

Effect of Supplementation with Dried Leaves of *Acacia albida*, *Acacia seyal* and their Mixture on Feed Intake and Digestibility of Local Sheep Fed Barley Straw as a Basal Diet

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Abstract

This study was conducted to evaluate the effect of supplementation of *Acacia Albida* (AA), *Acacia Seyal* (AS) and their mixture on feed intake and digestibility of local sheep fed a basal diet of barley straw (BS). "Twenty four yearling intact male sheep with initial BW of 16.6 kg ± 2.4 (Mean ± SD)" were blocked in to six based on initial BW and animals within a block were randomly assigned to treatments. Treatments were ad libitum barley straw(BS) and 100 g wheat bran (WB) alone (T1) or supplemented with 200 g of dried leaves of *Acacia Albida*(AA) (T2), *Acacia Seyal*(AS) (T3) and a 1:1 mixture of AA:AS (T4). The feeding and digestibility trial "was" conducted for 90 and 7 days, respectively. Dry matter (DM) intake of BS was in the order of T1>T2=T4>T3 (P<0.05). Total DM intake (500, 650, 597 and 636 g/day (SEM=12.96) for T1, T2, T3 and T4, respectively) was lowest for T1, highest for T2 and T4 and intermediate for T3 (P<0.05). Total CP intake "were" 38, 77, 65 and 71 g/day for T1, T2, T3 and T4, respectively, and was increased by supplementation (P<0.05). Among the supplemented treatments, T2 had higher (P<0.05) CP intake than T3, while the CP intake of T4 was similar with T2 and T3. Apparent digestibility of DM and CP increased (P<0.05) and that of NDF and ADF was unaffected (P>0.05) by the supplementation. Therefore, result of the current study suggested that 200g AA leaf meal supplementation to barley straw basal diet to be better in feed intake and digestibility.

Keywords: *Acacia albida*; *Acacia seyal*; Sheep; Intake and digestibility

Introduction

Ethiopia is believed to have the largest livestock population in Africa. This livestock sector has been contributing considerable portion to the economy of the country, and still promising to rally round the economic development of the country [1]. Small ruminants are important sources of foreign currency [2] and at a farm level small ruminants serve as investment and insurance due to high fertility, short generation interval and their ability to produce in limited feed resource and their adaptation to harsh environment [3]. Cereal crop residues can play an important role in the feeding of sheep under different management systems [4]. However, crop residues are low in crude protein and phosphorus, marginal in calcium and high in fiber and lignin. As a result, digestion is slow and voluntary intake is limited [5].

To solve the problem of low digestibility and correct nutrient deficiencies in crop residues use of leaves of browse plants and agro-industrial by-products as supplements is regarded as a good option [6]. Leaves of many trees and shrubs are rich sources of protein, vitamins and minerals and can be used for supplementing low quality roughages (grasses, straws and stovers) [7]. Assessing the feeding value of certain browse species such as *Acacia albida* and *Acacia seyal* "are" essential to develop alternative and relatively cheaper "supplemental diets" to improve animal performance during harsh environmental conditions when insufficient amount of natural pasture and crop residues are available in the area. *Acacia albida* and *Acacia seyal* are important "source" of protein and they can be used to correct nutritional deficiencies of low quality feeds such as crop residues. Studies on supplementation of *Acacia albida* and *Acacia seyal* fodder tree leaves on feed intake and digestibility of local sheep found in Eastern zone of Tigray (Northern part of Ethiopia) has not been done so far. The present study was therefore, undertaken to explore the feeding value of *Acacia albida* and *Acacia seyal* fodder tree leaves available in the Eastern zone of Tigray around Adigrat for small ruminants. In view of these facts the present study was designed "with the objective to assess" the feed intake and digestibility of local sheep fed a basal diet of barley straw and supplemented with dried leaves of *Acacia albida*, *Acacia seyal* and their mixture.

Materials and Method

Description of the study area

The experiment was conducted at Ganta-Afeshum Woreda, which is found in Eastern Zone of Tigray Regional State. The study area is located at 898 km North of Addis Ababa and 115 km from Mekelle (capital city of Tigray). It is found between 14°16' N latitude and 39° 27' E longitudes with an elevation of 2457 meter above sea level. It has Weinadega climate, with 552 mm mean annual rain fall and 16°C temperatures.

Feed preparation and feeding

Barley straw was purchased from surrounding farmers and stored under a shade to maintain its quality and was used as basal diet throughout the experimental period. *Acacia Albida* and *Acacia Seyal* tree leaves were collected by hand harvesting the small side branches containing the green leaves from trees of area closures, farm lands, and grazing lands. The collected leaves were dried under shade on plastic sheet for later use in animal feeding. After they were dried, the leaves were stored in sacks. Wheat bran was purchased from flour milling factory in the surrounding and used to adjust the maintenance requirement for the control treatment since the CP content of barley straw is low or under the maintenance requirement. The amount of supplement to be offered to each animal was weighed separately and

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offered to the animal. When offered in mixture the supplements were weighed separately and mixed together for feeding animals. Barley straw, salt and water were offered *ad libitum* to the animal throughout the experiment.

Experimental design and treatments

Twenty four yearling local male sheep with a live weight of 16.6 kg ± 2.4 (Mean ± SD) were purchased from local market and used for the experiment. During the quarantine period of 21 days the animals were ear tagged, drenched with Albendazol a broad-spectrum “anti-helminthic” drug, vaccinated against ovine Pasteurellosis and sprayed with Acaricides against external parasites. To conduct the experiment a randomized complete block design (RCBD) was used. Before the adaptation period the experimental animals were blocked in to six blocks of four animals based on their initial body weight. The initial body weight of lambs for blocking was determined after overnight fasting of the lambs during the starting of adaptation period. Then after the animals were offered *ad libitum* barley straw with 100 g wheat bran and supplemented with dried leaves of *Acacia albida*, *Acacia seyal* alone or their 1:1. They were “adapted to the feeds” prior to the feeding trial for 15 days. The four treatment diets (Table 1) were randomly assigned to each animal in the block which results in six animals per treatment.

Measurements

Feed intake: Feed offered to the experimental animals and the corresponding refusals of every animal were recorded daily throughout the experimental period to determine daily feed intake. Both basal and supplement feed intake was determined as a difference between the amount of feed offered and refused. Daily refusal and offered samples were taken from each feed offered and feed refusals of each animal for chemical analysis. Then, at the end of week 12, the refusal and offered samples were mixed well for each animal and each feed, respectively. Because of the high expense associated with chemical analysis, the refusal samples were bulked into 4 (i.e., refusal of six animals per treatment bulked together).

Digestibility: Digestibility trial was conducted after the 90 days of feeding trial. The lambs were fitted with fecal collection bags (harness) and were adapted to fecal collection bags for 3 days which was followed by 7 days fecal collection period. Samples of faeces were collected every day in the morning. The total faeces voided in the harness per

animal was weighed daily during the fecal collection period. After the daily collected faeces were weighed a 20% representative sample was taken from each sample to form a composite of fecal sample for each animal and stored in the refrigerator for 7 days. Then after, the fresh faeces from each animal was taken to Mekelle soil laboratory for an oven drying and dried at 55°C for 72 hours. Partially dried, weight of samples was taken, and faeces samples were grounded to pass through 1 mm sieve and were stored in air tight polyethylene bag until analyzed. The apparent digestibility coefficient (DC) of nutrients was calculated by using the equation:

$$\text{Apparent digestibility coefficient} = \frac{\text{Nutrient intake} - \text{Nutrient in feces}}{\text{Nutrient intake}}$$

Results and Discussion

Chemical composition of treatment feeds

The chemical compositions of the treatment feeds are given in Table 2. The CP content of the barley straw used in this study was 4.66%, indicating that the CP content of the straw used in this study has a low potential to support the maintenance requirements of sheep, and as such wheat bran was added to fulfill the maintenance requirement of the sheep especially for the control treatment. The CP content of barley straw used in this study was relatively comparable to the CP of 4% reported by Mesfin and Ledin [8] but higher than the CP content of 3.9% and 3.55% reported by Dawit and Zewdie [9,10], respectively. The difference in CP content of barley straw in different studies may be due to the variation in variety and the environment the crop was grown. The chemical composition of the barley straw could be characterized by its low CP, high NDF and ADF contents. This high content of NDF in barley straw may imply low intake of the basal diet since NDF is a major factor regulating feed intake as it is the major component limiting rumen fill, and directly correlated with rumination or chewing time [11].

The NDF content of barley straw used in this study was similar to the NDF content of 78.9% [8]. Acid detergent fiber content of barley straw used in this study was higher than 50.2% reported by Mesfin and Ledin [8].

The DM content of wheat bran used in this study was similar to the result of 90.5% and 90.4% reported by Emebet and Hirut [12,13],

Treatments	Barley straw	WB (gDM/day)	Supplement(gDM/day)
1	<i>Ad libitum</i>	100	—
2	<i>Ad libitum</i>	100	200g <i>Acacia albida</i> leaves
3	<i>Ad libitum</i>	100	200g <i>Acacia seyal</i> leaves
4	<i>Ad libitum</i>	100	100 g <i>Acacia albida</i> + 100 g <i>Acacia seyal</i>

DM=dry matter; WB=wheat bran

Table 1: Experimental treatments.

Feed offered	Chemical composition					
	DM (%)	CP (% DM)	NDF (% DM)	ADF (% DM)	ADL (% DM)	Ash (% DM)
Barly straw	91.96	4.66	77.50	51.20	7.92	10.49
Wheat bran	90.15	17.49	48.57	13.95	6.94	4.71
AAL	91.28	20.81	51.28	35.59	15.57	9.49
ASL	91.60	16.96	68.43	58.32	24.70	13.18
AAL:ASL	91.23	18.18	62.67	52.94	19.75	11.86

AAL = *Acacia albida* leaves; ASL = *Acacia seyal* leaves; ADF = Acid detergent fiber; ADL = Acid detergent lignin; CP = crude protein; DM = dry matter; NDF = Neutral detergent fiber. T1= Barley straw *ad libitum* + 100 g Wheat bran; T2 = Barley straw *ad libitum* + 100 g Wheat bran + 200 g *Acacia albida* leaf meal; T3 = Barley straw *ad libitum* + 100 g Wheat bran + 200 g *Acacia seyal* leaf meal; T4 = Barley straw *ad libitum* + 100g Wheat bran + 100 g *Acacia albida* leaf meal + 100 g *Acacia seyal* leaf meal.

Table 2: Chemical composition of treatment feeds.

respectively. The NDF and ADF content of the wheat bran was higher than the values reported by Awet and Jemberu [14,15]. But, the NDF content is lower than 58% and 55.5% reported by Emebet and Hirut [12,13] respectively. The CP content of wheat bran is variable. According to Lonsdale [16], the CP content of wheat bran varies from 13.3 to 17.0%. The result of the current study (17.49%) also relates to the highest value (17%) of this range. The CP content of wheat bran used in this experiment was also comparable to the values of 17 and 19.55% reported by Fentie and Simret [17,18] respectively. The differences between the results in chemical composition of wheat bran used in the different studies observed might be due to the variation in milling method, and possibly due to the variation in variety of the crop.

The DM contents of *Acacia albida*, *Acacia seyal* leaves and their mixtures were almost similar and ranged from 91.23-91.6%. But the OM content of *Acacia albida* leaf meal was higher than that of *Acacia seyal* leaf meal. The CP content of *Acacia albida* leaf meal was relatively higher than that of *Acacia seyal* leaf meal. The CP content of *Acacia albida* leaf used in this study was similar to the CP content of 20.1% reported by Reed et al. [19]. Robyn et al. [20] also found 19.7% CP for *Acacia albida* leaf. The CP content of *Acacia seyal* leaf was lower than that of 19.43% reported by Ahmed et al. [21], but higher than the result of 15% CP reported by Dommergues [22]. The NDF and ADF values of *Acacia albida* leaf meal were lower than that of *Acacia seyal* leaf meal. Feeds that contain high proportion of ADF have lower availability of nutrients due to ADF being less correlated with feed digestibility [23]. The NDF and ADF content of *Acacia* leaves used in this study was comparable to the findings of Kamalak et al. [24] that reported 42% to 56% and 28.3% to 34.2% and Kaitho et al. [25] that noted 22% to 69.4% and 14% to 52.3 % for NDF and ADF, respectively.

Feed intake

The mean daily feed DM and nutrient intake of the experimental sheep is given in Table 3. There was a significant difference among treatments in barley straw DM intake. Barley straw DM intake was highest for the control diet ($P < 0.05$). Thus, the non-supplemented animals consumed more barley straw in order to satisfy their nutrient requirements. Similar to the present result DM intake of basal diet in various studies was greater for the non-supplemented than the supplemented animal [12]. On the other hand, the decline in barley straw DM intake with the supplementation of *Acacia seyal* leaf meal alone than the other supplemented treatments might be associated with the high fiber contents of *Acacia seyal* leaf meal as compared to *Acacia albida* leaf meal. The higher the composition of the NDF and ADF in feedstuffs, the lower the nutritive value and/or intake of that feed

[26]. Wheat bran as well as the supplemental leaf meals were readily consumed by all animals with no left over.

Total DM intake was lowest for T1, highest for T2 and T4 and intermediate for T3 ($P < 0.05$). The greater DM intake in the supplemented sheep is obviously due to the additional DM intake from the supplement. Difference in total DM intake among the supplemented treatments was also consistent with differences in intake of the basal diet. Similar result to the present study was reported by Girma et al. [27] in which sheep fed maize stover supplemented with legumes and legumes plus concentrate mixture showed significantly higher total DM intake. Becholie et al. [28] also reported that supplementation with a protein source (tagasaste) increased total DM, OM and CP intakes in lambs fed on a basal diet of grass hay. The values of total DM intake noted in this study was within the range of values of 434.8-753.3 g/d reported by Ermias [29] for sheep fed a basal diet of fababean haulms and supplemented with barley bran, linseed meal and their mixtures.

The total OM intake followed a similar trend with DM intake as it is the reflection of total DM intake. Total CP intake was significantly increased by supplementation ($P < 0.05$). Among the supplemented treatments, animals on sole *Acacia albida* leaf meal supplementation had higher ($P < 0.05$) CP intake than sole *Acacia seyal* leaf supplemented animals, while the CP intake of the mixture supplemented animal was similar ($P > 0.05$) with the other two supplemented treatments. It appeared that differences in total CP intake were a result of difference in intakes of the basal diet and the chemical composition of the feeds. Intakes of total NDF and ADF were lower ($P < 0.05$) for control treatment as compared to the supplement treatments being proportional to variation in total DM intake.

Dry matter and nutrient digestibility

Apparent digestibility of DM, OM, CP, NDF and ADF is given in Table 4. The apparent digestibility of DM, OM and CP in the present study increased ($P < 0.05$) by the supplementation of the *Acacia albida* or *Acacia seyal* leaf meal or their mixture. Differences in DM, OM, and CP digestibility among the supplemented treatments were not significant ($P > 0.05$). NDF and ADF digestibility were not significantly affected ($P > 0.05$) in the current study. The lower DM and OM digestion for barley straw sole diet as compared to the supplemented treatments may be explained in part by the presence of high fiber concentration in barley straw. This result is in line with the value reported by Arthun et al. [30] where barley straw was supplemented with alfalfa hay. The similarity in apparent digestibility of DM and OM among the supplemented treatments may be explained by the relatively similar

Intake (g/day)	Treatments				SEM
	T1	T2	T3	T4	
Barley straw DM	399.91 ^a	350.24 ^b	296.75 ^c	335.81 ^b	8.72
Wheat bran DM	100	100	100	100	-
BS+WB DM	499.91 ^a	450.24 ^b	396.75 ^c	435.81 ^b	8.72
Supplement DM	-	200	200	200	-
Total DM	499.91 ^c	650.24 ^a	596.75 ^b	635.81 ^a	12.96
OM	483.58 ^c	617.23 ^a	555.98 ^b	598.43 ^a	11.49
CP	38.03 ^c	76.86 ^a	65.45 ^b	70.87 ^{ab}	3.33
NDF	384.76 ^c	446.29 ^{ab}	433.98 ^b	456.93 ^a	6.75
ADF	236.05 ^c	280.13 ^b	294.75 ^{ab}	306.81 ^a	6.47

^{a-c}Means with different superscripts in a row are significantly different ($P < 0.05$); ADF = Acid detergent fiber; CP = Crude protein; DM = Dry matter; NDF = Neutral detergent fiber; OM = Organic matter; SEM = standard error of mean; BS = Barley straw; WB = Wheat bran; T1 = Barley straw *ad libitum* + 100 g Wheat bran; T2 = Barley straw *ad libitum* + 100 g Wheat bran + 200 g *Acacia albida* leaf meal; T3 = Barley straw *ad libitum* + 100 g Wheat bran + 200 g *Acacia seyal* leaf meal; T4 = Barley straw *ad libitum* + 100 g Wheat bran + 100 g *Acacia albida* leaf meal + 100 g *Acacia seyal* leaf meal.

Table 3: Dry matter and nutrient intake of local sheep fed barley straw basal diet and supplemented with *Acacia Albida*, *Acacia Seyal* leaves and their mixture.

Digestibility coefficient	Treatments				SEM
	T1	T2	T3	T4	
DM	0.59 ^b	0.69 ^a	0.67 ^a	0.69 ^a	0.52
OM	0.66 ^b	0.72 ^a	0.70 ^a	0.71 ^a	0.29
CP	0.56 ^b	0.73 ^a	0.68 ^a	0.70 ^a	0.02
NDF	0.58	0.63	0.65	0.64	0.87
ADF	0.51	0.53	0.57	0.56	0.43

^{a,b}Means with different superscripts in a row are significantly different ($P < 0.05$); ADF = Acid detergent fiber; CP = Crude protein intake; DM = Dry matter; NDF = Neutral detergent fiber; OM = Organic matter; SEM = standard error of mean; T1= Barley straw *ad libitum* + 100 g Wheat bran; T2 = Barley straw *ad libitum* + 100 g Wheat bran + 200 g *Acacia albida* leaf meal; T3 = Barley straw *ad libitum* + 100 g Wheat bran + 200 g *Acacia seyal* leaf meal; T4 = Barley straw *ad libitum* + 100 g Wheat bran + 100 g *Acacia albida* leaf meal + 100 g *Acacia seyal* leaf meal.

Table 4: Apparent dry matter and nutrient digestibility of feeds in local sheep fed barley straw basal diet and supplemented with *Acacia Albida*, *Acacia Seyal* leaves and their mixture.

intake of DM and nutrients in the supplemented group. In line with the current result Dawit [9] reported that the apparent digestibility of DM of the diet increased by supplementation of urea treated barley straw with vetch and alfalfa hay as compared to the control. Korlagama et al. [31] also reported that supplementation significantly improved the apparent digestibility of DM and OM in sheep supplemented with cowpea or commercial concentrate at 150 or 300g DM/day to maize-stover.

The increased digestibility of CP in supplemented animals compared to non-supplemented ones could be due to the high total CP intake of the supplemented animals and relatively lower CP intake of sheep fed the basal diet alone and any increase in protein intake may result in an increase in apparent digestibility of CP. In agreement with the present study, Abebe and Amare [32,33] reported that supplementation with oil seed cakes and wheat bran improved ($P < 0.05$) the digestibility of CP. On the other hand, the lack of difference in fiber digestibility due to supplementation may be attributed to reduction in rumen PH which has a depressing effect on the population of fiber fermenting rumen microorganisms, as a result of feeding more digestible supplement to the animals. The digestibility coefficient for fiber constituents observed in the present study is in agreement with the result reported by Kaitho et al. and Abebe [32,34] who concluded that supplementation had little or no effect on fiber digestibility.

Summary and Conclusions

This study was conducted to evaluate the effect of supplementation of *Acacia albida*, *Acacia seyal* leaves and their mixture on feed intake and digestibility of local sheep. Feed intake was measured daily and fecal output was measured in the digestibility period. Samples of feed offered and refusals during both trials and feces during the digestibility trial were collected for chemical analysis (DM, ash, CP, NDF, ADF and ADL).

There was a significant difference among treatments in barley straw DM intake. Barley straw DM intake was highest for the control diet ($P < 0.05$) and was in the order of $T1 > T2 = T4 > T3$ ($P < 0.05$). Total DM intake was lowest for T1, highest for T2 and T4 and intermediate for T3 ($P < 0.05$). The greater DM intake in the supplemented sheep is obviously due to the additional DM intake from the supplement. Total CP intake was significantly increased by supplementation ($P < 0.05$). Among the supplemented treatments, animals on sole *Acacia albida* leaf meal supplementation had higher ($P < 0.05$) CP intake than sole *Acacia seyal* leaf supplemented animals, while the CP intake of the mixture supplemented animal was similar ($P > 0.05$) with the other two supplemented treatments. The differences in total CP intake were a result of difference in intakes of the basal diet and the chemical composition of the feeds.

The apparent digestibility of DM, OM and CP in the present study increased ($P < 0.05$) by the supplementation of the *Acacia albida* or *Acacia seyal* leaf meal or their mixture. However differences in DM, OM, and CP digestibility among the supplemented treatments were not significant ($P > 0.05$). NDF and ADF digestibility were not significantly affected ($P > 0.05$) in the current study. The lower DM and OM digestion for barley straw sole diet as compared to the supplemented treatments may be explained in part by the presence of high fiber concentration in barley straw. Therefore, result of the current study suggested that feeding barley straw basal diet plus 100g wheat bran and supplemented with 200 g *Acacia albida* leaf meal to local sheep to be better both in feed intake and digestibility.

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