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Effect of Feeding Acacia Pods (*Acacia seyal*) with or without Wheat Bran on Feed Intake and Digestibility of Tigray Highland Sheep in Hay Based Feed

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Abstract
The study was conducted with the objectives to evaluate feed intake and digestibility of Tigray Highland sheep supplemented with Acacia seyal pods and wheat bran mix in hay based feeding. Twenty five Tigray Highland yearling rams with initial live body weight of 17.5 ± 1.7 kg (mean ± SD) were used. The experimental sheep were divided into five blocks of 5 rams each based on their initial body weight. The feeding trial consisted of grass hay (control), supplemented Acacia seyal pods, wheat bran and their mixture. A randomized complete block design was used to conduct the feeding trails. The chemical composition of grass hay in this experiment was found to be 119.5, 880.5, 84.4, 708.3 and 296.0 g Kg^{-1} for ash, organic matter (OM), crude protein (CP), Neutral detergent fiber (NDF), and Acid detergent fiber (ADF) parameters, respectively. The mean grass hay DM intake was; 481.8, 301.6, 298.9, 303.8 and 301.9 g/day for T_1, T_2, T_3, T_4 and T_5, respectively. The DM intake of supplemented animals were 299.3, 298.7, 299.3 and 296.6 g/day/ram for sole Acacia seyal pods, 2:1 ratio Acacia seyal pods and wheat bran, 1:2 ratio of Acacia seyal pods and wheat bran and wheat bran, respectively and the intake was 97.81% of their offer. Grass hay DM intake was significantly depressed ($P<0.001$) as compared from the supplementation. Total DM, OM and CP intake were significantly higher ($P<0.001$) in supplemented groups than the control animals. There was significant different ($P<0.05$) in digestible coefficient DM, OM, CP, and NDF whereas not significant different ($P>0.05$) in apparent digestibility ADF amongst treatments.
Keywords: acacia seyal pod, intake, wheat bran, digestibility

INTRODUCTION

Livestock production is a key element of socio-economic development in many countries in the tropics like Ethiopia (FAO, 2005) and also contributes to nutritional, food security and plays an important role in cultural events (Nianogo and Thomas, 2004). Among livestock and livestock products it is projected by year 2015 that Africa would export only mutton and goat meat while the continent would import beef and continue importing milk and pig meat (FAO, 2002).

Ethiopia has a large number of sheep population, 25.9 million head (CSA, 2009), in parallel with its diverse ecology, production systems and ethnic communities. Many different breeds of sheep are found in different parts of Ethiopia. These breeds are characterized by varying physical, productive and reproductive features (Solomon, 2009). Sokota (Tigray highland) sheep is one of the Ethiopian highlands sheep with a diverse population and have a good performance in meat, skin, and milk with small extent good wool quality. In spite of huge number (CSA, 2009) and genetically diverse (DAGRIS, 2006) sheep population off-take is very low at 33% (EPA, 2002) with an average lamb carcass weight of 10 kg. Among the constraints to sheep production are like scarcity of feed, stunt growth rate and high mortality rate are the major limiting factors (Markos *et al.*, 2006; Markos, 2006). This limitation is because of backward sheep production system, little knowledge and skill up on the overall management and breeding system of sheep production in Ethiopia, poor disease control, and nutrition management are very poor this leads to low production and productivity of sheep.

Sheep are important animal species in controlling unwanted and invasive vegetation. There are many plant species that cattle do not prefer that are consumed by sheep and goats. As cropland increases and animals are forced to graze increasingly less productive land, the need for animals that consume a diverse array of plant species is paramount importance. Fodder trees and shrubs have high potential value as a source of feed for domestic livestock and wildlife. They can be successfully integrated into production systems to provide additional feed resources for use in mixed diets of livestock, fuel and cover the land, to control erosion when planted as wind breaks and to maintain or rehabilitate degraded areas of rangelands. Numerous shrub and tree species have been investigated and the multiple attributes of some of them have been confirmed (Makkar, 2003).

Feed is generally available in the rainy season but inadequate in the dry season. This calls for strategies to bridge the feed gap between the dry and rainy seasons. Browse pods could be used as a "stop gap" measure during the transition period from dry to rainy seasons. Browse pods are high in nutritive value (Ncube and Mpofu, 1994) and can be used as supplements to low quality roughages. Browse plants have tannin effect. This effect of tannins can be either adverse or beneficial for the animal depending on their concentration and chemical structure (Min *et al*., 2003). Browse plants are available in the off season (Babayemi *et al*., 2006). Animals are consumed pods, especially during nutritional shortage periods which means in the dry seasons. Leaves and pods of leguminous browse provide a good source of protein supplement to ruminants in tropical countries of Africa. Acacia pods are highly nutritive and serve as a potential source of protein for diets based on crop residues (Ngwa *et al*., 2000). The digestible protein content of *Acacia seyal* is high, 8-12% in leaves and 13-15% in fruits (Dorthe, 2000).

The crude protein content of seeds or pods is higher than in the leaves. The crude protein content ranges from 19.45% to 38.69% and from 17.5% to 26.6% for seeds and leaves, respectively (Mahala and Fadel, 2007). Red acacia (*Acacia seyal*; also known as Shittim wood or Shittim tree) is a thorny, 6-10 m (20-30 ft) high tree with a pale greenish or reddish bark. At the base of the 3-10 cm (1-4 in) feathery leaves there are two straight, light grey thorns. The blossoms are displayed round, bright yellow clusters approximately in 1.5 cm (0.5 in) diameter, growing to 7-20 cm (3-8 in) long. *Acacia seyal* is a nitrogen fixing species with potential in silvo- pastoral systems. Its net energy contents of 6-8 MJ kg^{-1} (foliage) and 4-7 MJ kg^{-1} (fruits), the associated digestible protein levels are 100-150 g kg^{-1} in the foliage, and higher in the fruits. For both foliage and fruits, analyses indicate a well balanced supply of minerals and very favorable qualities in terms of proximate fractions (e.g., crude fiber 10-20%-, ether extract <7%) (John, 1994).

Acacia plants particularly *Acacia seyal* are widely spread in Ethiopia, particularly in Tigray Region Southern Zone. The farmers' uses these plant species for many purposes such as for fire wood, for construction purposes, for increasing the soil fertility and protect the soil from erosion and also used for shelter. However, no well organized study has been conducted on its intake and digestibility in mixture with concentrate feeds like wheat bran. Nevertheless, sheep were observed to consume the fallen leaves and pods of the browse species. Therefore, it is anticipated that supplementation of *Acacia seyal* pods alone or in mixture with wheat bran was affect the intake and digestibility of Tigray highland sheep in hay based feeding system.

Therefore, this study was conducted with the following objectives

- To evaluate the feed intake of Tigray Highland sheep supplemented with *A. seyal* pods and wheat bran mix in hay based feeding.
- To evaluate the digestibility of supplementing *Acacia seyal* pods and wheat bran mix in hay based feeding in Tigray highland yearling rams.

3. MATERIALS AND METHODS

3.1 Description of the Study Area

The experiment was conducted at Maichew Town Keyh Saeri sheep fattening farm in Southern Zone of Tigray Regional State.

3.2 Experimental Animals

Twenty five yearling male Tigray Highland sheep were purchased from local market at Maichew. The animals were quarantined for 15 days and during this period they were de- wormed by Albendazol and Ivermectin against internal and sprayed by Diazenon against external parasites, respectively. They were also vaccinated against common diseases of the area like anthrax and ovine pasteurellosis.

3.3 Feed Preparation and Feeding

Grass hay was used as basal diet for the experiment. Grass hay was purchased from the surrounding farmers, chopped and stored under shade. The ripened red *Acacia seyal* pods were collected from the communal grazing lands of the study area and chopped and stored in sacks and the wheat bran was purchased from Mekelle Huda powder factory and stored in safe place.

3.4 Experimental Design and Treatments

The experiment was conducted by using completely randomized block design. At the end of the quarantine period, the experimental animals were divided into five blocks of five rams each based on their initial body weight (17.5±1.7 kg (mean ± SD). The initial body weight was determined as a mean of two consecutive weight measurements that were taken after withholding overnight feed. The animals within a block were randomly assigned to one of the five treatments. The dietary treatments are given in Table 1. The experimental animals were used for feeding trial of 90 days.

Table 1. The dietary treatments

	Type and quantity of feeds				
Treatments	Grass Hay	*A. seyal* pods (g)	WB (g)	*A. seyal* pods (%)	WB (%)
T_1	*ad-lib*	-	-	-	-
T_2	,,	306	-	100	-
T_3	,,	204	102	66.7	33.3
T_4	,,	102	204	33.3	66.7
T_5	,,	-	306	-	100

WB=wheat bran; ad-lib= *ad-libtium; A.seyal=Acacia seyal*

3.5 Feeding Trial

The feeding trial lasted for 90 days. Initial body weight of each animal at the beginning of feeding trial was taken after overnight fasting.

3.6 Chemical Analysis

Feeds offered and refusals were subjected to laboratory analysis for DM, nitrogen and ash determination following the procedure of AOAC (2005). The Acid detergent fiber (ADF), Nutrient detergent fiber (NDF) and Acid detergent lignin (ADL) contents of refusal samples were determined following the procedures of (Van Soest and Roberrtson, 1985) at Mekelle University nutrition laboratory.

3.7. Statistical Analysis

Data on intake was analyzed using the general linear model procedure of SAS (2002). The treatment means were separated by least significant difference (LSD). The model used for feed intake parameters during feeding trial was using the model:

$$Yij = \mu + Ti + Bj + eij$$

Where: - Yij = response variable
μ = overall mean
Ti = treatment effect
Bj = block effect
Eij = random error

4. RESULTS AND DISCUSSION

4.1 Chemical Composition of Feeds

The chemical composition of grass hay, the supplemented sole *Acacia seyal* pods*,* 2:1 ratio *Acacia seyal* pods and wheat bran and 1:2 ratios of *Acacia seyal* pods and wheat bran and wheat bran alone are given in Table 2. In this experimental study the dry matter content of all feeds was almost similar each other. The OM content of the control group was highly depressed whereas its ash content was higher from the supplement feeds.

The CP chemical composition of *Acacia seyal* pods was higher from other feeds, which is 112.7 g Kg^{-1} is similar with the reported values (John, 1994), which is 100-150 g kg^{-1} in the foliage. For foliage and fruit, analyses indicate a well balanced supply of minerals and very favorable protein qualities. The CP content of *Acacia seyal* pods is 11.27%. This is a good indication that this browse plant could serve as a good source of protein feed that can provide adequate CP content >7% for proper function of rumen microbes (Van Soest, 1994). The chemical composition of *Acacia seyal* pods in this study was found 94.3%, 56.1%, and 33.7% for OM, NDF and ADF contents, respectively.

The result in the current study of *Acacia seyal* pods and grass hay have significantly higher ($P<0.001$) NDF and ADF when compare with the other ones. The higher the ADF composition of a feed, the lower the nutritive value of that feed and vice versa. The content of lignin influences the digestibility of feeds (Van Soest, 1994). The chemical composition of grass hay in this experiment was found to be 119.5, 880.5, 84.4, 708.3 and 296.0 g Kg^{-1} for ash, OM, CP, NDF and ADF parameters, respectively. These results are collaborated to the reports of (Ameha *et al.*, 2007) and values were 88.7, 911.3, 50.6, 720 and 389, respectively. The CP content of wheat bran in this experiment was 98.8 which is agreed with the value reported by (McDonald *et al.*, 2002), that found the CP content of wheat bran varies between 80 and 140 g kg^{-1} of chemical composition.

Table 2. Chemical composition of experimental feeds

Chemical Composition	Feeds g Kg^{-1} Hay	Asp	2:1Asp WB	1:2Aspwb	WB
DM	897.3	895.6	897.6	896.6	896.6
OM	880.5	942.8	940.8	957.9	966.2
Ash	119.5	57.2	59.2	42.1	33.8
CP	84.4	112.7	101.6	98.8	94.7
NDF	708.3	560.5	503.7	481.8	472.9
ADF	296.0	336.5	262.0	162.0	110.0
ADL	224.5	98.0	84.0	60.5	32.5

Asp= *Acacia seyal* pods; 2:1 Asp WB = 2:1 ratio of *Acacia seyal* pods and wheat bran; 1:2Aspwb= 1:2 ratio of *Acacia seyal* pods and wheat bran; WB= wheat bran; DM=dry matter; OM= organic matter; CP= crude protein; NDF= neutral detergent fiber; ADF= acid detergent fiber; ADL= acid detergent lignin.

The hay offered to the experimental animals in the current study was relatively lower in CP and higher in NDF and ADL. Therefore, the hay used in the current study, which predominantly consisted of relatively pure grass hay was characterized as good quality hay with moderate CP content, satisfy the maintenance requirement of animals and less body weight gain.

4.2 Feed Intake

The mean daily feed DM and nutrient intake of the experimental sheep is given in Table 3. There was a highly significant difference ($P<0.001$) between the control and the supplemented treatments in grass hay but grass hay intake was not significantly different ($P>0.05$) in the supplemented treatments in g/day as the result of *Acacia seyal* pods supplementation (T_2), compared to the control group (T_1) and supplemented with 2:1 ratio *Acacia seyal* pods and wheat bran (T_3), 1:2 ratio of *Acacia seyal* pods and wheat bran (T_4) and wheat bran (T_5) treatments, respectively.

The finding of (Mulu, 2005) also supports the current result in that the DM intake of hay was greater for the non-supplemented sheep (477 g/d) than the supplemented ones (411-465 g/d) when Wogera sheep fed basal diet hay were supplemented with brewery dried grain. Such types of results could be reasonably acceptable that sheep in the control treatment consume more of the roughage when compared to supplemented ones since the former had the only chance to satisfy their nutrient requirements via more basal DM intake than the supplemented ones. Grass hay was readily consumed by all animals and there was no significant difference ($P>0.05$) among treatments in supplemented intake. This non significant difference could be due to the offering of additional supplements. The intake of the basal diet (g/day) was not significantly affected by protein supplementation ($P>0.05$). The DM intake of supplemented animals were 299.3, 298.7, 299.3 and 296.6 g/day/ram for *Acacia seyal* pods, 2:1 ratio of *Acacia seyal* pods and wheat bran, 1:2 ratio of *Acacia seyal* pods and wheat bran and wheat bran, respectively and the intake were 97.81% of their offer.

In the present study the total DM intake of experimental animals were 481.8, 600.9, 597.5, 603.9 and 598.5 g/day for T_1, T_2, T_3, T_4 and T_5, respectively. Total DM intake g/day was highly affected by protein supplementation, but differently with the different protein sources. Animals supplemented with *Acacia seyal* pods and 1:2 ratio *Acacia seyal* pods and wheat bran had higher ($P<0.001$) in total DM intake compared to the control group, which is highly depressed ($P>0.05$) from the other treatments. The total DM intake g/kg BW and %BW were highly significant different ($P<0.001$) among the control group and the supplemented one, whereas not significant ($P>0.05$) between the supplemented treatments.

Table 3. Daily dry matter intake and nutrient intake of Tigray Highland yearling rams supplemented with *Acacia seyal* pods and Wheat bran mix in hay based feeding.

	Treatments						
Feed intake	T_1	T_2	T_3	T_4	T_5	SEM	SL
Hay DMI (g/day)	481.8^a	301.6^b	298.9^b	303.8^b	301.9^b	5.90	***
Supplemented DMI g/day	---	299.3	298.7	299.3	296.6	0.58	ns
Total DMI (g/day)	481.8^c	600.9^{ab}	597.5^b	603.9^a	598.5^{ab}	5.10	***
Total DMI (g/kg BW)	24.4^b	27.5^a	27.6^a	27.7^a	27.6^a	1.15	***
Total DMI (% BW)	2.4^b	2.7^a	2.8^a	2.77^a	2.8^a	0.12	***
Nutrient intake (g/day)							
Total OMI	424.2^c	547.7^b	544.1^b	554.2^a	552.3^a	10.50	***
Total CPI	40.7^d	59.2^a	55.6^b	55.2^b	53.9^c	1.31	***
Total NDFI	329.4^c	337.6^{ab}	336.8^{ab}	335.1^b	339.0^a	1.57	***
Total ADFI	142.6^c	189.9^a	166.7^b	138.4^d	121.9^e	4.89	***

a-c Means with different superscripts in the same row differ significantly ** = (P<0.01); *** = (P<0.001);(p> 0.05) ns= none significant; SEM=Standard error of the mean; SL=Significant level; DMI= dry matter intake; BW=body weight; %BW= percentage body weight; OMI=organic matter intake; CPI= crude protein intake; NDFI=nutrient detergent fiber intake; ADFI= acid detergent fiber intake; T_1= grass hay ; T_2= grass hay + *Acacia seyal* pods; T_3=grass hay + *Acacia seyal* pods and Wheat bran (2:1 ratio); T_4= grass hay +1:2 ratio of *Acacia seyal* pods and wheat bran; T_5= grass hay + wheat bran

The total OM and intake of this experiment were highly significant (P<0.001) amongst the treatments, whereas the CP intake of animals supplemented with *Acacia seyal* pods significantly higher P<0.001) from the other treatment groups. The total NDF intake of this experimental study was highly significant (P<0.001) amongst the treatments, whereas highly depressed in the control group. The ADF intake of the control group was significantly depressed from the other treatments, whereas significantly higher (P<0.001) in sole *Acacia seyal* pods those fed.

4.3 Apparent Dry Matter and Nutrient Digestibility of Experimental Feeds

The digestibility coefficient (%) of nutrients is given in table 4 and the digestibility as calculated by difference method in table 5. The perusal of the results indicated that the digestibility of DM, CP and NDF were significantly (P<0.01) more in T_5 as compared to other treatment groups. Apparent DM and nutrient digestibility of DM, OM, CP, NDF and ADF is given in Table 5. There was a significant difference (P<0.05) in the digestibility percentage of DM, OM, CP and NDF of the control group from the supplemented treatments whereas, there was not significant different (P>0.05) in ADF digestibility coefficient amongst the treatments.

Digestibility coefficient of DM, OM, and NDF of the sole *Acacia seyal* pods fed group was highly depressed (P<0.001) from the other group. This is due to anti-nutritional factors or secondary compounds like tannin that affect palatability, intake and digestibility of the feed. There was significant different (P<0.05) in digestible coefficient DM, OM, CP, and NDF whereas not significant different (P>0.05) in apparent digestibility ADF amongst treatments. As the level of wheat bran increased, the apparent digestibility of DM, CP and NDF content increased and also digestibility of the DM, CP and NDF of the basal diet improved.

Relatively higher CP and NDF intake, but lower in apparent digestibility of *Acacia seyal* pods in this experiment could be explained by different factors affecting the nutritive value of Acacia pods like tannin effect, stage of maturity at harvest, harvesting length and nature of the feed *etc*. One of the major disadvantages of browse as a livestock feed is the presence of perceived anti-nutritional factors such as phenolic compounds, of which tannins represent a large part. (Timberlake *et al.*, 1999).

The value of organic matter digestibility (%) of supplemented treatments in this experiment was ranges from 55.82-65.41, in the range with values are (51.4-89.8), as reported by (Roothaert and Franzel, 2001; Roothaert *et al.*, 2003). The NDF percentage of *Acacia seyal* pods of this experiment was found like (56.05%) which is high and decrease digestibility. The percentage of the feeds greater than 55% can limit DM intake (Van Soest, 1967). Digestibility decreases with increased NDF content and increased lignifications of the fiber (McDonald *et al.*, 2002).

Table 3. Apparent digestibility (%) and digestible nutrients of Tigray Highland yearling rams supplemented with *Acacia seyal* pods and wheat bran mix in hay based feeding

Apparent digestibility (%)	Treatments						
	T_1	T_2	T_3	T_4	T_5	SEM	SL
DM	58.89^{bc}	54.83^{c}	59.80^{b}	59.75^{b}	65.83^{a}	0.914	***
OM	61.47^{ab}	55.82^{c}	60.20^{bc}	59.86^{bc}	65.41^{a}	0.892	**
CP	58.23^{b}	58.22^{b}	60.73^{b}	59.71^{b}	66.47^{a}	0.941	*
NDF	47.44^{c}	50.70^{c}	55.72^{b}	56.87^{b}	64.63^{a}	1.370	***
ADF	46.20	44.95	44.60	43.35	39.32	0.908	ns
Digestible nutrients (g)							
DM	283.73^{d}	329.45^{c}	357.33^{b}	360.33^{b}	393.97^{a}	7.635	***
OM	260.98^{d}	305.55^{c}	327.87^{bc}	331.72^{b}	365.45^{a}	7.826	***
CP	23.69^{c}	34.87^{ab}	33.78^{ab}	32.97^{b}	35.87^{a}	0.973	***
NDF	192.42^{a}	202.05^{a}	160.32^{ab}	134.47^{b}	200.48^{a}	8.318	*
ADF	65.89^{c}	85.39^{a}	74.36^{b}	60.00^{d}	47.96^{e}	2.604	***

a-e Means with different superscripts in the same row differ significantly **= (P<0.01); *** = (P<0.001); T1= grass hay; T_2= grass hay + *Acacia seyal* pods; T_3= grass hay + *Acacia seyal* pods and wheat bran (2:1 ratio); T_4 = grass hay +1:2 *Acacia seyal* pods and wheat bran; T_5 = grass hay + wheat bran; SEM= standard error of mean; SL= significance level; DM=dry matter; OM=organic matter; CP=crude protein; NDF=neutral detergent fiber; ADF=acid detergent fiber.

The DM digestible nutrient intake of this experiment was highly significant (P<0.001) amongst treatments, whereas highly depressed in T_2 that fed only sole *Acacia seyal* pods. The digestibility of a feed is influenced not only by its own composition, but also by the composition of other feeds consumed with it (McDonald *et al.*, 2002). In many instances it is desirable to evaluate the digestibility of a feedstuff when fed in mixture with one or more other feeds such as protein supplements or single feedstuffs that are normally never used as a complete diet by themselves (Pond *et al.*, 1995). Roughages could be given to animals as the sole item of diet. Digestibility of concentrate feed is determined by giving them in combination with roughage of known digestibility (McDonald *et al.*, 2002). In this situation it was necessary to determine digestibility by difference the basal diet was fed and with the test feed, fed at one or more levels. After digestibility of the complete diet has been determined, the digestibility of the test feeds was calculated (McDonald *et al.*, 2002).

The lowest apparent digestibility in NDF and ADF but have high nutrient intake, in sole *Acacia seyal* pods (T_2) fed from other treatments was due to the highest anti-nutritional effect like tannin effect of the feed which reduced the digestibility (%) of the feed. As (Bennison and Paterson, 2004) observed that Acacia species have acquired a variety of physical and chemical defense mechanisms aimed at reducing the palatability and nutritive value of the plant to predators including both insects and animals. As ADF decreased supplementation levels of *Acacia seyal* pods decreased and that of wheat bran increased due to lignifications of the *Acacia seyal* pods.

Common phenomenon observed with the digestibility data is that mixtures of feeds do not always give results that would be predicted from digestibility values of the individual components of the mixture and this response was due to an associative effect. According to (McDonald *et al.*, 2002) associative effects are usually negative (i.e. the digestibility of mixed rations is less than the expected) and greatest when a low quality roughage is supplemented with a starchy concentrate.

5. SUMMARY AND CONCLUSIONS

The experiment was conducted to evaluate feed intake and digestibility of Tigray Highland sheep supplemented with *Acacia seyal* pods and wheat bran mix in hay based feeding. Twenty five Tigray Highland yearling rams with an average live weight of 17.5±1.7 kg (mean ± SD) were used in the feeding and digestibility trials. The feeding trial consisted of *ad libitum* feeding of grass hay (control) supplemented with 306, 204 and 102 g DM per head per day of sole *Acacia seyal* pods and their mixture with wheat bran and wheat bran for T_2, T_3, T_4 and T_5, respectively. A randomized complete block design was used to conduct the feeding trails.

The results of chemical analyses of this experimental study indicated that the CP content of *Acacia seyal* pods was 112.7 g kg^{-1}. There was highly significant different (P<0.001) between the control and supplemented treatments in the intake of grass hay. Grass hay was readily consumed by all animals and there was not significant different (P>0.05) among supplemented treatments in supplement intake. Animals supplemented with *Acacia seyal* pods (T_2) and its mixtures with wheat bran (T_4) had higher P<0.001) in total CP as well as the total DM intake compared to their grass hay feeding which is not significantly different (P>0.05).

There were significant differences (P<0.05) in digestibility coefficient of DM, OM, CP and NDF amongst treatments. As the level of wheat bran increased, the apparent digestibility of DM, CP and NDF increased and also digestibility of the basal diet improved. Digestibility coefficient of DM, OM, and NDF of the sole *Acacia seyal* pods fed group was highly depressed (P<0.001) from the other group. This is due to anti-nutritional factors like tannin effect or secondary compounds like tannin that affect palatability and digestibility of the feed.

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APPENDIX

Table 1. Summary of ANOVA for Daily dry matter and nutrient intake of Tigray Highland yearling rams supplemented with *Acacia seyal* pods and wheat bran mix in hay based feeding

Parameters	DF	Type III SS	Mean Square	F Value	Pr > F
DM intake;					
DMI Hay (g/day)	16	130032.56	32508.14	1892.17	<.00014
Supplemented DMI (g/day)	12	24.44	8.15	3.29	0.0580
Total DMI (g/day)	16	55967.89	13991.97	1064.11	<.0001
Total DMI (g/kg BW)	16	40.62	10.16	15.50	<.0001
Total DMI (%BW)	16	0.41	0.10	15.50	<.0001
Nutrient intake (g/day);					
Total OMI	16	63185.18	15796.29	1541.33	<.0001
Total DMI	16	55967.89	13991.97	1064.11	<.0001
Total CPI	16	1014.04	253.51	1222.64	<.0001
Total NDFI	16	279.54	69.88	10.81	0.0002
Total ADFI	16	14163.21	3540.80	2937.46	<.0001