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NUTRITIONAL VALUE AND ECONOMICAL EFFICIENCY OF WHOLE MAIZE SILAGE FOR FATTENING LAMBS AND CARCASS CHARACTERISTICS

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ABSTRACT

Thirty Ossimi growing male lambs (5 months of age) with an average of live body weight (LBW) 20.85 ± 2.26 kg were divided according to their LBW into two similar groups. Group 1 fed control diet: concentrate feed mixture (CFM) plus bean straw (BS) at 3.0 and 1% of their LBW, respectively. Group 2 fed CFM and whole maize silage at 2 % of their LBW (test group). The digestion coefficients of all nutrients and feeding value of maize silage ration were higher significantly (P<0.01) than those of control ration. Digestibility coefficients of ration containing maize silage were higher significantly (p <0.01) in DM ,OM, CP,CF and NFE than control ration, while the differences in both CP and NFE were not significant between diets. The feeding value (TDN and DCP) of tested ration were higher significantly (P<0.05) and (p < 0.01) than control ration. Daily gain, feed and economical efficiency were higher with maize silage group than control. Dressing percentage, prime cuts, weight constituents of *longismus dorsi* and chemical composition of slaughtered lambs fed maize silage were better than those fed control ration. It could be concluded that, it can partialy replace maize silage by 33% instead of concentrate feed mixture in growing lamb diets to improve their digestibility coefficients, nutritive value, daily gain, feed and economic efficiency and their carcass characteristic

Keywords: Wholel maize silage, Feeding value, Sheep performance.

INTRODUCTION

In Egypt, the shortage of animal feeds is a serious problem during the summer season. Furthermore, animals suffer malnutrition in this period where forage crops with reasonable protein contents are not adequate. The total area cultivated with maize in Egypt averaged 2033074 feddans which produced 56.93 million ton whole maize green fodder and represent the main supply of grains available for food production and animal feeding (Ministry of Agriculture, 2004). Maize is most widely used in European countries and U.S.A. for silage production. Feeding silage to sheep is an excellent way to economically mechanize and help reduce the manual labor involved in feeding a large flock. It has also a low buffering capacity and high content of water soluble carbohydrates which are necessary to produce high quality silage (Stuart 1984).

The objective of this experiment was to study the feasibility of utilizing whole maize silage in fattening lambs in comparison with traditional feeding on concentrate –straw ration.

MATERIALS AND METHODS

This study was carried out at Fatthalla-Basha fattening farm in Mallawi. Maize (*Zea maize*) was harvested at 75 days (dough stage), chopped (2.5 cm) and ensiled in banker silo (2 x 1.5 x 1.7 meter) in the ground and lime stone as

a source of calcium (2 %) and common salt (1 %) were added. Silo was pressed well by tractor, then covered by plastic sheet with sand soil 25 cm and lauded with big stones. Banker was opened after ensiling period of about two months.

Digestibility experiment:

Two digestibility trials using total collection method were conducted with mature 45 kg LBW Ossimi rams (4 for each) to evaluate the feeding values of the experimental rations. All animals were kept into metabolic cages along the experiment. Each trail lasted 14 days for preliminary period followed by 7 days as total fecal collection period. Tested diets were offered twice daily in two equal portions of feeds at 9.00 a.m and 3.00 p.m to each animal. Fresh water as well as minerals and vitamins mixture blocks were available in front of animals in each cage.

Concentrate feed mixture and bean straw at amounts that represented 3.0 and 1 % of their live body weight, respectively (control diet) were offered to group 1. Rams in group 2, were fed at 2% of their live body weight of concentrate feed mixture and 2% maize silage. In the third week, total feces were collected, weighed, mixed thoroughly and 10 % representative sample was taken from each animal, dried at 70°C for 24 hs and kept in a tightly tied plastic bag until the end of 7 days total collection period, where daily samples for each animal were pooled together, ground and stored for proximate analysis.

Group feeding experiment:

Thirty growing Ossimi lambs of 20.85 $\pm$ 2.26 kg as an average initial body weight were used in a T- test experiment. Animals were kept in shded pens and they were divided into two groups each of 15 animals. Group 1 fed the control diet (concentrate feed mixture and bean straw) in amounts that represented 3.0 and 1 % of their live body weight, respectively. Lambs in group 2, were fed at 2% of their live body weight of both concentrate feed mixture and maize silage. Pelleted concentrate feed mixture was consisted of (35% yellow corn, 30% undicorticated cotton seed meal, 12% rice bran,15% wheat bran, 5% molasses, 2% lime stone and 1% common salt. The animals were weighed individually biweekly before feeding and drinking. Feeds were offered twice daily at 9 a.m. and 3 p.m. in two equal portions. Water was free available in front of the animals along the experimental period except the night before weighing them. The feeding period prolonged for 112 days where the lambs achieved the marketable weight (42 - 45 kg) that was considered as final weight.

Slaughter experiment:

Three lambs having live body weight around the group average weight (marketable weight) were selected for slaughter test. The lambs were fasted for 16 hours before to slaughter and the fasting weight was recorded, they were dressed out and carcass weight was registered. The fasting and empty dressing percentage was calculated. Carcasses were longitudinally split into two equal half's. The right half was cutted according to the English system of mutton (Gerracl 1953). The 9, 10 and 11th ribs of each carcass was dissected in their physical components and the percentages of each component was calculated. After chilling, fat sickness over the eye muscle *(Longismuss dorsi)*

was measured. Fraction weight of meat, fat and bone of carcass was calculated according to Field *et al.* (1963) procedures.

Chemical analysis:

Proximate chemical analysis of feeds, meat and feces samples was done according to A.O.A.C. (1990) for dry matter (DM), crude protein (CP), crude fiber (CF), ether extract (EE) and ash determination. While nitrogen free extract (NFE) was calculated by difference.

Statistical analysis:

Statistical analysis was performed using GLM procedure of SAS system (1995) for T- test design.

RESULTS AND DISCUSSION

Chemical composition:

Results obtained in Table 1 indicate that the chemical composition of feedstuff especially OM, CP and CF tended to increased with ration containing silage, while ash content was decreased. The presents results are in accordance with those obtained by Mohamed *et al.* (1999) and Mohsen *et al.* (2001).

Table (1): Proximate analysis of the experimental diets.

Item	Chemical composition (DM basis)						
	DM	OM	CP	CF	EE	NFE	Ash
CFM	90.00	84.05	16.54	10.52	4.49	52.50	15.95
Bean straw (BS)	7.9 1	87.48	5.41	40.89	0.40	40.78	12.52
Maize silage(MS)	32.52	90.96	12.62	31.29	3.01	44.04	09.04
Group 1	85.73	74.91	13.76	18.11	3.47	49.57	15.09
Group 2	61.26	87.51	14.58	20.91	3.75	48.27	12.50

Digestibility coefficients:

Results obtained in Table 2 indicate that the digestion coefficients of all nutrients and feeding value of maize silage ration were higher than those of the control ration. This may be due to the high OM and CP contents which leads to increase the apparent digestibility significantly ($P<0.01$) with adding maize silage in the ration compared with bean straw. These results could be explained in light of chemical composition and the reduced practical size of concentrate in contrast to maize silage, so it may be resulted in increasing DM intake, faster rate of passage reduced ruminal digestion time and subsequently lowered the digestibility of CFM fcr DM, OM, CP, CF and NFE. These results are in agreement with the findings of Cilliers *et al.* (1998), Mohamed *et al.* (1999) and Mohsen *et al.* (2001).

Nutritive Value:

The values of TDN, and DCP for rations containing maize silage were higher compared with the control ration (Table 2). Differences were highly significant ($P<0.01$). These results could be explained in light of chemical composition and digestibility's. Since the best mixture ratio of concentrate and maize silage characterized by the best mature stage of maize to making maize silage subsequent better utilization therefore better feeding values. These

results agree with the findings of Taie *et al.* (1998), Mohamed *et al.* (1999) and Mohsen *et al.* (2001).

Table 2: Digestibility coefficients and nutritive values of the experimental rations (on DM basis).

item	Experimental rations		
	Control	Silage	± SE
Digestibility coefficients %			
DM	60.69 [b]	68.58 [a]	2.71**
OM	61.54 [b]	69.69 [a]	1.41 **
CP	60.61 [b]	65.78 [a]	2.25**
CF	59.36[a]	69.37[a]	1 .77**
EE	69.63 [a]	65.22 [b]	1.53**
NFE	63.15 [b]	69.98 [a]	2.78 **
Feeding values %			
TDN	55.82[b]	63.35[a]	1.09 **
DCP	8.34[b]	9.59 [a]	0.18 *

*, **: Dissimilar superscripts (a, b, and c) at the same row are significantly differ (P<0.05) and(p<0.01), respectively.

Growth Performance:

Results of performance shown in Table 3 indicated that the final weight was higher for lambs fed ration containing maize silage than those fed the control ration (46.92 vs. 43.5 kg). The same trend was recorded in total and daily gain for lambs fed ration containing maize silage (26.32 kg vs. 22.4 kg and 235 vs. 200 g/day, respectively.

These results may be due to high CP and NFE (energy) contents and their digestibility in ration containing maize silage than the control ration. These results are in agreement with those reported by Petite *et al.* (1994), Taie *et al.* (1998) and Mohsen *et al.* (2001) who found that feeding high energy diets resulted in greater daily body weight gain.

Data in (Table 3) indicated also that, the lambs fed the ration containing maize silage recorded higher amounts consumed of DM, TDN and DCP compared with those fed the control ration and the differences were significant for TDN and DCP at (P<0.05) and (P<0.01), respectively. Also, feed conversion of lambs received ration containing silage was better significantly (P<0.05) than those fed the control ration (5.87 vs 6.80), while feed conversion expressed as TDN and DCP was not significantly differenc.

This result is due to the good maize silage palatability. Chusak (1990) confirmed that, lambs fed maize silage ration consumed more feeds as DM and TDN and had higher gain and feed efficiency than those fed bean straw *ad-libitum* plus 3% of LBW concentrate feed mixture. These findings are in agreement with those found by Petite *et al.* (1994), Mohamed *et al.* (1999) and Mohsen *et al.* (2001).

Economic efficiency:

Diet containing maize silage showed better economic efficiency (P<0.05) which had better daily gain and feed efficiency than lambs diet containing the control, , due to its high cost of feed (Table 3). Mahmoud *et al.*.(2003) mentioned that, the economic efficiency was the best for Barki lambs consumed the roughage portion only from groundnut vine hay which due to the

low cost of the daily ration. Etman and Soliman (1999) indicated that, using groundnut tops hay with 1.5% L.B.W, CFM for Barki lambs resulted in better economical efficiency and lower feed cost to produce one kg gain. Ahmed (2003) pointed that, the increase of concentrate ratio in kid's diet had slight incremental effect on economic efficiency.

Table (3): Feed intake, growth performance, feed conversion and economic efficiency of lambs fed the experimental rations.

Treatment	Control	Silage	+ SE
Number of animals	15	15	---
Experimental period, d	112	112	---
Daily Feed Intake:(DM basis)			
Bean straw, kg	0.340	--	---
Maize silage, kg	--	0.690	---
CFM, kg	1.020	0.689	---
DM, kg	1.360	1.379	0.21 NS
TDN, g	0.759^{b}	0.874^{a}	0.03 *
DCP, g	113.42^{b}	132.25^{a}	2.85 **
Growth performance:			
Initial wt. / kg	21.10	20.60	2.21 NS
Final wt. / kg	43.50^{b}	46.92^{a}	2.18 *
Total gain / kg	22.40^{b}	26.32^{a}	1.45 *
Daily gain (g)	200.00^{b}	235.00^{a}	16.34 *
Feed conversion as:			
Kg, DMI/kg daily wt. gain	6.8^{a}	5.87^{b}	0.42 *
Kg, TDN/kg gain	3.795	3.719	0.19 NS
g, DCP/kg gain	567.10	562.77	3.04 NS
Economical efficiency:*			
Lamb wt gain income, L.E.(A)	3.40^{b}	3.995^{a}	0.02 *
Diet cost/lamb, L.E.(B)	1.42^{a}	1.143^{b}	0.01 *
Economical efficiency.(Y)	1.39^{b}	2.495^{a}	0.26 *

a, and b, means on the same row having different superscripts differ significantly (P<0.05).

- Based on free market prices of feeds at, 2006, the cost of the experimental rations were estimated as the total. prices of concentrate feed mixture, bean straw and silage, being, , 1050, 500 and 160 L.E, per ton, respectively, while, the cost of the price of one kg body weight gain on selling being, 17.00 (L.E.).

*** Economic efficiency Y = [(A-B/B)], where A= selling cost of the obtain gain, and B=feeding cost of this gain.**

Carcass Characteristics:

The slaughter data are given in Table 4. The fasting body weight, carcass weight, fore quarter and hid quarter weight were not significantly (P<0.05) different between the two groups. The opposite trend was noticed with respect to fasting dressing percentage and empty dressing percentage (carcass weight on fasting or empty body weight) since they were significantly (P<0.05) different among dietary treatments in favor of the control diet. Ahmed (2003) on goats reported that, dressing % of carcass either with or without offal's were improved significantly (P<0.05) with increasing concentrate levels in the diet. The same trend was mentioned by Nowar (1993) on lambs fattened on rations differed in concentrate levels (40, 60 and 80%). Also, these results were in accordance with those findings by Suliman (1994) and Rossi and Loerch (2003).

Table 4: Carcass parameters (carcass traits, carcass cuts and carcass constituents) for lambs the experimental diets.

Item	Control	Maize silage	± SE
Carcass traits, kg:			
Fasting body weight	42.00[b]	44.002[a]	2.012*
Carcass weight	21.5[a]	20.36	1.13*
Dressing%*	51.19[a]	46.27[b]	1.16*
Dressing%**	67.19[a]	53.48[b]	1.03*
Fore quarter weight	4.65[a]	4.69[a]	0.25 NS
Hind quarter weight	4.45[a]	4.31[a]	0.31 NS
Total fat	2.20[a]	2.22[a]	0.12 NS
Tail fat	2.00[a]	2.00[a]	0.11 NS
Bow fat	0.20[a]	0.22	0.21 NS
Leg weight	3.00[a]	3.00[a]	0.02 NS
Chin weight	1.45[a]	1.31[a]	0.34 NS
Ribs weight	0.70[b]	1.10[a]	0.42 *
Shoulder weight	2.6[a]	1.65[b]	0.45 *
Sets weight	1.10[a]	1.53[a]	0.44 NS
T. weight and constituents of LD., kg	250[b]	304[a]	3.75 *
Lean weight	185.0[b]	218.4[a]	2.64 *
Fat weight	33.5[a]	15.3[b]	0.26 *
Bone weight	31.5[a]	70.7[b]	1.42 *

+a, and b, means on the same row having different superscripts differ significantly (P<0.05).
Dressing%*: dressing percentage on fasting body weight
Dressing%: dressing percentage on empty body weight**

The hot carcass cuts presented that, the values of leg, chine , ends and hind quarter weight were not significantly (P<0.05) different (Table 4). Carcass cuts of fattened kids as percentage of the carcass weight had slight differences in shoulder, legs, loin, rack, neck and flank weight due to concentrate ratio in the diet (Ahmed 2003).

Data in Table 4 showed that, the values of deposit carcass fat as the weight of bowel and tail fat were not significantly (P<0.05) different. The lambs received silage recorded lowest values of internal fat (15.3 g), while those fed the control ration recorded the highest value (33.5 gm). Different offal's as a percentage of carcass weights did not show valid differences due to concentrate ratios in the diet of fattened kids (Ahmed 2003).

Data indicated that, the prime cuts percentage (chine and shoulder)) relative to carcass weight of the control ration (D1) was higher than those fed the silage diet, also, hind quarter and leg were relatively higher for those fed the silage diet than those fed the control.

Weights of different carcass components of 9, 10 and 11th ribs cuts for the animals fed the silage diet were found significantly different than those received the control diet in total weight (304 g), lean (218.4 g), fat (15.3 g) and bone (70.7 g), while the lambs fed control ration had recorded the lowest values of the previous items (250, 185.0, 33.5 and 31.5 gm, respectively). In this respect, Taie *et al.* (1998) on sheep reported that, dressing % and dissectible fat both as weight increased with increasing levels of energy, while

bone% in carcass decreased. Ahmed (2003) on goats, mentioned that, eye muscle ribs weight did not show clear differences as a percentage of carcass weights. Also, meat% in the ribs of fattened kids decreased by increasing concentrate ratio in the diet (-2.5 to -5.6%), while fat% in the ribs oppositely increased for this factor by 7.7 and 10.9%, respectively. These results in the same trend with the findings of Abo-El-Naga and EL-Shobokshy (1974) and Hanafy *et al.* (1998). On the other hand these results disagree with those reported by Nik- Khah and Assadi – Moghaddam (1977) and Hassan and El-Feel (1991).

The results of chemical composition are illustrated in Table 5. The chemical composition of carcass showed significant ($P<0.05$) differences in carcass moisture, protein and fat % . While in ash %, no significant difference was detected between the two groups. The highest protein % was recorded in the carcass from animals fed maize silage compared with those fed the control diet, but the opposite was observed by fat %, the carcasses of silage diet recorded the lowest value. These results could be explained in light of the lean , fat and ash content of the 9,10 and 11th ribs cut and it's physical separation, age of animal, and energy of feeding. These results are in accordance with those reported by Abd El-Wahed (1999) and Suliman *et al.* (2000). .

Table (5): The effect of rations on the chemical composition of longismus dorssi (LD) for lambs fed the experimental rations.

treatments	Chemical composition of (LD)			
	Moisture	Protein	Fat	Ash
Control	62.8 ± 0.27b	18.0 ± 0.22b	15.8 ± 0.24a	1.2 ±0.05a
Maize Silage	63.7 ±0.19a	20.8 ± 0.14a	13.0 ± 0.22b	1.1 ±0.05a
Significance	*	*	*	NS

*: Significant at P<0.05. NS: Not significant at P>0.05.

Conclusion

From the present study results it could be concluded that feeding maize silage resulted in superior digestibilities and feeding values, better daily gain, feed and economical efficiency and also carcass characteristics as compared with traditional bean straw-concentrate of growing lambs diet. Thus, replacing 33% of the concentrate with maize silage could be recommended .

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القيمة الغذائية و الكفاءة الغذائية و الاقتصادية لسيلاج الذرة الكامل لتسمين الحملان و خصائص الذبيح

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استخدم فى هذة الدراسة ٣٠ حملا من ذكور الأوسيمى عمر ٥ شهور ووزن حى ٢١,٨٥ كجم و التى قسمت طبقا إلى الوزن الحى إلى مجموعتين متماثلتين . المجموعه الأولى غذيت على عليقه

مكونه من مخلوط علف مركز بالإضافه إلى تبن فول بنسبة ٣و١% من وزن الجسم الحى على التوال (العليقة المختبره)، وغذيت المجموعة الثانيه على مخلوط علف مركز وسيلاج ذرة كامل بنسبة٢%حسب الوزن الحى لكل منهما . أشارت النتائج إلى أن معاملات الهضم لكل المركبات الغذائية كانت عاليه المعنوية عند مستوى (١%) للعلائق المحتوية على سيلاج الذرة الكامل مقارنة بعليقة المقارنة. كانت القيمه الغذائية فى صورة مركبات كلية مهضومة وبروتين خام مهضوم للعليقة المختبرة(التى تحتوى على سيلاج الذرة) كانت عالية معنويا (١%) عن عليقة المقارنة . كما أن معدل النمو اليومى و الكفاءة الغذائية والاقتصادية للعليقة المحتويه على سيلاج كانت أعلى من عليقة المقارنة. كما أظهرت النتائج أفضلية فى نسبة التصافى والقطع الممتازة و التركيب الكيماوى للعضلة العينية لذبائح الحملان التى غذيت على عليقة تحتوى على سيلاج الذرة الكامل عن الحملان التى غذيت على المقارنة.

تدلل النتائج السابقه على إمكانية إحلال سيلاج الذرة الكامل بنسبة ٣٣% محل مخلوط العلف المركز فى علائق الحملان النامية لتحسين معاملات الهضم و القيمة الغذائية و الكفائة الغذائيه والاقتصاديه وخواص ذبائحها .