USE OF MORINGA LEAVES (*MORINGA OLEIFERA*) IN FATTENING LAMBS RATIONS

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SUMMARY

The effect of moringa leaves (*Moringa oleifera*) on fattening lambs, digestibility, feeding values, feed conversion, growth performance and economical evaluation were studied. The moringa leaves was included at a rate of 0, 7.5, 15 and 30% of the tested rations replacing soybean meal forming four dietary treatments. The control ration consisted of 75% concentrate feed mixture + 25% wheat straw. Twenty lambs with average live body weight 45 ± 1.0 kg at 10 months of age were used for 90 days feeding period. Five animals were allotted per treatment. Results revealed that moringa leaves containing high of ether extract, crude protein and nitrogen free extract (5.8, 16.5 and 52.7), respectively, but containing low of crude fiber, acid detergent fiber and nutrient detergent fiber (13.1, 20.0 and 30.3), respectively. Digestibility of all nutrients were non-significant except that ether extract (EE). Nutritive values tended to decrease as the level of moringa leaves increased. While DM intake and feed conversion tended to increase as the level of moringa leaves increased in the ration. Significant effects of blood analysis were obtained at liver and kidney function, when the level of moringa leaves increased in the rations. Economical evaluation was in favor of the 15% and 30% level supplementation regarding relative percentage of net revenue and relative percentage of cost of feed consumed. In conclusion, moringa leaves could be used economically and successfully for feeding lambs.

Keywords: *Fattening lambs, moringa leaves, digestibilities, intake, growth performance and economical evaluation.*

INTRODUCTION

One of the major factors limiting the productivity of small ruminants in developing countries is the over-dependence on low digestibility feeds which at certain periods of the year cannot meet even the maintenance requirements of these animals. In recent years there has been a growing interest in many countries to identify potentially important feed sources among shrubs and trees for inclusion in the ruminant diet to provide green fodder that is high in protein to supplement the available low protein forage. This has been recognized as one of the most effective means of improving animal performance in smallholder livestock production (Blair 1989). The availability and price of concentrates, in particular of protein sources, are a serious problem for animal producers, especially for small farms stakeholders. Consequently, there is a need for alternative ingredients with high protein content and balanced amino acids profile, and with a suitable cost. Plants leaf meal, forage trees, saltbush and shrubs are good and cheap sources of protein (Mendieta- Araica et al., 2011; Alsersy et al., 2015; Salem et al., 2006 ،2015 and Kholif et al., 2015). *Moringa oleifera* is a well-known tree in West Africa especially in semi-arid areas where it is often cultivated as a living fence around people's gardens and consumed in various forms as food. Leaves of the tree are noted for high content of crude protein, essential vitamins, minerals and amino acids (Makkar and Becker 1997; Gidamis *et al*. 2003). *Moringa oleifera* is a widespread, drought tolerant tree with a high DM yield in the tropics (Reyes-Sánchez *et al*., 2006), the potential for using moringa as animal feed is still underappreciated. It is a tree with a high CP content, varying from 179 to 268 g kg DM^{-1} (Reyes- Sánchez *et al*., 2006; Mendieta-Araica *et al*., 2009). Due to this recent interest in moringa, feeding trials using fresh moringa have been performed with many types of animals such as pigs, goats and creole cows (Ly *et al*., 2001; Aregheore, 2002; Reyes- Sánchez *et al*., 2006). The objective of this study was to evaluate the effect of replace soybean meal protein by *Moringa oleifera* protein to fattening lambs on the intake, digestibility, growth performance, and blood parameters.

MATERIALS AND METHODS

The present study was carried out at experimental farm and laboratories of animal production department, faculty of agriculture, Fayoum University, Egypt. The tested rations (R_1, R_2, R_3 and R_4) represent four dietary treatments that contain moringa leaves at levels of 0, 7.5, 15 and 30% replaced with soybean meal, respectively, as presented in Table (1). The chemical compositions of ingredients as well as the tested rations are present in Table (2). Nutrient digestibility and feeding values were determined by chosen 3 lambs randomly from each group, using acid insoluble ash (AIA) technique of Van Keulen and Young (1977). Feeds and feces were sampled and the conventional analytical methods of A.O.A.C. (1990) were applied. Also, digestibility coefficient and feeding values of the tested rations were determined. Gross energy and digestible energy (DE) were calculated after Nehring and Haenlien (1973).

Feeding trials was conducted using 20 ram lambs with an average age of 10 months and 45.0 $\pm$ 1.0 kg live body weight. Animals were allotted in equal numbers to test the four rations (5 animals/each). The experimental duration extended for 90 days and the rations were fed to cover the nutritional requirements of fattening sheep according to N.R.C (1985). Rations were offered twice daily at 9.0 a.m. and 4.0 p.m. in equal portions. Fresh water was available and animals were healthy and under veterinary care. Lambs body weight was recorded biweekly before morning feeding. Daily gain, average feeding intake and feed conversion were determined.

Blood samples were collected from jagular vein in heparinzed tubes before feeding in the morning at the end of fattening lambs trial from each animal. Blood samples were centrifuged at 4500 round/min. for 20 min. to obtain blood serum. Serum total protein and albumin were estimated by calorimetric method as described by Cannon (1974), serum globulin was calculated, and serum glucose was measured calorimetrically according to Howanitz and Howanitz (1984).

Simple economical evaluation was calculated for the tested rations. The price of one kg live weight gain of sheep was 36 L.E. and the cost of one ton of moringa leaves, corn, wheat bran, soya bean meal, fed additive mixture and wheat straw were 1500, 2000, 1800, 4200, 2300 and 800 L.E, respectively. Complete randomize design was used for experimental rations. Data obtained were subjected to statistical analysis according to general linear models procedure adapted by SPSS (1997).

RESULTS AND DISCUSSION

Nutritive evaluation:

Moringa contained 28.91% DM, 16.52% CP, 5.78% EE, 11.14% Ash, 13.14% CF, 30.27% NDF, 20.03% ADF, 5.4% ADL, 10.78% hemicelluloses, 14.63% cellulose and 1.81% tannins (Table 2). Regarding DM, OM, EE and NDF%, the results obtaining by Kholif et al. (2015) may suggest the obtained results in this study. Data of NDF, ADF, ADL, hemicelluloses and cellulose were decreased slightly compared to Khayyal et al. (2015) which may reflect the differences of moringa parts samples that analyzed, but the same trend was found with Taninat. Comparing the four tested rations, their chemical composition was nearly similar expiate that CP. Table (3) showed insignificant effect on the digestibility coefficients regarding DM, OM, CP, CF and NFE in the presence of moringa leaves. The EE digestibility did show significant differences ($P\leq 0.05$) in the presence of moringa leaves. Khayyal et al. (2015) reported higher DM, OM, EE and NFE with lower CP and CF digestibilities than the obtained results of R4 (30% moringa).Energy values of total digestible nutrients (TDN) and digestible energy (DE) of the tested rations in Table (3) had insignificant effect in moringa leaves containing rations, while digestible crude protein (DCP) was significantly affected ($P\leq 0.05$) of control ration compared with other rations. The results were in favour of R_2 in general. These results are in agreement with those reported by Seshadri (2003), Khalafalla *et al*. (2010), Debela and Tolera (2013) and Teixeira *et al*.(2014) mentioned that the moringa leaves contain high levels of lipids and protein. Although moringa leaves contain considerable amounts of crude protein these are mostly insoluble and have low digestibility. Also, Mahmoud (2013) and Jelali and BenSalem (2014) concluded that daily and alternate distribution of moringa leaves had similar effect on digestibility and feeding value in sheep than soybean meal.

Feed intake and growth performance:

Data of Table (4) indicated that the lambs total gain and daily gain were affected significantly ($P\leq 0.05$) when moringa leaves was included at 15% (R_3) in the ration compared with other rations. However, daily crude protein intake and feed conversion were improved significantly ($P\leq 0.05$) when moringa

leaves was included at 7.5% (R_2) in the ration compared with other rations. These results are in accordance with those obtained by Aregheore (2002), Sarwatt *et al*. (2002), Ben Salem and Makkar (2009), Asaolu *et al*. (2012), Mahmoud (2013) found that rations contained moringa leaves improved growth performance and feed conversion.

Blood parameters:

Regarding blood parameters (Table 5) showed insignificant increase in fattening lamb's total protein, albumin and glucose as the time of treatment advanced. Meanwhile, the concentration of urea, AST and ALT were decreased significantly ($P< 0.05$) as the time of treatment advanced. Such results were nearly similar to that obtained in growing lambs by Boyd (2011) and Mahmoud (2013). In the same time, the values of all blood parameters of all tested animals were within the normal range of healthy animals.

Economical evaluation and conclusion:

The presence of moringa leaves reduced the cost of consumed feed and improved the net revenue especially when added at 15% of ration (Table 6). The relative costs of feed consumed/head/period were 100, 97.19, 94.69 and 87.32% for rations of R_1, R_2, R_3 and R_4 respectively. The corresponding values of relative percentage of net revenue were 100, 56.45, 171.83 and 125.6 %. These results were in harmony with those of Jelali *et al*. (2014) who found that using moringa leaves in growing lambs decreased feed cost and increased the economic return. Also, Mahmoud (2013) found that the concentrate feed mixture could be replaced by moringa while improved animal performance and increased net return.

In conclusion the rations containing moringa leaves could be used economically and successfully for fattening lambs since it improved daily gain, feed efficiency and economic efficiency. On the other hand, soybean meal could be replaced by moringa leaves which could result in improving animal performance and increase the net revenue which represent a partial solution for the high price of soybean meal.

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Table (1). Formulation of the tested rations.

Ingredients	% on DM basis			
	R_1	R_2	R_3	R_4
Yellow Corn	55	55	55	55
Wheat Bran (WB)	22	19.5	17	12
Soybean meal (SBM)	20	15	10	--
Moringa	--	7.5	15	30
Fed Additives*	3	3	3	3

**fed additives, composed of 2% limestone,0.5% mineral and vitamins and 0.5% common salt.*

Table (2). Chemical composition of ingredients and the tested rations on DM basis.

Item	DM %	Chemical composition, % on DM basis								GE, Mcal/kg
		OM	CP	EE	CF	NFE	Ash	ADF	NDF	
Ingredients:										
C	93.79	92.19	7.53	4.52	2.41	77.73	7.81	5.09	13.20	
WB	94.10	89.63	12.27	4.51	8.47	64.38	10.37	11.52	36.13	
SBM	91.99	85.55	40.31	2.90	5.44	36.94	14.45	9.16	21.67	
MOL	28.91	88.16	16.52	5.78	13.14	52.72	11.84	20.03	30.27	
WS	94.43	79.68	2.66	1.85	33.62	41.55	20.32	49.61	77.26	
Rations:										
R_1	91.62	85.57	11.84	3.51	11.61	58.61	14.43	17.77	33.96	3.93
R_2	88.04	85.64	11.03	3.64	11.99	58.98	14.36	18.34	34.19	3.93
R_3	84.45	85.71	10.22	3.77	12.37	59.35	14.29	18.91	34.40	3.93
R_4	77.27	85.85	8.60	4.03	13.12	60.10	14.15	20.04	34.83	3.93

R1 (55%C, 22%WB and 20% SBM), R2 (55%C, 19.5%WB, 15% SBM and7.5% MOL), R3 (55%C, 17%WB, 10% SBM and 15%MOL) and R4 (55%C, 12%WB and 30%MOL)
Moringa leaves (MOL), corn (C), Wheat bran (WB), soya bean meal (SBM) and Wheat straw (WS)

Table (3). Digestibility coefficients and nutritive values of the tested rations on DM basis.

Item	Tested rations				SE
	R_1	R_2	R_3	R_4	
Digestibility coefficients %:					
DM	71.35	69.14	65.22	64.62	0.42
OM	68.51	66.19	66.21	64.34	0.51
CP	67.28	69.72	67.95	66.45	0.46
EE	58.64^b	65.21^a	64.57^a	52.18^c	0.64
CF	62.56	59.22	57.68	55.38	0.39
NFE	72.63	73.29	70.37	67.94	0.52
Nutritive values:					
TDN, %	62.45^a	63.35^a	61.32^b	58.54^c	0.42
DE, Mcal/kg DM	2.69^a	2.72^a	2.63^b	2.49^c	0.03
DCP, %	7.97^a	7.69^a	6.94^b	5.70^c	0.07

Average in the same row having different superscripts are differ significantly ($P \leq 0.05$)

Table (4). Effect of moringa leaves on growth performance of fattening lambs.

Item	Rations				SE
	R_1	R_2	R_3	R_4	
Average initial weight, kg	45.36	45.58	44.94	44.86	1.04
Average final weight, kg	54.90	53.65	56.23	54.31	1.22
Total gain, kg	9.54^{b}	8.08^{c}	11.29^{a}	9.45^{b}	0.18
Daily gain, g	106.00^{b}	89.72^{c}	125.42^{a}	105.00^{b}	3.07
Average daily feed intake/head:					
DM, kg	1.35	1.39	1.44	1.52	0.09
TDN, kg	0.84	0.88	0.88	0.89	0.03
DE, Mcal	3.63	3.78	3.79	3.78	0.16
DCP, g	107.60^{a}	106.90^{a}	99.94^{b}	86.64^{c}	2.97
Feed conversion:					
DM/gain, kg/kg	12.74^{b}	15.50^{a}	11.48^{c}	14.48^{a}	0.22
TDN/gain, kg/kg	7.92^{b}	9.81^{a}	7.02^{c}	8.48^{b}	0.40
DE/gain, Mcal/kg	34.25^{b}	42.47^{a}	30.32^{c}	36.00^{b}	0.83
DCP/gain, g/g	1.02^{b}	1.19^{a}	0.80^{c}	0.83^{c}	0.05

Average in the same row having different superscripts are differ significantly ($P \leq 0.05$)

Table (5). Effect of moringa leaves supplements in the fattening lamb rations on some blood parameters.

Item	Rations				SE
	R_1	R_2	R_3	R_4	
Total protein, g/dl	4.07	4.33	4.47	4.50	0.09
Albumin, g/dl	2.67	2.97	3.17	3.20	0.13
Globulin, g/dl	1.40	1.37	1.30	1.30	0.05
A/G ratio	1.91:1	2.17:1	2.44:1	2.46:1	0.03
Urea, mg/dl	44.67^{a}	34.33^{b}	26.67^{c}	28.33^{c}	2.73
Creatinine, mg/dl	0.70	0.76	0.71	0.73	0.03
AST,IU/l	183^{a}	104^{c}	95^{c}	116^{b}	12.70
ALT, IU/l	45.33^{a}	26.00^{b}	21.00^{c}	21.33^{c}	4.61
Sugar	39.33	47.33	45.00	44.00	1.80

Serum Aspartate aminotransferase (AST) and Alanin aminotransferase (ALT)
Average in the same row having different superscripts are differ significantly ($P \leq 0.05$)

Table (6). Economical evaluation of moringa leaves level in the rations.

Item	Rations			
	R1	R2	R3	R4
Total weight gain/head/period, kg	9.54	8.08	11.29	9.45
Dry matter consumed/head/period, kg	121.50	125.1	129.6	136.8
Price of one kg DM of the ration, L.E.	1.96	1.85	1.74	1.52
Cost of feed consumed/head/period, L.E.	238.14	231.44	225.5	207.94
Relative cost of feed consumed/head/ period	100	97.19	94.69	87.32
Total revenue, L.E	343.44	290.88	406.44	340.2
Net revenue, L.E	105.3	59.44	180.94	132.26
Relative percentage of net revenue	100	56.45	171.83	125.6

The price of one kg live body weight gain of sheep was 36.0 L.E. and the cost of one ton DM of moringa leaves, corn, wheat bran, soybean meal, fed additive mixture and wheat straw were 1500, 2000, 1800, 4200, 2300 and 800 L.E, respectively.

إستخدام أوراق المورينجا في علائق حملان التسمين

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أجريت هذه الدراسة فى مزرعة الانتاج الحيواني بكلية الزراعة بالفيوم واستخدم فيها 20 ذكر من حملان التسمين متوسط وزن الجسم 45 ±1 كجم فى عمر10 شهور وتم تغذيتها على العلائق التجريبية لمدة 90 يوم، وزعت هذه الحملان عشوائيا فى اربع مجموعات متماثلة تضم كل مجموعة 5 حيوانات، تغذت المجموعة الاولى (مجموعة المقارنة) على 75% علف مصنع يحتوي على 20% كسب فول صويا + 25% تبن قمح، تم استبدال كسب فول الصويا بأوراق المورينجا بنسبة 25%، 50%، 100% أو بنسبة 0%، 7.5%، 15%، 30% من العليقة في أربعة علائق تجريبية على التوالي. كان هدف الدراسة هو معرفة تأثير استبدال كسب فول الصويا بأوراق المورينجا على معاملات الهضم والقيم الغذائية والمأكول ومعدل النمو وبعض تحاليل الدم وكذلك التقييم الاقتصادي للعلائق المختبرة وقد أوضحت النتائج ما يلى:

- أحتوت أوراق المورينجا على نسب مرتفعة من الدهن الخام والبروتين الخام والكربوهيدرات الذائبة بينما أنخفض محتواها من الالياف الخام والالياف الذائبة في المحاليل الحامضية والالياف الذائبة في المحاليل المتعادلة.
- أظهرت معاملات هضم المركبات المختلفة تأثير غير معنوي بين العلائق المختبرة فيما عدا الدهن الخام فاظهر تأثيرمعنوي لصالح العليقة الثانية والثالثة.
- لم يكن هناك أختلاف معنوي بين القيم الغذائية للطاقة نتيجة إضافة أوراق المورينجا للعليقة بينما أظهرت قيم البروتين المهضوم انخفاض معنوي بزيادة مستوي أوراق المورينجا في العليقة.
- كان هناك تحسين معنوية نتيجة إضافة أوراق المورينجا للعليقة على الزيادة اليومية للحملان ومعدل استهلاك الغذاء وكذلك الكفاءة التحويلية للغذاء بزيادة مستوى أوراق المورينجا فى العليقة.
- أظهرت تحاليل الدم تحسن معنوي في كل من وظائف الكبد والكلى بزيادة مستوى أوراق المورينجا فى العليقة.
- من التحليل الاقتصادى لهذه الدراسة وجد ان استبدال كسب فول الصويا بأوراق المورينجا بنسبة 15% من العليقة كان الأفضل ثم نسبة 30% حيث خفض تكاليف التغذية وادى الى زيادة العائد الاقتصادى.
- نستخلص من هذه الدراسة انه يمكن استخدام أوراق المورينجا كبديل لكسب فول الصويا بنجاح فى علائق تسمين الحملان حيث انه يقلل من استخدام كسب فول الصويا المرتفع فى ثمنه وبذلك يخفض من تكلفة العلائق ويؤدى الى زيادة العائد الاقتصادى.