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Effect of supplementing fixed level of treated Acacia saligna (Labill) H.L.Wendi. leaves on weight change and carcass characteristics of Abergelle goats

Shumuye Belay[a,]*, Yayneshet Tesfay[b]
[a]*Mekelle Agricultural Research Centre, Tigrai, Ethiopia.*
[b]*International Livestock Research Institute (ILRI), Livestock and Irrigation Value Chains for Ethiopian Smallholders (LIVES), Tigrai Region, Ethiopia.*

*Corresponding author; Mekelle Agricultural Research Centre, Tigrai, Ethiopia.

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ABSTRACT

A study was conducted to evaluate the effect of feeding fixed level of treated Acacia saligna leaves (ASL) on feed intake, live body weight change and carcass characteristics of Abergelle goats. The experiment was executed in Aberegelle Agricultural Research Centre goat farm in the northern Ethiopia. Four treatments namely grass hay (GH) as a control, air dried acacia saligna leaves (ADASL), water soaked acacia saligna leaves (WSASL) and wood ash soaked acacia saligna leaves (WASASL) each included at 300 g head^{-1} day^{-1} were used as supplement. Feed intake was measured daily and live weight gain recorded weekly. Measurements were also taken on empty body weight (EBW), hot carcass weight (HCW), dressing percent (DP) and rib eye muscle area (REMA). Higher total crude protein intake was observed in the supplemented goats as compared to non-supplemented. As a result, better body weight gain was observed in the supplemented goats as compare to non-supplemented goats. Similarly, better HCW was obtained in the supplemented goats than non-supplemented in general and in particular goats fed on air dried and water soaked leaves showed significantly higher HCW than the control. So that it could be included that, it is important to feed acacia saligna leaves as an alternative feed particularly at the time of feed scarcity. However, dressing percent on slaughter

weight base (SWB), EBW base and REMA were not showed any significant different (P>0.05) among the treatments. Generally, goats supplemented with air dried leaves showed higher body weight gain and carcass value compared with the other treatments.

1. Introduction

Browse species such as *Acacia saligna* leaves can play a major role in providing feed for small ruminants in arid and semi-arid regions, particularly during the dry season when poor quality roughage and crop residues prevail. In those areas animals are fed commonly on crop residues and grazing lands which have low nutritional value and digestibility. Woodward and Reed (1989) reported that *A. saligna* leaves are valuable seasonally when other forages are scarce due to astringent taste. Their foliage may be used as a protein and energy supplement when animals are given low quality roughage (Devendra and Burns, 1983; Kreb et al., 2007). However, the presence of secondary plant compounds could provide major constraints to their use. The primary anti-nutritional agent in Acacia species and many other browse species are condensed tannins. This could be resulted in low feed intake and hence low body weight gain. *A. saligna* appears to have fairly good potential as an animal fodder plant if the leaf, young shoots, pods and seeds are selected and either fresh or dry and are protein-rich and non-toxic and palatable to small ruminants (Maslin and McDonald, 2004). Ramirez et al (1991) and Ramirez et al (1992) reported that calcium hydroxide and wood ash solutions are alkaline (pH >10) and could improve the nutritive value of cereal straws and sorghum and maize stover. Van Thanh et al (2005) also suggested that condensed tannins (CT) in Acacia cyanophylla foliage were reduced after two days of drying under shade or in the sun and as a result, the total tannins content were reduced by 22.6 and 11.3% for the drying and wilting, respectively, compared to fresh leaves.

Replacement of *A. saligna* leaves up to 40% in growing lambs diet improved growth performance traits and dressing percentage (Mousa, 2011). Feeding of *A.saligna* leaves in the dried form could increase the utilization of nutrients with the increasing of growth performance of lambs as compared to fresh leaves (Brhan and Getachew, 2009). To increase the feed intake of animals, different feed improvement mechanisms such as urea and molasses treatment, ensiling process, calcium hydroxide and wood ash soaking, chopping and drying are being practiced to decrease the anti-nutritional factors. These pre-treatments ways are not only to increase feed intake but also to increase palatability, digestibility and nutritional value of the feed. Sheep that consumed *A. saligna* leaves treated with polyethylene glycol gained more weight than those fed untreated leaves (Ben Salem et al., 1998). Therefore, the objective this study was to evaluate the effect of feeding fixed level of treated *A. saligna* leaves on feed intake, live body weight change and carcass characteristics of Abergelle goats by deactivating the detrimental effect of the leaf.

2. Materials and methods

2.1. Description of the study area

The study was conducted in Tanqua Abergelle district (13^{o} $14^{'}$ $06^{"}$ N latitude and 38^{o} $58^{'}$ 50" E longitude) in the central zone of Tigray Regional State in northern Ethiopia. The study area is categorized as hot to warm sub-moist lowland (SM1-4) sub-agro ecological zone with an altitude of 1300-1500 m.a.s.l. The mean annual rainfall ranges from 400 to 600 mm and annual temperature ranges from 28 to 42^{o}C. The dominant soil type includes vertisols and silt loam soils with dwarf shrub vegetation dominated by acacia species. The area has also huge number of livestock population especially goats. The major crops types are sorghum, maize, *Eragrostis tef,* cow pea, sesame, linseed and in some parts of the districts lentil and barely are also produced.

Fig. 1. Map of the study area (Source: http://www.tigraionline.com/tigrayGIF.gif).

2.2. Preparation of experimental feeds

A. saligna leaves used in this experiment were harvested from 3-5 years old stand growing in an enclosure, which is the property of Abergelle Agricultural Research Centre in Tigray regional sate, northern Ethiopia. A total of 474 kg leaves were harvested by hand plucking and the leaves excluding twigs and petioles were harvested from all branches of the plant and mixed thoroughly.

The collected leaves were divided into three equal parts (air dried, water soaked and wood ash solution soaked leaves). According to Ben Salem et al (2005) one kg fresh leaf was soaked in 6 liter of wood (*A. etbaica*) ash solution for 48 hours. The leaves were washed with water to remove the dusty materials and alkalinity. About 316 kg (158 kg for each) fresh leaves were soaked both in water and wood ash solution for 48 hours. The remaining 158 kg of fresh leaves were dried only in air.

Photo. 1. Acacia salign tree/ shrub**.**

2.3. Experimental animals and treatments

A total of 20 Abergelle intact male goats aged 14-18 months and weighed 16.1± 2.47 kg (mean±standard deviation) were purchased from Yechilla town and nearby areas. Ages of the experimental goats were estimated by asking the owners and by their dentition. The goats were grouped according to their initial body weight that ranges from 17.7-19 kg in block one, 16.6-17.5kg block two, 15.5-16.5kg block three, 14.8-15.4kg block four and 13.5-14.4kg block five that is in to five blocks of four goats in each block in a randomized complete block design. Initial body weight was measured after overnight fasting of the experimental goats at the end of two weeks adaptation period. The treatments comprised of native grass hay alone provided on *ad libitum* basis; grass hay plus 300 g DM air dried leaves; grass hay plus 300 g DM of Water soaked leaves; and grass hay plus 300 g DM of Wood ash solution soaked leaves.

The inclusion of a fixed amount of *A. saligna* leaves was based on Mousa (2011) recommendation which was suggested replacement of A. saligna leaves up to 40% in growing lambs diet improved growth performance traits, economical efficiency, and dressing percentage and decreased feed cost per kg body gain from weaning to marketing weight.

2.4. Measurements

2.4.1. Live weight change

Live weights of the experimental goats were measured in the morning time before feeding and watering with the help of spring balance weekly during the 90 days experimental period. The live weight gain was calculated as;

Live weight gain (LWG) = Final weight - Initial weight/ Number of days

2.4.2. Feed conversion rate

Feed conversion rate was calculated as the proportion of daily feed intake / daily live weight gain

2.4.3. Feeding trial

Dry matter (DM) intake and body weights were recorded during the 90-days feeding trial. Daily feed offered and feed refusals were recorded throughout the experimental period. It was calculated as:

Feed intake = Amount of feed offered – Amount of feed refused

2.4.4. Carcass parameters

From each treatment group, five goats were taken and fasted overnight and weighed before slaughtering. During slaughtering, goats were suspended head down; the oesophagus tied off to cease the blood flow, the jugular vein severed using a kitchen knife and then the blood was collected in a container and weighed with the help of electronic sensitive balance. The skin was flayed cautiously to avoid adherence of fat and muscle tissue to the skin. The hot carcass weight (HCW) was measured with the help of spring balance to the nearest 0.5 kg after head and offal were removed. The empty body weight (EBW) is the weight of the goat excluding the gut fill. The dressing percentage (DP) was calculated as proportion of HCW or EBW to slaughter body weight (SBW). The carcass was divided into two parts: hind and fore quarter between 9^{th} and 10^{th} ribs. The four ribs from (10^{th} to 13^{th}) were chilled overnight in deep freezer and the rib eye muscle area (*longissimus dorsi*) was measured at the 11^{th} and 12^{th} rib site (Jones and William, 1993). It was taken as the mean of the left and right sides. The cross sectional area of the rib eye muscle area (REMA) was marked out first on transparent plastic paper after it was cut at the 11^{th} and 12^{th} ribs perpendicularly to the backbone. The transparent plastic paper was attached to 0.25 cm^2 square paper, which was used to calculate the number of squares within the traced transparent plastic paper manually. The area of the squares that fell within the tracer paper was then counted on both sides and the average of the two sides was used to calculate the REMA. The EBW is the weight of the goat excluding the gut fill and was calculated with the following formula;

EBW = SBW- Gut fills

Therefore, DP was calculated as the proportion of HCW or EBW / SBW.

Photo 2. Rib eye muscle area.

2.5. Statistical model and Data analysis

The collected data were subjected to analysis of variance (ANOVA) using JMP-5 software (SAS Institute, 2002). Treatment means were compared by using Tukey HSD test. The following statistical model was used to analyze the data.

$$Y_{ijk}=\mu+\alpha_i+\beta_j+\varepsilon_{ijk}$$

Where:

Y_{ijk} = Dependent variables

μ = Overall mean

α_i = i^{th} treatment effect (i=1-4)

β_j = j^{th} block effect (j=1-5)

ε_{ijk} = random error term.

3. Results

3.1. Feed intake

The total DMI of the supplemented goats were 702.03, 689.83 and 713.59 g day^{-1} $head^{-1}$ for air dried, water and wood ash soaked acacia leaves supplementations, respectively. Whereas the total DMI of the non-supplemented goats were 529 g day^{-1} $head^{-1}$ which was significantly lower than the supplemented goats. Experimental goats supplemented with acacia leaf were observed to consume higher DMI compare with the non-supplemented goats. This was due to the fact higher CP intake which results a large number of micro flora in the rumen that can facilitate the digestibility of fiber feeds.

Table 1
Feed intake of Abergelle goats supplemented with treated air dried acacia saligna leaves fed grass hay as a basal diet.

Parameter (g $h^{-1}d^{-1}$)	Treatments				SE	P
	GH	ADASL	WSASL	WASASL		
Hay DMI	529	451	444	475	25.6	0.125
leaf DMI	0.00	252[a]	246[a]	238[a]	9.8	0.0001
Total DMI	529[b]	702[a]	690[a]	712[a]	33.26	0.006
Total OMI	520[b]	702[a]	692[a]	714[a]	33.13	0.004
Total CPI	44.7[b]	71.5[a]	66.3[a]	69.5[a]	3.15	0.002
Total NDFI	375[b]	455[ab]	462[ab]	509[a]	23.22	0.012

[abc]Means within a row not bearing a common superscript letter differ at (P<0.05); GH= grass hay; ADASL=air dried acacia saligna leaves; WSASL=water soaked acacia saligna leaves; WASASL=wood ash soaked acacia saligna leaves; DMI=Dry matter intake; SE= Standard error; OMI=Organic matter intake; CPI = Crude protein intake; NDFI = neutral detergent fiber intake.

3.2. Live body weight change

There was significant difference (P<0.001) in daily live weight gain of supplemented than non-supplemented goats. However, there was no observed any significant differences among the supplemented goats. This might be happened due to similar amount of nutrient available to the experimental goats. Even though there was not statistical variation among the three treatments (air dried, water and wood ash soaked leaves). The highest average daily weight gain (34 g $head^{-1}$ day^{-1}) was recorded for goats that received air dried leaves. The supplemented goats showed a weight gains increment of 16.5-19.1 percent whereas the non-supplemented goats were increased their weigh again by 5 percent.

Table 2
Live weight change and feed conversion efficiency of Abergelle goats supplemented with treated ASL fed grass hay as a basal diet.

Parameters	Treatments					
	GH	ADASL	WSASL	WASASL	SE	P
IBW (kg)	16.2	16.2	16.1	15.8	0.212	0.997
FBW (kg)	17.0^{b}	19.3^{a}	18.9^{a}	18.4^{ab}	0.38	0.006
ADBWG (g/d)	8.2^{b}	34.0^{a}	30.0^{a}	21.9^{ab}	0.341	0.002
FCR(DMI / LWG)	0.018^{b}	0.05^{a}	0.046^{a}	0.038^{ab}	0.005	0.007

^{ab}Means in the same row with different superscript differ at (P<0.05); SE = Standard error; IBW= Initial body weight, FBW= Final body weight, ADBWG= Average daily body weight gain, FCR= Feed conversion rate.

This figure below indicated that IBW of the experimental goats were almost the same when the real experiment was started then after all treatments showed a progressive body change with different rate. The reason for body weight change was not only due to high CPI and DMI but also due to the higher feed conversion ratio of supplemented goats compare to non-supplemented goats.

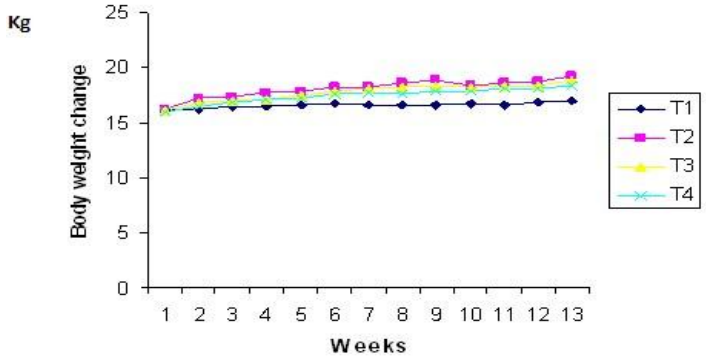

Fig. 2. Live body weight change of Abergelle goats supplemented with treated *acacia saligna leaves* fed grass hay as a basal diet.

3.3. Carcass characteristics

3.3.1. Hot carcass weight and dressing percentages

The carcass yield of an animal is important to Compare and determine the real potential and meat production performance of an animal. The carcass traits of goats can be affected by environment (nutrition, season, management etc) and genotype. The age and sex of an animal are also other factors. Carcasses were evaluated based upon dressing percentage on SBW and EBW base. Dressing percentage (DP) on SBW base and EBW base, and REMA did not significantly vary among the treatments (Table 3). The highest HCW and DP in SWB were observed in goats supplemented with ADASL. In contrast, the lowest HCW was observed in goats fed on the GH alone even though there was not any statistical difference with goats fed on WASASL. Lowest DP in SWB was seen in goats supplemented with WASASL. It is a major parameter to describe meat production performance of an animal.

3.3.2. Rib eye muscle area

Goat traders or any goat buyers in market are used to compare the emaciated goats from the fattened goats by laying a hand on the rib eye muscle area (REMA) or the loin meat. Therefore, it is important to predict the quality and yield factors and grades. The type supplement did not significantly influence the REMA. In this experiment there was not observed any significant different (P>0.05) among the supplemented and non-supplemented goats on the rib eye area though there was numerical difference.

Table 3
Carcass characteristics of Abergelle goats supplemented with treated acacia saligna leaves fed grass hay as a basal diet.

	Treatment					
Parameters	**GH**	**ADASL**	**WSASL**	**WASASL**	**SE**	**P**
HCW (kg)	6.14[c]	7.06[a]	6.90[ab]	6.50[bc]	0.13	0.001
EBW (kg)	11.94[b]	13.54[a]	13.22[a]	12.91[ab]	0.23	0.002
DP						
SWB (%)	35.9	36.2	36	35.3	0.51	0.234
EWB (%)	51.4	52.13	52.2	50.3	0.53	0.081
REMA (cm^2)	4.49	5.47	5.64	5.04	0.31	0.093
BFT (cm)	1.06	1.28	1.26	1.32	0.06	0.06

[abc]Means in the same row with different superscript differ at (P<0.05); SE = Standard error; HCW=Hot carcass weight; EBW=Empty body weight; DP=Dressing percentage; SWB=Slaughter weight base; EWB= Empty weight base; REMA= Rib eye muscle area; BFT =Brisket fat thickness.

4. Discussion

Feed intake and digestibility of different fibrous feeds could be improved either by treating with urea, molasses, alkaline compounds (such as calcium hydroxide and wood ash solution) or water (Ben Salem et al., 2005). These tannin binding agents help to decrease the condensed tannin content of the tannin containing feed such as browse tree leaves, straws and results in increasing the palatability and digestibility. Brhan and Getachew (2009) reported that condensed tannin content of *A.saligna* leaves were decreased by air drying and increases the DM and OM digestibility. Similarly, in the present study acacia leaves treated with air drying was one of the best ways of feed treatment mechanisms as a result numerically higher feed intake was observed in this treatment. Economically, it was also the cheapest and easiest to implement at farmers level as compare to the other treatments. Ben Salem et al (1997) also noted that in comparison to fresh acacia, field-dried *A. saligna* leaf intake was higher when mixed with good quality roughages (e.g. Lucerne hay), and ascribed this to: (i) a possible interaction between a component of Lucerne hay, may be protein, and acacia tannins in the rumen (ii) a decrease of the astringent taste of acacia and (iii) a reduction of its effect on rumen function. Supplementation of treated *ASL* significantly increased the total DMI of goats. The increased total DMI observed in the supplemented goats was due to the fact that higher CP intake which results in a large number of micro-flora in the rumen that can facilitate the digestibility of fiber feeds (Van Soest, 1994). However, in this study Lower DMI of acacia saligna leaf was observed compared with Ben Salem et al (2000) report which might be due to the fact that acacia leaves were not offered free of choice in the present study.

The highest average daily weight gain (34 g $head^{-1}$ day^{-1}) was recorded for goats that received air dried leaves. This was comparable with the weight gain recorded by Abdulrazak et al (2005) in goats supplemented with *A. tortilis* leaves and pods (14.4-33.9 g $head^{-1}$ day^{-1}). The reason for the weight gain in supplemented goats were due to the sufficient supply of fermentable substrate to ruminal microbes enhance the growth and protein synthesis and will result in improving the availability of microbial protein in the small intestine (Abdulrazak et al., 2005). Goats fed on grass hay alone showed lower live weight gain than supplemented goats throughout the experimental period. This was mainly due to lower DM and CP intake. However, Bruh (2008) reported that a loss of 21.9 g $head^{-1}$ day^{-1} for Abergelle goats fed on grass hay alone. This might be due to nutritional value difference of the grass hay. But the native grass hay used in this experiment had better crude protein content (7.85 %) compared to Bruh (2008) report which was 6.6 CP content which below the body maintenance requirement of goats.

Dressing percentage can be affected by breed type, age, sex and the nutritional content of the feed type. Dressing percentage on slaughter weight base or hot carcass weight of yearling Abergelle intactmale goats were ranged from 35.3-36.2 percent. Similarly, Bruh (2008) were also reported a dressing percentage on slaughter weight base of 34.5- 37% on same breed type and similar age. Hower, the present was incomparable to Boer goats' breeds of the South Africa with HCW of 48-60 percent (ESGPIP, 2008). It was also dissimilar with the report of Solomon and Simret (2008) on Somali goats both in DP based on SWB and EBW. This difference might be due to the difference in genetic potential of goat breeds and feed type provided to the experimental goats

Similar, values were also reported by Solomon and Simret (2008) for the Somali goat. Chestnut (1994) also reported that plane of nutrition had no effect on REMA. Breed and plane of nutrition did not influence REMA and its depth (Kirton et al., 1995). Bruh (2008) also indicated that Abergelle goats supplemented with *Zizphus Spina-christi* foliage and *Sterculia Africana* foliage were deposited relatively more lean flesh than goats kept on hay alone. Goats supplemented with air dried *acacia saligna* leaves had better weight gain and HCW and hence have better REMA than the other treatments though there was not any significant different among the treatments. Higher production of lean in the carcass and lean/bone ratio is associated with greater eye muscle area (Wolf et al., 1980).

5. Conclusion

Based on the research results, it was concluded that:

- higher body weight gain was observed in goats supplemented with air dried *A.saligna* leaves as compared to non-supplemented goats
- Acacia saligna leaf is important as alternative small ruminant feed especially during the time of feed scarcity
- Acacia saligna leaf has low condensed tannin content so that it could not cause any digestion problem
- Air drying could the best feed treatment mechanisms as compare to the others being its leaf is easily palatable, cheapest and easiest to treat.

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