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FEED UTILIZATION AND PERFORMANCE OF LAMBS FED *KOCHIA INDICA* SHRUBS UNDER DESERT CONDITIONS OF SINAI

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A feeding trial was conducted using ten lambs in two groups (5 animals/each) for 60 days in order to determine feed intake, feed efficiency, average daily gain, nutrient digestibility and nitrogen, sodium and potassium balances. The lambs in the first group consumed clover hay *ad libitum* whereas their mates consumed chopped green *kochia indica ad libitum* in the second group. Both groups were fed concentrate feed mixture to cover 50% of their energy maintenance requirements.

Concentrations of crude protein and potassium were similar between *kochia indica* and clover hay. Digestibilities of dry matter, crude protein, crude fiber, ether extract, nitrogen free extract and organic matter were greater for *kochia indica* diet than those of clover hay diet. The nutritive values (TDN% and DCP%) were greater for *kochia indica* diet than clover hay diet. Nitrogen balance of lambs fed *kochia indica* diet was higher ($p<0.05$) than that for the clover hay diet. Both sodium and potassium balances were positive for both groups and were greater in *kochia* than clover hay diets. Average daily gain and feed efficiency was similar between the two diets but the cost of *Kochia indica* diet (diet 2) was less than clover hay (diet1). It could be recommended that *kochia indica* is used instead of clover hay for lambs feeding in Sinai to decrease the feeding costs.

Keywords: sheep, *kochia indica*, feed intake, nutrient digestibility, nutritive value, nitrogen balance, sodium balance and potassium balance.

The use of halophytes for fodder production may be one of means of utilizing salt affected soils. *Kochia indica* is a salt and /or drought tolerant shrubs which produced in great biomass during dry season (Sherrod, 1973; Sadek, 1974; Zahran, 1986 and Abou Ziada 1988). These shrubs are more palatable than other halophytic plants and grazed by animals in their natural stands. It had a good nutritive value (Sherrod 1971 and 1973; Zharan *et al.*, 1999). Some investigators studied the nutritive value of *kochia indica* in the form of hay or silage using adult sheep and goat (Nour, 1995; Fahmy and Fayed, 2000).Other investigators studied the effect of *Kochia indica* feeding on milk yield and composition of goats (Shehata *et al.*, 2001). There is a difict in information about the effect of utilizing Kochia indica for lambs feeding on growth rate under the desert conditions. Therefore, the present study aimed to determine the nutritive values (TDN and DCP%) of *kochia indica* based diet and the impact on the productive performance of lambs under desert conditions of Sinai.

MATERIALS AND METHODS

This study was carried out at Ras Sudr Research Station in Southern Sinai where *Kochia indica* shrubs were planted in salt affected lands irrigated with ground water (8000 ppm total dissolved salts). The dominant cation in the irrigation saline water was sodium (30 meq/L) whereas the dominant anion was chloride (50 meq/L). The soil of this area is characterized as loamy sand texture containing 6100 ppm total salinity, 1200 ppm Cl^-, 510 ppm Na^+, 270 ppm Ca^{++} and 170 ppm Mg^{++}.

Kochia indica shrubs (twigs) were daily harvested at early bloom stage then mechanically chopped into small pieces before offering to animals. On the other hand, clover hay (*Trifolium Alexandrium*) was bought from the market which made from the third cut and stored for lambs feeding.

A feeding trial was conducted in autumn season on ten growing Barki male lambs of six months old and 18.5 $\pm$1.77 kg live body weight. Animals were randomly distributed into two groups (5 animals/each). Both groups were fed concentrate feed mixture (CFM) to cover 50% of energy maintenance requirements (Kearl, 1982). Animals in the first group were fed clover hay *ad libitum* (*Trifolium alexandrinum*) whereas, the second group were fed chopped green *kochia indica* shrubs *ad libitum*. The roughages were offered 20% of the previous day intake twice daily to the animals at 8 am. and 3 pm., meanwhile the concentrates were offered at 4 p.m. The feeding trial was carried out for 60 days followed by 15 days for digestibility trial. During the feeding trial, feed offered and refusals were daily recorded in order to estimate feed intake. Drinking water was available free choice all time to animals. The animals were weighed at the beginning and biweekly

intervals during experimental period to determine average daily gain (ADG). After 60 days, The same animals (5 animals / each) were placed in separate metabolism cage for two weeks; 8 days adaptation period followed by 7 days collection period. The animals were individually fed in the metabolism cages. Feed offered, refused were recorded while faeces and urine were collected during the collection period and kept for proximate analysis according to A.O.A.C. (1990). Intakes from drinking water (free water), combined water (feed moisture) and metabolic water were daily determined. Metabolic water intake was estimated as one gram TDN intake produce 0.6 ml water (English, 1966). Water excretion in both faeces and urine was also daily recorded. Water balance was estimated by the difference between the total water intake and total water excretion in both faeces and urine. Sodium and potassium concentrations in feeds, faeces and urine were tested using flame photometer (A.O.A.C., 1990).

During the whole feeding trial, feed intake was estimated as the difference between feed offered and feed refusal. Feed efficiency was calculated according to the equation: feed efficiency = (Number of kilogram feed dry matter intake / one kilogram gain).Total feed cost was also calculated according to the price of 2004. Net return = (profit of gain – total feed cost), other head cost such as drugs, labour and housing assumed constant.

Data was statistically analyzed by one-way analysis of variance (T-test) using computer programme (SAS, 1988).

RESULTS AND DISCUSSIONS

Chemical composition and mineral contents of feed ingredients and the tested diets are presented in table (1). Although *kochia indica* shrubs considered to be halophytic plants, their ash, crude protein, crude fiber and potassium contents were similar to those of clover hay (17.2,13.3, 26.3, 1.87 vs 14.1, 13.9, 29.6, 1.96%, respectively). In comparison between two halophytic plant species, their contents from ash, crude fiber, sodium were lower than those of *Atriplex nummularia* (Fahmy *et al.*, 1999). These shrubs are highly palatabale. The present results regarding the chemical composition of *kochia indica* are close to the findings of Nour (1995) and Shehata *et al.* (2001).

Lambs consumed more dry matter, from *kochia indica* diet (D2) than clover hay diet (D1) as shown in table (2). Because of *kochia indica* shrubs contained low crude fiber and potassium concentrations and high nitrogen free extract(NFE) contents (Table 1), their palatability was higher as judged by dry matter intake. Nour (1995) found that when fresh *kochia indica* used as a sole diet for feeding of adult Rahmany rams , the dry matter intake was 753 gram / head / day. All nutrient digestibility coefficients (Table 2)

particularly crude protein (CP) and organic matter was higher (P<0.05) for (D2) compared to (D1). The improvement in digestibility coefficients of D2 may be due to low fiber content of *kochia indica* that may decrease the rate of passage. The nutritive value of *kochia indica* diet (D2) particularly their digestible crude protein (DCP%) was higher (p<0.05) than that of clover hay diet. The digested nutrient intakes (TDN and DCP) from *kochia indica* diet recorded higher values compared to those of clover hay diet. The differences were not significant between the experimental diets. Concerning DCP % of kochia indica, the results in the present study are similar to that reported by Shehata *et al.* (2001) who used *Kochia indica* silage as a sole diet for adult Zaraibi bucks feeding. Their corresponding values were 9.96 % vs 9.60%.

TABLE (1). Chemical composition and mineral contents of feed ingredients and the tested diets as % of dry matter

Feed	DM	Ash	CP	CF	EE	NFE	Na	K
Clover hay	89	14.1	13.9	29.6	3.90	38.5	2.52	1.96
Kochia indica	38.6	17.2	13.3	26.3	2.80	40.4	3.90	1.87
CFM *	90.0	8.20	15.5	25.7	3.61	46.99	0.80	1.37
Diet 1	89.3	12.4	14.4	28.4	3.81	40.99	2.01	1.79
Diet 2	53.0	14.7	13.9	26.1	3.03	42.27	3.02	1.73

*CFM= Concentrate feed mixture

Diet 1:consists of clover hay plus concentrate feed mixture.

Diet 2 : consists of *Kochia indica* shrubs plus concentrate feed mixture.

DM: dry matter ; CP : crude protein ;CF : crude fiber ; EE :ether extract ; NFE : nitrogen free extract ; Na : sodium ; K : potassium

Nitrogen intake, excretion and retention are summarized in table (2). Neither nitrogen intake nor nitrogen excreted in both faeces and urine were statistically significant between the two diets. The higher nitrogen intake for lambs fed the *kochia indica* diet is a reflection to their slightly dry matter intake. The digested nitrogen intake from *Kochia indica* was higher (p>0.05) than clover hay diet. This is may be due to higher nitrogen intake in addition to lower faecal nitrogen excretion for *Kochia* diet than clover hay diet. Total nitrogen excretion did not significantly vary between the two diets. The nitrogen balance was 146% higher (p>0.05) for lambs fed *kochia indica* diet (D2) than that of clover hay diet (D1).

TABLE (2). Feed consumption, digestibility coefficients, nutritive value and nitrogen balance of the tested diets fed to lambs during the digestibility trial.

Item	D1	D2	±SE	significance
No. of animals	5	5		
Live body weight, Kg	23.9	24.0	1.77	N.S.
Dry matter intake, g/kg BW				
Roughage	26.7	32.2	2.49	N.S.
Concentrate	10.9	10.9	0.28	N.S.
Total	37.6	43.2	2.75	N.S.
Digestibility coefficients, %				
DM	59.5	65.3	1.64	N.S.
CP	54.2	63.1	2.19	*
CF	49.6	56.0	2.47	N.S.
EE	57.5	62.2	1.84	N.S.
NFE	67.5	72.6	1.46	N.S.
OM	58.2	66.4	2.01	*
Nutritive value, %				
TDN	54.6	58.3	1.39	N.S.
DCP	7.79	8.74	0.26	*
Digested nutrients intake:				
TDN, g/head/day	469	542	26.7	N.S.
g/kg $W^{0.75}$	45.4	54.5	3.95	N.S.
DCP, g/head/day	67.1	81.2	4.36	*
g/kg $W^{0.75}$	6.48	8.16	0.59	N.S.
Nitrogen intake, g/head	19.75	20.6	0.78	N.S.
Faecal nitrogen, g/head	8.97	7.60	0.47	N.S.
Digested nitrogen, g/head	10.78	13.0	0.69	N.S.
Urinary nitrogen, g/head	9.97	11.0	0.52	N.S.
Nitrogen balance, g/head	0.81	2.00	0.37	N.S.

D1 = Clover hay plus concentrate feed mixture,
D2 = Kochia indica plus concentrate feed mixture.
N.S.= Not Significant, * = $P < 0.05$, ** = $P < 0.01$
DM : dry matter ; CP : crude protein ; CF : crude fiber ; EE :ether extract ; NFE : nitrogen free extract ; OM : organic matter ; TDN : total digestible nutrients ; DCP : digestible crude protein.

Drinking water intake values as shown in table (3) were significantly lower for lambs fed *kochia* diet than the control diet. This may be due to that *kochia indica* was fed to the lambs as green fodder but clover (berseem)was offered in the hay form. In contrast, lambs fed *kochia indica* attained higher consumption from both combined water or metabolic water. Total water intake for lambs fed *Kochia* was slightly higher than their mates fed clover hay. Total water excreted in both faeces and urine for lambs fed *Kochia* was

10.8% higher than those fed berseem hay. The water balance recorded similar values for the two diets.

TABLE (3). Water balance for lambs fed the tested diets during the digestibility trial.

Criteria	D1	D2	±S.E.	Significance
Drinking water intake:				
ml/kg $W^{0.82}$	258	185	15.8	**
ml/gDMI	2.93	2.51	0.29	**
Combined water intake:				
ml/kg $W^{0.82}$	7.86	89.4	16.0	**
Metabolic water intake				
ml/kg $W^{0.82}$	21.9	26.4	2.04	N.S.
Total water intake,				
ml/kg $W^{0.82}$	288	301	12.2	N.S.
Water excreted in faeces:				
ml/kg $W^{0.82}$	40.8	31.3	3.84	N.S.
% of intake	14.2	10.6	1.34	N.S.
Water excreted in urine:				
ml/kg $W^{0.82}$	94.4	118	8.27	N.S.
% of intake	32.7	39.2	1.84	N.S.
Total water excretion:				
ml/kg $W^{0.82}$	135	149	7.46	N.S.
% of intake	46.8	49.8	1.43	N.S.
Water balance:				
ml/kg $W^{0.82}$	152	152	7.24	N.S.
% of intake	53.2	50.2	1.43	N.S.

Combined water = feed moisture
Metabolic water = one gram TDN intake produce o.6 ml water (English,1966).
N.S.= Not Significant, ** = P< 0.01.
D1= clover hay plus concentrate feed mixture.
D2= *kochia indica* plus concentrate feed mixture

Averages of both sodium and potassium intake, excretion and balance are summarized in table (4). Because of higher feed intake of *Kochia indica* diet and also its higher sodium content, the sodium intake as gram / head/day or mg Na / kg body weight (mg Na/ kg BW) was higher (P<0.01) than the control diet. Sodium excreted in faeces was comparable for the two diets. On the other hand, sodium excreted in urine was 68.3% higher (p<0.01) for Kochia than clover hay diets. Total sodium excretion expressed as mg Na / Kg BW followed the same trend and recorded higher value (p<0.01) for *kochia* than clover hay diets. Sodium balance was significantly higher for *Kochia* than clover hay diets. This may be due to that animals fed *kochia*

indica consumed sodium 68.8%higher than those fed clover hay diet. No adverse effect was found when sheep fed diet containing 9.1% sodium chloride at the end of 235 day (Meyer and Weir, 1954).This explain that sheep can tolerate sodium chloride up to 9.1% in their diets without adverse effect.

Potassium intake recorded comparable values in diet 1 and diet 2 as indicated in table (4). Potassium excreted in either faeces or urine was similar for the two diets. Total potassium excretion in both faeces and urine followed the same pattern of faecal and urinary potassium excretion and recorded similar values. Potassium balance was positive ($p > 0.05$) for the two diets.

TABLE (4). Sodium and potassium balances for growing lambs fed the tested diets during the digestibility trial.

Criteria	D1	D2	±S.E.	Significance
Sodium intake:				
g/head/day	17.0	28.7	2.31	**
Faecal sodium:				
g/head/day	2.72	2.41	0.21	N.S.
Urinary sodium:				
g/head/day	9.98	16.8	1.59	**
Total sodium excretion:				
g/head/day	12.72	19.21	1.57	*
Sodium balance:				
g/head/day	4.28	9.49	1.17	**
Potassium intake:				
g/head/day	15.2	16.17	0.60	N.S
Faecal potassium :				
g/head/day	2.59	1.94	0.20	N.S.
Urinary potassium				
g/head/day	11.35	11.27	0.49	N.S.
Total potassium excretion:				
g/head/day	13.9	13.2	0.53	N.S.
Potassium balance:				
g/head/day	1.33	2.95	0.46	N.S.

N.S.= Not Significant, * = $P < 0.05$, ** = $P < 0.01$
D1=clover hay plus concentrate feed mixture
D2= kochia indica plus concentrate feed mixture

Parameters of economic evaluation of the tested diets are presented in table (5). Total gain and average daily gain (ADG) was similar between diets 1 and 2. Feed efficiency as kg DM required to produce one kg daily gain for the two diets was similar. Since the profit of total gain in the two diets are similar, but the total feed cost of kochia are 16.9% less than clover hay. The

net return of *kochia* are 18.4% higher than clover hay. Hinojosa *et al.* (1986) reported that *kochia* hay was inferior to alfalfa hay when average daily gain, feed efficiency and apparent organic matter digestibilities were measured in cattle.

It may be concluded that *kochia indica* could be used as a good quality roughage in feeding of lambs in the arid lands.

TABLE (5). Economic evaluation of the tested diets during the feeding trial.

Criteria	D1	D2	±S.E.	Significance.
No. of animals	5	5		
Initial live body weight, kg	18.5	18.5	1.77	N.S.
Final live body weight, kg	23.9	24.0	1.77	N.S.
Total gain, kg	5.40	5.50	0.27	N.S.
Profit of gain (LE)	91.80	93.50		
Average daily gain, g/head/day	90.0	91.7	4.55	N.S.
Feed efficiency, kg DM/kg gain.	10.66	10.94		
Roughage dry matter intake, kg/ head	40.7	43.6		
Concentrate dry matter intake, kg/head	16.87	16.6		
Total dry matter intake, kg/head	57.57	60.20		
Roughage cost (LE)	24.42	17.44		
Concentrate cost (LE)	18.56	18.26		
Total feed cost (LE)	42.98	35.7		
Net Return (LE)	48.82	57.8		

N.S.= Not significant
Price of one kilogram gain = 17 LE. According to price of 2004
Price of one kilogram clover hay dry matter = 0.60 LE.
Price of one kilogram kochia dry matter = 0.40 LE.
Price of one kilogram concentrate feed mixture dry matter = 1.1 LE.
Net return = (profit of gain – total feed cost).
LE : Egyptian pound.

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الاستفاده من الغذاء وآداء الحملان المغذاة على شجيرات الكوخيا انديكا تحت الظروف الصحراويه فى سيناء

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أجريت تجربة تغذية لعدد عشرة من ذكور الأغنام البرقى النامية لمدة ٦٠ يوم حيث قسمت الى مجموعتين (٥ حيوان / مجموعة) وذلك لتقدير المأكول من الأعلاف، الكفاءة الغذائية، معدلات النمو اليومية، معاملات هضم العناصر الغذائية، موازين النتروجين، الصوديوم والبوتاسيوم. غذيت حيوانات المجموعة الأولى (لحد الشبع) على دريس البرسيم المصرى بينما غذيت قرينتها فى المجموعة الثانية على شجيرات الكوخيا انديكا الخضراء المقطعة (لحد الشبع) كأعلاف خشنة كما غذيت كلتا المجموعتين على مخلوط العلف المركز لتغطية نصف الاحتياجات الحافظة من الطاقة.

كانت تركيزات كل من البروتين الخام والبوتاسيوم متساويه فى كل من العليقتين وهما دريس البرسيم المصرى وشجيرات الكوخيا انديكا.

كانت جميع معاملات هضم العناصر الغذائية (مادة جافة - بروتين خام - ألياف خام - دهن خام - مستخلص خالى من النيتروجين) الأفضل للمجموعة المغذاة على الكوخيا بمقارنتها بدريس البرسيم المصرى. كذلك وجد أن القيم الغذائيه كنسبة مئويه (مركبات مهضومه كليه- بروتين خام مهضوم) لعليقة الكوخيا هى الأكبر مقارنة بدريس البرسيم المصرى. أظهر ميزان الأزوت لحيوانات المجموعة المغذاة على الكوخيا قيماً أكبر عن مثيلاتها للعليقة المقارنة. كانت قيم ميزان كل من الصوديوم والبوتاسيوم لكلتا المجموعتين موجبه وكانت قيم ميزانى الصوديوم والبوتاسيوم الأعلى لمجموعة الكوخيا انديكا من قرينتها المغذاة على دريس البرسيم المصرى. كانت معدلات الزيادة فى الوزن والكفاءة الغذائية متماثلة لكلتا المجموعتين بينما كانت تكلفة التغذية أقل للمجموعة المغذاة على الكوخيا انديكا مقارنة بمجموعة دريس البرسيم مشيرة الى كفاءة اقتصادية أعلى. لهذا يمكن التوصية باستخدام شجيرات الكوخيا انديكا الخضراء المقطعة كمادة علف خشنة جيدة بدلاً من دريس البرسيم المصرى فى تغذية الحملان فى سيناء وذلك لتقليل تكلفة التغذية.