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UTILIZATION OF *Moringa oleifera* AS A NEW RABBITS FEED. 1- EFFECT OF DIETARY INCLUSION OF *Moringa oleifera* HAY ON PRODUCTIVE PERFORMANCE, CARCASS TRAITS AND ECONOMIC EFFICIENCY OF GROWING RABBITS

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ABSTRACT

A total number of 90 weanling New Zealand White (NZW) rabbits of both sexes, 5 weeks old with an average initial live body weight of 550.5 ± 20.23(g) was used in this study to evaluate the effect of dietary inclusion of different levels of moringa hay (which composed of leaves 50 % + twigs 50%) as a partial substitute for alfalfa hay on productive performance, carcass traits and economic efficiency. The animals were randomly allotted into three experimental groups (30 each). The first group (A) was fed the basal diet as control, while the second (B) and third groups (C) were fed diets containing Moringa oleifera hay as a replacement of 50% and 75% of alfalfa hay in the basal diet, respectively throughout the growing period (5-13 week of age).

***The obtained results showed** that live body weight at 9 and 13 weeks of age, weight gain, daily weight gain and relative growth rate during the different experimental periods increased significantly (P<0.01) for growing NZW rabbits fed Diet B and Diet C than those fed the control one Diet A . However, rabbits fed Diet C showed the highest values (P <0.05) of daily weight gain during the period from 9-13 weeks of age as compared with those fed Diet B or those fed basal diet (Diet A). Mortality percentages during the different experimental periods of study decreased significantly (P<0.01) for growing NZW rabbits fed Diet B and Diet C than those fed Diet A (control one). The differences in daily feed intake during the period from 5-13 weeks were insignificant among all the experimental groups. Growing NZW rabbits fed Diet B and Diet C recorded the best feed conversion ratio (P<0.01 or P < 0.05) than those fed basal*

diet (Diet A) during all experimental periods. The economic efficiency and relative economic efficiency (R.E.E.) for rabbits fed Diet C or Diet B was superior than those fed Diet A (control group). Most of carcass traits for rabbits fed Diet B or C were increased (P<0.05) than those fed Diet A (control group). However, the differences in trunk %, hind limbs weight and percentages, fore limbs %, liver weight and percentages, kidney weight and percentages, edible weight and percentages and inedible weight and percentages were not significant. The differences in chemical composition of meat between the growing NZW rabbits either fed different level of Moringa oleifera hay (leaves +twigs) as a substitute for alfalfa hay in the diet or control animals were insignificant.

***Conclusively,** the results of the present study demonstrated that, Moringa oleifera hay (leaves+ twigs) is supportive as unconventional source of protein for feeding growing rabbits and could be added in the diet at levels up to 15% to replace about 75% of alfalfa hay without any adverse effects on productive traits of growing NZW rabbits.*

Key word: *Moringa oleifera*, feeding, productive performance, growth performance, rabbits

INTRODUCTION

In Egypt as in the other developing countries, there is a severe shortage of animals feeds and its high cost represented the major problems for the shortage of animal protein sources in human food. Limited land resources and the high competition between human and livestock animals for high quality grain and protein supplements are the major contributors to nutrient deficiencies. Therefore, efforts have been made towards solving feeds shortage by improving the conventional sources and investigating more unconventional feeds for availability in animal feeds.

Moringa oleifera is the most widely cultivated species in the family moringaceae. It is rich in antioxidants, has high capacity to scavenge free radicals and play a significant role in reducing mortality and mobility due to cancer, heart diseases and other chronic illness. *Moringa oleifera*

leaves became popular as a natural leaf powder supplement, although the pods, root, bark, flowers, seeds and fruits are also edible.

The moringa leaves contain high amount of β-carotene, protein, vitamin C, calcium and potassium and serve as a good source of natural antioxidant which enhance the shelf-life of fat containing foods due to the presence of various types of antioxidant compounds such as ascorbic acid, flavonoids, phenolics and carotenoids also, moringa leaves are rich in, essential amino acids (Siddhuraju and Becker 2003, Bennett *et al*. 2003, Aslam *et al*. 2005, Manguro and Lemmen 2007, Amaglo *et al*. 2010 and Gowrishankar *et al*. 2010).

Therefore, the present study was carried out to evaluate the effects of inclusion of moringa hay (leaves and twigs) at different levels in the diet to substitute alfalfa hay on productive performance, carcass traits and economic efficiency of growing NZW rabbits under Egyptian condition.

MATERIALS AND METHODS

The experimental work of the present study were carried out at the Rrabbits Research Unit, Department of Animal and Poultry Production, Faculty of Technology and Development, Zagazig University, Zagazig, Egypt. The experimental work was initiated in December 2015 and terminated in September 2016. The laboratory work was performed at Central Lab for Soil, Foods and Feedstuffs (International accredited Laboratory, has ISO 17025, since 2012) belongs to Faculty of Technology & Development, Zagazig University, Zagazig, Egypt.

A total number of 90 weanling New Zealand White (NZW) rabbits of both sexes, 5 weeks old with an average initial live body weight 550.5 ± 20.23gm were used in this study to evaluate effects of dietary inclusion of different levels of moringa hay (leaves(50%) +twigs(50%)) in their productive performance traits. The growing rabbits were allotted to three experimental groups (30 each) which were fed three different diets.

Group (A) was fed a basal pelleted diet. Group (B) was fed a diet contained 10 % *Moringa oleifera* hay as a substituted for 50% alfalfa hay in the basal diet. Group (c) was fed a diet contained 15 % *Moringa oleifera* hay as a substituted for 75% alfalfa hay in the basal diet. All the experimental diets were iso nitrogenous and iso energetic.

Moringa plants were cultivated at research farm of faculty of technology and development, Zagazig University. All plants were first harvested at 90 days of growth and each 45 days for the following successive cuts. Representative samples of the air- dried moringa leaves and twigs were taken for chemical analysis, also samples of feed ingredients of the experimental diets were taken for chemical analysis to determine crude protein, crude fiber, ether extract, nitrogen free extract, calcium and phosphorus according to the methods of AOAC (1995).Chemical analysis was performed in the Central Lab for Soil, Foods and Feedstuffs (International accredited Lab, since 2012 and has ISO 17025), Faculty of Technology& Development, Zagazig University, Egypt.

The diets were formulated to meet the nutrient requirements of growing rabbits according to NRC (1977). The diet were mixed and pelleted at a commercial feed mill of Atmida, Meet Ghamr, Dakahlia Governorate, Egypt.

Chemical analysis of alfalafa hay and *Moringa oleifera* hay (leaves(50%) and twigs(50%)) is presented in Table 1. Ingredients and chemical composition of the three experimental pelleted diets are shown in Table 2.

Table (1): Chemical analysis of alfalafa hay and *Moringa olifera* hay (leaves and twigs)

Chemical analysis	**Alfalafa hay %**	***Moringa olifera* hay**		**Moringa hay (50%leaves +50% twigs)**
		Leaves %	**Twigs %**	
Dry matter	10.93	8.03	9.14	8.58
Crude protein	14.8	24.4	6.2	15.3
Ether extract	2.2	5.2	3.2	4.2
Crude fiber	28.2	19.2	43.0	31.1
Nitrogen free extract	34.9	34.2	29.1	31.65
Ash	8.97	8.97	9.36	9.17
Total	**100**	**100**	**100**	**100**

The animals were housed in flat deck batteries, provided with galvanized feeders and automatic drinkers. The growing rabbits were housed (each 3 rabbits together) in wire cages (50 x 55 x 40 cm). Buck rabbits were housed separately in individual cages (50 x 60 x 40 cm). All batteries were located in a naturally ventilated room. All rabbits were provided with food pellets and drinking water *ad libitum* throughout the experimental period. All animals were kept under the same management and hygienic conditions.

At the termination of the experimental period (13 weeks of age,) 6 rabbits (3males and 3 females) from each group were taken randomly from each experimental group, fasted for 12 hours, weighed and slaughtered by severing the jugular vein with a sharp knife. After complete bleeding, the head, pelt, viscera, feet and tail were removed and the hot carcass was weighed. Giblets (liver, heart and kidney) were weighed and expressed as a percentage of pre-slaughter weight. The dressing percentage was calculated as the hot carcass weight in addition to giblets weight (dressed weight) divided by pre-slaughter weight. The carcass was separated into three primal cuts (fore-limbs, hind-limbs and trunk). Each of three cuts was weighed and expressed as a percentage of carcass weight without the giblets. Meat samples from carcass cuts were taken for chemical analysis.

During the growth period (5-13) weeks of age individual live body weight, weight gain, relative growth rate, feed intake and feed conversion ratio during the period of 5-13 weeks of age and, as well as the pre-slaughter weight and dressing weights (fore-limbs**,** trunks, hind-limbs, head, liver, kidney, and heart) at slaughtering of the growing rabbits were measured according to Abdel-Lateef (1998). The economic efficiency (EE) was calculated according the following equation:

$$EE = (A\text{-}B/\ B) \times 100.$$

Where, A is the selling cost of the obtained gain and B is the feeding cost of this gain. The growth performance index (PI) was calculated according the equation described by North (1981) as follows: PI = (live body weight (kg)/ feed conversion) x 100.

Relative growth rate $= [W_1 - W_2/\ 1/2(W_1+W_2)\ ] \times 100$ was determined according to Abou-Warda (2001).

Where: W_1 is the initial body weight (g) and W_2 is the final body weight (g), during the experimental periods (5-9, 9-13 and 5-13 weeks of age), respectively.

Table (2): Ingredients and chemical analysis of the experimental pelleted diets fed to NZW rabbits.

Ingredients	**Experimental diet groups**		
	Group A (Control)	**Group B**	**Group C**
Yellow corn	17.00	17.00	17.00
Barley	18.00	18.00	18.00
Wheat bran	26.00	26.00	26.00
Soya bean (44.0 CP,%)	16.00	16.00	16.00
Alfalfa hay	20.00	10.00	5.00
***Moringa oleifera* hay**			
Leaves	00.00	5.00	7.50
Twigs	00.00	5.00	7.50
Limestone	2.00	2.00	2.00
Sodium chloride	0.5	0.5	0.5
Premix*	0.3	0.3	0.3
DL-Methionine	0.1	0.1	0.1
Anti Mycotoxins	0.1	0.1	0.1
Total	**100.00**	**100.00**	**100.00**
Chemical analysis:			
Dry matter	11.78	12.62	11.44
Crude protein	17.49	17.65	17.83
Ether extract	3.04	3.24	3.35
Crude fiber	11.02	11.01	10.99
Nitrogen free extract	46.34	48.26	48.26
Ash	10.33	7.22	8.13
Ca	1.02	1.01	1.01
P	0.51	0.56	0.57
Laysine	0.92	1.15	1.28
Meth+cysteine	0.54	0.69	0.76

***One kilogram of premix provides**: Vit. A 12000 IU, Vit. D_3 2000 IU, Vit E 10 mg, Vit. K_3 2mg, Vit B_1 1mg, Vit B_2 5mg, Vit.B_6 1.5 mg, Vit. B_{12} 10 mg; Niacin 30 mg, Pantothenic acid 10 mg; Folic acid 1mg, Choine 250 mg, Biotin 50 mg, Copper 5mg, Manganese 60 mg, Zinc 50mg, Iron 30mg, Iodine 0.3 mg Selenium 0.1mg and Cobalt 0.1mg.

Group A: was fed a basal pelleted diet.

Group B: was fed a diet contained 10 % *Moringa oleifera* hay as a substituted for 50% alfalfa hay in the basal diet.

Group c: was fed a diet contained 15 % *Moringa oleifera* hay as a substituted for 75% alfalfa hay in the basal diet.

Statistical analysis:

Least Square Maximum Likelihood method of analysis (SPSS, Statistics Users Guide, Version 21) was used to analyze the obtained data according to Snedecor and Cochran(1982) using the formula:

$$Yij = \mu + Ti + eijk$$

Where: Yij is any observation, μ is the overall mean of observation, Ti is the effect of treatment and eijk is the random error. Duncan's New Multiple Range test was used for multiple comparisons (Duncan, 1955).

RESULTS AND DISCUSSION

Effect of dietary inclusion of Moringa oleifera hay on:
Growth performance and economic efficiency

Table 3 showed that live body weight at 9 and 13 weeks of age, total weight gain and daily weight gain during the different experimental periods increased significantly ($P<0.01$) for growing NZW rabbits fed Diet B (10%) and Diet C (15%) *Moringa oleifera* hay (leaves50% + twigs50%) than those fed Diet A (basal diet).

Results indicated, also that the inclusion of rabbit diet with 10% and 15% *Moringa oleifera* hay as a substitute for 50% and 75% alfalfa hay increased significantly ($P<0.01$) the relative growth rate during the periods from 5-9 and 5-13 weeks of age compared with the control one. However, moringa hay substitution had no significant effect on the relative growth rate at 9-13 weeks of age.

The mortality percentages during the different experimental periods of study (9-13 and 5-13 weeks of age) decreased significantly ($P<0.01$) for growing NZW rabbits fed Diet B and Diet C than those fed Diet A (control). These results were confirmed with those reported by Talha (2013) who noticed that weaned rabbits fed diet containing moringa leaves meal increased significantly ($P<0.05$) daily weight gain. Also, Enu (2009) who found that growing crossbred rabbits fed diets containing 20% *Moringa oleifera* leaves meal increased weight gain and daily weight gain as compared with those fed with diet containing 0, 10, and 30% *Moringa oleifera* leaves meal. The improvement occurred in growth performance resulting from adding *Moringa oleifera* to rabbit diets may be attributed to the high content of protein (especially the essential amino acids), vitamin B,

Table 3. Growth performance (× ± S.E) and economic efficiency of growing NZW rabbits (5-13 weeks of age) as affected by feeding diets containing different levels of *Moringa oleifera* hay (50% leaves+50% twigs) as a substitute for alfalfa hay in the diet.

Traits	Experimental diet groups			Sig.
	Group A (Control)	Group B	Group C	
Live body weight (g) at :				
5 weeks	543.13±15.32	536.80±13.77	542.90±14.89	NS
9 weeks	1134.00^{b}±39.61	1252.24^{a}±28.26	1318.27^{a}±28.74	**
13 weeks	1876.38^{c}±58.33	2001.59^{b}±35.07	2163.83^{a}±34.82	**
Weight gain(g) from :				
5-9 weeks	596.19^{b}±34.35	711.41^{a}±21.90	775.37^{a}±23.77	**
9-13 weeks	744.65^{b}±31.27	749.34^{b}±24.67	834.72^{a}±22.00	*
5-13 weeks	1335.04^{c}±54.69	1460.76^{b}±31.18	1621.69^{a}±31.70	**
Daily weight gain (g) from :				
5 -9 weeks	21.29^{b}±1.22	25.40^{a}±0.87	27.69^{a}±0.84	**
9-13 weeks	26.59^{b}±1.12	26.76^{b}±0.88	29.81^{a}±0.78	*
5-13 weeks	23.84^{c}±0.97	26.08^{b}±0.56	28.96^{a}±0.57	**
Relative growth rate:				
5 -9 weeks	70.54^{b}±2.67	79.33^{a}±1.74	83.41^{a}±2.07	**
9-13 weeks	49.80±1.88	46.27±1.49	47.96±1.23	NS
5-13 weeks	109.88^{b}± 2.32	114.97^{ab}± 1.55	120.00^{a}± 1.72	**
Mortality percentage from:				
5-9 weeks	3.33	3.33	3.33	NS
9-13 weeks	3.70	0.00	0.00	**
5-13 weeks	13.33	3.33	3.33	**

NS = not significant, * = $P \leq 0.05$ and ** = $P \leq 0.01$

Means in the same raw within the same classification with different litters, differ significantly ($P < 0.05$).

Group A: Fed a basal pelleted diet contained zero % *Moringa oleifera* hay (leaves+ twigs).

Group B: Fed a diet contained 10 % *Moringa oleifera* hay as a substitute for 50% alfalfa hay in the basal diet.

Group **C**: Fed a diet contained 15 % *Moringa oleifera* hay as a substitute for 75% alfalfa hay in the basal diet.

powerful antioxidant vitamins, potassium and essential micronutrients with antioxidants activity selenium and zinc (Fuglie, 1999).

Table 4 shows that daily feed intake during the period from 5-9 weeks of age was increased significantly ($P<0.01$) for growing NZW rabbits fed

Table 4. Means and standard error of daily feed intake (g), daily weight gain (g) and feed conversion (g feed/ g gain), during the period from 5 to 13 weeks of age of growing NZW rabbits fed different level of *Moringa oleifera* hay (50%leaves +50% twigs) as a substitute for alfalfa hay in the diet.

Traits	Experimental diet groups			
	Group A	Group B	Group C	Sig.
Daily feed intake (g) from :				
5-9 weeks	59.12^{b}±0.92	64.47^{a}±0.45	62.85^{a}±0.61	**
9-13 weeks	109.14^{a}±1.42	100.95^{b}±1.59	105.62^{a}±1.24	**
5- 13 weeks	84.13±1.08	82.71±0.79	84.24±0.69	NS
Daily weight gain (g) from :				
5 -9 weeks	20.74^{b}±0.91	25.61^{a}±0.75	27.69^{a}±0.80	**
9-13 weeks	26.83^{b}±1.30	26.79^{b}±0.61	30.21^{a}±0.98	*
5- 13 weeks	23.78^{c}±0.51	26.20^{b}±0.58	28.95^{a}±0.65	**
Feed conversion (g feed /g gain) from :				
5- 9 weeks	2.89^{a}±0.13	2.53^{b}±0.06	2.29^{b}±0.07	**
9-13 weeks	4.16^{a}±0.21	3.79^{ab}±0.12	3.52^{b}±0.10	*
5-13 weeks	3.55^{a}±0.07	3.17^{b}±0.07	2.92^{c}±0.06	**

NS = not significant, * = $P \leq 0.05$ and ** = $P \leq 0.01$

Means in the same raw within the same classification with different litters, differ significantly ($P < 0.05$).

Group A: Fed a basal pelleted diet contained zero % *Moringa oleifera* hay (leaves+ twigs).

Group B: Fed a diet contained 10 % *Moringa oleifera* hay as a substitute for 50% alfalfa hay in the basal diet.

Group C: Fed a diet contained 15% *Moringa oleifera* hay as a substitute for 75% alfalfa hay in the basal diet.

Diet B and C than those fed basal diet (Diet A). However, daily feed intake during the period from 9-13 weeks of age decreased significantly ($P<0.01$) for growing NZW rabbits fed Diet B than those fed Diet C or those fed basal diet (Diet A). The differences in daily feed intake during the period from 5-13 weeks were insignificant.

Daily weight gain during the experimental periods from 5-9 and 5-13 weeks of age was increased significantly ($P<0.01$) for growing NZW rabbits fed Diet B and C than those fed the basal diet (Diet A). However, rabbits fed Diet C showed the highest values ($P <0.05$) of daily weight gain during the period from 9-13 weeks of age as compared with those fed Diet B or those fed basal diet (Diet A).

During all the experimental periods (from 5-13 weeks of age), the best values ($P<0.01$ or $P < 0.05$) in feed conversion ratio was obtained in growing NZW rabbits fed Diet B and C than those fed basal diet (Diet A). Similar results were with those reported by Nuhu (2010) who mentioned that, increasing level of *moringa* leaves resulted in an improvement in feed conversion ratio and an increase in both daily gain ($P <0.05$) and daily feed intake. Similarly, Aboha, *et al.* (2012) and Dougnon *et al.* (2012) reported that *Moringa oleifera* pelleted leaves enhanced average daily weight gains ($P<0.001$) of growing rabbits. Also, feed conversion ratio was better for rabbits fed diet substituted with 10 % and 15% *Moringa oleifera* leaves pellets as compared with the control group. El-Badawi *et al*. (2014) reported that feeding rabbits on rations supplemented with moringa dry leaves up to 0.30% was associated with significant ($P<0.05$) increases in dietary nitrogen utilization and weight gain, as well as, an improvement in feed conversion ratio. On the other hand, Adeniji and Lawal (2012) found that feed intake values showed significant difference ($P<0.05$) between groups of rabbits fed dietary treatments with *Moringa oleifera* leaves meal replacing groundnut cake at 0, 20, 40, 60, 80 and 100%. The rabbits fed on 40% groundnut cake replaced with *Moringa oleifera* had significantly the highest ($P<0.05$) feed intake value as compared with the other treatment groups. However, the lowest values of feed intake ($P<0.05$) were recorded at 100% *Moringa oleifera* leaves meal. Enu (2009) found that the difference of feed intake and feed conversion rate were significant ($P<0.05$) among the experimental groups of rabbits fed diets containing 10, 20, and 30% *Moringa oleifera* leaves meal. The efficiency of feed conversion was significantly better ($P< 0.05$) for group of rabbits fed diets containing 10% and 20% *Moringa oleifera* leaves meal than the other groups. Also, *Moringa oleifera* leaves meal can conveniently replace up to 15% of expensive sources of protein in rabbit diet without compromising performance.

***Economic efficiency**:*

The economic efficiency was defined as the money returned for body weight gain relative to the price of feed consumed. Calculation of the values was based upon the prevailing marked prices for feed ingredients for the experimental ration used during the experimental period in 2016. The cost for each kg of the different rations was 2.60, 2.69 and

2.74 LE for Diet A, Diet B and Diet C, respectively. However, the average market price was 30 LE for one kg live rabbit weight Table 5.

The economic efficiency during the whole experimental period (*i.e.* from 5-13 weeks of age), Diet C (402.5%) was superior to Diet B (382.02%) and Diet A (359.43%). Also, the relative economical efficiency (R.E.E.) was the best for group fed Diet C (142.15) as compared with the control (100). Moreover, the relative economical efficiency (R.E.E.) was better for group fed Diet B (119.51) as compared with the control (100). These results are in agreement with those reported by Vantsawa and Daramola (2014) who revealed that the economics of raising rabbits using *Moringa oleifera* leaves meal as replacement for soybeans in rabbit's feed were significant ($P<0.05$ or 0.01) existed in weight gain, feed intake, feed conversion ratio, cost of feed (kg), cost of weight gain and net benefit

From the economic point of view it could be concluded that the cost of formulated growing rabbit diets could be reduced by partial substitution of alfalfa hay up to 75 % by untraditional source as *Moringa oleifera* hay (50% leaves + 50% twigs) by decreasing feed cost for one kilogram gain.

Carcass traits

Data in Table 6 showed that rabbits fed Diet A or B increased ($P<0.05$) pre-slaughter weight, trunk weight, carcass weight, carcass %, dressed weight and dressed % compared to the control group. Also fore limbs weight were increased significantly ($P<0.01$) for growing NZW rabbits fed Diet A or B than those fed basal diet (Diet A). However, the differences in trunk%, hind limbs weight and percentages, fore limbs%, liver weight and percentages, kidney weight and percentages, edible weight and percentages and inedible weight and percentages were not significant. *Moringa oleifera* hay (leaves and twigs) can be incorporated in the rabbit's diets up to 50 or 75% as a replacement of alfalfa hay without any deleterious effects on the carcass and organ weights of growing rabbits. Similar results are in agreement with those reported by Odetola *et al.* (2012) who showed that the value of loin, hind limbs, spleen and heart weight of growing crossbred rabbits fed diet containing 5, 10 and 15% dried *Moringa oleifera* leaves meal as a replacement of

Table 5. Effect of dietary inclusion of *Moringa oleifera* hay (leaves and twigs) on economic traits of the growing New Zealand White rabbits.

Items	Experimental diet groups		
	Diet A (control)	Diet B	Diet C
Final live body weight (g)	1876.38	2001.59	2163.83
Average feed consumed (kg/rabbit)	4.711	4.631	4.717
Feed conversion (g feed/ g gain)	3.55	3.17	2.92
Price / kg feed (LE)	2.60	2.69	2.74
Total feed cost (LE)	12.25	12.46	12.92
Average weight gain (kg/rabbit)	1335.04	1460.76	1621.69
Price / kg live body weight (LE)	30.0	30.0	30.0
Total return (LE)	56.28	60.60	64.92
Net return (LE)	44.03	47.6	52
Economical efficiency (%)	359.43	382.02	402.5
Performance index (PI)	52.84	63.15	75.11
Relative economic efficiency (R.E.E.)	100	119.51	142.15

Group A: Fed a basal pelleted diet.
Group B: Fed a diet contained 10 % *Moringa oleifera* hay as a substitute for 50% alfalfa hay in the basal diet.
Group C: Fed a diet contained 15 % *Moringa oleifera* hay as a substitute for 75% alfalfa hay in the basal diet.

soybean meal were significant ($P<0.05$). Enu (2009) showed that the effect of dietary inclusion of *Moringa oleifera* leaves meal by 0, 10, 20, and 30 % increased significantly ($P<0.05$) lion, liver and spleen weights of growing crossbred rabbits. However, there was no significant difference on the other parameters such as, liver, dressed, head, fore limb, hind limb, heart and kidney weights. El-Badawi *et al.* (2014) revealed that carcass dressing percentage and carcass traits were significantly higher ($P<0.05$) for rabbits fed 0.15 and 0.30% moringa dry leaves supplemented rations than the control group.

4. Chemical analysis of meat (%)

Data of Table 7 showed that no significant differences in chemical composition of meat between either growing NZW rabbits fed different level of *Moringa oleifera* hay (leaves + twigs) as a substitute for alfalfa hay in the diet or fed the control one. Similarly, Abd-El-Rahim, *et al.* (1992) reported that the chemical composition of rabbit meat showed

Table 6. Carcass traits (Mean ± S.E) and chemical analysis of meat for growing NZW rabbits as affected by feeding diets containing different levels of *Moringa oleifera* hay (leaves +twigs) as a substitute for alfalfa hay in the diet.

Traits	Experimental diet groups			Sig.
	Group A (control)	Group B	Group C	
Pre-slaughter weight(g)	1804.20^{b}±61.23	1991.20^{ab}±58.07	2049.60^{a}± 76.24	*
Carcass:				
Weight (g)	894.80^{b}±29.17	1039.60^{a}±23.01	1021.80^{a}± 44.69	*
(%)	49.62^{b}±0.76	52.25^{a}± 0.503	49.81^{b}± 0.599	NS
Trunk:				
Weight (g)	397.40^{b}±21.89	474.60^{a}± 9.48	451.80^{ab}± 19.89	*
(%)	44.31±1.44	45.68±0.64	44.22±0.62	NS
Hind limbs:				
Weight (g)	355.80 ±12.85	394.80 ± 17.17	408.60 ± 24.42	NS
(%)	39.83± 1.24	37.92± 0.86	39.91± 0.87	NS
Fore limbs:				
Weight (g)	141.60^{b}± 3.37	170.20^{a}± 1.71	161.40^{a}± 5.92	**
(%)	15.86±0.37	16.41±0.42	15.87± 0.68	NS
Liver:				
Weight (g)	57.47 ± 8.15	57.95 ± 4.28	57.50 ± 7.17	NS
(%)	69.90 ±2.45	68.11± 0.81	66.17±2.40	NS
Kidney:				
Weight (g)	17.80 ±0.55	20.39 ± 1.46	22.20 ± 1.82	NS
(%)	22.68±2.02	23.97±0.67	26.24±1.79	NS
Edible parts:				
Weight (g)	81.08 ± 8.25	85.11 ± 6.24	85.98 ± 8.59	NS
(%)	9.04 ± 0.79	8.15 ± 0.42	8.40 ± 0.72	NS
Inedible parts:				
Weight (g)	327.71 ±27.86	313.68± 25.19	378.94± 15.43	NS
(%)	18.10± 1.15	15.67± 0.85	18.51± 0.49	NS
Dressed:				
Weight (g)	975.88^{b}±33.81	1124.71^{a}±29.04	1107.78^{a}±49.84	*
(%)	54.09^{b}± 0.64	56.51^{a}±0.51	53.99^{b}± 0.50	*

NS = Not significant, * = $P \leq 0.05$ and ** = $P \leq 0.01$

Means in the same raw within the bearing different letters different litters, differ significantly ($P < 0.05$).

Group A: Fed a basal pelleted diet contained zero % *Moringa oleifera* hay (leaves+ twigs).

Group B: Fed a diet contained 10 % *Moringa oleifera* hay as a substitute for 50% alfalfa hay in the basal diet.

Group C: Fed a diet contained 15 % *Moringa oleifera* hay as a substitute for 75% alfalfa hay in the basal diet.

Table 7. Means and standard error of meat composition of growing NZW rabbits fed different level of *Moringa oleifera* hay (leaves +twigs) as a substitute for alfalfa hay in the diet.

Traits	Experimental diet groups			Sig.
	Diet A (Control)	Diet B	Diet C	
Dry matter (%)	30.19±0.49	29.84±1.04	30.43±0.82	NS
Crude protein (%)	24.23±1.33	24.20±1.30	24.22±1.35	NS
Ether extract (%)	3.19±0.29	3.51±0.39	3.26±0.28	NS
Ash (%)	1.65±0.18	1.54±0.06	1.49±0.16	NS

NS = Not significant

Group A: Fed a basal pelleted diet contained zero % *Moringa oleifera* hay (leaves+ twigs).

Group B: Fed a diet contained 10 % *Moringa oleifera* hay as a substitute for 50% alfalfa hay

Group C: Fed a diet contained 15 % *Moringa oleifera* hay as a substitute for 75% alfalfa hay in the basal diet.

no significant differences between groups of rabbits fed on commercial pelleted ration or in which soybean was replaced by taro leaf meal or orang peal meal.

Conclusively, results of the present study demonstrated that *Moringa oleifera* hay (leaves 50%+ twigs 50%) can be used as a good source of protein for feeding growing rabbits up to 15% to replace about 75% of alfalfa hay without any adverse effects and reduced the cost of the commercial diets the cost of formulated rabbit diets could be reduced by partial substitution of alfalfa hay up to 75 % by untraditional source as *Moringa oleifera* hay (leaves + twigs), under environmental conditions of Egypt.

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إستخدام دريس المورينجا أوليفيرا كعلف جديد للارانب . 1- تأثر أدخال دريس المورينجا أوليفيرا في العلائق على الاداء الانتاجى، صفات الذبيحة والكفاءة الاقتصادية للارانب النامية.

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إستخدم فى هذة الدراسة 90 أرنب نيوزيلندى أبيض مفطوم عمر خمسة أسابيع متوسط وزن الجسم 550.5 ± 20.23جرام . وزعت الأرانب عشوائيا على ثلاثة معاملات تجريبية (30 أرنب فى كل معاملة). غذيت المعاملة الأولى (A) على العليقة الأساسية (المقارنة) وغذيت المعاملة الثانية (B) والثالثة (C) على العليقة المستبدل فيها دريس المورينجا أوليفيرا (أوراق + أعناق) محل دريس البرسيم الحجازى بنسبة 50% و 75 % على التوالى وذلك خلال فترة النمو (5 الى 13 أسبوع من العمر) تم دراسة الاداء الانتاجى للارانب النامية ، صفات الذبيحة والكفاءة الاقتصادية.

أظهرت النتائج زيادة فى وزن الجسم الحى عند عمر 9 و 13 أسبوع وأيضا زيادة فى وزن الجسم ومعدل النمو اليومى للأرانب النامية خلال الفترات التجريبية (من 5- 9 ، 9- 13 و 5 - 13 إسبوع من العمر) وكانت هذة الزيادة معنوية (علي مستوي إحتمال 0.01) فى المعاملة B و C بالمقارنة بالمعاملة A (المقارنة). ومع ذلك لوحظ زيادة معنوية فى معدل النمو اليومى (علي درجة إحتمال 0.05) فى المعاملة C خلال فترة النمو من 9 - 13 إسبوع من العمر بالمقارنة بالمعاملة A التى غذيت على العليقة الأساسية .كما لوحظ زيادة معنوية (علي مستوي إحتمال 0.01) فى معدل النمو النسبى خلال فترات النمو من 5 - 9 و 5 - 13 إسبوع من العمر فى المعاملة B و C (50 و 75% دريس المورينجا أوليفيرا بدلا من دريس البرسيم الحجازى على التوالى. كما أظهرت النتائج إنخفاض معنوى (علي مستوي إحتمال 0.01) فى نسبة النفوق لأرانب المعاملة B و C بالمقارنة بالارانب المعاملة A التى غذيت على العليقة الأساسية خلال فترات النمو (5- 9 ، 9- 13 و 5 - 13 إسبوع من العمر) . أيضا لوحظ زيادة معنوية (علي مستوي إحتمال 0.01) فى إستهلاك العلف اليومي فى الأرانب المعاملة B و C مقارنة بالمعاملة A التى غذيت على العليقة الأساسية وذلك خلال فترة النمو من 5- 9 أسابيع

من العمر . كما لوحظ إنخفاض معنوى (علي مستوي إحتمال 0.01) فى العلف المستهلك يوميا خلال فترة النمو 9 - 13 إسبوع فى أرانب المعاملة الثانية (B) مقارنة بأرانب المعاملة (C و A). كما لم يلاحظ أى فروق معنوية فى كمية العلف المستهلكة يوميا خلال فترة النمو من 5 - 13 أسبوع من العمر بين المعاملات التجريبية . لوحظ خلال جميع الفترات التجريبية (5 - 9 ، 9 - 13 و 5 - 13 إسبوع من العمر) أن أفضل القيم لمعدل التحويل الغذائى للأرانب النامية للمعاملة B و C (علي مستوي إحتمال 0.01 أو 0.05) بالمقارنة بأرانب المعاملة (A) التى غذيت على العليقة الأساسية. كما بلغت تكلفة كيلو جرام العليقة 2.60 ، 2.69 و 2.74 جنيها مصريا فى كلا من المعاملة A ، B و C على التوالى . فى حين بلغ سعر الكيلو جرام من وزن الجسم الحى للأرانب 30 جنيها مصريا . كانت الكفاءة الإقتصادية خلال الفترة التجريبية (5 - 13 إسبوع من العمر) للأرانب التى تم تغذيتها على عليقة المعاملة C (402.5%) أعلى من تلك التى غذيت على عليقة المعاملة B (382.02%) وعليقة المعاملة A (359.43 %) . كانت الكفاءة الاقتصادية النسبية هى الأفضل بالنسبة للأرانب التى غذيت على عليقة المعاملة C (142.2) و المعاملة B (119.51) بالمقارنة بالمعاملة A (100) التى غذيت على العليقة الأساسية . كما لوحظ زيادة معنوية (علي مستوي إحتمال 0.05) فى كلامن الوزن الحى للأرانب قبل الذبح ، وزن الرأس ، وزن الجزع ووزن الذبيحة (جم) والنسبة المؤية للذبيحة والتصافى فى المعاملة الثانية والثالثة (B و C) مقارنة بمعاملة المقارنة (A) . كما لوحظ أيضا زيادة معنوية (علي مستوي إحتمال 0.01) فى كلا من وزن الجلد والأطراف الأمامية فى أرانب النيوزيلندى البيضاء فى المعاملة الثانية والثالثة (B و C) عن تلك الأرانب التى غذيت على عليقة المعاملة A (المقارنة). ومع ذلك كانت الإختلافات غير معنوية فى كلا من الوزن و النسبة المؤية للجذع والأطراف الخلفية و الكبد والكلى والأحشاء المأكولة والأحشاء الغير مأكولة. لذلك يمكن إستبدال دريس المورينجا أوليفيرا (أوراق + أعناق) فى عليقة الأرانب محل دريس البرسيم الحجازى بنسبة 50 % الى 75% دون أى تأثير ضار على وزن الأعضاء والذبيحة فى الأرانب النيوزيلندى النامية. كما أظهرت النتائج عدم وجود إختلافات معنوية فى التركيب الكيماوى للحوم الأرانب (% للرطوبة ، % للمادة الجافة ، % للبروتين الخام ، % لمستخلص الإثير و% للرماد) بين جميع المعاملات التجريبية المختلفة .

التوصية: يمكن من خلال هذه الدراسة إستبدال دريس المورينجا أوليفيرا (أوراق + أعناق) فى علائق الأرانب النامية محل دريس البرسيم الحجازى حتي 75% دون أى تأثير ضار على معدل الإداء الإنتاجي وصفات الذبيحة للارانب النيوزلندى البيضاء النامية تحت ظروف البيئة المصرية .