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UTILIZATION OF FRESH *Leucaena leucocephala* PLANT AND ITS SILAGE IN SHEEP NUTRITION

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ABSTRACT

An experiment was carried out at the experimental station of the Faculty of Agriculture, Cairo University to evaluate fresh *Leucaena leucocephala* plants and its silage as a unconventional feed in rations of growing Rahmani males sheep. A total number of 12 growing Rahmani rams aging 6-7 months and weighing 28.5 kg on the average were devided into two groups of 6 animals each to represent two experimental groups. The first group was offered barley according to energy and protein requirements plus green *Leucaena leucocephala* whole plants *ad-libitum*, while the second group was offered barley (requrements) and Leucaena silage *ad-libitum.* The experiment lasted 12 weeks.

Results obtained can be summerized as followes :

1) Group fed on barley plus Leucaena silage showed significantly ($P<0.05$) superior live body weight compared to the group fed on barley plus Leucaena fresh plants.
2) Significant differences ($P < 0.05$) occurred on the rumen liquor characteristics (pH, ammonia-N and TVFA's) for the favor of the group fed on barley and Leucaena silage diet.
3) Digestibility coefficients of DM, OM, CP, CF and NFE were significantly higher in the silage fed group compared to the other group.
4) Barley plus Leucaena silage diet showed significantly better feeding values as TDN %, SV%, DCP and N.B, compared to barley plus fresh Leucaena diet.

Keywords : *Leucaena leucocephala,* sheep, feeding value, growth.

INTRODUCTION

Leucaena leucocephala, is a legume plant which can be fed as protein supplement in tropics (NAS, 1997). It offers a potentially rich and cheap source of protein (Adeneye, 1979). Tangendjaja et al (1986) found that the crude protein content of leucaena decreased from about 31 to 14% during devedopment. El-Ashry et al., (1989) reported that leucaena was imported to Egypt to be tested as forage plant. The DM composition of *Leucaena leucocephala* was characterized by its high CP (26%) and low conntents of CF (16%) and ash (9%). Its cell wall constituents showed lower values of hemicellulose (14%) and cellulose (9%), Mohamed (1996) who reported that *Leucaena leucocephala* was voluntary consider to cover 50% of the maintenance energy of ruminants while the DCP of this forage could fairly provide animals with at least 50% DCP over their protein maintenance needs.

The overview of *leucaena leucocephala* chemical composition might support its use as potential tropical leguminous plant for feeding ruminant. However, claims concerning its high level of toxic substances (mimosine) investigated by many authors (Megarity and Jones. 1983), constrained its use a sole feed for ruminants. Many authors (Megarity and Jones, 1983 and Eliot et al., 1985), indicated that feeding *leucaena leucocephala* with a soluble source of carbohydrates increased nutrients digestibilities by ruminants. They attributed the improvement of digestbility to the effect of readily available carbohydrates on mimosine (toxic amino acid) degradation in the rumen to active goitrogen 3-hydroxy-4 (LH)-pyridine (DHP). However, they mentioned that, the effect of memosine was not constant, but varies between animal species. In order to make maximum use of the leucaena material in animal nutrition, several relatively successful methods to reduce the deleterious effect caused by mimoisine were reported. These include :

i) Genetic method., through a new hybrid of leuceana with lower mimosine content.
ii) Chemical treatment of leucaena meal by addition of ferrous sulphate or aluminium sulphate.
iii) Ensiling method to reduce their memosine content without substancially influencing their protein content (Shukla, 1982).

The present study was conducted to investigate the utilization of *Leucaena leucocephala* forage and its silage as unconventional feed source for sheep nutrition.

MATERIALS AND METHODS

This study was carried out in the Experimental Farm Station of Animal Production Department, Faculty of Agriculture, Cairo University. The present study was designed to evaluate the nutritive value of fresh *Leucaena leucocephala* plant and its silage.

Twelve weaned male Rahmani lambs aged 6-7 month old and weighing about 28.5 kg live body weight were used in this study. The experimental lambs were divided into two feeding treatment groups, with six lambs per each.

The feeding system followed during the feeding trial which lasted for 12 weeks was based on offering restricted amount of ground barley grains sufficient to provide animals with their energy maintenance requirements calculated as TDN (NRC, 1975).

Experimental rations were offered twice daily. The concentrate portion (barley) plus one half of roughage portion were offered at 8.00 am, while the rest of forages was offered at 12.00 a.m.

Fresh or silage *Leucaena leucocephala* plant consisted the roughage portion of the diet, which were offered *ad-libitum*.

Digestibility and nitrogen balance were conducted on sheep to evaluate the nutritive value of fresh and silage of Leucaena plant. Each trial was carried out on three animals. Each trial continued for 14 days as a preliminary period followed by 7 days as a collection. Chemical composition of feed, faeces and urine were determined according to A.O.A.C (1984).

Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined according to Goering and Van Soest (1970). Hemicellulose was calculated as the difference between (NDF and ADF) and cellulose, was calculated as the difference between (ADF and ADL).

Samples of rumen liquor were individually collected through a stomach tube. The sample was collected at 3 hrs after feeding. The pH of rumen liquor was immediately recorded using Gallen Kanp pH stick pH K. 120. B. The concentration of ammonia nitrogen in the rumen liquor was determined by the method described by Conway and O'Malley (1942). Total volatile fatty acids were determined by steam distillation as described by Warner (1964).

Fresh Leucaena plants were harvested daily and chopped (10-15 cm length). The chopped plant was their mixed with molasses (10% from the dry matter of Leucaena plant). The mixture was ensiled in a plastic barrel, which was tightly covered. Ensilling took place in about 60 days before feeding. Sample of each plastic barrel of each silage mixture were taken, thoroughly mixed and composite sample of each silage mixture was taken to determine silage quality. The fermented material was prepared by extracting 300 gm, wet material in a blender for 3 min and well pressed; then filtrate was extracted through four layers of muslin cloth. The filtrate was used for measurement of pH using a combination electrode pH meter, ammonia nitrogen according to Conway and O'Malley (1942) method, total volatile fatty acids by steam distillation as described by Warner (1964) and Lactic acid by Coloumetric Method of Barker and Summerson (1941). Acetic, propionic, isobutyric, butyric, valeric and isovaleric acids by HPLC kenaur pump 64 U.V. Dector column. Rezex organic acid Aequisition: Wave length : 210 nm Flow rate : 0.8 ml/min.

Data were statistically analysed according to (SAS, 1990) using simple one-way. The differences among means were examined using Multiple Range test according to Duncan (1955).

RESULTS AND DISCUSSION

Chemical composition and feeding value :

Results presented in table (1) show the chemical composition of the experimental diets ingredients.

Results revealed that OM contents of the experimental ingredients were 96.79% 91.75% and 93.79% for barley, Leucaena fresh and its silage, respectively. Ensiling Leucaena did not appreciably affect CP content since it was 25.83% in the fresh Leucaena plant and was 25.94 for Leucaena silage low. On the other hand the CF content of fresh Leucaena plant (17.52%) was reduced to 13.69% after ensiling. Ether extract contents showed that differences between the fresh and silage of Leucaena were low (5.03% and 5.13%, respectively). Ash content showed slight increase for Leucaena fresh compared with the silage. The same trend was observed with NFE content (43.37% of Leucaena and 49.63 for Silage), these results are in accordance with the findings of Sharma et al (1989). Cell wall constituents of Leucaena

and its silage are presented in table (1). The high content of NDF and ADF were found with fresh Leucaena plant, while the low content were recorded with Leucaena after treatment as silage. Also ADL content in Leucaena silage become little value compared with fresh Leucaena.

Silage quality:

There are many factors affecting the pH value especially the chemical composition of the ensiled material and the ensiling procedures. Results of Leucaena silage quality are presented in table (2). Results revealed that pH of silage was found to be 4.1 which indicate that the Leucaena silage had an acidic value which indicate the success of the ensiling process. These results agree with the findings of Tabana (1994) who found that the pH value ranged from 3.5 to 4.5 and found there are a positive relationship between the pH values and lactic acid concentration in addition Ranjhan (1980) reported that the chemical characteristics of good silage are : pH value would range from 4 to 5., NH_3-N production should not be more than 10-12% of total N. Also the high quality silage is characterizaed by low percentage of NH_3-N concentration from total N (Langston et al, 1958).

Results in table (2) show that NH_3-N concentration of the Leucaena silage was 3.40% of DM. The Leucaena silage is the present study could be considered of intermediate quality on the basis outlined by Langston (1985) who designated silages as good intermediate or poor as follows :

Ammonia - N as % DM :

Good	1.02 to 2.87
Intermediate	2.89- 3.62
Poor	5.33 – 9.82

The high quality silage is characterized by low TVFA's concentration (Langston et al., 1958). Therefore, the volatile substances in the silage must be comparatively less than lactic acid concentration (Ranjhan, 1980). Results in table 2 revealed also that total volatile fatty acids in the silage were 4.84 (m mol/100 g DM).

Average concentration of the lactic acid, acetic, propionic, isobutyric and butyric acids were found to be 10.20, 2.50, 0.57, 0.05 and 0.77 percent, on DM basis.

The prepared silage could be considered of good quality in terms of lactioc acid and marginol between good and intermediate with regards to butyric acid according to the specific outlined by langston *et al.* (1989) and Ranjhans (1980) who indicated that silage quality of silage could be designated as follows:

	Butyric acid %	lactic acid %
Good	traces	3.03 to 18.16
Intermediate	0.76 to 1.55	a good silage should have
Poor	> 1.55	more than 6% even 13.16%

The high silage quality is characterized by high level of lactic acid. The soluble carbohydrates are the major source of lactic acid production. During ensiling, hemicellulose is broken-down to pentose sugars which may be fermented to lactic and acetic acid as described by Whittenburg et al., (1967).

Growth performance:

Averages of initial body weight ranged between 28 to 29 kg (Table3) and differences among treatment groups were insignificant. Final body weights were 41.44 and 44.96 kg for fresh and silage diets, respectively. The analysis of variance for final body weight between the two treatments indicated that difference between the two groups was significant ($P < 0.05$) in favor of the silage group. The same trend was observed for total gain in live weight where the silage group had significantly ($P < 0.05$) higher total gain compared to fresh Leucaena group (Table 3). The same trend was also observed in average daily gain, since the silage group had significantly ($P < 0.05$) higher Av. daily gain compared to the Leucaena group.

Averages of growth rate for the silage group and fresh Leucaena group were found to be 55.03 and 48.0% respectively indicating that growth rate was improved by ensilage Leucaena. These results are in agreement with those obtained by Jaikishan et al (1986).

Results presented in table (3) show that the total DM intake (Barley + fresh Leucaena or silage) calculated as g/day were 800 and 983 (g/h/day), respectively. The corresponding TDN intake g/h/day were 501.36 g, and 657.14. Theses differences were significant ($P < 0.05$) in favor of the silage group. Results of DCP intake (g/h/day) were of similar trend to DM and TDN intrakes, where the lower value was reported for the Leucaena group (74.56 g/h/day) and higher value was obtained by silage group (111.08 g/h/day). These results are in agreement with those reported Gupta *et al* (1986).

Results of feed conversion ratio calculated as kg of DM required for each kg gain in live weight for the Leucaena and silage groups were 5.0 and 5.17, respectively (Table 3). These results indicate better feed conversion ratio for the silage group.

Result of TDN conversion ratio for the experimental groups showed that the best TDN conversion ratio was better for the Leucaena group than the silage group. The same trend was observed for the protein utilization efficiency (calculated as kg of dietary protein required for each kg gain in live weight) were (0.585 and 0.466, respectively) indicating improvement in the protein utilization efficiency by ensilage group.

Digestibility Coefficients

Averages of digestibility coefficients for the DM, OM, CP, CF, EE and NFE are illustrated in table (4). Results revealed that DM digestibility in silage diet group was (65.47) followed by the Leucaena diet (60.23) and the difference was significant ($P < 0.05$). The same trend was observed for OM, CP, CF and NFE digestibility were significant ($P< 0.05$). Concerning the EE digestibility the difference was insignificant between the two diets..

Feeding Values:

Averages of feeding values as TDN %, DCP, NR*. and NB g/h/day are illustrated in table (4). Data of this table revealed that the TDN %, DCP%,

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* **NR = TDN/DCP - 1**

NR and N.B. g/h/day were better for the silage group than by the Leucaena group. Differences between the experimental groups were significant ($P < 0.05$).

However differences between the experimental groups in N.R % were in favor of the Leucaena group but were insignificant.

These results indicate a clear negative correlation between the NR% values and the N.B since the excreted nitrogen decreased as the N.R increased.

Rumen liquor Characteristics :

Results of ruminal pH, NH_3-N and TVFA's concentrations are shown in table (5). The pH value is a major factor influencing the fermentation in rate the rumen and consequently the utilization of different nutrients. Results revealed that pH values of rumen liquer were 6.83 and 6.13 for Leucaena and silage respectively. The analysis of variance for results indicated that the Leucaena group had significantly ($P < 0.05$) higher pH than the silage group. It is well known that ruminal pH values are influenced by TVFA's produced in the rumen. These result are in accordance with the findings of Abd El-Kareem (1990) and Tabana (1994). They reproted that the ruminal pH decreased with high levelse of TVFA's concentration in the rumen.

Results presented in Table (5) show that difference in NH_3-N concentration between the two group were significant ($P < 0.05$) being higher in silage group (25.54 mg/ 100 ml) compared with fresh Leucaena group (21.81 mg / 100 ml). High NH_3-N concentration observed in silage group compared with Leucaena group might be due to relatively high consumption of silage as well as high crude protein consumption. These results are in agreement with the findings of Hanafy (1985).

Results of TVFA's concentration are shown in table (5). Averages of TVFA's concentration for silage group and Leucaena groups were 14.15 and 11.21 meq/ 100 ml., respectively ($P < 0.05$) indicating that TVFA's increased with silage feeding. These reslts are in agreement with those obtained by Deraz (1996) he found that TVFA's concentration in rumen liquor of lambs fed corn stover silage was higher than those fed corn stover. The low level of TVFA's led to high pH values. These results agree with the findings of Salem *et al*. (1989).

Kandil and El-Shaer, (1988) found that when supplemented with a source of readily available carbohydrate such as molasses improved the performance of sheep or goat by increased the rumen volatil fatty acids. Also the maximum utiliztion of Leucaena may be obtaine by ensilag method (Shukla, 1982).

Table (1): Chemical composition (%, DM basis).

Item	DM	OM	CP	CF	EE	NFE	Ash	NDF	ADF	ADL
Barley	88.12	96.79	8.37	11.06	1.35	76.01	3.21	--	--	--
Leucaena Leucocephala	29.41	91.75	25.83	17.52	5.03	43.37	8.25	35.22	22.39	10.47
Silage	31.66	93.79	25.94	13.09	5.13	49.63	6.21	33.15	20.87	8.16

Table (2): Silage quality

pH	NH_3-N (mg/100ml)	TVFA's (meq./100 ml)	Lactic acid %	Acetic acid %
4.1	3.40	4.84	10.20	2.5
Propionic acid %	**Isobutyric %**	**Butyric acid%**		**Isovaleric%**
0.57	0.05	0.77		0.77
Valeric acid %				
0.55				

Table (3): The average live body weight, daily gain and feed conversion.

Item	Leucaena	Silage
Initial weight (kg)	28.00	29.00
Final weight (kg)	41.44[b]	44.96[a]
Total gain (kg)	13.44[b]	15.96[a]
Av. daily gain (g)	160.00[b]	190.00[a]
Growth rate %	48 %	55 %
Intake :		
Total DMI g/h/day	800[b]	983[a]
Barley g/h/day	470	493
Leucaena	330	-
Silage	-	490
TDN intake g/h/day	501.36[b]	657.14[a]
DCP intake g/h/day	74.56[b]	111.08[a]
Feed conversion		
Kg DM /Kg gain	5.00	5.17
Kg TDN/Kg gain	3.13	3.46
Kg DCP/kg gain	0.47	0.59

a and b : Means in the same column with different superscripts are significantly differents (P < 0.05).

Table (4): Digestibility coefficients of the two experimintal rations.

Digestibility coefficients	Leucaena rations	Silage rations
DM	60.23[b]	65.47[a]
OM	63.88[b]	68.33[a]
CP	63.71[b]	68.47[a]
CF	49.87[b]	56.99[a]
EE	50.77	51.33
NFE	68.11[b]	72.53[a]
Feeding values		
TDN	62.67[b]	66.85[a]
DCP	9.32[b]	11.30[a]
N.R	5.72[a]	4.92[a]
N.B	3.53[b]	6.45[a]

a and b : Means in the same column with different superscripts are significantly differents (P < 0.05).
TDN : Total digestible nutrients.
DCP : Digestible crude protein
NR : Nutritive ratio

Table (5): Rumen liquor parameters :

Item	Leucaena	L. silage
PH	6.83[a]	6.13[b]
NH_3-N (mg/100 ml)	21.81[b]	25.54[a]
TVFA's (meq/100ml)	11.21[b]	14.15

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استخدام نبات الليوكينا الطازج وسيلاجه فى تغذية الأغنام

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أجريت هذه الدراسة فى محطة قسم الإنتاج الحيوانى كلية الزراعة جامعة القاهرة لتقييم نبات الليوكينا كغذاء أخضر للأغنام وكذلك كسيلاج استخدم فى هذه الدراسة ١٢ كبش تتراوح أعمارها بين ٦-٧ شهور ومتوسط وزن ٢٨,٥ كجم قسمت هذه الكباش إلى مجموعتين فى كل مجموعة ٦ كباش وأستمرت التجربة ١٢ أسبوعاً وكانت كل مجموعة تغذى على الشعير كمركزات والمجموعة الأولى يقدم لها الليوكينا كنبات أخضر لحد الشبع أما المجموعة الثانية فكان يقدم لها سيلاج الليوكينا لحد الشبع وأوضحت النتائج المتحصل عليها ما يلى :

1- وجود فروق معنوية بين المجموعة التى تغذت على الليوكينا الطازج والمجموعة التى تغذت على سيلاج الليوكينا وهذه الفروق كانت لصالح المجموعة المغذاة على سيلاج الليوكينا.

2- كان معدل النمو اليومى للمجموعة المغذاة على سيلاج الليوكينا ١٩٠ جرام /يوم بينما كان ١٦٠ جرام للمجموعة التى تغذت على الليوكينا الطازج.

3- كان هناك فروق معنوية بين المجموعتين من حيث المادة الجافة الكلية المأكولة لصالح المجموعة المغذاة على سيلاج الليوكينا ٩٨٣ جرام/يوم مقارنة بالمجموعة التى تغذت على الليوكينا الطازجة ٨٠٠ جرام/ رأس/يوم

4- كانت هناك فروق معنوية بالنسبة لـ TDN ، DCP بين المجموعتين لصالح مجموعة سيلاج الليوكينا.

5- حدث تساقط لألياف الصوف للمجموعة التى تغذت على نبات الليوكينا الطازج بعد شهر تقريبا من التغذية وأصبحت الكباش عارية تماما ثم بعد ذلك عاود الصوف نموه وظهر بصورة أحسن من الأول فى حين لم يحدث أى تساقط لألياف الصوف للمجموعة التى تغذت على سيلاج الليوكينا.

6- كانت هناك فروق معنوية فى صفات سائل الكرش (pH، ammonia، TVFA's) كانت لصالح المجموعة المغذاة على سيلاج الليوكينا.

7- أيضا كانت هناك فروق معنوية بين المجوعتين بالنسبة لمعاملات هضم NFE and DM, CP, CF لصالح المجموعة المغذاة على سيلاج اللوكينا بينما لم يكن هناك فروق معنوية فى معاملات هضم EE بين المجموعتين.

8- أيضا كان هناك فروق معنوية لصالح المجموعة المغذاة على سيلاج الليوكينا من حيث S.V DCP% ,N.B, TDN%, % ولكن الفروق بين المجموعتين فى N.R % لم تكن معنوية .

وأخيرا نستطيع القول أن نبات الليوكينا يصبح غذاءاً جيداً للحيوانات بعد عمله سيلاج لارتفاع قيمته الغذائية والتخلص من بعض المواد غير المرغوب فيها والتى أحدثت تساقطاً لألياف الصوف حيث أن عمله سيلاج أحدث انخفاضاً فى CF من 17.52 إلى 13.09 كذلك حدث ارتفاع فى NFE من 43.37 فى النبات الطازج إلى 49.63 فى السيلاج.