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EFFECTS OF LENTIL (*Lens culinaris*) SCREENING AS A REPLACEMENT FOR NOUG SEED CAKE (*Guizotia abyssinica*) ON THE DIETS OF GROWING FARTA LAMBS IN ETHIOPIA

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Abstract

A study was performed with the objective to assess nutrient biological performance and assess economic feasibility of Farta lambs fed wheat straw (WS) as a basal feed and supplemented with lentil screening (LS) in replacement for noug seed cake (NSC). The experimental sheep were blocked into five based on their initial body weight and randomly assigned to treatment diets within each block. The experimental design used for this study was randomized complete block design (RCBD) with five replications. Result indicated %CP contents of experimental feeds were 26.13, 25.00 and 5.66 for lentil screening, NSC and WS, respectively. There was significant difference in WS DM intake ($p<0.05$) in all treatment groups. The supplement DM intake increased significantly ($p<0.001$) as lentil screening level increased from 0, 29.4, 55.4, 78.8, and 100% from (T1-T5), respectively. Total DM intake was significantly different ($p<0.01$) among all treatment groups but CP intake was not significantly different among treatments ($p>0.05$). Average daily body weight gain (ADG) and feed conversion efficiency (FCE) were significantly different ($p<0.01$) among treatment groups. Among treatment groups, T5 had higher ($p<0.01$) daily body weight gain (76.44 g/d) as compared to T4 (72.1 g/d), T3 (69.8 g/d), T2 (62.89 g/d), T1 (58.28 g/d). T5 returned a higher net income (110.94 Ethiopian Birr (EB)/sheep) as compared to the other treatment groups. From biological performance and economic return T5 could be recommended as an alternative supplement for growing Farta sheep both in biological performance and better economic gain.

Key words: *lentil screening, local sheep, Rice Bran.*

INTRODUCTION

Livestock production in Ethiopia is an important component of agriculture serving as the pillar of the economy. In spite of favorable environmental circumstances the present livestock productivity in the country is not as anticipated due to different constraints. The main livestock production constraints in Ethiopia include inadequate feed and nutrition, widespread diseases, poor genetic potential of local breeds, market problem, and ineffectiveness of livestock development services (Asfaw et al., 2011; CSA, 2018). Of the above listed problems, feed scarcity and poor feed quality during the dry period presents a serious challenge to livestock production in the country (Mengistu et al., 2017).

The existing feed resources are primarily low nutrients which cannot assure the necessities of animals late alone production but also maintenance. As a result the livestock population often experiences cyclic loss of body condition following seasonal feed production patterns (Melekamu et al., 2014), which influences the supply and price of livestock products in the local market. To alleviate nutritional limits of feeds and boost performance of animals particularly sheep, use of locally produced industrial byproducts as feed was very crucial. In this regard, feed resources like lentil screening is one of candidate supplement which can be considered to be accessible as supplementary feeds to improve the current poor feeding condition in the country.

One of the conventional supplements used in ruminant feed in the country, noug seed (Niger seed) cake is becoming relatively expensive and un-accessible for most producers in the recent times. As a result, the current study was designed to evaluate the effect of lentil screening as a replacement for noug seed cake on feed intake, digestibility and body weight

change of yearling Farta lambs and to assess the assessing the economic feasibility of the feeding regime.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted at Debre Tabor town, Ethiopia which is situated at11°40' North latitude and 38º 00' East longitudes and at 2650 meter above sea level. The mean annual rainfall is 1570 mm and the mean minimum and maximum annual temperatures are 9.6 and 21.5^{0}C, respectively (FWAO, 2019).

Experimental Animals and Their Management

Twenty-five yearling intact male Farta sheep with an initial body weight of 16.65 ± 1.82 kg (Mean ± SD) were purchased from local markets. The age of the sheep was determined by dentition (Vatta et al., 2006) and information obtained from the owners. The sheep were quarantined for 21 days in order to observe their health condition and followed by 15 days of acclimatization period of the experimental feed prior to the beginning of the actual feeding and data collection. All animals were sprayed against external parasites by using Diazinon and drenched against internal parasites using Ivermectin based on the recommendation of veterinarian. Experimental lambs were also vaccinated against common diseases of the area (pasteurellosis, sheep pox and anthrax).

Experimental Design and Treatments

The experiment was conduct by using randomized complete block design with five replications. The experimental lambs were blocked into five blocks based on their initial body weight. The initial BW of the experimental animals was determined by taking the means of two consecutive weighing after overnight fasting. The animals in a block were randomly assigned to one of the five treatment diets. The dietary treatments in the current study consisted of 240 g NSC (T1), a mixture of 75 g LS and 180 g NSC (T2), 149 g LS and 120 g NSC (T3), and 223 g LS and 60 g NSC (T4)] and 297 g LS (T5) per head/day on DM basis.

Feeds and Feeding Management

Wheat straw (WS) used for the experiment was purchased from local farmers and stored properly under the shade prior to feeding. The straw was chopped into 5-7 cm long (McDonald et al*.,* 2010) and made ready for the feeding experiment. Lentil screening (LS) was purchased from locally available processing mills. The WS was provided *ad libitum* to experimental sheep. Common salt and water were provided *ad libitum* to all experimental animals. Concentrate mix was prepared on ISO N basis by mixing LS, NSC and RB. The formulations of supplements were done based on the daily dry matter requirement, metabolizable energy and crude protein requirement of sheep. Ensminger (2002), who suggested that for moderate growing lambs that weigh 10 to 20 kg body weight, the CP required per day would be 16.7% of the feed DM. The maintenance requirement of energy however is 4.8 MJME/kg (McDonald et al., 2010). All animals were given the concentrate mixture at 0800 and 01600 hours in two equal portions. The experimental animals were offered *ad libitum* the basal diet wheat strawat 20% refusal adjustment very week throughout the experimental period.

Measurements and Observation

Feed and nutrient intake

Daily supplements and basal feed refusals were collected from each treatment throughout the experimental period. Daily mean feed intake was calculated as differences between feed offered and refused: Feed Intake = Feed Offer – Feed Refusal; Nutrient Intake = Nutrient in feed Offered – Nutrient in refused feed.

Dry matter and nutrient digestibility

The digestibility trial was conducted with four days adaptation of fecal bags followed by seven successive days for fecal gathering. Feces voided was weighed and recorded every morning, mixed, 20% of representative samples were taken and pooled over the collection period for each animal. Daily pooled feces air dried on the shaded area and stored in air tight container until sent to the laboratory for chemical analysis. The metabolize energy MJ/day intake was estimated from digestible

organic matter intake (DOMI) values by using the equation of AFRC (1993) as ME (MJ/d) = 0.0157*DOMI g/kg DM. The apparent digestibility of DM, OM, CP, NDF and ADF were determined using the following equations:

Apparent DM digestibility coefficient =

$$\frac{\text{DMI} - \text{Feacal DM output}}{\text{DMI}}$$

Apparent nutrient digestibility coefficient =

$$\frac{\text{Nutrient intake} - \text{Feacal nutrient output}}{\text{Nutrient intake}}$$

Where: DM = dry matter; DMI = dry matter intake

Body weight change

The body weight of each sheep was measured at every ten days after overnight fasting using weighing balance. Average daily body weight gain was calculated as the difference between final live weight gain and initial live weight divided by the number of feeding days.

Feed conversion efficiency

The feed conversion efficiency (FCE) was calculated by dividing the daily live weight gain by daily DM intake and multiplied by 100 following formula (Brown et al., 2001) as follows:

$$\text{FCE} = \frac{\text{Daily body weight gain (g)}}{\text{Daily feed intake (g)}} * 100$$

Chemical Analysis

The chemical analysis of the experimental feeds, i.e., wheat straw, Lentil screening, noug seed cake, rice bran and the mixtures and feces were done by taking the representative samples. Partially dried samples of feeds and feces were ground using laboratory mill to pass through 1mm screen size. Dry matter (DM) was determined after oven drying of sub samples of partially dried samples at 105^0C to a constant weight. The samples were analyzed for DM, Ash, and crude protein (CP) based on the procedure of AOAC (1990). The CP content using Kjeldhal procedure after multiplying %N value with 6.25. Neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) were analyzed according to the procedures of (Van Soest and Robertson, 1985).

Partial Budget Analysis

The partial budget analysis was done to evaluate the economic profitability of supplementation of LS and NSC substitution according to the procedure of Upton (1979). The purchasing and selling prices of experimental sheep and the total quantity of basal and supplement feed and its purchasing prices were recorded. The analysis involved the calculation of the variable costs of experimental sheep, feeds and benefits gained from the result. The total variable cost (TVC) calculated as purchasing price of sheep (ETB/head) and total fed (ETB). The total return (TR) was determined by calculating the difference between selling and purchasing price of experimental sheep. At the end of the experiment, the selling price of experimental sheep was estimated by experienced sheep dealers. The cost of feeds was computed by multiplying the actual DM intake for the whole feeding period with the prevailing feed prices. Net return (NR) was calculated as the difference between TR and total variable costs (TVC) while change in net return (ΔNR) was calculated as difference between changes in total return (ΔTR) and change in total variable costs (ΔTVC).Δ NI= ΔTR- ΔTVC.

The marginal rate of return (MRR) measures the increase in net income (ΔNR) associated with each additional unit of expenditure (ΔTVC). This is expressed in percentage as:

MRR% = (ΔNR/ΔTVC) X 100%

Data Analysis

Data obtained from feeding trial, body weight change and digestibility were subjected to the analysis of variance (ANOVA) using General Linear Model (GLM) procedures of statistical analysis system (SAS 9.4). The significant treatment means were separated using Turkeys 'Studentized range (HSD) test. The model used for data analysis was:

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

where: Yij = observation in the i^{th} treatment and j^{th} block; μ = the overall mean;Ti = the ith treatment effect; Bj = the jth block effect; Eij = the random error.

RESULTS AND DISCUSSIONS

Chemical Composition of Treatment Feeds

The chemical compositions of experimental feeds used in the current study are presented in Table 1. The wheat straw (WS) used in the

current study had a DM, OM, CP and Ash were 93, 93.55, and 5.66, 11.03%, respectively. The CP content of WS refusals were 1.8% (T1), 2.44% (T2), 1.97% (T3), 2.59% (T4), 1.34% (T5), respectively. Lentil screening (LS) used in the current study had DM, OM and CP contents of 92.25, 89.48 and 26.13% CP, respectively. The NDF, ADF and ADL contents of LS were 24.38, 16.74 and 4.38%, respectively. The percent DM, OM and CP of NSC of the present finding were 91.5, 93.41 and 31.25, respectively.

Table 1. Chemical composition of treatment diets and wheat straw refusals

Chemical composition(% for DM and % for others on DM basis							
Feed samples	DM	OM	CP	NDF	ADF	ADL	ASH
WS	93.00	93.55	5.66	78.03	66.67	11.03	6.45
LS	92.25	89.48	26.13	24.38	16.74	4.38	6.52
NSC	91.50	93.41	31.25	39.09	28.36	6.51	6.59
RB	94.00	77.40	7.80	68.74	59.47	13.24	22.60
LS+NSC (29.4:70.6)	91.20	93.43	29.74	37.20	26.77	4.88	6.57
LS+NSC (55.4:44.6)	91.60	93.45	28.42	35.83	25.74	4.68	6.55
LS+NSC (78.8:19.2)	89.97	93.60	26.60	33.91	23.30	4.51	6.40
WS refusal							
T1	92.25	97.83	1.88	88.82	71.09	12.20	2.17
T2	94.00	96.81	2.44	80.00	68.91	7.60	3.19
T3	93.50	97.85	1.97	87.59	70.12	12.16	2.15
T4	92.00	97.83	2.59	80.00	65.45	12.20	2.17
T5	93.00	96.77	1.34	89.13	73.57	13.45	3.23

Detergent fiber; ADF= acid detergent fiber; ADL= acid detergent lignin; RB=Rice Bran; LS= lentil Screening; NSC= noug seed cake.

The NDF, ADF and ADL content of NSC in the current study were 39.09, 28.36, and 6.51%, respectively. The DM, OM and CP content of RB were 94, 77.4, and 7.8%, respectively while the NDF, ADF and ADL contents were 68.74, 59.47, and 13.24%, respectively.

Dry matter and nutrient intake

The mean daily DM and nutrient intake of Farta sheep fed wheat straw as a basal diet and supplemented with lentil screening and noug seed cake mixture at different level is presented in Table 2. There was significant difference wheat straw DMintake (p<0.05) in all treatment groups. In the current finding there was significant different in basal diets wheat straw DMintake at (p<0.01) in (T1) compared to the treatment groups (T4 and T5) but not significant different (p>0.05) between treatment (T3 and T4) and (T1 and T2). The present study showed that as the amount of lentil screening offered to lambs increased, the DM intake of wheat straw decreased among the treatments which were significantly higher (p<0.05) in the order T1>T2>T3>T4>T. Generally DM intake was in the order of T5>T4>T3>T2>T1.

Table 2. DM and nutrient intakes of yearling Farta sheep fed wheat straw basal diet and supplemented with different level of lentil screening and noug seed cake mixtures

Parameters	T1	T2	T3	T4	T5	SEM	SL
Basal DMI (g/d)	362.33^{c}	353.53^{bc}	340.32^{abc}	339.49^{ab}	333.38^{a}	15.81	*
LS +NSCDM intake (g/d)	240.00^{d}	255.00^{d}	269.00^{c}	283.00^{b}	297.00^{a}	0.00	***
RB DMI (g/d)	100.00	100.00	100.00	100.00	100.00	-	-
Total DMI (g/d)	702.33^{d}	708.53^{cd}	716.32^{cb}	722.49^{ab}	730.38^{a}	15.81	**
Total DMI (g/kg$W^{0.75}$)	70.05	70.21	70.46	70.59	70.37	0.42	Ns
TDMI (as %BW)	2.96	3.10	3.10	3.12	3.18	7.33	Ns
Nutrient Intake (g/d)							
OMI (g/d	616.72^{b}	632.37^{b}	652.65^{a}	656.18^{a}	663.41^{a}	15.17	**
CPI (g/d	102.11	102.35	102.65	102.77	102.80	0.63	Ns
NDFI (g/d)	438.18^{d}	442.02^{cd}	451.81^{cb}	457.46^{ab}	466.64^{a}	9.79	**
ADFI (g/d)	334.27^{c}	340.72^{c}	343.56^{cb}	357.01^{ab}	361.59^{a}	10.96	**
1MEI (MJ/Kg DM)	5.46^{c}	6.13^{b}	6.60^{ab}	6.90^{a}	7.22^{a}	0.51	**

a, b, c = means within rows having different superscript letters are significantly different at *** = P<0.001; ** = P<0.01; ns = not significant at (P>0.05); ADF = acid detergent fiber; BW = body weight; CP = crude protein; DM= dry matter; DMI = dry matter intake; NDF = neutral detergent fiber; OM = organic matter; RB = rice bran; SEM = standard error mean; SL = significance level;T1-T5 = treatment 1 to treatment 5.

The total DM intake as percent of body weight and DM intake per unit metabolic body weight in the current study was not significantly different (p>0.05) among treatments. There were significant difference (p<0.01) among all the treatment groups in NDF and ADF intake. The supplement dry matter intake was increased significantly higher at (p<0.001) as lentil screening supplement DM increased from 0g LS at T1, 75 g LS at T2, 149 g LS at T3, 223 g LS at T4, and 297 g LS at T5. Total DM intake in the current study was significantly different at (p<0.01) among all treatment groups. Higher DMI recorded on T5 and T4 that, sheep supplemented higher lentil screening DM. The NDF intake was significantly higher (p<0.01) in order T5>T4>T3>T2>T1 which had similar, trend to DM and OM intakes. The intake of NDF was significantly different (p<0.01) for all treatment groups and had comparable value between each treatment. The ADF intake of the current result showed that significant difference (p<0.01) among treatment groups. But sheep in T1 and T2 were not significantly different. However; sheep in T3, T4 and T5 were significantly different among them and from T1 and T2 shown in the Table 3. The NDF and ADF intake of the current study also showed that significant difference (p<0.01) among treatment groups. But sheep in T1 and T2 were not significantly different (p>0.05).However; sheep in T3, T4 and T5 were significantly different (p<0.01) among them.

Dry Matter and Nutrient Digestibility

The DM and nutrient digestibility of yearling Farta sheep fed wheat straw basal diet and supplemented with different combination of lentil screening and noug seed cake supplement mixtures are given in Table 3. Digestibility of DM, OM and CP were significantly different (P<0.001) among all treatment groups. The DM and nutrient digestibility also increased with increasing levels of lentil screening concentrate supplement groups. Higher DM, OM and CP digestibility observed in T4 and T5 treatment group's sheep fed the increased level of lentil screening supplementation 223 g/d at (T4) and 297 g/d at (T5). Among the treatment groups the higher digestibility observed at (p<0.001) in T5 sheep feed 100% lentil screening supplementing. The digestibility of NDF and ADF in T5 is higher (p<0.01) than the other treatment groups (T1, T2 and T3) sheep feed that low NSC supplement but, not statistically varied NDF and ADF digestibility in T1 and T2.

Table 3. Mean dry matter and nutrient digestibility by yearling Farta sheep fed wheat straw basal diet and supplemented with different level of lentil screening and noug seed cake mixture

Parameters	T1	T2	T3	T4	T5	SEM	SL
Digestibility coefficient							
DM	0.58^{d}	0.59^{d}	0.63^{c}	0.68^{b}	0.71^{a}	0.02	***
OM	0.56^{c}	0.58^{c}	0.61^{b}	0.62^{b}	0.70^{a}	0.03	***
CP	0.76^{c}	0.77^{c}	0.79^{b}	0.80^{b}	0.81^{a}	0.01	***
NDF	0.45^{d}	0.48^{c}	0.54^{bc}	0.56^{b}	0.62^{a}	0.04	***
ADF	0.43^{c}	0.44^{c}	0.46^{bc}	0.52^{ab}	0.55^{a}	0.06	***

a,b,c,d = means within the rows having different superscript letters are significantly different at *** = p<0.001; ** = P<0.01;
ADF = acid detergent fiber; CP = crude protein; DM= dry matter; NDF = neutral detergent fiber; OM = organic matter; SEM= standard error mean; SL = significance level;T1-T5=treatment 1 to treatment 5.

Body Weight Change and Feed Conversation Efficiency

The body weight changes and feed conversion of yearling Farta sheep fed wheat straw and supplemented with different levels of Lentil screening (LS) and noug seed cake (NSC concentrate mix are given in Table 4. The final body weight of sheep in the current study was insignificant (p>0.05) in all treatment groups. The average daily weight gain was highly significant (p<0.01) in all treatment groups. Sheep in T5 and T4 (p<0.01) gained significantly higher (p<0.01) weight per day than sheep consumed T3, T2 and T1 diets. The highest average daily gain 76.44 g/d was recorded in T5, followed by T4 (72.1 g/d), T3 (69.8 g/d), T2 (62.89 g/d), T1 (58.28 g/d). Among the treatment groups, sheep in T5

attained significantly better (p<0.01) final body weight and average daily gain than sheep in all other treatment groups with high levels of LS supplement.

Based on the current finding, among the treatments (T5) records better average daily weight gain. This might be due to sheep consume better amount of CP (77.6 g/d/sheep) from lentil screening as compared to 75 g/d/sheep) from NSC in T1.

The feed conversion efficiency of sheep fed wheat straw basal diet and supplemented with different levels of lentil screening and noug seed cake was significantly at (p<0.01) for all treatment groups.

Table 4. Body weight and feed conversion efficiency of Farta sheep fed wheat straw basal diet and supplemented with different levels of lentil screening and noug seed cake mixture

Parameter	T1	T2	T3	T4	T5	SEM	SL
IBW (kg)	15.76	15.74	15.64	15.68	15.6	1.99	Ns
FBW (kg)	20.76	21.4	21.92	22.17	22.28	2.16	Ns
BWC (kg)	4.84^{b}	5.66^{ab}	6.28^{a}	6.49^{a}	6.88^{a}	0.98	**
ADG (g/day)	58.28^{b}	62.89^{ab}	69.8^{a}	72.1^{a}	76.44^{a}	9.54	**
FCE	0.09^{b}	0.1^{ab}	0.11^{a}	0.12^{a}	0.12^{a}	0.02	**

a,b means within a row not bearing a common superscript are significantly different; ***=(p<0.001);**=(p<0.01); *= (p<0.05); ns= non-significant; SEM= standard error of mean; SL= significance level; IBW=initial body weight; FBW= final body weight; BWC=body weight change; ADG= average daily gain; FCE=feed conversion efficiency;T1-T5=treatment 1 to treatment 5.

Feed conversion efficiency was significantly improved (p<0.01) for all treatment groups with the lentil screening increased. Among all treatment groups feed conversion efficiency was significantly higher (p<0.01) in T5 and T4 as compared to in T3, T2, and T1. Sheep supplemented with high amount of lentil screening had significantly better (p<0.01) feed conversion efficiency than others treatment groups.

Partial budget analysis

Table 5. Partial budget analysis of Farta sheep fed wheat straw basal diet and supplemented with lentil screening and noug seed cake mixture

Variables	Treatment				
	T1	T2	T3	T4	T5
Purchasing price of sheep (ETB/head)	1026.00	1026.00	1026.00	1026.00	1026.00
Total wheat straw consumed (kg/head)	32.40	31.60	30.20	29.70	29.25
LS and NSC mixture consumed (kg/head)	21.60	22.95	24.21	25.47	26.73
RB Consumed (kg/head)	9.00	9.00	9.00	9.00	9.00
Total concentrate consumed (kg/head)	30.60	31.95	33.21	34.87	38.73
Cost for wheat straw (ETB/head)	129.60	126.40	124.80	118.80	117.00
Cost for concentrate (ETB/head)	252.00	258.75	264.69	282.63	296.36
Total feed cost/TVC (ETB)	381.60	385.15	389.49	401.43	413.36
Total variable cost (TVC) (ETB/head)	1407.60	1411.15	1415.49	1427.43	1449.36
Gross income sell price (ETB)	1485.00	1490.00	1500.00	1520.00	1560.00
Total return (ETB)	459.00	464.00	474.00	494.00	534.00
Net return (ETB)	77.40	78.85	84.51	92.57	110.94
ΔNI (ETB)	-	1.45	5.66	8.06	18.07
ΔTVC (ETB)	-	3.55	4.34	11.94	21.93
MRR (ETB)	-	0.41	5.32	0.32	1.00

ETB= Ethiopian birr; WS=wheat straw; RB= rice bran; LS=lentil screening; NSC= noug seed cake; TR= total return; ΔNR change in net return; ΔTVC= change in total variable cost; MRR= marginal rate of return; T1-T5=treatment 1 to treatment 5.

The result of partial budget analysis in the current study presented in Table 5 indicated that the gross financial margin or total return obtained in this trial 459, 464, 474, 494 and 534 ETB/sheep for sheep fed T1, T2, T3, T4 and T5 diets, respectively. Accordingly, sheep fed on higher level of lentil screening supplement (T5) returned a higher net income (110.64 ETB/sheep) as compared to the other treatment groups. On the other hand, sheep fed the high level of NSC diet (T1) had showed low net return as compared others

supplemented (72.4 ETB/sheep). The loss could be attributed to the fact that the animals in (T1) did not gained as much as others supplemented groups and their body condition was poor. Experienced people who have much experience in buying and selling sheep were estimated the price of sheep. Estimators judged (T1 and T2) sheep was poor in body condition and lowered their price. The marginal rate of return for supplemented sheep in T2, T3, T4 and T5 were 0.41, 5.32, 0.32, and 1.00 ETB respectively. Sheep fed the highest level of lentil screening supplement (T5) had the highest net income, but had the lower MRR value as compared to T3 due to difference in the cost of the supplement between the treatments diet. The current finding revealed that as lentil screening supplementation increased the average daily body weight gain increased. The results of this study indicated that supplementation of poor quality diets like wheat straw with non-conventional feeds like lentil screening as noug seed cake improvement the animals biological performance and also offer a positive and higher net return. Thus, from the overall results of this study, it would show that supplementation with 297 g/d of LSplus 100 g RB (T5) on DM basis could be recommended for growing Farta sheep based on biological performance and net return.

Chemical Composition of Treatment Feeds

The DM content of wheat straw is higher than the DM content of 90.7% reported by Temesgen & Yayneshet (2013) and comparable to the DM content of 93.05% reported by Michael & Yaynshet (2014). However, lower than the DM content of 97.5% reported by Kidane et al. (2018). The variation might due to species of wheat, time of harvesting, storage and management of wheat straw. The CP content of the basal diet is in the current study is higher than as compared to the CP values 3.72 and 4.7% reported by different authors (Michael & Yaynshet 2014; Kidane et al., 2018), respectively. The CP value recorded for WS used in the current study was found to be below the maintenance requirement of sheep for microbial function (Van Soest, 1994). It is evident that CP composition of straw various depends on the species and, like other crop residues, on the proportions of stems, leaves and other material such as soil (McDonald et al., 2010). The NDF component of wheat straw used in the current study was higher than the NDF values of 72% reported by Kidane et al. (2018) respectively and comparable to the value 79% NDF reported by (McDonald et al., 2010). Ruminants require sufficient NDF in their diets to maintain rumen function and maximize production.

The DM and OM contents of the wheat straw refusal in the present study were almost similar among all treatments. There was a small various among the five treatment feeds. This might be due to the fact that experimental sheep selected more edible portions of the basal diet wheat straw and left the more fibrous parts, such as stems of the straws which have higher fiber (NDF, ADF and ADL) fractions. In line with this, McDonald et al. (2010) also indicated a reciprocal relationship between the protein and fiber content. The DM value of LS in the current study was higher than the value 89.6 DM % reported by Gezu et al. (2017) and comparable with the 91.73% DM content of LS reported by (Wude, 2017) and, the OM value of LS in the present study was higher than value 84.39% OM content reported by (Wude, 2017). The LS used in the present study had content higher than to the CP content 23.72% reported by Gezu et al. (2017). The CP content of LS in the current study indicated that this feed resource could be used as protein supplement for small ruminants under poor quality roughages by smallholder farmers to substitute conventional protein supplements feed sources. But theses variations might be due to the efficiency of processing methods which may or may not allow inclusion of broken and discarded lentil, the varieties of lentil and inclusion of cereal grains and weed seeds. The DM content of NSC in the present study was comparable with the DM content 92% reported by Dessie et al. (2019). The CP content of NSC (31.25%) used in the current study was comparable with the values 31.55 and 31.6% CP, reported by Diriba et al. (2013) and Worknesh (2014), respectively.

The NDF content of NSC (39.09%) in the current study was higher than 33 and 36.3% NDF reported by researchers (Diriba et al., 2013; Girma, 2013) respectively and, comparable with 41.3 and 40.78% NDF

reported earlier (Worknesh, 2014; Dessie et al., 2019). ADF (28.36%) content of NSC in the current study was higher than 25.95% ADF (Diriba et al., 2013) and lower than 35.7% ADF (Worknesh, 2014), respectively. The DM content of RB (94%) used in the present study was higher than DM content reported by Alemayehu et al. (2015). The CP content of RB (7.8%) used in the current study was comparable with the values 8.8% CP reported by (Alemayehu et al., 2015) and lower than 10-11% CP reported by Abebaw and Solomon (2009) and 12-14.5% CP reported by McDonald et al. (2010). The NDF content of RB (68.74%) was higher than the values 64.1% NDF reported by (Alemayehu et al., 2015). This variation of nutrient composition might due to rice processing industries, harvesting time of rice, handling and storage conditions of the rice bran.

Dry Matter and Nutrient Intakes

There was increment in dry matter and nutrients intakes in the present study mainly in T5 and T4 which might be related to the nutrient availability in the NSC than LS feed sheep. The variation of fiber fractions intake also related to higher CP and low NDF and ADF contents of lentil screening used in the present finding. The current result agrees with reports of Yeshambel and Bimrew (2018) that states there was a significant difference (p<0.001) between T1 and T5 in terms of total DM (TDM). Hence, supplementation of basal diet with LS and NSC mixture significantly increased total DM intake, but depressed the basal diet as the combination of lentil screening supplement increased which might be due to the supplement satisfy the nutrient needs of the sheep.

In the current study, wheat straw DM intake and palatability generally is low due to the straws have high lignin constituent which hinder the passage rate of feed ingested DM and longer fermentation time in the reticulum rumen. Therefore, providing lentil screening supplement with highest level of LS amount (297 g/d) did not support higher total DMI which needs alternative action to improve the feeding value of LS. The current result agrees with Gezu et al. (2017), reported a significant increase in total intake of DM, OM and CP with increased level of supplement for Farta and Menz sheep, respectively. The significant total DMI among treatments might be related to the DM of LS on feed base was greater than NSC to balance CP composition between the supplement of feed. But, total CP intake in the current study was not significantly different (p>0.05) among all treatment groups because of the increased lentil screening supplement DM make substitute for Noug seed cake supplement. The current result agrees with Gezu et al. (2017) who reported DM, OM and CP intake by sheep increased with increasing level of supplementation with protein and energy diets.

The values of DMI per metabolic body weight of sheep in all treatment groups were within the range of (70.1-70.37 gkg-1$W^{0.75}$). The result is lower than (Dessie et al. 2019) who reported that, 70.9-80.6 g/kg-1$W^{0.75}$ for Farta sheep fed hay and supplemented with Noug seed cake and lentil hulls. On the higher lentil screening supplement DMI in (T5) recorded better metabolic body weight as compared to T1, T2 and T3 which might be due to sheep feed high DM in T5 than T1, T2 and T3. The NDF and ADF intake in the current result agrees with (Michael, 2018) who reported that, total NDF and ADF intake on, the effects of feeding dried *Acacia saligna*, *Sesbania sesban or Vigna unguiculata* leaves as a replacement for cotton seed cake on production performances and semen quality of *Begait* sheep.

Dry Matter and Nutrient Digestibility

The DM and nutrient digestibility of yearling Farta sheep fed wheat straw basal diet and supplemented with different combination of lentil screening and noug seed cake supplement showed increment as the levels of lentil screening concentrate supplement groups. The results agree with high nutrient digestibility coefficient (0.84.41) was observed at high lentil screening supplement by Wude (2017), lambs fed different combinations of wheat bran and LS mix. Also the current result in line with grain screenings pellets are characterized by high ruminal protein (more than 80%) and starch (more than 90%) degradability by Lardy et al. (2009).

The higher DM, OM and CP digestibility observed in T4 and T5 might be due to the

quality of lentil screening which containing whole and broken lentil seed, cereal grains which used in the current study had higher CP content as compared to the previous studies (Lardy et al., 2009; Gezu et al., 2017) with CP value 23.43 and 23.72% respectively. On the other hand, the lower digestibility of DM, OM and CP recorded at T1, T2, and T3 sheep consumed high noug seed cake supplement as compared to T4 and T5. The digestibility of nutrient intake in the current result is in agreement with Dessie et al. (2019), who reported that digestibility of DM, OM, CP, NDF and ADF were improved by increasing lentil screening supplement DM levels as the following orders, 0 g/d (T1), and 75 g/d in (T2), 149 g/d in (T3), 223 g in (T4), and 297 g/d in (T5).The increase in CP digestibility for the high level of lentil screening supplemented sheep (T5) indicated that increased protein level in the feed improved apparent protein digestibility. The digestibility of NDF and ADF in T5 in the present result agrees with Teklu (2016), who reported apparent digestibility depends on the chemical composition of the feed like CP, NDF and ADF. The lower digestibility of DM, OM and CP recorded in the higher noug seed cake supplement groups than higher lentil screening supplemented group. This might due to noug seed cake supplement in the current study had lower conversion efficiency as compared to lentil screening supplement. High CP digestibility observed in T4 and T5 due to sheep feed higher lentil screening supplement compared to others treatment groups (McDonald et al., 2010).

Body Weight Change and Feed Conversion Efficiency

The observed average daily gain in the present result is higher than with the average daily gain of Menz sheep (29.9-68.24 g/day/head) was observed by Gezu et al. (2017) for sheep supplemented with graded levels of Oats grain and lentil screening concentrate mix. The significantly lower records of BWC and ADG observed in T1 and T2 might be due to the lower lentil screening intake of sheep in T1 and T2. The current finding indicated that increased level of lentil screening supplementation increases average daily body weight gain and body weight change. The finding agrees with the result of Wude et al. (2017), who reported that higher average daily body weight gain (ADG), final body weight FBW) and FCE were observed for sheep consumed high CP contents of feed. The possibilities of improving ADG, FBW and FCE has been shown by the reports of Dessie et al. (2019) who stated that average daily body weight gain (ADG), final body weight and FCE were improved by supplementation. On the other hand feed conversion efficiency among treatment groups (T2 and T2), (T3, T4 and T5) had no significant difference (p>0.05). The increased feed conversion efficiency seemed to be related to higher lentil screening concentration of the supplements and the consequent increase in body weight gain. The current finding revealed that as lentil screening supplementation increased the average daily body weight gain increased, which is in agreement with the results of Larbi and Olaloku (2005), with increasing level of crude protein in the diets of small ruminants there is a proportional improvement in average daily gain and hence growth performance.

CONCLUSIONS

The present study indicated that supplementing yearling Farta sheep fed wheat straw as basal diet with different levels of Lentil screening and Noug seed cake that improved total DM intake, digestibility of nutrients and digestible nutrient intake which resulted in improving biological performance of sheep. The DM and digestible nutrient intake as well as digestibility of nutrients which resulted in improvements of body weight gain performance increased as the amount of lentil screening DM increased. The wheat straw DM intake is low as compared to total offered due to high lignin content of the straws. However, based on partial budget analysis it can be recommended that, supplementation of LS could be used as economically feasible and biologically optimum for sheep production and used as protein supplements.

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