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Utilization of wheat bran and dried *Acacia saligna* (Labill) H.L.Wendl leaves by highland rams

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This study was conducted to evaluate body weight gain, feed intake and digestibility of highland sheep supplemented with wheat bran and dried *Acacia saligna* leaf five treatments, namely grass hay as a control (T1), 100 g per day *A. saligna*, (T2), 200 g per day *A. saligna* (T3), 300 g per day *A. saligna* (T4) and 400 g per day *A. saligna* (T5) with a fixed amount (200 g per day) of wheat bran was provided to the supplemented groups. Ram lambs in the control group gained 7.8 g/day while ram lambs placed under T2, T3, T4 and T5 gained 42.8, 63.9, 62.2 and 57.8 g/day. Thus, supplementation of 200 g/day dried *A. saligna* and 200 g/day wheat bran is biologically more efficient and economically more profitable and thus recommended for highland ram lambs fattening.

Key words: *Acacia saligna*, digestibility, grass hay, highland sheep, Mekelle Agricultural Research Centre, wheat bran.

INTRODUCTION

Acacia cyanophylla Lindl. (Syn. *A. saligna* (Labill.) H. Wendl) is a leguminous shrub which provides large amounts of fodder for ruminants in arid and semi-arid regions (Ben Salem et al., 1999; Safinaz et al., 2010). *A. saligna* is one of the introduced browse shrub or tree species, which is widely grown and evergreen in different agro-ecological zones of Tigray (Shumuye and Yayneshet, 2011). *A. saligna* has reasonably large amount of crude protein (Moujahed et al., 2000), which has the potential to supplement the predominantly poor quality fibrous feeds widely used by smallholder farmers. As with other acacia species, the major limiting factor in the use of *A. saligna* is the presence of high concentration of tannins (Moujahed et al., 2005; Shumeye and Yayneshet, 2011). The low protein digestibility of *A. cyanophylla* in sheep was due to the high level of condensed tannins (CT) in its foliage (Degen *et al.,* 1995). Although the use of polyethylene glycol (PEG) to deactivate tannin has been recommended (Ben Salem et al., 1997; Moujahed et al., 2000; Ben Salem et al., 2005b; Olivares et al., 2013; Rojas et al., 2015a; Rojas et al., 2015b), its wider use under smallholder

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farmers is constrained not only by its cost (Moujahed et al., 2005) but also its availability in the market. Air drying improves palatability, intake and digestibility (Shumuye and Yayneshet, 2011; Olivares et al., 2013). Sun-drying was slightly more efficient in reducing CT levels in the acacia foliage (Ben Salem et al., 1999).

Like other tropical forages, *A. saligna* is deficient in energy and could be provided to ruminants with other energy sources (Silanikove et al., 1997; Nicholas et al., 2007; Safinaz et al., 2010). With the flourishing of agro-processing plants (Yayneshet, 2010), the availability and price of wheat bran make it tone of the best energy sources under the smallholder socioeconomic context. Beside to improving the feeding value of *A. saligna* the appropriate level to supplement sheep is not yet studied in our country. Hence, the objectives of this study were to: (1) Evaluate the nutrient contents of the experimental diets; (2) Measure body weight gain, feed intake and digestibility; (3) Evaluate the nitrogen balance in highland rams fed wheat bran and *A. saligna* in different proportions.

MATERIALS AND METHODS

Study area description

The study was conducted at Mekelle Agricultural Research Center (MARC) 13°31'N latitude and 39°58'E longitude. Average annual rainfall is 475.5 mm and altitude fall in 2000 m.a.s.l (Siyoum and Yesuf, 2013).

Experimental feeds

A. saligna leaves were collected from 2 to 3 years old stand by hand plucking. The harvested leaves were air dried for five days. A total of 500 kg dried *A. saligna* leaves were collected and packed in waterproof sacks. Native grass hay (*Cynodon dactylon*) was harvested from MARC's experimental fields at 50% heading. Wheat bran was purchased from a private flour milling industry, and mixed with *A. saligna* leaves.

Experimental animals and their management

Twenty yearling highland sheep rams with an average initial body weight of 21.9±1.86 kg were purchased from the local market in Atsbi district in the study region. Age was estimated from the presence of milk tooth. The experimental animals were tagged for identification and treated against internal and external parasite using anti-helminths Albendazole (7.5 mg/kg weight ingested through mouth) and Ivermaectin (0.2 mg/kg weight, administered through subcutaneous injection), respectively (DACA, 2013). The housing was made of concrete floor, aerated from the sides, roofed with corrugate sheet and had good drainage for ease of cleaning. Clean water and salt were provided freely throughout the experiment period on individual bases.

Experimental design and treatments

A randomized complete block design (RCBD) with four blocks and five treatments/block was used. The experimental treatments were (1) T1: Grass hay *ad libitum*; (2) T2: T1+ 100 g of air dried *A. saligna* leaves + 200 g wheat bran; (3) T3: T1+ 200 g of air dried *A. saligna* leaves+ 200 g wheat bran; (4) T4: T1+ 300 g of air dried *A. saligna* leaves + 200 g wheat bran and (5) T5: T1+ 400 g of air dried *A. saligna* leaves + 200 g wheat bran. The supplementation was scheduled at two equal portions (8:00 am and 16:00 pm).

Measurements

Chemical composition

Nitrogen (N) content of the feed, feces and urine were analyzed according to Kjeldahl method (AOAC, 1990). The CP was calculated N x 6.25. The apparent nutrient digestibility coefficient (DC) was calculated total amount of nutrients in feed minus the total amount of nutrient in feces divided by the total amount of nutrient in the feed and finally multiplied by 100. Digestibility of the dry matter (DDM), digestibility of the organic matter (DOM) and digestible organic matter in dry matter (DODM) was analyzed according to MAFF (1975). The fiber content (dry matter (DM), neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL) and Ash) of the experimental feeds was examined according to (Van Soest et al., 1991) and the condensed tannin content was determined according to (Burns, 1971).

Feed intake and feed conversion efficiency

The amount of feed offered and refused for each sheep was measured every day for the whole 90 days of the experimental period. The feed intake was calculated by subtracting the refusal from the offered feed. Feed conversion efficiency was calculated by dividing daily live weight gain by daily feed intake.

Live weight change

Live body weight record was taken every Friday for each animal for the whole experimental days. The live weight change and daily live weight gain were calculated initial body weight subtracted from the final live weight and the daily live weight gain was a result of final body weight minus initial body weight divided by the 90 days the trial undertaken.

Digestibility

Feces and urine were collected for 7 days following 3 days adaptation trial. The daily fecal excretion of each ram was mixed thoroughly according to their treatment and 10% was sampled and kept in air tight plastic containers and stored at -4°C refrigerator. About 100 mL urine was mixed with 10% H_2SO_4 to maintain pH value below 3.0 (Osuji et al., 1992). Urine was collected twice a day in the morning and evening. Out of the total collected urine 10% of urine was sampled from each sheep and stored frozen for each treatment prior to determine N yield (Chen et al., 1990).

Statistical model and data analysis

The following statistical model: $Y_{ij} = \mu + \tau_i + \beta_j + \epsilon_{ijk}$ was used in analyzing the data. Where; Y_{ij} = the overall response; μ = overall mean; τ_i = ith treatment effect (i= 1,2,3,4,5); β_j = jth block effect (j= 1, 2, 3, 4); ϵ_{ijk} = overall treatment and block effect. Data on the nutrient and dry matter intake, nutrient digestibility, nitrogen balance and live weight change were subjected to analysis of variance (ANOVA) using JMP5 (SAS Institute Inc, 2002) and mean

Table 1. Chemical composition of experimental feeds and treatments.

Feeds	Chemical composition (%)										
	DM	**OM**	**CP**	**NDF**	**ADF**	**ADL**	**Ash**	**SM**	**H**	**C**	**CT**
GH	94.71	91.77	6.55	76.15	50.62	10.43	8.23	23.85	25.53	31.96	-
WB	93.58	93.73	16.20	48.01	15.52	3.52	6.27	51.99	32.49	5.73	-
AS	92.03	84.91	14.84	43.39	30.56	8.04	15.09	56.61	12.83	7.43	13.78
Trt	**Chemical composition (g d^{-1})**										
	DM	**OM**	**CP**	**NDF**	**ADF**	**ADL**	**Ash**	**SM**	**H**	**C**	**CT**
T1	751.7	690	49.2	572	380	78.4	62	428	193	240	-
T2	981.5	898	90	515	317	106	83.4	485	198	128	12.7
T3	1095	996	105	721	451	97	99	279	270	255	25
T4	1168	1057	117	749	471	103	111	251	278	258	37
T5	1227	1106	127	769	468	107	121	231	283	258	47.5

GH = grass hay; WB = wheat bran; SM = soluble matter; H = hemicelluloses; C = cellulose; Trt = treatment; DM = dry matter; OM = organic matter; CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = acid detergent lignin; AS = *Acacia saligna*; [a'] = 100%-NDF; [b'] = NDF-ADF; [c'] = ADF-(ADL+Ash); CT = Condensed Tannin; - = value not found.

Table 2. Daily dry matter and nutrient intake of highland sheep rams.

Parameters (g $days^{-1}$)	Treatments					SEM	SL
	T1	**T2**	**T3**	**T4**	**T5**		
DMI	751.73^{d}	981.47^{c}	1095.29^{bc}	1167.92^{ab}	1226.88^{a}	28.988	***
OMI	689.86^{d}	898.05^{c}	996.21^{bc}	1057.13^{ab}	1105.95^{a}	26.511	***
CPI	49.24^{e}	89.98^{d}	105.04^{c}	116.72^{b}	126.98^{a}	2.0569	***
NDFI	572.44^{c}	664.56^{b}	721.19^{ab}	749.14^{ab}	768.77^{a}	21.692	***

[a, b, c, d, e] means within a row not bearing a common superscript letter significantly differ. ***= (p<0.0001); NS = not significant; DMI = Dry matter intake; SEM = Standard error of mean; OMI = Organic matter intake; CPI = Crude protein intake; NDFI = Neutral detergent fiber intake; SL = significant level.

comparison was done using Tukey's (Honest Significant Difference) HSD test at P<0.05 (Sokal and Rohlf, 1981).

RESULTS

Chemical composition

The chemical composition of *A. saligna*, wheat bran and grass hay is presented in (Table 1). The nutrient content of experimental feeds varied as they came from different sources. Wheat bran contained the highest CP content followed by *A. saligna* and grass hay. The NDF content of *A. saligna* was lower than wheat bran and grass hay. The CT content of treatment feeds rose progressively from T2 to T5.

Dry matter and nutrient intake

The dry matter intake and nutrient intake data are presented in (Table 2). The highest total DMI (1226.88 g $days^{-1}$) and OMI (1105.95 g $days^{-1}$) were recorded for rams placed under T5. Total DMI and OMI significantly (P<0.001) higher in the supplemented rams than the control rams. The daily grass hay dry matter intake was not affected by supplementation and showed no significant difference (p>0.05) between the supplemented and control group.

Nutrient digestibility

Nutrient digestibility in rams supplemented with wheat bran and different levels of *A. saligna* leaves were significantly (P<0.001) higher in nutrient digestibility from the control group (Table 3). DCP values were significant (P<0.0001) higher at supplemented rams and pronounced at rams assigned to T4. *A. saligna* supplementation did not impose any negative effect on digestibility as the supplemented groups had higher digestibility than the control group.

Nitrogen balance

Nitrogen (N) intake and retention was efficiently utilized in T4 rams as that group had significantly (P<0.05) higher in

Table 3. Nutrient digestibility in highland sheep fed on grass hay and supplemented with wheat bran and graded level of *A. saligna.*

Nutrient (%)	Treatment					SEM	SL
	T1	T2	T3	T4	T5		
DMD	64.89[e]	75.51[d]	78.34[c]	80.54[a]	79.98[b]	0.0613	***
DOM	69.99[e]	78.34[d]	80.58[c]	81.99[a]	81.31[b]	0.07533	***
DCP	58.56[e]	75.48[c]	73.81[d]	77.38[a]	76.75[b]	0.10273	***
DNDF	58.51[e]	63.29[d]	69.60[a]	68.81[b]	67.12[c]	0.07922	***
DADF	57.61[c]	61.11[b]	68.88[a]	68.87[a]	68.90[a]	0.08847	***

[a, b, c, d, e] means within a row not bearing a common superscript letter significantly differ. ***= (p<0.0001); DMD = Dry matter digestibility; SEM = Standard error of mean; OMD = Organic matter digestibility; CPD = Crude protein digestibility; NDFD = Neutral detergent fiber digestibility; ADFD = Acid detergent fiber digestibility; SL= Significance level.

Table 4. Nitrogen intake, excretion and retention in highland sheep rams feed on hay and supplemented with wheat bran and graded level of *A. saligna.*

Parameter (g days^{-1})	Treatment					SEM	SL
	T1	T2	T3	T4	T5		
Total N intake	7.44[b]	10.91[ab]	13.97[ab]	14.86[a]	13.42[ab]	1.662	*
N voided in feces	2.41[b]	2.68[ab]	3.52[a]	3.50[a]	3.36[ab]	0.23775	*
N voided in urine	1.62	0.89	1.05	0.69	1.08	0.274	Ns
Total N voided	4.03[ab]	3.57[b]	4.57[a]	4.19[ab]	4.44[a]	0.1994	*
N retention	3.41[b]	7.34[ab]	9.40[ab]	10.66[a]	8.98[ab]	1.5262	*

[a, b]means within a row not bearing a common superscript letter significantly difference; *= (p<0.05); Ns = not significance; g days^{-1} = gram per day; SEM = Standard error mean; SL= Significance level.

Table 5. Body weight change and efficiency of highland sheep fed on basal diet grass hay and supplemented with wheat bran and graded level of *Acacia saligna.*

Body weight	Treatments					SEM	SL
	T_1	T_2	T_3	T_4	T_5		
Initial body weight (kg)	21.80[a]	21.9[a]	22.45[a]	21.6[a]	21.95[a]	1.0323	Ns
Final body weight (kg)	22.5[b]	25.75[ab]	28.2[a]	27.2[a]	27.15[a]	1.1805	*
ADBWG (g/d)	7.78[b]	42.78[ab]	63.89[a]	62.22[a]	57.78[a]	8.5515	*
FCE (g LWG/ g DMI)	0.007[b]	0.04[ab]	0.065[a]	0.061[ab]	0.066[a]	0.01255	*

[a, b]Mean in the same row with different superscript differ significantly; * = (P<0.05); SEM = standard error of mean; SL = Significance level; Ns = not significance; FCE = feed conversion efficiency; ADBWG = average daily body weight gain; (g/d) = gram per day); DMI = dry matter intake; LWG = live weight gain; kg = kilogram; g = gram; SL = significance level.

N intake and retention, but not to the other supplemented group and control group (Table 4). Rams assigned to T3 and T5 was higher (P<0.05) in N excretion, but T2 rams excrete less N (P>0.05).

Live weight changes

Rams of the supplemented group (T3, T4 and T5) had better (P<0.05) in their final weight and daily live weight gain (DLWG) (Table 5). However, the DLWG increased till T3 and start to decline even with an increase level of *A. saligna* in the highest supplemented rams (T4 and T5). This implies rams satisfy their requirement with supplemente of 200 g/days *A. saligna* and 200 g/days wheat bran. Adding more *A. saligna* means they excrete either in the form of urine or feces. The feed conversion efficiency (FCE) also varied significantly (P<0.05) between T1 and T3 and T5. However, for economic reasons T3 was best suited to the rams.

DISCUSSION

Chemical composition

DM, OM and CP of A. *saligna* used in this study contained 92.03, 84.91 and 14.84%, respectively. The

OM content found in this study is comparable with other authors (Ahmed, 2007; Moujahed *et al*., 2000; Mousa, 2011; Shumuye and Yayneshet, 2011). The CP content of *A. saligna* was comparable to 13.8, 13.76 and 15.7% CP (Krebs et al., 2007b; Safinaz et al., 2010; Chentli et al., 2014) and higher than the value reported by others (Shumuye and Yayneshet, 2011; Moujahed et al., 2000; Ahmed, 2007; Mousa, 2011). This variation arises from age and species of the Acacia plant, soil fertility where the Acacia plant grown and the season of the leaf harvest. Different studies also suggested this idea the differences in CP content between these browse plants are probably due to differences in protein accumulation in them during growth (Salem et al., 2006). Some differences might also have been due to stage of plant growth and/or season of collection (Ben Salem et al., 2005a). Nutritive value difference in *A. saligna* were primarily the result of change in maturity (Abdel-Fattah, 2005). Inconsistencies could also be due to sampling site and climatic influences on foliage growth and plant nutrient accumulation (Salem, et al., 2006). Abdel-Fattah (2005) also explains season of production affects the CP content of *A. saligna* that is CP content was lower in summer compare to autumn, winter and spring. Overall, the environment in which the plant grow had high impact on the plant characteristics and composition (Abdel-Fattah, 2005; Ben Salem et al., 2005a) also insisted soil type, fertility and water supply affect nutrient concentrations in plants.

The NDF, ADF and ADL content are less than the value reported by Shumuye and Yayneshet (2011). Similar to the CP content of *A. saligna* its fiber content also affected by different factors like production season and soil type, age of the plant and the like. In agreement with this (Abdel-Fattah, 2005) reported NDF, ADF and ADL content of *A. Saligna* had lower in winter compared to other seasons. The Acacia leaf used in this study was at the young age this may contribute to low fiber content. As the plant get older the fiber content rise and vice versa. Abdel-Fattah (2005) described the nutritive value variation of Acacia leaves were primarily due to maturity variation.

Condensed tannin content of dried *A. saligna* found in this study is lower than the value reported by (Abdel-Fattah, 2005) 63 g/kg DM to 113 g/kg DM in summer and winter, respectively for fresh *A. saligna*, 63.1 g/kg DM CT for fresh *A. saligna* (Chentli et al., 2014), 24.6 g/kg DM CT for *A. saligna* (Krebs et al., 2007b) and 18.67% of CT for *A. saligna* reported by Shumuye and Yayneshet (2011). The CT value of this study is within the beneficial category of 20 to 40 g/kg DM reported by Thi et al. (2005) of the variability in condensed tannin content contribution of many factors. According to Abdel-Fattah (2005), variation in CT appear because of soil type, fertility and water supply affect tannin concentrations in plants. CT content varied from source of plant parts and growing stage (Getnet et al., 2008) and plant age (Krebs et al., 2007a). Beside to the above variation treatment effect also one of the main factors in reducing the condensed tannin content of *A. saligna*. Drying of acacia foliage under shade or sun reduced their CT content (Ben Salem et al., 1999). Season of harvest, which collected in spring for this study also contributed in reducing tanning effect. According to Abdel-Fattah (2005), explains the high temperature effect in summer contributes to the concentration of tannin that change because of physiological maturity.

Dry matter intake

The daily total DM, OM, CP and NDF intake in this study was 24, 23.6, 44 and 14%, respectively. Similar to this study, Tamir and Asefa (2009) and Shumuye and Yayneshet (2011) reported that different forms of *A. Saligna* supplementation significantly increased the total DMI, OMI and CPI.

When animals exposed to tannin rich feeds they try to control their intake, this may affect further performance of the animal. Adverse effect of tannin rich feeds control animals by restricting their intake (Ben Salem et al., 2005a). As negative effect of tannin in *A. saligna* leaf can be healed by treating the intake of nutrient improves. Salem et al. (2006) reported that PEG treatment of *A. saligna* increased intake of DM and its components in sheep and goats. Ben Salem et al. (1999) brief treatment of *A. saligna* with PEG increase DCP intake. Similar to this Moujahed et al. (2000) also reported 195 g DM intake improvement observed when sheep feed on dry *A. saligna* and supplement with mineral block. In this study highest intake contribution of *A. saligna* in (T5) to the total DM intake reach 22%. This result was less as compared to 46% share of *A. saligna* from the total DM intake of sheep feed on lucerne hay based diet (Ben Salem et al., 1997). This variation may arise from the supplemental effect of wheat bran and the basal diet grass hay (Moujahed et al., 2000) insisted Acacia intake is somewhat related to the associated forage. Different A. saligna state improve the intake of animals when mixed with good quality roughage (Ben Salem, et al., 1997). Beside treatment methods in reducing the tannin effect of *A. saligna,* feeding to sheep is also beneficial than other livestock as sheep are more resistance to tannin rich feed. Abdel-Fattah (2005) supported this idea; it may be possible to use sheep as models for cattle to characterize tanniniferous feeds (Abdel-Fattah, 2005).

Nutrient digestibility and nitrogen balance

In this study nutrient digestibility increment was observed when moving from control to the supplemented group. Similar to this result, Ben Salem et al. (1999) and Krebs et al. (2007b) reported treatment of *A. saligna* with PEG improves DM and OM digestibility compare to feeding *A.*

saligna in fresh form. Ben Salem et al. (2005b) also insisted wood ash treatment have no effect on intake and OM digestibility of the diet rather it increase crude protein and NDFom digestibility. Similar to this study, Rojas et al. (2015) reported *Acacia* supplemention in sheep diet do not affect the digestibility rather it improves the intake and weight gain of sheep. Increase level of *A. saligna* in ewe supplementation improves digestibility (Maamouri et al., 2011).

Not only the *Acacia* treatment improves the digestibility in this study the supplemental wheat bran also contribute its own share. In agreement to this Moujahed et al. (2000) presented comparism between sheep fed on oat hay and dried *A. saligna* sheep fed on a similar basal diet supplemented with mineral block improves CP digestibility and nitrogen retention. The DCP value found in this study at the supplemental group 73.81 to 77.38% was comparable to 72.8% DCP reported for sheep fed *A. saligna* treated with PGE (Ben Salem et al., 1999). Further mineral block supplementation on *Acacia* based diets have a positive effect (Moujahed et al., 2000). Unlike to this result, Ben Salem et al. (1997) reported field drying, do not have an effect on nutrient digestibility till the DM 150 g whereas with exceeding this level negatively affect nutrient digestibility. The problem pronounced when supplement 300 g DM level of Acacia as it decreases OM, CO and NDF digestibility by 9, 12 and 15% respectively. At the highest level it can also decrease digestibility by 36% (Ben Salem et al., 1997). Air-drying of *A. saligna* has no effect on fiber digestibility (Ben Salem et al., 1999). The disparity of the results with respect to the effect of tannins on cell wall digestibility, suggests that the interaction between CT and cell wall carbohydrates may vary with plant species, animal species, tannin levels and possible tannin structure (Ben Salem et al., 1999). Ben Salem et al. (2005a) reported animals exposed to tannins early in life exhibited higher digestible crude protein intake. The differences in DM intake could affect diet digestibility (Ben Salem et al., 1997).

N intake was higher by 20 to 33% in the supplemented group than the control group. Similarly, N retention was higher in the supplemented group by 32 to 36% of the control group. However, the total N voided was not significant difference between the supplement and control group. This result agreed with Ben Salem et al. (1999) increased urinary N excretion, though not significant. This implies the N consumed was converted to desired hvoided through the wastes Ben Salem et al. (1999) explained, although sheep ingested equal amounts of nitrogen (N), N excretion in feces and urine was similar in sheep fed fresh or air-dried acacia foliage. Hence, *A. saligna* treatment with shed drying had significant impact in reducing the protein binder tannin as the supplemental group display higher N intake but similar in voided N. This may arise from the early adaptation of the rams to the *A. saligna* as the digestibility trial undertaken following the growth evaluation trial. In agreement to this idea. Ben Salem et al. (2005a) reported animals exposed to tannins early in life exhibited higher retained more N than the inexperienced lambs. Over all in this study the N balance was positive this helps all the rams in this study display weight gain. The positive N balance in this study may arise from the treatment applied to *A. saligna* as Ben Salem et al. (1999) reported PEG treatment of *A. saligna* had positive effect on N balance. Ben Salem et al. (2005b) also insisted feeding untreated acacia resulted in negative N balances but with treatment, N balance resulted in positive N balance. Overall, supplementation of *A. saligna* had posetive effect on N balance and improves digestibility in sheep feeding (Safinaz et al., 2010).

Live weight changes

The daily live weight gain was increased as level of *A. saligna* increased to 183.8 g DM day in T3 and declined gradually when the level of *A. saligna* was increased to 267.3 and 344.4 g DM day in T4 and T5, respectively. *A. saligna* leaves could be best included in the grass hay based feeding in dried form at the rate of 183.8 g DM day for improved nutrient utilization and growth performance of yearling lambs.

Live weight gain found in this study was comparable to 73 g/day gain for Barbarine and Queue Fine de l'Ouest sheep fed on ad libitum dried *A. saligna* and supplemented with 400 g barely and 30 g mineral and vitamin supplement (Ben Salem et al., 1999). Similarly Ben Salem et al. (2005a) also reported 50 g day gain for Barbarine lambs early experienced to dried *A. Saligna* leaf. Unlike this finding, Mousa (2011) reported daily weight gain of 186.31$\pm$19.28 g/day for Awassi fed *ad libitum* dried *A. salina* supplemented with concentrated ration. However, Ben Salem et al. (2005a) reported weight loss of Barbarine lamb in-experienced to dried *A. saligna* leaf. The daily live weight gain found in this study was the result of the supplemental feed of wheat bran and the treatment applied to *A. saligna* leaf. Ben Salem et al. (1999) described an increase in the rate of gain for growing sheep given PEG-treated acacia reflects the positive effect of PEG on the availability of nutrients, mainly proteins, in the diet. Ben Salem et al. (2005b) also insisted higher growth performance of lambs probably results from the higher intake and better provision of available nutrients to these animals.

Conclusions

The present result suggested that supplementation of highland sheep with wheat bran and graded level of *A. saligna* had a positive effect on the feed intake, live weight gain and digestibility. The effects were relatively more pronounced for sheep supplemented with 183.8 g DM day dried *A. saligna*.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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