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Body Weight Gain and Carcass Parameters of Tigray Highland Sheep Supplemented with Acacia Seyal Pods and Wheat Bran Mix in Hay Based Feeding

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Abstract
The study was conducted in Southern Zone of Tigray to evaluate body weight gain and carcass parameters of Sokota (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 trial. Carcass evaluation was done at the end of digestibility trial. Highest daily body weight gain was recorded in animals supplemented with Acacia seyal pods (51.1 g/day. Acacia seyal pods is not recommended for fattening but to lessen the body weight fluctuation and uses as supplementation in the dry season and small average daily gain (28.4 g/day) was also observed in sheep on the control treatments. There was significant difference ($P<0.001$) amongst treatments in rib eye area muscles. The Partial budget analysis of this study was based on the total variable costs, purchasing and selling prices of sheep. Best net income was gained in Tigray Highland rams supplemented with sole Acacia seyal pods and the value; of marginal rate of return (MRR) was found positive in all treatments except in treatment one.
Keywords: carcass, body weight, sheep, acacia seyal pod, Tigray highland

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. Numerous shrub and tree species have been investigated and the multiple attributes of some of them have been confirmed. 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; Makkar, 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. 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 nutritive value as a sole supplement and 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 will bridge the gap in feed shortage during dry season and enable animals to maintain or slightly gain body weight (BW) in hay based feeding system. Therefore, this study was conducted to address the following objectives

- To evaluate body weight change and carcass traits of Tigray Highland sheep supplemented with *A. seyal* pods and wheat bran mix in hay based feeding.
- To assess the profitability of different supplementation regimes.

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 (T1 = ad-lib grass hay, T2 = 306g A. seyal pods + ad-lib, T3 = 204g A. seyal + 102g wheat bran + ad-lib, T4 = 204g wheat bran + ad-lib and T5 = 306g wheat bran + ad-lib).

3.5. Carcass Evaluation

At the end of feeding trial and digestibility trial, all experimental animals were taken immediately in to an abattoir of Maichew city. At the abattoir, the lambs were kept in a resting house without feed and water for about 12 hours. Pre slaughter body weight was taken shortly before slaughtering. This weight was taken as the slaughter weight on which the calculation of dressing percentage was based. The rams were slaughtered by severing the jugular vein and the carotid arteries. Each part of the gastro-intestinal tract was weighed with and without the contents and recorded. Empty body weight was determined by subtracting the gut fill from slaughter

body weight. The rib-eye muscle was chilled for 12 h in a refrigerator for proper cutting. Both the right and left halves were cut between the 11th and 12th ribs perpendicular to the backbone to measure the cross-sectional area of the rib-eye muscle placed first on transparency paper then sketch by pencil and the area was measured by using the square paper, then count the number of squares multiplied by 0.25 cm^2 and take the value as rib eye muscle area. Dressing percentage was calculated on the basis of slaughter and empty body weight using the formula;

$$\text{Dressing percentage} = \frac{\text{Hot carcass weight}}{\text{Slaughter body weight}} \times 100\%$$

3.6 Partial Budget Analysis

The partial budget analysis was done to determine the profitability of supplementation of different protein and energy sources of yearling male sheep by using the procedure of Upton (1979).

3.7 Statistical Analysis

Data on body weight gain were analyzed using the general linear model procedure of SAS (2002). The treatment means were separated by least significant difference (LSD). The model used for body weight change parameters was using the model:

$Y_{ij} = \mu + T_i + B_j + e_{ij}$

Where: - Y_{ij} = response variable
μ = overall mean
T_i = treatment effect
B_j = block effect
E_{ij} = random error

4. Result and Discussion

4.1. Live Weight Change

The initial, final body weight, total weight change and average daily gain of the experimental yearling rams are given in Table 6. In the present study the supplemented group had a highly significant (P<001) in final body weight, live weight change and average daily gain compared to the control treatment, supplemented animals had higher (P<0.001) final body weight. Moreover, animals supplemented with *Acacia seyal* pods had significantly higher difference (P<0.001) in live weight change and average daily gain. However, animals fed grass hay did not differ significantly (P>0.05) in final body weight. Similarly, no significant difference (P>0.05) was observed between the treatments, T_2, T_3, T_4 and T_5. The mean average daily weight gains were: 28.44, 51.11, 47.56, 48.67 and 43.56 g for T_1, T_2, T_3, T_4 and T_5, respectively. The animals fed *Acacia seyal* pods were superior in final body weight, average daily gain and body weight change.

Table 1. Live body weight in Tigray Highland yearling rams supplemented with *Acacia seyal* pods and wheat bran mix in hay based feeding

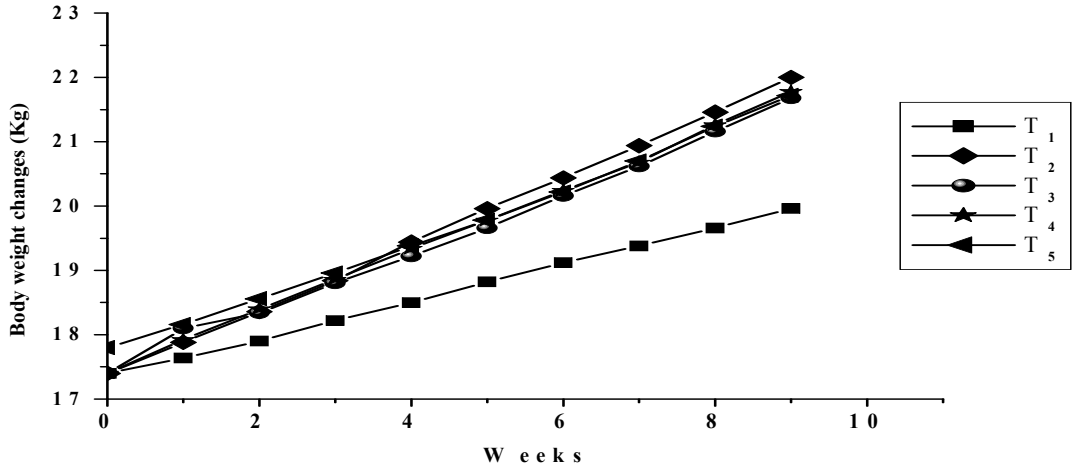
	Treatments						
Live weight	T_1	T_2	T_3	T_4	T_5	SEM	SL
Initial live weight (Kg)	17.4	17.4	17.4	17.4	17.8	0.95	ns
Final live weight (Kg)	19.9^b	22.0^a	21.7^a	21.8^a	21.7^a	1.4	**
Weight change (Kg)	2.7^c	4.6^a	4.3^{ab}	4.4^{ab}	3.9^b	1.95	***
Average daily gain (g/day)	28.4^c	51.1^a	47.7^{ab}	48.7^{ab}	43.6^b	6.76	***
FCE	0.059^c	0.085^a	0.080^{ab}	0.081^{ab}	0.070^b	0.05	**

a-c Means with different superscripts in the same row differ significantly ** = (P<0.01); ***= (P<0.001); 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* and wheat bran; and T_5 = grass hay + wheat bran; FCE = feed conversion efficiency; SEM = standard error of the mean; SL = significance level.

The increased live weight gain and average daily gain in animals supplemented with *Acacia seyal* pods were observed. Average daily gain (g/day) *Acacia seyal* pods (T_2) might be explained by the higher total DM and CP intake. FCR was significant (P<0.001) among the supplemented and control groups, whereas not significant between supplemented groups, similarly, the non significant difference observed in average daily gain between T_3 and T_4, but significantly different (P<0.001) among control and supplemented treatments. The FCE is

significant (P<0.001) among the treatments each other but supplemented treatments had similar body weight change among T_3 and T_4 (appendix Table 1). Meanwhile sheep fed on the basal diet only maintained weight and even showed slight gain (28.44 g/day) indicating that the basal diet had adequate nutrients for maintenance and slight growth. This positive gain could be the result of the CP content of the basal diets.

Figure 1. Trends in live weight change of Tigray Highland yearling rams supplemented with *Acacia seyal* Pods and Wheat Bran Mix in Hay Based Feeding.



4.2 Carcass Parameters

Carcass characteristics of the experimental yearling rams are given in Table 7. Carcass characteristics of animals under different treatment groups were assessed on the basis of slaughter weight, empty body weight, dressed hot carcass weight, dressing percentage, rib-eye muscle area (*longissmus dorsi muscle*), total usable product and edible and non edible offal. The categorization of edible and non edible offal depends on the eating habit of the people (social taboos) situation of the area, where the experiment was conducted.

4.2.1. Slaughter weight, dressed carcass weight and dressing percentage

There was significant difference in slaughter weight (P<0.001) among the control and supplemented group but no significant (P>0.05) between supplemented treatments, the empty body weight, and dressed hot carcass weight were significant different (P<0.001) between the control and supplemented treatments. Animals in the control group had the lowest slaughter weight compared with the supplemented groups. The supplemented groups did not significantly differ (P>0.05) from each other in slaughter weight, empty weight and hot carcass weight basis (Appendix Table 2). This present study is in agreement with (Atti *et al.*, 2004) that indicates slaughter weight increased as the result of supplementation.

Table 2. Carcass characteristics of Tigray Highland yearling rams supplemented with *Acacia seyal* pods and wheat bran mix in hay based feeding

	Treatments						
Parameters	T_1	T_2	T_3	T_4	T_5	SEM	SL
Slaughter weight (kg)	19.9^b	22.0^a	21.7^a	21.8^a	21.7^a	1.40	**
Empty body weight (kg)	16.5^b	19.6^a	19.1^a	19.4^a	19.3^a	0.39	***
Hot carcass weight (kg)	8.8^b	11.7^a	11.2^a	11.4^a	11.3^a	0.30	***
Dressing percentage on;							
Slaughter weight base	44.2^b	53.2^a	51.7^a	52.3^a	52.1^a	0.84	***
Empty body weight base	52.9^b	59.7^a	58.7^a	59^a	58.9^a	0.62	***
Rib-eye muscle area (cm^2)	4.8^d	8.0^a	6.4^c	7.2^b	6.2^c	0.35	***

a-d Means with different super scripts in the same row differ significantly *= (P<0.05); **= (P<.01); 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 +the reverse of T_4; T_5 = grass hay + wheat bran; SEM=standard error of the mean; SL=significant level.

Dressing percentage values on the slaughter weight basis in supplemented group ranges from 51.7-53.2%, which agreed with values of (Mousa, 2011; Allam *et al.*, 2005; Sanon *et al.*, 2008b and Abdel, 2009). In the present study, supplementation significantly improved (P<0.001) in dressing percentage as calculated on slaughter weight basis, with no difference among the supplemented groups. The dressing percentage of this study was similar within the previous reports of (Tesfay and Solomon, 2008) showed higher dressing percentage on empty body weight bases in supplemented animals than non-supplemented ones. In general, level of nutrition is known to influence body condition or carcass composition significantly.

Dressing percentage values on empty body weight basis were higher than on slaughter weight basis indicating the influence of digesta (gut fill) on dressing percentage. (Gibbs and Ivings, 1993) reported that ingesta constitute a large portion of the body weight even when the animals are fasted for long hours. This indicates that predicting carcass weight of sheep using their live weight at slaughter may not be appropriate, as carcass quality and weight must be judged using slaughter records such as hot carcass weight and empty body weight. The dressing percentage on both the slaughter and empty body weight basis were significant higher (P<0.001) between the supplemented and control group whereas not significant among the supplemented treatments. Empty body weight ranged from 52.9% in the control group to 59.7% in supplemented treatments.

4.2.2 Rib-eye muscle area

The rib eye muscle area of the experimental sheep fed on different treatment feeds is given in Table 8. The rib eye muscle area which is an indicator of muscling in the present study was: 4.8, 8, 6.4, 7.2 and 6.2 cm^2 for T_1, T_2, T_3, T_4 and T_5, respectively. Compared to the control treatment animals, supplemented treatments had significantly higher (P<0.001) rib eye muscle area and there was significant difference (P<0.05) between the supplemented treatment (T_2, T_3, T_4 and T_5). The rib eye muscle area was significantly affected by supplementation of different protein sources (P<0.01). Relatively higher rib eye muscle area in *Acacia seyal* pods supplemented animals might be related to the higher crude protein content of the feed.

4.2.3 Offal's of the carcass

The edible and non edible offals of the carcass obtained from the slaughter of Tigray highland rams kept on *Acacia seyal* pods and wheat bran mix in hay based feeding is presented in Table 8 and Table 9. In countries where offals are used in the food habit such as Ethiopia, salable offals add values to the carcass. Due to differences in eating habit and social taboos of the people, what salable and edible portion of the carcass in one area of the country may not be the other? Therefore, in this study categorization of offals as edible or non edible offals was made based on the eating habit of the people in the locality where the study was conducted. Heart, lung with esophagus, liver, kidney, empty gut and tongue were considered as edible offals. Blood, gut content, spleen and pancreas, testicles, penis, skin, and feet, were categorized as non edible offals.

Table 3. Edible carcass offals of Tigray Highland yearling rams supplemented with *Acacia seyal* pods and wheat bran mix in hay based feeding

	Treatments						
Parameters	T_1	T_2	T_3	T_4	T_5	SEM	SL
Lung, trch & eso (g)	286^{c}	312^{b}	300^{bc}	314^{b}	338^{a}	0.005	**
Heart (g)	106^{c}	137^{a}	120.4^{b}	146^{a}	139.4^{a}	3.620	***
Liver (g)	286^{b}	328^{a}	306^{b}	306^{b}	302^{b}	0.005	**
Kidney (g)	110^{c}	126^{b}	144^{a}	136^{ab}	144^{a}	0.002	***
Empty gut (kg)	1.7	1.7	1.6	1.7	1.7	0.039	ns
Tail (g)	273.6^{b}	271.6^{b}	281.6^{a}	268.2^{b}	276^{b}	0.009	**
Tongue (g)	186.8	186	191.8	185	184	0.004	ns
TEO (kg)	2.9	3.1	2.9	3.04	2.9	0.050	ns
TEO (% SW)	14.9	14.1	13.6	13.9	13.7	0.240	ns

a-c Means with different superscripts in the same row differ significantly * = (P<0.05); **= (P>0.05); ns=non significant;T_1= grass hay; T_2= grass hay +*Acacia seyal* pods; T_3=grass hay + *Acacia seyal* pods and wheat bran (at ratio 2:1); T_4= grass hay+1:2 ratio of *A. seyal* pods and wheat bran; T_5 =grass hay + wheat bran; TEO=total edible offals; SW=slaughter weight; trch & eso = trachea and esophagus; g= gram; Kg= kilo gram; SEM=standard error mean; SL=significant level.

In the present study, the size of lung, heart, liver, tail and kidney were affected by supplementation, whereas the weight of empty gut and tongue were not significantly affected (P>0.05) by supplementation. Generally the offals of supplemented rams were higher as compared to the control treatments. There was a significant different (P<0.01) in heart, kidney, gut content, spleen and pancreas, skin with leg, lung, tail and liver, whereas not

significant different (P>0.05) in empty gut, testicles and penis, Head without tongue, blood and tongue weigh were observed (appendix Table 3).

Table 4. Non edible offal's of Tigray Highland sheep supplemented with *Acacia seyal* pods and wheat bran mix in hay based feeding

Parameters	Treatments					SEM	SL
	T_1	T_2	T_3	T_4	T_5		
Blood (g)	256	254	250	254	250	0.005	Ns
Gut content (gut fill) (kg)	3.5^{a}	2.4^{c}	2.6^{b}	2.4^{c}	2.5^{bc}	0.110	***
Spleen and pancreases (g)	120^{b}	120^{b}	104^{b}	118^{a}	120^{b}	0.003	**
Testicles and penis (g)	230	238	240	230	207	0.005	Ns
Skin with legs weight (kg)	2.2^{b}	2.1^{c}	2.2^{b}	2.2^{b}	2.3^{a}	0.031	***
Head without tongue (kg)	2.1	2.3	2.4	2.4	2.3	0.032	Ns
TNEO (kg)	5.6	5.7	5.6	5.7	5.6	0.610	Ns
TNEO (% SW)	28.2	25.8	25.6	26.1	25.9	0.350	Ns

a-c Means with different superscripts in the same row differ significantly *= (P<0.05); **= (P>0.05); (p<0.001) = highly significant; ns=non significant; T_1= grass hay; T_2= grass hay +*acacia seyal* pods; T_3=grass hay +66% *acacia seyal* pods and 33% wheat bran; T_4= grass hay +reverse of T_3; T_5 =grass hay + wheat bran; TNEO=total non edible offals; SW=slaughter weight; SEM=standard error of the mean; SL=significant level**.**

The gut content differ significantly (P<0.01) among the control and the supplemented treatments, was it was higher in the control animals. There were not significant different (P>0.05) in total edible and non-edible offals, total edible and non-edible offals percentages among treatments (appendix Table 4).

4.3. Partial Budget Analysis

Partial budget analysis of the experiment is given in Table 5. Based on the total variable costs, purchasing and selling prices of sheep, the highest total income was gained from sheep supplemented with Acacia seyal pods (T_2), Acacia seyal pods and wheat bran (at a ratio of 2:1). These values were directly related with the live weight gain, body conditions of sheep and the prices of experimental feeds. The best net income gained in T_2, T_3 and T_4 (94.9, 50 and 15 ETB, respectively) were due to the relative low cost of Acacia seyal pods (0.66 ETB/kg), better feed conversion efficiency and better body weight gain of the rams. On the other hand, the net income loss of rams on treatment T_1 and T_5 were as low as -27 and 4 ETB, respectively, which was affected by high cost of hay and wheat bran which is (0.80 and 2.00 ETB/kg) and as low as body weight change of rams during the experimental period in T_1.

The values of MRR at the present study were found to be positive for T_2, T_3, T_4 and T_5. This indicated that each additional unit of one ETB per unit cost increment resulted in one ETB and additional 21.8, 5, 1.4 and 0.7 ETB for T_2, T_3, T_4, and T_5, respectively. As can be observed from the results of feed intake, digestibility, and body weight change and feed conversion efficiency in the present study, they were affected by the quality of feeds in the treatments, which in turn affected the net return per ram.

Since the live body weight gain of the rams for T_3 and T_4 were not significantly different (P>0.05), both were found to be economically feasible in comparison with T_2. From these findings, the author concluded that supplementation of sole Acacia seyal pods and Acacia seyal pods and wheat bran mixtures at a ratio of 2:1 and/or 1:2 for Tigray Highland yearling rams was economically more profitable than the supplementation with the sole wheat bran.

Table 5. Partial budget analysis for Tigray Highland yearling rams supplemented with *Acacia seyal* pods and wheat bran mix in hay based feeding

	Treatments				
Variables	T_1	T_2	T_3	T_4	T_5
Purchasing price of rams (ETB/ram)	223	235	233	236	234
Selling price of rams (ETB/ram)	235	374	337	320	322
Total hay consumed (kg/ram)	48.2	30.2	29.9	30.4	30.2
Total supplement consumed (kg/ram)	0	29.9	29.8	29.9	29.7
Total feeds Consumed (kg/ram)	48.2	60.1	59.8	60.3	59.9
Cost for hay (ETB/ram)	38.5	24.1	23.9	24.3	24
Cost for supplements (ETB/ram)	0	20	29. 9	44.9	59
Total feed cost or VC (ETB/ram)	38.5	44.1	54	69	84
Gross income (sell- purchase) (ETB/ram)	12	139	104	84	88
ΔGR (ETB/ram)	0	127	92	72	76
NI (ETB/ram)	-27	94.9	50	15	4
ΔNI (ETB	0	121.9	77	42	31
ΔVC (ETB)	0	5.6	15.5	30.5	45.5
MRR or (ΔNI/ΔVC) (ETB)	0	21.8	5	1.4	0.7

TRR= Total rate of revenue; NI = Net income; TVC = total variable cost; ΔNI = change in net income; ΔTR = change in total return; ΔMRR = change marginal rate of return; ETB = Ethiopian Birr; T_1= grass hay; T_2= grass hay +*Acacia seyal* pods; T_3=grass hay +2:1 ratio of *Acacia seyal* pods and wheat bran; T_4= grass hay +1:2 ratio of *Acacia seyal* and wheat bran; T_5 =grass hay + wheat bran.

5. SUMMARY AND CONCLUSIONS

The experiment was conducted to evaluate body weight change and carcass traits 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 and digestibility trails. Carcass evaluation was made at the end of digestibility trial using five animals per treatment in a randomized completely block design.

The mean average daily weight gain were; 28.4, 51.1, 47.6, 48.7 and 43.6 g for T_1, T_2, T_3, T_4 and T_5, respectively. The animals fed *Acacia seyal* pods (51.1 g) were superior in final, average daily gain and body weight change. This moderate gain shows, that *Acacia seyal* pods is not recommended for fattening but to improve the body weight fluctuation and uses as supplementation in the dry season, and average daily gain of the control group were inferior, but positive average daily gain (28.4 g) was also observed in sheep on the control treatments. Empty body weight, dressed carcass weight and dressing percentage were higher in supplemented animals than the control group. The mean rib eye muscle areas were 4.8 cm^2 in the control animals and 6.2-8 cm^2 in the supplemented group. In this experiment categorization as edible or none edible offals was made based on the eating habit of the local people where the study conducted. Heart, lung, esophagus, liver, kidney, empty gut and tongue were considered as edible offals, where as blood, gut content, spleen and pancreas, testicles, penis, skin and feet, were categorized as non-edible offals. The highest total income was gained from sheep supplemented with *Acacia seyal* pods (T_2) and the mixture with *Acacia seyal* pods and wheat bran at a ratio of 2:1 (T_3). These values were directly related with the live weight gain, body conditions of sheep and the prices of experimental feeds. Therefore, it can be concluded that the yearling rams may be fed 306 g *Acacia seyal* pods and *ad-lib* grass hay without affecting the feed intake, body weight gain, carcass characteristics and economics profitability of feeding.

6. ACKNOWLEDGMENT

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Appendix:

Table 1. Summary of ANOVA for live body weight 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
Initial live weight (kg)	16	0.64	0.16	0.37	0.8280
Final live weight (kg)	16	13.77	3.44	6.79	0.0022
Weight change (kg)	16	13.25	3.31	17.87	<.0001
Average daily gain (g /d)	16	1635.36	408.84	17.87	<.0001
FCE	16	0.002	0.0005	7.08	0.0018

Table 2. Summary of ANOVA for carcass characteristics 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
Empty body weight (Kg)	16	32.84	8.21	16.93	<.0001
Hot carcass (Kg)	16	28.22	7.05	15.52	<.0001
Dressing (%) on Slaughter weight	16	311.26	77.82	13.72	<.0001
Dressing (%) on Empty body weight	16	155.95	38.99	9.21	0.0005
Rib eye area (cm^2)	16	28.64	7.16	34.1	<.0001

Table 3. Summary of ANOVA for edible carcass offals 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
Empty gut	16	0.102	0.025	0.50	0.7369
Tail (g)	16	505.60	126.40	1.01	0.4293
Tongue (g)	16	0.001	0.00015	0.31	0.8671
Lung (g)	16	7400.00	1850.00	6.49	0.0027
Liver (g)	16	5306.16	1326.54	14.22	<.0001
Heart (g)	16	5306.16	1326.54	14.22	<.0001
Kidney (g)	16	4120.00	1030.00	9.81	0.0003
TEO (Kg)	16	0.08	0.021	0.37	0.8270
TEO (%)	16	5.88	1.471	1.25	0.3307

Table 4. Summary of ANOVA for none edible carcass offals 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
Gut content (Kg)	16	4.147	1.037	10.99	0.0002
Head (Kg)	16	0.210	0.053	2.49	0.0845
Skin with legs (Kg)	16	0.034	0.008	0.24	0.9132
Spleen and pancreas (g)	16	1612.16	403.04	4.05	0.0187
Testicle and penis (g)	16	5144.000	1286.000	8.52	0.0007
Blood (g)	16	1336.000	334.000	0.15	0.9625
TNEO (Kg)	16	0.388	0.097	1.20	0.3476
TNEO (%)	16	7.111	1.778	1.03	0.4202

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