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Effect of Feeding *Acacia* as Supplements on the Nutrient Digestion, Growth Performance, Carcass Traits and Some Blood Constituents of Awassi Lambs under the Conditions of North Sinai

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ABSTRACT
This research was conducted to study the effect of different levels of acacia in the feed of weaned Awassi lambs on the digestibility coefficient and nutritive values, growth performance, carcass traits and some blood constituents. Four rations were nutritionally evaluated through four digestion trials with ram lambs. Rations 2 and 3 which gave the highest feeding value were chosen and compared with the control ration in a feeding trial conducted using 18 newly weaned (16 weeks of age) Awassi lambs which were divided into three similar groups of 6 lambs each for 84 days. The main results showed significant differences among rations in the digestibility coefficients for DM, OM, CP, EE, CF and NFE which decreased as acacia consumption increased. Diet 1 and 2 had the highest ($p<0.01$) TDN value, followed by diet 3 then diet 4. All animals were in positive N balance in the four experimental rations. Feed cost/kg gain was reduced and economic efficiency improved by increasing acacia in sheep rations. Lambs fed 40% acacia recorded the highest values of dressing percentage. Dietary had no significant effects serum constituents of lambs which were all within the normal ranges for healthy lambs. It could be concluded that replacement of acacia up to 40% in growing lambs diet improved growth performance traits, economical efficiency, dressing percentage and decreased feed cost per kg body gain from weaning to marketing weight.

Key words: *Acacia saligna*, growing lambs, growth performance, digestibility, carcass quality, blood metabolites

INTRODUCTION
In Egypt, in the new reclaimed desert lands, there is a great shortage in animal feedstuffs during summer season and early autumn (Yousef, 2005). Using non-traditional feeds in animal feeding substantially aid in solving this problem, which decreased the cost of feeding and hence the market price of animal products. Many attempts have been made to introduce forage which suit the weather and soil conditions of the new reclaimed lands (Yousef, 2005).

The energy rich ingredients (mainly, cereal) are not available for the nomadic tribes in Sinai, especially middle Sinai, since they are transported to Sinai from the Nile valley at high costs compared with acacia plants which grow all year round in Sinai and are considered as a good feed source for livestock (goats sheep and camels), especially during the dry season (Mousa and El-Shabrawy, 2003).

In North Sinai, *Acacia saligna* has the potential to provide both protein and energy supplements for small ruminants raised on poor quality forage particularly during the dry season (Mousa and Shetaewi, 2002; Mousa and El-Shabrawy, 2003). *Acacia* plants grow all round the year in North Sinai (Mousa and El-Shabrawy, 2003).

Acacia contains about 12 to 18% crude protein on DM basis (Ben Salem *et al.*, 2002b; Mousa and Shetaewi, 2002; Mousa and El-Shabrawy, 2003; Bhatta *et al.*, 2002; Moujahed *et al.*, 2005; Salem, 2005; Yousef, 2005; Van Thanh *et al.*, 2005; Nyambati *et al.*, 2006; El-Waziry, 2007; El-Meccawi *et al.*, 2008; Sanon *et al.*, 2008a; Yayneshet *et al.*, 2008; Ngambi *et al.*, 2009) depending on area and aridity.

Several studies were conducted to partially replace traditional feed ingredients by acacia. Replacing 40% of the Total Digestible Nutrients (TDN) from basal ration for Awassi sheep by acacia increased milk yield by 16.5% compared with feeding control diet and improved growth performance of their lambs from birth to weaning and reduced the costs of feeding by of 38% compared to those fed the control diet (Mousa and Shetaewi, 2002). Replacing 50% of the daily dry matter alfalfa intake for Barki sheep with acacia foliage increased Total Digestible Nutrients (TDN) and reduced digestible protein (El-Lakany *et al.*, 1991).

Many leguminous fodder trees and shrubs have high protein levels and are potentially promising supplements to overcome nutrient deficiencies provided anti-nutritional factors as tannins and other secondary compounds can be controlled. Tannis are polyphenolic substances that occur widely in plants and have the ability to bind proteins (Makkar, 2003; Min *et al.*, 2003). Salem *et al.* (2004), detected phenolic compounds, saponins, alkaloids and lectins, in *Acacia saligna* leaves which can be highly toxic to ruminal and intestinal bacteria. Anti-nutritional factors such as condensed tannins protect proteins from degradation in the rumen.

Tannin-protein complex on one hand reduces the availability and digestibility of proteins for ruminants, but on the other hand it allows more dietary protein to escape rumen degradation to reach the lower digestive tract (Reed, 1995; Min *et al.*, 2003).

Among the different means investigated to reduce the deleterious effects of anti-nutritional factors was air-drying and supply of exogenous nutrients. The PEG was found more efficient in improving the nutritive value of acacia foliage (Ben Salem *et al.*, 1997; Moujahed *et al.*, 2000), thus increasing sheep growth (Ben Salem *et al.*, 1999a; Moujahed and Kayouli, 2003).

Metabolism traits have shown that the nutritive value of *acacia* foliage is low although the Crude Protein (CP) content is high. Condensed Tannins (CT) which from insoluble complexes with proteins, proved to be the major constraint reducing the feeding value of acacia (Degen *et al.*, 1997).

The most important effect of tannins on intake and digestibility was due to formation of tannin-protein complex's (Jones and Mangan, 1977). However, Terril *et al.* (1992) and Bhatta *et al.* (2000, 2001) suggested that tannin could have a positive effect. Moreover, Bhatta *et al.* (2005) reported that, formation of Condensed Tannins (CT)-protein complex had a positive effect for sheep grazing on semi-arid range; this was due to the levels of tannins ingested.

Van Thanh *et al.* (2005) reported that the Condensed Tannins (CT) in *Acacia cyanophylla foliage* were reduced after 2 days of drying under shade or in the sun. The total tannins were reduced by 22.6 and 11.3% for the wilting and drying, respectively, compared to fresh, but these differences were not significant.

Mahgoub *et al.* (2008) reported that feeding non-conventional foods containing phenols and condensed tannins for extended periods may produce subtle negative effects on animal's health and production.

The aim of this experiment was to study the effect of feeding of different levels of *Acacia saligna* on digestibility, nitrogen balance, growth performance, carcass traits and serum constituents of Awassi sheep under North Sinai conditions.

MATERIALS AND METHODS

This study was carried out at the experimental farm of Animal Production Department, Faculty of Environmental Agricultural Sciences, El-Arish, Suez Canal University during the period from 2006 to 2007. The climatic characteristic of this region is semi-arid (Long. 33.75 E, Lat. 31.27 N) with an average annual rain in fall of about 94 mm (average 10 years from 2000 to 2009) in North Sinai (CLAC, 2008).

Plant material: *Acacia saligna* (leaves and twigs) were harvested daily at morning from the farm of Animal Production Department. These plants were collected by hand, then air-dried until DM content was around 450 g kg^{-1} feed.

The experimental work of this study was divided into two successive parts. During the first period, digestibility and nitrogen balance trails were conducted before the commencement of the feeding trial to evaluate the four experimental diets. Three ram lambs with an average live body weight of 38 kg were used to estimate the digestibility coefficients of the diets. They were individually kept and fed in metabolic crates. The digestibility trial consisted of 14 days as a preliminary period followed by 7 days as a collection period. The control ration (T1) was a basal diet consisting of CFM and rice straw to cover their nutritional requirements according to NRC (1985). Rations 2, 3 and 4 consisted of CFM to cover 80, 60 and 40% of the TDN requirements and were offered air-dried acacia, respectively.

The daily CFM of rations were offered in almost two equal parts at 8:00 am and 4:00 pm whereas acacia was offered ad lib. 9:00 am Refusals were collected just before offering the next days. During the collection period, total daily faces output was collected and 10% sample was taken. And acacia were first dried at 65°C for 48 h. The final dry matter of feed and faces were determined after drying in a forced air oven at 105°C for 24 h. Dried samples were mixed and ground through in a wily mill with a 2 mm screen. Dry samples were kept in a plastic vials at room temperature for the chemical analysis. Total daily urinary excreted from each ram lambs were collected in jar containing 100 mL of 20% H_2SO_4 to prevent ammonia loss. Daily samples of 10% were taken from each animal.

During the second part, the effect of the control ration, 2nd and 3rd rations on growth performance, carcass characteristics, some blood metabolites and economical evaluation were (ration 4 was discarded). Eighteen newly weaned Awassi lambs (16 weeks of age) were divided according to body weight into three similar groups of six lambs each. The three groups were assigned at random to receive the three experiments rations for 12 weeks. The average initial body weights of lambs for T1 (control), T2 and T3 were 23.38, 23.04 and 24.41 kg, respectively.

The lambs of the control ration (T1) was fed a basal ration consisting of concentrate feed mixture and rice straw to cover their nutritional requirements according to NRC (1985) which was adjusted every two weeks according to body weight and growth rate. Second and 3rd rations were fed CFM to cover 80 and 60% of the Total Digestible Nutrient (TDN) requirements and were offered air-dried acacia *ad libtum*.

The lambs were drenched against internal parasites before the start of the experimental. The animals were watered. natural saline well water containing 3400 ppm. The analysis of drinking under ground water was carried out to Page *et al.* (1982).

The animals of each group were fed and housed in a 6×10 m^2 semi-open shaded pens.

Animals were individually weighed at the beginning of the experiment then every two weeks and daily gain was calculated for each animal.

Mineral and vitamins blocks were fixed among cages to enable the animals to lick when ever they required. Samples of the experimental ingredients, acacia was taken for chemical analysis at the beginning of the collection period of the digestibility trials and the chemical of the consumed rations were calculated.

Slaughtering procedure and carcass measurements: At the end of the growth experiment, three male animals in each group were randomly selected for slaughter. The lambs were fasted for at least 12 h and body weight recorded before slaughtering. The body was weighed again after bleeding, skinned eviscerated and the skin, head, fore feet, hind feet and the viscera were removed. Weight of the gut content was calculated as the difference between full and empty weight. The weight of other components of offal or non-carcass parts such as kidney and pelvic fat and different organs (liver, spleen, lung and trachea diaphragm, heart, kidneys and testes) were recorded.

$$\frac{\text{The dressing percentages were calculated as carcass weight}}{\text{Weight at slaughter}}\times 100$$

Blood samples were taken monthly before morning feeding. Blood samples were by jugular puncture from 3 animals from each group. Within one hours of collection, the samples were centrifuged at 3000 rpm for 10 min. The serum was separated and stored at -20°C until analysis. The results of the 3 months samples were averaged.

Serum total protein, albumin, total lipids, glucose, cholesterol, urea, creatinine, ALT, GPT, AST and GOT levels were determined colorimetrically using commercial kits Bio-Merieus, Laboratory Reagent and products, France. The globulin values were obtained by subtracting albumin values from protein values.

Samples of feeds, faces and urine were chemically analyzed according to AOAC (1990). All animals were kept under the same managerial and environmental conditions.

Data were subjected to statistical analysis by the SAS (1996) computer program using the General Linear Models (GLM). Differences between treatments means were tested for using Duncan multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical of the ingredients and the experimental rations: The chemical composition of the ingredients used to formulate the experimental rations (Table 1), was within the normal ranges published in Egypt (El-Shaer *et al.*, 1984; MAO, 1997; Mousa and Shetaewi, 2002; Mousa and El-Shabrawy, 2003) and Bhatta *et al.* (2005) and Van Thanh *et al.* (2005).

Table 1 shows that Crude Fiber (CF) was higher in acacia than CFM, while Ether Extract (EE), crude protein, Nitrogen Free Extract (NFE) and ash were lower than CFM. The values were 1.75, 13.07, 53.61 and 8.07% for acacia vs. 2.90, 17.30, 58.39 and 9.81 for CFM, resp. These results are in agreement with those reported by Mousa and El-Shabrawy (2003).

The proximate analyses of the consumed experimental rations are also shown in Table 1. The control ration (T1) had higher DM% then rations 2, 3 and 4 because of the higher moisture content in acacia. Ration 4 had lower CP, EE and ash contents but higher CF than other rations.

Digestibility coefficients and nutritive values: Digestion coefficients of the experimental rations are presented in Table 2. Differences were observed in the digestion coefficients of DM, OM,

Table 1: Chemical composition of the ingredients and calculated chemical composition of the consumed rations (%)

		On DM basis						
Ingredients	DM	OM	CP	EE	CF	NFE	ASH	GE*
Concentrate Feed Mixture (CFM)	87.30	90.19	17.30	2.90	11.60	58.39	9.81	17.65
Acacia	46.05	91.93	13.07	1.75	23.50	53.61	8.07	17.67
Rice straw	91.30	80.60	3.50	1.15	39.20	36.75	19.40	15.22
Calculate chemical composition								
Ration 1	88.0	88.65	15.82	2.76	17.81	52.65	11.35	17.42
Ration 2	74.83	90.76	16.17	2.64	17.46	54.49	9.24	17.72
Ration 3	70.01	90.94	15.71	2.53	18.94	53.76	9.06	17.73
Ration 4	61.14	91.18	15.20	2.39	20.21	53.38	8.82	17.74

*Ration 1 Concentrate feed (CFM) plus rice straw, *Ration 2 Concentrate feed (CFM) plus ad lib acacia (20%), *Ration 3 Concentrate feed (CFM) plus acacia ad lib (40%), *Ration 4 Concentrate feed (CFM) plus acacia ad lib (60%), *Gross energy concentration (MJ kg^{-1} DM), calculated according to MAFF (1975) using the equation GE MJ kg^{-1} DM = 0.0226CP+0.0407EE+0.0192CF+0.0177NFE, Where, CP, EE, CF and NFE are presented as g kg^{-1} DM

Table 2: Digestion coefficients and nutritive values of the experimental rations

	Experimental rations			
Items	1	2	3	4
DM%	65.85 ± 0.43^{A}	62.93 ± 0.75^{B}	62.60 ± 0.21^{B}	60.06 ± 0.52^{C}
OM%	68.67 ± 2.06^{a}	67.35 ± 0.36^{b}	65.54 ± 1.38^{ab}	62.17 ± 0.93^{b}
CP%	75.07 ± 2.84^{A}	68.51 ± 2.08^{B}	64.81 ± 1.13^{Bc}	59.67 ± 0.60^{C}
EE%	68.05 ± 0.17^{A}	67.2 ± 0.15^{B}	68.08 ± 0.14^{A}	67.78 ± 0.12^{A}
CF%	55.13 ± 0.41^{A}	53.07 ± 0.18^{B}	52.73 ± 0.14^{B}	49.77 ± 0.12^{C}
NFE%	70.81 ± 0.31^{A}	69.26 ± 0.18^{B}	66.87 ± 0.13^{C}	65.77 ± 0.14^{B}
Nutritive value (%)				
TDN	62.11 ± 0.69^{A}	62.07 ± 0.31^{A}	60.06 ± 0.15^{B}	57.88 ± 0.06^{C}
DCP	12.4 ± 0.47^{A}	11.07 ± 0.31^{B}	10.18 ± 0.17^{B}	9.07 ± 0.09^{C}

$^{A, B, C, D}$: Means bearing different superscripts within the same row are significantly different at p<0.01, ^{a,b}: Means bearing different superscripts within the same row are significantly different at p<0.05

CP, EE, CF and NFE among rations 1, 2, 3 and 4. The digestibility coefficients of DM, OM, CP and CF were significantly (p<0.01) higher in ration 2 (CFM to cover 80 and 60% of the TDN requirements and acacia ad lib) than 4 (CFM to cover 40% of the TDN requirements and acacia ad lib. There was no differences among EE digestibility of rations 1, 3 and 4, but EE digestibility (67.2) was low (p<0.05) for ration 2 compared to other rations. These results agree with the data of Mousa and El-Shabrawy (2003) who found that the digestibility coefficients of DM, OM, CP, EE, CF and NFE of diet consisted of Concentrate Feed Mixture (CFM) to cover 70% of the TDN requirements of kids and green acacia ad lib were lower than those of the control diet. On the other hand, Mugweni *et al*. (2001) reported that the dry matter digestibility of acacia/maize mixture was similar to maize alone (62.2 vs. 63.8%), both higher than the *Leucaena*/maize mixture (57.6%).

Generally, the coefficients of DM, OM, CP, CF and NFE decreased with increasing acacia inclusion in the diet. The best CP digestibility (75.07) was that of ration 1 (control) followed by rations 2, 3 and 4 (68.51, 64.81 and 59.67, respectively).

The adverse effect of acacia the digestibility of the ration should be ascribed to the inhibitory effect of its high tannin content on microbial activity (Malechek and Provenza, 1981). The type of tannin, the level and activities of tannin in browse are variable leading to varied effects on the reduction of digestibility (Ebong, 1995).

On the other hand, Sanon *et al.* (2008b) reported that the *Acacia senegal* leaves with high cp content had good intake characteristics and showed high nutrient digestibility. It seems that the protein in acacia is poorly digested by sheep and goats owing to the presence of tannins (4-11%) DM basis (Degen *et al.,* 1995; Abou El-Nasr *et al.*, 1996).

Anti-nutritional factors such as condensed tannins protect plants from degradation in the rumen. They are reported to form combination with proteins in the rumen rendering them unavailable for digestion and consequently increase their out put in faces (Robins and Brooker, 2005).

Feeding values: The feeding values of, ration 1 (control) and 2 had the highest (p<0.01) TDN value followed by ration 3 then ration 4 which had the lowest TDN value The superiority of the rations 1 and 2 in TDN is mainly due to their almost equal high CFM contents. On the other hand, rations 3 and 4 contained high levels of acacia which reflected lower TDN value. Regarding the DCP% of the four experimental rations (Table 2), it was clear that the differences among the four rations were significant (p<0.01). The highest value was that of ration 1 (control) followed by ration 2, 3 and 4. The low DCP% value of ration 4 may be due to its high level of acacia which contains a high value of tannins therefore is showed the lowest value of CP digestibility, as reported by Mousa and El-Shabrawy (2003). The present findings are in agreement with those reported by Abou El-Nasr *et al.* (1996) and Mohamed (1996).

The absence of negative effects of tannin on intake could be attributed to the relatively low quantity of tannin ingested and/or to the effect of drying the acacia before feeding. Barry *et al.* (1986) reported that less than 40% of tannin in the ration was beneficial to ruminants. Igwebuike *et al.* (2008) reported that the growing rabbits can tolerate 40% *Acacia alibido* pods in their diets without adverse effect on nutrient digestibility and blood parameters.

Nitrogen balance: The date of N-balance recorded for the four experimental rations are reported in Table 3.

Table 3: Nitrogen balance of lambs fed the experimental rations

	Experimental rations			
Items	1	2	3	4
No. of animals	3	3	3	3
N-intake (g/h/d)	31.24±0.22^{A}	29.39±0.12^{C}	29.90±0.02^{B}	26.66±0.12^{D}
Fecal-N (g/h/d)	7.80±0.06^{D}	9.15±0.23^{C}	10.26±0.05^{B}	11.46±0.23^{A}
N-digested (g/h/d)	23.44±0.37^{A}	20.24±0.33^{B}	19.63±0.06^{B}	15.20±0.26^{C}
Urinary-N (g/h/d)	11.03±0.32^{A}	8.70±0.15^{B}	8.50±0.19^{B}	8.77±0.10^{B}
N-balance (g/h/d)	12.04±0.06^{A}	11.45±0.17^{B}	11.13±0.13^{B}	6.43±0.17^{C}
NB/NI x100	39.71±0.45^{A}	38.96±0.57^{A}	37.22±0.46^{B}	24.12±0.58^{C}
NB/ND x100	51.02±1.52^{A}	56.94±1.37^{A}	57.54±1.36^{A}	42.44±1.21^{B}

$^{A, B, C, D}$: Means with different superscripts within the same row are significantly different at p<0.01

In all animals on the four rations were in N. balance. The highest N intake was recorded for ration 1 followed by group 3, 2 and 4. The amounts excreted in the feces are reflected on the CP digestibility coefficients. Fecal-N was highest with ration 4 including high levels from acacia compared with rations 1, 2 and 3.

The negative effect of acacia tannins on N-balance was demonstrated in numerous studies on sheep and goats (Reed *et al.*, 1990; Degen *et al.*, 1995; Ben Salem *et al.*, 1999a, b, 2000, 2002a, 2005). In addition, acacia leaves contains in average 20% of its total N bound to fiber (N-ADF) as reported by Ben Salem *et al.* (1995).

The present findings are in agreement with those reported by Woodward and Reed (1997) and Mousa and El-Shabrawy (2003).

The amount excreted in the urine was highest with ration 1 which received the highest N-intake.

Ben Salem *et al.* (2005) reported that lambs fed on acacia diet retained less nitrogen than those on the oat hay diet ($p<0.001$). While, Sotohy *et al.* (1997) reported that absorbed and retained nitrogen (g/d) were decreased with increasing levels of *Acacia nilotic* (tannin-rich plants) by Baladi goats in Assuit.

The value of N-balance/N-absorbed (the biological values) was also improved as acacia inclusion was increased.

The growth trial:

Live body weight and daily gain: The Awassi lambs used in the experiment were of North Sinai type especially in Rafah, Shiekh Zeyuied and El-Arish regions, this breed is well adapted in the semi-arid zones, Awassi sheep have a high potential for milk production (Guirgis, 1988).

The final weights and daily gain of lambs were not significantly affected by three experimental rations during the whole experimental period (Table 4).

Generally lambs fed ration 3 (40% acacia) had the highest body weight followed by ration 2 (20% acacia) then those fed ration 1 (control). The highest values of Total Weight Gain (TWG) and Daily Gain (DG) were shown for ration 3 (15.65 kg and 186.31 g/d), respectively. While, the intermediate values was recorded for ration2 (14.21 kg and 171.9 g/d, resp.) and the lowest total gain and daily gain were recorded for control ration (13.48 kg and 160.47 g/d), respectively. Similar

Table 4: Growth performance of lambs as affected by feeding diets containing different levels of acacia (X-±SE) from 16 to 28 weeks of age

	Experimental rations		
Items	1	2	3
16 weeks (kg) initial	23.38±1.24	23.04±0.58	24.41±1.18
18 weeks (kg)	26.05±1.33	25.66±0.70	26.97±1.41
20 weeks (kg)	28.44±1.21	28.22±0.88	30.66±1.47
22 weeks (kg)	31.26±0.89	30.94±1.05	33.52±1.76
24 weeks (kg)	32.94±1.05	32.74±1.27	36.36±2.17
26 weeks (kg)	34.84±2.49	34.74±1.37	38.37±2.4
28 weeks (kg)	36.86±1.48	37.48±1.38	40.06±2.42
Total gain (kg)	13.48±1.48	14.44±0.84	15.65±1.62
Daily gain (g)	160.47±17.60	171.90±10.05	186.31±19.28

All difference between three rations were not significant $p<0.05$

Table 5: Performance of lambs fed the experimental rations

	Experimental rations		
Items	1	2	3
Initial body weight (kg)	23.385±1.24	23.04±0.58	24.41±1.18
Finial body weight (kg)	36.86±1.48	37.48±1.38	40.06±2.42
Total gain (kg)	13.48±1.48	14.44±0.84	15.65±1.62
Daily gain (g)	160.47±17.6	171.90±10.05	186.31±19.28
Total dry matter intake (kg)	99.34	94.34	99.64
Total DMI (g/h/d)	1182.60	1123.10	1186.30
TDN intake (g/h/d)	734.00	697.00	711.60
DCP intake (g/h/d)	146.64	124.33	120.76
Feed conversion			
kg DM/kg gain	7.37	6.53	6.37
kg TDN/kg gain	4.57	4.05	3.82
kg DCP/kg gain	0.91	0.72	0.65

trends were obtained by Shetaewi *et al.* (2001), Mousa and El-Shabrawy (2003) and Yousef (2005) reported that the concluded that up to 40% acacia leaves could be used and safely in the diet of rabbits without adversely affecting their reproductive under subtropical conditions.

Abd-Alla *et al.* (2007) and Abdel-Samee *et al.* (2008) reported that feeding *Acacia saligna* improved productivity of heat stressed growing lambs and increased ($p<0.05$) daily gain and relative growth rate by 15.48 and 16.0%, respectively.

DM intake and feed conversion: The average of dry matter intake by lambs given ration 1 (control) compared to rations 2 and 3 supplemented with acacia are present in Table 5. The DM intakes (kg/heed/d) were 1.182, 1.123 and 1.186 kg for lambs fed rations 1, 2 and 3, respectively. Feed conversions in terms kg feed kg^{-1} gain of were 7.37, 6.53 and 6.37 for rations 1, 2 and 3, respectively. These values were worse than those obtained by Momani Shaker *et al.* (2002, 2003) for Awassi ram lambs. However, similar results were reported by Harb (1994) who found the feed conversion of Awassi male lambs to be 6.55 in an experiment lasting for 154 days with high concentrate rations.

Daily TDN and DCP intakes (g/head/d) were 734, 697 and 712 and 147, 124 and 121, for rations 1, 2 and 3, respectively. Daily intake from CFM and acacia by Lambs for ration 3 could cover their nutritional requirements (maintenance and growth) according to NRC (1985) from TDN for sheep. However, these values of TDN from acacia could cover 40% TDN from nutritional requirements. These obtained results are in agreement with those reported by EL-Lakany *et al.* (1991), Mousa and Shetaewi (2002), Mousa and El-Shabrawy (2003) and Yousef (2005). The corresponding TDN intake/kg gain was 4.6, 4.05 and 3.82 kg and DCP intake/kg gain were 0.91, 0.72 and 0.65.

This indicated better feed conversion as DM, TDN and DCP intakes/kg gain for ration 3 (40% acacia) compared with lambs fed ration 2 and the control. In general, feed conversion improved by increasing acacia ratio up to 40%.

Economical evaluation: The obtained results of economical for lambs fed the experimental diets are presented in Table 6. Data revealed that ration 1 (control) was the highest in feed cost to give kg gain (8.89 LE) followed by ration 2 (6.61 LE) and ration 3 (5.74 LE).

Table 6: Economical efficiency for lambs fed the experimental rations

	Experimental ration		
Items	1	2	3
Dry matter intake (kg)			
Roughage	15.34	26.14	35.47
Concentrate	84.00	68.20	64.17
Total DM intake	99.34	94.34	99.64
Roughage cost (LE)	2.30	---	---
Concentrate cost (LE)	117.60	95.48	89.84
Total feed cost (LE)	119.90	95.48	89.84
Feed cost/kg gain (LE)	8.89	6.61	5.74
Total interest (LE)	149.70	193.32	223.16
Interest/kg gain (LE)	11.11	13.39	14.26
Improvement (%)	---	20.52	28.35

Price of 1 kg DM feed for CFM and rice straw were 1.40 and 0.15 LE, respectively. Total feed cost = Price of 1 kg DM feed×total dry matter consumed. Feed cost/kg gain = Total feed cost/Total body weight gain. Price of 1 kg Live body weight = 20 LE at the time of the experiment. Total interest = (price of 1 kg live body weight×Total gain kg) – (total feed cost). Interest/kg gain = Price of 1 kg live body weight gain-feed cost/kg gain

The highest cost of one kg gain for the ration was mainly due to the high proportion and price of CFM which increased the total cost of the diet by increasing of CFM in diet. While, lower cost of one kg gain for ration 2 and 3, was due to the lower price of acacia and to the low proportion of the expensive CFM, which reduced the total cost of the diet by increasing the acacia, which was associated with the highest daily gain and the best feed conversion.

Addition of acacia to the diet resulted in an improvement of interest/kg gain. The improvements were 20.52 and 28.35 for rations 2 and 3 above the control diet.

Similar results were reported by Mousa and El-Shabrawy (2003) who found that cost of feeding/kg gain was reduced when CFM was substituted by acacia in ration of Damascus kids.

Carcass characteristics: The effects of diets on carcass and organ weights are shown in Table 7. The averages of fasting weight; hot carcass and dressing out percentage of ration 3 were higher than those of the other rations, with no significant differences among them. The dressing percentages (including tail fat) were 52.51 and 50.28% in lambs fed experimental rations 3 and 2, respectively when compared with lambs of the control group (48.28%) but with no significant differences. These results agree with those of Momani Shaker *et al.* (1997, 2002), Allam *et al.* (2005) and Sanon *et al.* (2008b).

Dressing percentage in cold condition in the ranged from 50.13 to 52.43% for fat tailed Awassi ram lambs Momani Shaker *et al.* (2002). Also, Allam *et al.* (2005) reported that the average slaughter weight, average carcass weight and average dressing percentage were 42 kg, 21.57 kg and 51.35%, respectively for Saedi lambs. Mohamed *et al.* (2005) reported that the dressing percentage of lambs ranged from 49.44 to 51.67. On the other hand, Abdel Monein (2009) reported that the dressing percentage were 56.2, 53.3 and 53.10 for Ossimi, Barki and Rahmani ram lambs under intensive productions, El-Asheeri *et al.* (2006) found that the dressing percentage was approximately similar for Rahmani (49.1%) and Ossimi (49.8%) ram lambs.

The highest dressing percentage of carcass without tail fat was 48.28 and 46.04% in carcass of experimental ration 3 and 2 when compared with carcass of control ration 43.89%. These results

Table 7: Effect of feeding the experimental diets on carcass and organ weight of lambs

	Experimental rations		
Items	1	2	3
Slaughter weight (kg)	38.50±1.70	37.55±1.52	42.16±3.61
Hot carcass weight with tail fat (kg)	18.591±0.97	18.88±0.83	22.14±1.87
Dressing % with tail fat	48.28±0.22	50.28±1.02	52.51±0.63
Hot carcass weight without tail fat (kg)	16.90±1.12	17.29±0.70	20.36±2.06
Dressing % without tail	43.89±0.96	46.04±0.71	48.28±0.87
Feet weight (4 feet) (kg)	1.13±0.08	1.03±0.04	1.12±0.10
Head weight (kg)	2.59±0.20	2.39±0.17	2.49±0.19
Liver weight (g)	766.67±31.79	622.99±35.00	666.40±73.71
kidney weight (g)	155.00±12.58	125.33±7.42	124.67±8.82
Testis weight (g)	236.67±12.01	273.50±46.19	326.66±76.23
Spleen weight (g)	83.33±6.67[A]	52.34±4.40[B]	55.47±3.33[B]
Heart weight (g)	238.33±6.00	209.66±14.53	196.33±35.76
Lungs and trachea weight (g)	458.34±44.19	382.94±21.51	484.67±22.85
Total weight of offal's (kg)	1.94±1.02	1.67±0.83	1.85±0.95
Tail fat weight (kg)	1.69±0.25	1.59±0.15	1.78±0.25
Kidney fat (g)	188.33±51.88[b]	242.76±20.74[b]	528.33±141.2[a]
Internal fat weight (g)	506.60±91.0[b]	810.00±25.0[b]	1590.00±16.0[a]
Skin weight (kg)	3.66±0.16	3.92±0.11	3.89±0.03

[A, B]: Means bearing different superscripts within the same row are significantly different at p>0.01, [a, b]: Means bearing different superscripts within the same row are significantly different at p>0.05

agree with the data of Yayneshet *et al.* (2008), who found that the dressing percent for male goats increased with increased level of acacia etbic fruit supplement (1.5% on body weight basis). Similar, results were reported by Momani Shaker *et al.* (2003) who found that the average dressing percentage of Awassi ram lambs was 43.49%.

The head and legs weights did not show remarkable change among groups. Also, other offal's and organs (liver, kidneys, heart and lungs and testes) did not record any differences among rations.

Data in Table 7 showed that the internal fat and kidney fat were significantly ($p<0.05$ and $p<0.01$) the highest, being 1.59 and 0.53 kg, respectively in carcass of lambs fed experimental ration 3. The corresponding values for lambs fed rations 2 and 1 were 0.81, 0.242, 0.507 and 0.188 kg.

In general all organs appeared normal with no apparent lesions. It appeared therefore that of acacia in the ration had no deleterious effects on carcass quality.

Blood serum parameters: Table 8 shows the blood serum parameters in terms of total protein, albumin, globulin, urea, cholesterol, total lipids, glucose, creatinine, SGOT and SGPT concentrations when growing lambs were fed the experimental.

No significant ($p>0.05$) changes concerning these metabolites were found.

The values of total protein and their fractions, urea, cholesterol, glucose, creatinine, SGOT and SGPT concentrations were within the normal range reported by Mousa and Shetaewi (2002) on ewes fed *acacia*. Gabr *et al.* (2005) and Al-Shanti and Abo Omar (2005) reported similar results with growing lambs.

Table 8: Some blood serum constituents of lambs fed the experimental rations

	Experimental rations		
Items	1	2	3
Total protein (g dL^{-1})	6.28±0.20	5.87±0.33	5.77±0.24
Albumin (g dL^{-1})	3.19±0.17	2.98±0.22	3.35±0.09
Globulin (g dL^{-1})	3.09±0.28	2. 89±0.43	2.42±0.24
Albumin/Globulin ration	1.03	1.03	1.38
Urea-N (mg dL^{-1})	31.51±2.44	35.50±2.10	30.78±3.07
Cholesterol (mg dL^{-1})	84.43±1.35	82.44±0.60	83.22±0.75
Total lipids (g dL^{-1})	5.11±0.02	4.17±0.02	4.97±0.02
Glucose (mg dL^{-1})	51.08±4.82	41.75±1.75	49.76±3.07
Creatinine (mg dL^{-1})	1.17±0.08	1.30±0.15	1.20±0.21
SGOT (μ mL^{-1})	17.00±0.06	17.50±0.08	18.00±1.12
SGPT (u mL^{-1})	26.67±1.66	25.00±0.57	26.00±0.10

All difference among the three rations were not significant ($p>0.05$)

Generally, the values obtained of blood constituents indicated normal physiological and healthy status of lambs fed both rations containing acacia.

This study indicates that feeding Awassi lambs on diets including up to 40% of the TDN requirements from acacia did counter act their feedlot performance. Therefore, the use of *acacia* tested in the current experiment can be recommended for use by local farmers for lamb production under North Sinai conditions which should reduce their cost of meat production. During the dry season acacia remain green and maintain a relatively high crude protein content and is commonly used as protein and energy supplements for small ruminants during this period. This is supported by the findings of Youssef *et al.* (2003) who reported that *acacia saligna* shrubs showed a great potentiality as fodder for growing sheep under arid and saline conditions of Egyptian desert.

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