY	SES	SIR	NCTR	PCTR	SEM	
DM intake											
BDMI	0.57^{C}	0.58^{C}	0.58^{C}	0.52^{D}	0.60^{B}	0.57^{C}	0.56^{C}	0.71^{A}	0.53^{D}	0.01	<.0001
SDMI	0.32^{A}	0.31^{AB}	0.26^{C}	0.30^{B}	0.21^{E}	0.24^{D}	0.23^{DE}	-	0.15^{F}	0.01	<.0001
TDMI	0.89^{A}	0.89^{A}	0.84^{B}	0.82^{BC}	0.81^{BCD}	0.80^{CD}	0.79^{D}	0.71^{E}	0.68^{E}	0.02	<.0001

Mean within the row followed by different letters are significantly (P<0.001) different.
Treat, Treatments; DM= Dry matter, BDMI= Basal diet (TS+SCG); SDMI= Supplementary DM feed intake, TDMI=Total DM feed intake (BDMI + SDMI).

This result justifying that supplementation of forage legumes hay as protein sources improves the TDMI of growing lambs.

4. CONCLUSIONS

According to the study result, growing lambs fed with basal diets (TS + SCG) plus LUC and LAB hay supplementary protein source achieved higher ADG and FBW. Also the ADG of growing lambs in all supplemented treatment groups were higher for 10th week of feeding period. According to the total DMI of supplemented groups, supplementation of herbaceous forage legumes hay as protein source resulted higher TDMI.

Therefore, from this study result we recommend that supplementation of growing lambs with LUC and LAB hay until 10 weeks (70 days) would give optimum body weight gain.

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