THE EFFECT OF RATIONS CONTAINING DRUMSTICK TREE *(MORINGA OLEIFERA)* BY PRODUCT ON GROWTH PERFORMANCE YOUNG POST-WEANING RABBITS

Azza M.M. Badr[1]; A.A.M. Ahmed[1] and Fatma M. Salman[2]

1-Regional Center for Food and feed, Agric. Res. Centre., Giza, Egypt.

2- Animal Production Department, National Research Centre, Dokki , Giza

Azzabadr805@ yahoo.com

(Received 13/11/2018, accepted 24/12/2018)

SUMMARY

The study aimed to investigate the effect of using different dietary levels *Moringa* by product as a partial replacement (0, 25, 37.5 and 50%) for clover straw. Results indicated that the chemical composition of *Moringa Oleifera* by product value contained high protein, DM, OM and NSC and lowest contents other values compared to clover hay, values were recorded with of NFE, CF and P. The study rations of containing different dietary levels *Moringa* by product on growth performance, digestibility coefficient of nutrient, nutritive value, cecum activity, carcass characteristics, quality meat and some blood plasma constituents of growing New-Zealand White. The chemical composition of these ration has nearly similar CP, EE, CF and digestible energy. Growth performance of the experimental groups could be noticed that the carcass weight and total edible parts increased ($P<0.05$) with replacing *Moringa olifera* by product meal instead clover hay at level 25%, 37.5% and 50% compared to the control ration, the values of carcass weight were 940.92, 966.83 and 1024.33gm , the total edible parts were 52.22, 51.83 and 53.44 gm, respectively .The best results were recorded with R_4 containing *Moringa* by product meal 50%., the significantly improved up to rate 5.25%. This observation may reflect the relatively higher feed intake by rabbits on the *Moringa* by product meal diets resulting in higher daily weight gain**.** The values of ash and EE were insignificant effect in meat. The values of moisture, dry matter and crude protein were significant between values, the best results crude protein and dry matter meat recorded with R_2 compared with control R_1. The total period from (6-13 weeks) observed the total feed conversion ratio values significant increase between rations and the best feed conversion ratio recorded with R_4 (3.38g/feed /gain)). The result indicted to the best ration with replacement moringa by product meal by 50%. The results of digestibility coefficient were significant differences among three tested rations compared with control for indicated that adding *Moringa olifera* by product roughage meal at 25%, 37.5% and 50% significantly improved ($P<0.05$) digestibility coefficient. while the best improved significant values were recorded with 50% R_4 containing moringa by product followed by R_3 more than other R_2 and control (R_1). In rabbit diet (R_4) recorded the best results cell-wall constituent digestibility data and the highest nutrient digestibility. The highest content *Moringa* by product meal (50%) showed the highest TDN (67.41%) and DCP (12.27%) and significant increased caecum weight, caecum length, caecum PH and total volatile fatty acids (TVFA,s) caeca juice. There was insignificant trend towards a reduction in the cholesterol of level moringa R_4 by (3.13%) compared with control (R_1). This reduction in serum may be suggest a general decline in lipid mobilization. It may be suggested then that, moringa leaf meal diets can reduce serum cholesterol, hence assisting in the reduction and deposition of cholesterol in the muscles. The economic efficiency of $R_4$was higher by 11.31 %, total revenue increased by 4.45%, Net revenue by 10.35%, feeding cost was 1% slightly lower compared with control rations. No mortality of rabbits was recorded during the study by product

Keywords*: Moringa Oleifera by product, rabbit's growth performance, digestibility coefficient of nutrient, nutritive value, cecum activity.*

INTRODUCTION

Moringa Oleifera commonly known as drumstick-tree or horse radish tree is a multi-purpose that has given considerable fodder yield during the wet and dry seasons Fadyimu *et al.,* (2011). In Egypt great

attention has been given by plant breeders to implant *Moringa* imported seeds in agricultural and newly reclaimed lands for human and animal uses. The leaves can serve as a rich source of vitamin C and E and polyphenolics and it contains up to 25% crude protein Makkar *et al.*, (1996). *Moringa Oleifera* have been identified to contain natural antioxidants Siddhuraju *et al.*, (2003). Little studies have been conducted on lactating cattle, laying hens and rabbits. But most people in Egypt, however, are not aware of the potential benefits of *Moringa*, beside the expensive price.

The *Moringa Oleifera* by product are cheapest price and little studies have been conducted in rabbits. Rabbit plays a vital role in the utilization of fibrous by products which can be converted into animal protein for human consumption. They are selective feeders and therefore palatability of forages is very important, many forages and plants can be used for feeding rabbits one of such is *Moringa Oleifera*. These studies are conducted on growth performance Young Post-Weaning New Zealand White Rabbits. The ntritional impact of feeding different supplementation levels of *Moringa Oleifera* by product as partial replacement 0, 25%, 37.5% and 50% for clover hay on feed rabbits. Study the nutrients digestibility, dietary nitrogen utilization, average daily gain, feed conversion, carcass characteristics, blood parameters and caecum activity.

MATERIALS AND METHODS

Experimental diets:

The present experiment was carried out of the private farm in Giza, Egypt during 2012-2013. *Moringa* by product were air dried and hammer milled to produce dried meal. The test ingredient was mixed together with other materials to form four experimental rations, the formula of the experimental design was replacement 0, 25%, 37.5 and 50% clover hay by *Moringa Oleifera* by product are shown in Table (3). Experiments rations were formulated to meet the nutrient requirement of growing rabbits according to National Research Council NRC for rabbits (1977) as shown in Table (2).

Chemical composition: The chemical composition of the *Moringa Oleifera* by product meal and experimental rations were carried out according to A.O.A.C. (2002). Chemical composition of (*Moringa* by product meal and clover hay) and cell wall constituents of feed ingredients are presented in Table (1). Fiber fraction analysis according to Van Soest et al. (1991). Calcium and phosphor determined according to A.O.A.C. (2002) are shown in Table (2). Digestible energy (DE Kcal/Kg DM) =2833-40.8*ADF-25.7 ADL+47.4CP according to Fernandez. et al., (2004)., while the experimental rations have been done according to the Nutrient Requirements Council of growing rabbits NRC (1977).

Table (1): Chemical composition of *Moringa olifera* by product and clover hay: -

Ingredient	*Moringa olifera* by product	Clover hay
Dry matter	93.24	91.435
Organic matter	84.6	83.095
crude protein	10.42	9.5
crude fiber	35.94	36.54
Ether extract	1.63	1.6
Ash	8.67	8.34
Nitrogen free extract	43.36	44.02
Non-structure carbohydrate	29.92	25.31
Fiber fraction constituent:		
NDF	49.36	55.25
ADF	44.02	44.35
ADL	4.83	10.765
AIA	0.55	1.865
Hem.	5.34	10.9
Cell.	39.19	33.585
Lignin	5.34	8.9
NDF-cell soluble	50.64	44.75

Growth performance of the experimental groups: The experiment was done by New Zealand White rabbits of mixed sex, 36 number growing New Zealand White (NZW) rabbits aged 5-6 weeks with an average weight 494.75±3g were kept under the same managerial and hygienic conditions. The rabbits were assigned randomly, 9 for each in 3 replicates and assigned for control diet and 4 experimental diets contained moringa Olivera roughage which were replaced from clover hay in commercial diet at 0, 25, 37.5 and 50%. Rabbits were randomly divided into 4 equal groups; all rabbits were housed individually in galvanized wire hutches of rabbit batteries. Diets (on pellets form) and fresh water were available all times ad lib. during the experimental period that lasted 8 weeks. Live body weight of rabbits and feed consumption were weekly recorded. Feed conversion ratio was calculated as (g feed intake/ g gain).

Digestibility Trial: At the last week of experimental period, a digestibility trial was carried out over a period of 7 days. Six rabbits from each group were housed individually in metabolism cages. The weighted Feed daily and residual feed recorded each group, water intake was offered to rabbit during the digestion trail. Chemically analyzed of digestibility trails of feed, manure and urine samples were daily collected quantitatively during the collection period before feeding at 8:30 a.m. Feed intake of experimental rations and weight of feces and urine volume were daily recorded. Feces was dried, ground and stored for later chemical analysis determined by the A.O.A.C (2002).

Caracas characteristics and chemical composition of rabbit's meat: At the end of the experimental period, four representative rabbits from each treatment were randomly chosen and fasted for 12 hours before slaughtering according to Blasco et al. (1993) to determine the carcass traits.

Blood sample collection and analysis: At the end of 7 days the selected rabbits. The blood was collected after slaughtering from each rabbit (4 rabbits per group) into labeled sterile sample bottles without anticoagulant and used to determine the biochemical components. The blood samples were centrifuged at 4000 rpm for 20 min to obtain serum that was free from cell debris for the biochemical components. Seram was kept frozen at –18 °C for subsequent analysis. Cholesterol in blood plasma was measured according to Stein (1986). Total protein according to Gornall *et al.* (1949), Albumin according to Doumas *et al.*,(1971), Globulin was calculated by different between total protein and albumin value, urea was determined by enzymatic calorimetric according to Fawcett and Scott (1960), uric acid according to Henry and Dryer (1963), Tri-glyceride was determined according to (Greiling and Gressner 1995), Alkaline phosphatase determined by Belfield and Goldberg (1971). Caecum characteristics and activity was measured PH and determined TVFA, s according to Eadie et al., (1967).

Economic efficiency: Economic efficiency of each of the diets was defined as LE returned for one LE invested in feed. Economic efficiency was calculated by the following equation: Economic efficiency= (Selling price of one Kg live body weight – feeding coast of 1 Kg live body weight / Feeding cost of 1Kg live body weight) *100

Statistical Analysis: Statistical Analysis All data collected were subjected to analysis of variance (ANOVA) using SAS, (2002) and significant means separated by Duncan multiple range test Duncan (1955).

RESULTS AND DISCUSSION

Analysis of Moringa Oleifera:

Chemical composition: The proximate chemical composition of *Moringa Oleifera* by product and clover hay (H) is shown in Table (1). Obtained results indicated that the chemical composition of *Moringa* by product value contained high protein, DM, OM and NSC and lowest contents other values compared to clover hay, the values are 10.42, 93.24, 84.6 and 29.92%, respectively. The lowest of *Moringa* by product meal values were recorded with of NFE and CF compared to clover hay, the value 35.94 and 43.36%, *respectively.*

Fiber fraction: Observed that the highest values of cellulose and NDF -cell soluble compared with clover hay, the values 39.19 and 50.64%, respectively but the all fiber fractions had the lowest other values compared with clover hay. The mean NDF concentration of *Moringa* was 49.36 % compared with clover hay, the value 55.25% This value was reported by other authors (Malik *et al.* 1967; Gupta *et al.* 1989;

Becker, 1995; Makkar and Becker, 1996 and 1997 and Reyes Sa´nchez et al. 2006). Analysis of calcium, phosphor and calculate digestible energy of ingredient ration are shown in Table (2) observed the analysis of calcium, phosphor and calculate digestible energy of ingredient ration. The increase values are in calcium (1.07 %). Digestible energy (DE) were (1399 Kcal/Kg DM) of *Moringa* by product meal compared with clover hay. But decrease value of phosphor in moringa by product.

Table (2): calcium, phosphor and calculate digestible and growth energy of ingredient ration.

Ingredient	*Moringa olifera*	Clover
	By product	Hay
Ca	1.07	0.7
P	0.27	0.125
Digestible energy (DE), Kcal/Kg DM	1399	1281.5
Gross energy (Kcal / Kg DM)	403.29	403.039

*Digestible energy (DE), Kcal/Kg DM =2833-40.8*ADF-25.7 ADL+47.4CP according to Fernandez. et. al., (2004).*

Analysis of experimental rations:

Chemical composition of rations: formula of rations is recorded in Table (3) and its chemical composition are showed that in Table (4) the *Moringa* by product meal in ration has 0%, 25%, 37.5% and 50% replacement clover hay, the chemical composition of these ration has nearly similar CP, EE, CF and digestible energy. The percentages of organic matter ranged from 89.6 to 87.75 %, crude protein ranged

Table (3): The formulated of the experimental design ration containing different levels *Moringa Olivera* by product (Kg/ton).

Ingredient	Ration1 0	Ration2 25%	Ration3 37.5%	Ration4 50%
Barely rowed	193.35	196.7	195.925	195.15
Clover hay	300	225	187.5	150
Soybean	144	144.1	144.1	144.1
Moringa roughage	0	75	112.5	150
Corn gluten	37	35	34.5	34
yellow corn	153.1	153	154.75	156.5
Calcium	8.75	8.5	8.225	7.95
Sunflower oil	17.5	17.5	17.5	17.5
Sugarcane molasses	30	30	30	30
Coarse whea8I87989789t brain	95.3	95.3	95.275	95.25
Salt	3.5	3.5	3.5	3.5
Premix	3	3	3	3
Limestone	9.4	8.8	8.475	8.15
L-Lysin HCL%	1.5	1	1.125	1.25
Methionine	3.6	3.6	3.625	3.65
Total	1000	1000	1000	1000
price L.E./ Ton	2642.25	2606.55	2591.7	2576.85

**Each kg vitamins and minerals premix contain: Vit. A 2.00000 IU, 10.000 mg, B 1400 mg, B2 1200 mg, B6 400 mg, B12 .2 mg, K 3400 mg, D3 200000 IU, choline chloride 240 mg, pantothenic acid 400mg, niacin 1000 mg, folic acid 1000 mg, biotin 40 mg, manganese 1700 mg, zinc 14000 mg, iron 1500 mg, copper 500 mg, selenium 20 mg, iodine 40 mg and magnesium 8000 mg.*

from 16.72 to 16.81 %, ether extract ranged between 3.825 to 3.86 %, crude fiber ranged from 13.94 to 14.16 (%)

and nitrogen-free extract content was ranged from 57.52 to 59.01% for the different experimental rations. Digestible energy calculates (DE) ranged from 2525.25 to 2545.95 (kcal/ kg DM) for DE. Meanwhile, percentages of non-fibrous carbohydrates ranged between 29.245 to 16.08 % for the two tested rations. The variation in chemical composition and contents of cell wall constituents may be related to differ in source of by product incorporated in rations formulation

Table (4): The chemical analysis of the experimental rations containing different levels of *Moringa olifera* by product (%).

Ingredient	Ration1	Ration2	Ration3	Ration4
	0	25%	37.5%	50%
Dry matter (DM)	96.05	89.6	92.5	95.4
Organic matter (OM)	89.55	82.3	85.025	87.75
Crude protein (g/Kg)	16.725	16.72	16.765	16.81
Crude fiber (g/Kg)	13.94	14.06	14.11	14.16
Ether extract (g/Kg)	3.825	3.84	3.85	3.86
Ash	6.5	7.3	7.475	7.65
Nitrogen free extract	59.01	58.08	57.8	57.52
Methionine (g/Kg)	0.615	0.605	0.605	0.605
Lysine (g/Kg)	0.77	0.77	0.77	0.77
Ca (g/Kg)	0.84	0.84	0.84	0.84
P (g/Kg)	0.54	0.545	0.5425	0.54
Digestible energy (DE), Kcal/Kg DM	2525.25	2533.99	2545.95	2539.97
Non-structure carbohydrate (NSC)	29.245	25.6	20.84	16.08

*Non- fibrous carbohydrates (Mertens, 2002). NSC = 100 – {CP + EE + Ash + NDF}. DE (Kcal/kg) =2823-40.8) *ADF-25.7ADL+47.4CP according to Fernandez et al., (2004).*

Fiber fraction: Fiber fraction are shown in Table (5) percentages of neutral detergent fiber (NDF) were in the same range (between 49.55 to 55.6%) for the four experimental rations. The percentages of different cell

Table (5): The Fiber fraction of the experimental rations containing different levels of *Moringa olifera* by product.

Ingredient	Ration1	Ration2	Ration3	Ration4
Moringa olifera by product %	0	25%	37.5%	50%
NDF	49.55	53.2	54.4	55.6
ADF	39.45	41.49	42.52	43.55
ADL	5.51	2.94	2.685	2.43
AIA	0.96	0.93	0.91	0.89
Hem.	10.1	11.715	11.8825	12.05
Cell.	33.94	38.55	39.84	41.13
Lignin	4.55	2.01	1.775	1.54
NDF-cell soluble	50.45	46.8	45.6	44.4

Hemicellulose = NDF – ADF., Cellulose = ADF-ADL., NDF-cell soluble=100-NDF.

wall constituents (ADF, ADL, hemicellulose and cellulose) and NDF-cell soluble contents were also in the range (39.45 to 43.55%), (5.51 to 2.43%), (10.1 to 12.05%), (33.94 to 41.13%) and (44.4 % to 50.45) for the three experimental rations, respectively.

Growth Performance of Rabbits:

Live body weight weekly is shown in Table (6) and chart (1): The live body weights weekly was significantly increase (P> 0.05) when replacement *Moringa* by product meal in rabbit's rations. The end of the experiment (56 days old), the best results live body weight with the R4 (1991.41 g) followed R3 (1938.94g), the lowest values recorded with R2 (1897.05) compared with control rations (R1).

Table (6): Growth weeks of New-Zealand rabbits of the experimental rations containing different levels of *Moringa olifera* by product.

	initial weight	week1	week2	week3	week4	week5	weeks6	weeks7	weeks8
R1(0%)	494.75^{a}	604.83^{c}	762.83^{d}	1002.08^{c}	1233.92^{d}	1397.75^{d}	1599.65^{c}	1761.11^{b}	1885.93^{b}
R2(25%)	497.83^{a}	632.42^{b}	814.08^{c}	1033.84^{c}	1273.08^{c}	1455.09^{c}	1610.58^{c}	1750.69^{b}	1897.05^{b}
R3 (37.5%)	496.86^{a}	644.03^{ab}	842.20^{d}	1089.17^{b}	1321.86^{b}	1512.00^{b}	1668.09^{b}	1798.72^{ab}	1938.94^{ab}
R4(50%)	498.33^{a}	656.67^{a}	864.67^{a}	1144.42^{a}	1370^{a}	1576.25^{a}	1737.66^{a}	1874.85^{a}	1991.41^{a}

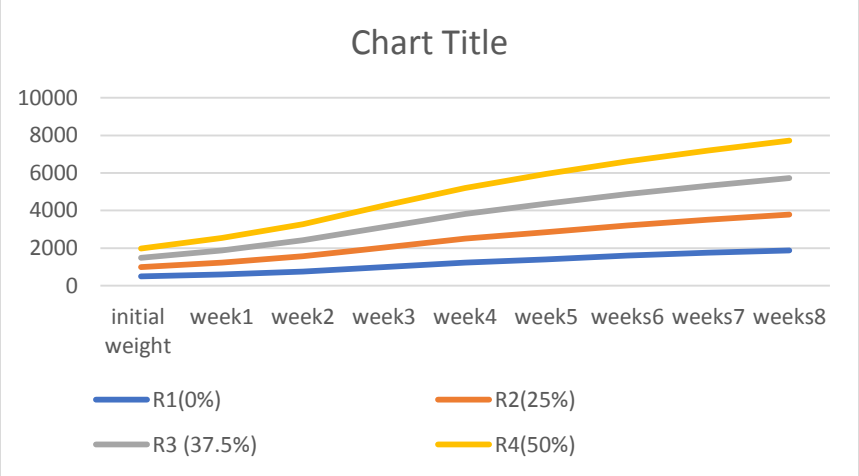

Chart (1): Growth weeks of New-Zealand rabbits of the experimental rations containing different levels of *Moringa olifera* by product.

Growth performance divided to three periods are shown in Table (7). The first period from (6-9 weeks of age), The best average growth performance rabbits was recorded with R4 which containing level 50% *Moringa* by product meal there were significantly increase in averages FBW, BWG, and FI the values 1370., 871.67 and 1789.84, respectively. The values of FCR were insignificant values between different rations. During the second period from (10-13 weeks of age) the results increased averages FBW, BWG, and FI, the values are 1991.42, 621.42, respectively and slightly improvement in FCR were recorded with rabbits group fed 50% *Moringa* by product meal. The total period from (6-13 weeks) observed the total feed conversion ratio values significant increase between rations and the best feed conversion ratio recorded with ration four (3.38). The result indicted to the best ration with replacement *Moringa* by product meal by 50%, these result agreement with Talha (2013) observed weaned rabbits a diet containing moringa leaf meal significantly increased daily weight gain.

Table (7): Growth performance of New-Zealand rabbits of the experimental rations containing different levels of *Moringa olifera* by product.

Ingredient	Ration1	Ration2	Ration3	Ration4
Moringa olifera by product %	0	25%	37.5%	50%
The first period (6-9 weeks)				
IBW (gm)	494.75[a]	497.83[a]	496.86[a]	498.33[a]
FBW (gm)	1233.92[d]	1273.084[c]	1321.86[b]	1370[a]
BWG (gm)	739.17[d]	775.25[c]	825[b]	871.67[a]
FI (gm)/D	1539.24[c]	1574.84[c]	1678.82[b]	1784.84[a]
FCR (gm)	2.09[a]	2.02[a]	2.03[a]	2.05[a]
The second period (10-13)				
IBW (gm)	1233.92[d]	1273.08[c]	1321.86[b]	1370[a]
FBW (gm)	1885.92[b]	1897.04[b]	1938.94[ab]	1991.42[a]
BWG (gm)	652.00[a]	623.96[a]	617.08[a]	621.42[a]
FI (gm)	3435.75[a]	3211.00[b]	3244.78[b]	3266.35[ab]
FCR (gm)	5.30[a]	5.18[a]	5.33[a]	5.27[a]
The whole period (6-13)				
IBW (gm)	494.75[a]	497.83[a]	496.86[a]	498.33[a]
TFBW (gm)	1885.92[b]	1897.04[b]	1938.94[ab]	1991.42[a]
TBWG (gm)	1391.17[c]	1399.21[c]	1442.08[b]	1493.09[a]
TADG (gm)	24.84[a]	24.99[b]	25.75[ab]	26.66[a]
TFI (gm)	88.84[a]	85.46[b]	87.92[a]	90.20[a]
TFCR	3.56[a]	3.42[b]	3.42[b]	3.38[b]

Digestibility of New-Zealand rabbit's trails:

The present results of digestibility coefficient and cell-wall constituent digestibility are shown in (Table 8) the results of digestibility coefficient were significant differences among three tested rations compared with control for indicated that adding *Moringa Oleifera* by product meal at 25%, 37.5% and 50% significantly improved ($P<0.05$) digestibility coefficient. while the best improved significant values were recorded with 50% moringa by product (R4) followed by R3 more than other R2 and control (R1). The range value of crude protein, fiber and fat digestibility significantly increased in R4 were 9.15%, 13.64% and 7.65%, respectively compared with control (R1). This observation may be because of the highly digestible nature of moringa. Dougnon *et al.,* (2012) and El-Badawi *et al.,* (2014). Reported that the feeding ration containing *Moringa* leaves up to 0.3% was improved of nutrient digestibility and nitrogen utilization

Results of cell-wall constituent digestibility are shown in Table (8). It's were significant differences among three tested rations for cell wall constituent digestibility (NDF, ADF, ADL, Hemicellulose, cellulose and lignin) digestibility compared with control, the highly significant was recorded with the R4 containing 50% *Moringa* by product meal followed R2 containing 25% while the lowest digestibility for NDF-cell soluble were recorded with R4 compared with R2 and control (R1) because it increase value of NDF in rations when increase percentage of *Moringa by product* meal. The best results cell-wall constituent digestibility data recorded with R4. In general, the best result of digestibility values of most nutrients obtained of all tested feed teste may be attributed to the effect of feeding such high-quality of Clover hay and *Moringa Oleifera* by product meal) which provided stimulatory reasons to cellulolytic and other bacteria. These reasons resulted in some changes in digestive function which led to increasing the availability and utilization of nutrients and could have a significant impact on digestion and nutritive values of experimental rations, these results agreement with Mahmoud A.E.M. (2013).

Nutritive values: Results of nutritive values (Table 8) revealed that TDN and DCP values for experimental rations appeared to be more affected by nutrients digestibility and concentrate roughages ratio. It was noticeable that R4 with highest nutrient digestibility and high content *Moringa* by product meal (50%) showed the highest TDN (67.41%) and DCP (12.27%), followed R2 content *Moringa* by product (25.00 %)

with Lowe nutrients digestibility recorded the Lowe values 63.30% and 11.55 % for TDN and DCP, respectively. The control (R1) content recorded lowest nutrients digestibility TDN (61.33) and DCP (10.93). These results nearest values recorded by Mahamoud (2013).

Table (8): Digestibility New-Zealand rabbit's trails of the experimental rations containing different levels of *Moringa olifera* by product.

Moringa olifera by product%	Ration1	Ration2	Ration3	Ration4
	0	25%	37.5%	50%
Digestibility coefficient:				
Dry matter	59.81^{b}	66.43^{a}	64.04^{a}	67.76^{a}
Organic matter	61.25^{b}	66.51^{a}	64.34^{ab}	67.85^{a}
crude protein	65.02^{c}	69.10^{b}	70.21^{ab}	71.57^{a}
crude fiber	45.45^{d}	48.18^{c}	50.6^{b}	52.63^{a}
Ether extract	32.23^{c}	41.23^{b}	42.10^{b}	43.89^{a}
Nitrogen free extract	68.08^{a}	73.04^{a}	68.93^{a}	73.72^{a}
cell wall constituent Digestibility: %				
NDF	34.68^{d}	37.58^{a}	38.93^{b}	40.17^{a}
ADF	35.76^{d}	38.28^{c}	39.60^{b}	40.81^{a}
ADL	21.42^{d}	24.08^{c}	25.37^{b}	26.55^{a}
Hem.	30.34^{d}	34.96^{c}	36.34^{b}	37.65^{a}
Cell.	38.08^{d}	39.37^{c}	40.57^{b}	41.65^{a}
Lignin	12.04^{d}	16.45^{c}	18.55^{b}	20.23^{a}
NDF-cell soluble	65.32^{d}	62.42^{c}	61.07^{b}	59.83^{a}
Nutritive values: %				
DCP	10.87^{c}	11.56^{b}	11.77^{b}	12.02^{a}
TDN	59.51^{b}	64.02^{a}	62.03^{ab}	65.33^{a}

Carcass characteristics:

The carcass yields of rabbits are present in Table (9), The effect of different replacement *Moringa* by product meal on carcass weight, dressing, liver weight, kidney weight, heart, edible giblets and total edible parts are study. The various dietary treatments imposed on the rabbits produced significantly increased ($p>0.05$) carcass weight, liver and heart. it was observed that the values tended to increase with increasing levels of *Moringa* by product in the rations. It could be noticed that the carcass weight and total edible parts increased ($P<0.05$) with replacing *Moringa* by product meal instead clover hay at level 25%, 37.5% and 50% compared to the control ration, the values of carcass weight were 940.92, 966.83 and 1024.33gm , the total edible parts were 52.22, 51.83 and 53.44 gm .The best results were recorded with R4 containing *Moringa* by product meal 50%., the significantly improved up to rate 5.25%. This observation may reflect the relatively higher feed intake by rabbits on the *Moringa* by product meal diets resulting in higher daily weight gain. These present results agreement with Safa (2014).

Table (9): Carcass characteristics of New-Zealand rabbits of the experimental rations containing different levels of *Moringa olifera* by product.

Ingredient	Ration1	Ration2	Ration3	Ration4
Moringa olifera by product %	0	25%	37.5%	50%
pre-slaughter weight	1849.58^{a}	1975.25^{a}	2048^{a}	2115.08^{a}
carcass weight	854.33^{b}	940.92^{ab}	966.83^{ab}	1024.33^{a}
dressing %	46.19^{a}	47.79^{a}	47.09^{a}	48.43^{a}
liver (gm)	63.83^{b}	65.33^{b}	74.67^{ab}	81.50^{a}
Kidney (gm)	15.08^{a}	14.67^{a}	15.50^{a}	17.00^{a}
heart (gm)	5.79^{b}	6.42^{b}	6.75^{ab}	8.00^{a}
edible giblets %	4.57^{a}	4.42^{a}	4.74^{a}	5.02^{a}
total edible parts	50.75^{a}	52.22^{a}	51.83^{a}	53.44^{a}

Caecum activity:

Results concerning of the experimental diets on caecum activity are shown in Table (10). It could be noticed that replacing effect of *Moringa* by product replacement of clover hay at level 50% in rabbits diets (R4) significant increased caecum weight, caecum length, caecum PH and total volatile fatty acids (TVFA,s) caeca juice, The values were 9.90 mg,11.23cm, 6.81, 4.05mg / 100 ml, respectively compared to values control ration 9.16 gm, 10.28 cm, 7.16, 3.26 mg/100ml, respectively. These results are supported by those reported with Mohamoud (2013). The nearest data showed by Ahmed *et al.,* (2016) the effect of *Moringa* petioles increased caecum weight and length and caecum TVFA, s compared to control.

Table (10). The caecum activity of the experimental ration containing different levels *Moringa olifera* by product.

Ingredient	Ration1	Ration2	Ration3	Ration4
Moringa olifera by product%	0	25%	37.5%	50%
Caecum PH	7.05^{a}	6.97^{ab}	6.91^{bc}	6.81^{c}
TVFA, s caeca juice (Mg/100ml)	3.31^{c}	3.76^{b}	3.85^{b}	4.06^{a}
caecum weight (Gm)	9.18^{c}	9.37^{bc}	9.48^{ab}	9.92^{a}
Caecum length (CM)	10.5^{b}	10.60^{b}	11.04^{ab}	11.32^{a}

Chemical composition of rabbit's meats:

Chemical composition meats of the ration's replacement different levels *Moringa* by product meal instead clover hay is found in Table (11). The values of ash and EE were insignificant effect in meat. The values of moisture, dry matter and crude protein were significant between values, the best results crude protein and dry matter meat recorded with R2 compared with control ration (R1). These results were agreement with Nuhu (2010) reported the rabbits diets containing *Moringa* leaf decreased value crude fat of meat when compared to the control rations. Rabbit meat is very nutritious and a rich source of protein, energy, minerals and vitamins, rabbit meat is low in fat Lebas and Matheron, (1982). The fat in the meat is mainly unsaturated which is believed to be a healthier type of fat than saturated fat which is common in other meat Fielding (1991). These results were disagreement with Frederick Nuhu (2010) observed the results of the rabbit's meat composition values were, 20.02 – 21.30% CP and 8.56 – 10.30% EE compare favorably with the 20.00 -22.00%CP and 10.00 – 12.00%EE reported by Fielding (1991) but contrast values of 21.55% CP and 2.73% EE reported by Mohammed (1989) in the tropics.

Table (11): The chemical composition of New-Zealand rabbit's meats of the experimental rations containing different levels of *Moringa olifera* by product.

Ingredient	Ration1	Ration2	Ration3	Ration4
Moringa olifera by product%	0	25%	37.5%	50%
Moisture	68.34^{b}	68.12^{c}	68.48^{b}	68.96^{a}
DM	31.66^{b}	31.88^{a}	31.52^{b}	31.04^{c}
CP	24.60^{ab}	24.88^{a}	24.48^{b}	24.07^{c}
EE	3.12	3.04	2.99	2.98
ASH	3.94	3.96	4.05	3.98

Serum biochemical characteristics:

In this study, Serum biochemical characteristics are shown in Table (12) the values of biochemical components fell within the normal physiological ranges for rabbits are insignificant values between different rations: total serum protein (6.25-6.43 g/dl), albumin (3.43-3.51 g/dl), globulin (2.82-2.92g/dl) and cholesterol (51.66 - 53.33 mg/dl), (Jenkins, 1993; Hillyer, 1994; Nuhu, 2010). Urea (11.08-11.57), creatinine (1.21-1.28), uric acid (2.26-

2.34), Triglyceride (1.50-1.62), Alkaline phosphates (32.69-33.81), AST (56.68-57.84), ALT (49.77-51.13). There were non-significant ($p>0.05$) differences of the average's rations test in the various biochemical components studied, and this suggests that the moringa by product in rations test did not influence the biochemical components studied. However, there was insignificant trend towards a reduction in the cholesterol level in the level of moringa by product in the rations from 53.33 in control ration to 51.66 in R4 by range (3.13%). This observation agreement with Ghasi *et al.*, (1999). This reduction in serum cholesterol level of rabbits fed the levels *Moringa* by product ration may suggest a general decline in lipid mobilization. It may be suggested then that, *Moringa* leaf meal diets can reduce serum cholesterol, hence assisting in the reduction and deposition of cholesterol in the muscles this agreement with Forjindu (2006).

Table (12): Serum biochemical characteristics of New-Zealand rabbits fed graded levels of *Moringa olifera* by product.

	Ration1	Ration2	Ration3	Ration4
Moringa olifera by product %	0	25%	37.5%	50%
Total protein	6.27[a]	6.33[a]	6.43[a]	6.25[a]
Albumin	3.43[a]	3.49[a]	3.51[a]	3.43[a]
Globulin	2.84[a]	2.84[a]	2.92[a]	2.82[a]
Urea	11.08[a]	11.21[a]	11.41[a]	11.57[a]
Creatinine	1.28[a]	1.21[a]	1.24[a]	1.25[a]
Uric acid	2.34[a]	2.26[a]	2.26[a]	2.26[a]
Triglyceride	1.62[a]	1.51[b]	1.5[b]	1.51[b]
Alkaline phosphates	33.81[a]	33.39[ab]	32.69[b]	32.60[b]
AST	57.84[a]	57.63[a]	56.91[b]	56.68[b]
ALT	51.37[a]	50.86[a]	49.77[a]	49.86[a]
Cholesterol	53.33[a]	52.10[b]	52.12[b]	51.66[b]

Economic efficiency:

The results of the economic efficiency are in Table (13). showed that the profitability of introducing *Moringa* with level of 50% in rabbit diets (R4) depend on the price of these feedstuffs, if the other costs are constant.

Table (13): Economical efficiency of New-Zealand rabbits of the experimental rations containing different levels of *Moringa olifera* by product.

Item	Ration1	Ration2	Ration3	Ration4
Moringa olifera by product %	0	25%	37.5%	50%
period to trails	56	56	56	56
Initial body weight (g/ rabbits)	494.75	497.83	496.86	498.33
Final body weight (g/rabbits)	1885.93	1897.05	1938.94	1991.41
Total weight gain (g/ rabbits)	1391.18	1399.22	1442.08	1493.08
Average daily gain (g/rabbits)	24.84	24.99	25.75	26.66
Total feed intake (g/ rabbits)	4975.04	4785.76	4923.59	5051.20
Total feed cost (g/ rabbits)	13.15	12.47	12.76	13.02
Average feed intake (g/rabbits/day)	88.84	85.46	87.92	90.20
Feed conversion ratio (g/feed /gain)	3.58	3.42	3.42	3.38
Total revenue / wt. gain L.E.	38.95	39.18	40.38	41.81
Net revenue	25.81	26.70	27.62	28.79
Economic efficiency Relative %	1.96	2.14	2.16	2.21
price feed /ton	2642.25	2606.55	2591.70	2576.85

Therefore, the value of economic efficiency of rabbits fed rations contained 50% *Moringa Oleifera* by product at marketing age (13 weeks) was higher than those of the other rations. Data of total revenue increased in R4 by 4.45%, Net revenue by 10.35% and economic efficiency by 11.31% compared with control rations. However, the feeding cost was 1% slightly lower for R4 than control. This slightly reduction in feed cost was explained by increased feed intake in R4 containing 50% *Moringa* by product. No mortality of rabbits was recorded during the study moringa by product.

CONCLUSION

Results of nutritive values was noticeable that R4 with highest nutrient digestibility and high content *Moringa* by product meal (50%) showed the highest TDN (67.41%) and DCP (12.27%). carcass yields of rabbits recorded the best results were recorded with R4 containing *Moringa* by product meal 50%., the significantly improved up to rate 5.25%. The best improved significant values were recorded with 50% R4 containing *Moringa olifera* by product followed by R3 more than other R2 and control (R1). In rabbits diets (R4) recorded the best results cell-wall constituent digestibility data, the highest nutrient digestibility and high content *Moringa* by product meal (50%) showed the highest TDN (67.41%) and DCP (12.27%) and significant increased caecum weight, caecum length, caecum PH and total volatile fatty acids (TVFA,s) caeca juice. There was insignificant trend towards a reduction in the cholesterol of level moringa rations (4) by (3.13%) compared with control, the value of economic efficiency of rabbits fed rations contained 50% *Moringa Oleifera* by product at marketing age (13 weeks) was higher than those of the other rations. No mortality of rabbits was recorded during the study moringa by product.

REFERENCES

Association of Official Analytical Chemists (A.O.A.C.2002). Official methods of analysis Association of Official Analytical Chemists, Washington, DC.

Ahmed A.A.M. (2016). Impact of partial replacement of some roughages with *Moringa* by products on rabbit's performance in Egypt and South Africa. Thesis Ph.D. Institute of African Research and Studies Cairo University Egypt.

Ajayi, A. F.; G. O. Farinu; O. O. Ojebiyi and T. B. Olayeni (2007). Performance evaluation of male weaner rabbits fed diets containing graded levels of blood-wild sunflower leaf meal mixture. World J. Agric. Sci. 3:250-255.

Asar M. A. Mona Osman; H. M. Yakout and A. Safoat (2010). Utilization of corn-cob meal and faba bean straw in growing rabbits' diets and their performance, digestibility and economic efficiency. Egypt Poultry Science. 30:415-442.

Bartles, H., (1972). Calorimetric determination of creatinine. Clin. Chem.Acte, 32:81.

Becker, K., (1995). Studies on utilization of *Moringa Oleifera* leaves as animal feed. Institute for Animal Production in the Tropics and Subtropics, vol. 480. University of Hohenheim, Stuttgart, p. 15.

Belfield A. and D. M. Goldberg (1971). Determination of alkaline phosphatase. Enzyme, 12:561.

Blasco,A.; Ouhayoun, J. and G. Masoero (1993). Harmonization of criteria and terminology in rabbit meat research. World rabbit Sci., (1):3-10.

Blaxter, K.L., (1968). The energy metabolism of ruminants. 2nd ed. Charles Thomas Publisher. Spring field. Illinois, U.S.A.

Dougnon, T.J.; B.A., Aboh; T.M., Kpodekon and S. HonvouandI (2012). Effect of substitution of pellet of *Moringa Oleifera* to commercial feed on rabbit's digestion, growth performance and carcass trait. J. appl. Pharmaceutical Sci. Vol. 2(9):015-019

Doumas, B.T.; W.A. Watson and H.G. Biggs (1971). Determination of serum albumin. J. Chem. Acta., 31:87-89.

Duncan, D.B. (1955). Multiple range and Multiple F- Test. Biometric,11:1-42.

Eadie J. M.; P. N. Hobsen, and S.O. Mann (1967). A note on some comparison between the rumen content of barley fed steers and that of young calves also fed on high concentrate ration. J. Anim. Production. 9: 247-250.

El-Badawi, A.Y.; H.A.A., Omer; A.A., Abedo and M.H.M., Yacout (2014). Response of growing New Zealand White rabbits to rations supplemented with different levels of *Moringa Oleifera* dry leaves. Global Veterinarian, 12(4):573-582.

Fadiyimu, A.A.; A.N., Fajeminsin; J. A., Alokan and R.D., Aladesanwa (2011) Effect of cutting regimes on seasonal fodder yield of *Moringa Oleifera* in the tropical rain forest of Nigeria. Livestock Research for Rural Development. 23(2).

Fawcett, J. and E. Scott (1960). Determination of urea. J. Clin. Path.,13:156-160.

Fernandez C.; J., Soriano; J.J., Pascual and C. Cervera (2004). The predication of nutritive value of rabbit diets from tables of feed composition. Proceedings 8th world rabbit congress September. 7-10. Puebio mixco.

Fielding, D. (1991). Rabbits: In Tropical Agricultural Series C.T.A. / Macmillan Education Ltd. London, pp 39-50.

Fujihara, A.; S. Fajemilehin and A. Omojola (2005). The egg quality characteristics of layers fed varying dietary inclusions of Siam weed (Chromolaena odorata) leaf meal (SWLM). Int. J. Poult. Sci., 4:752–757.

Frederick, Nuhu (2010): Effect of moringa leaf meal (MOLM) on nutrient digestibility, growth, carcass and blood indices of weaner rabbits. B.SC. (HONS) AGRIC. (CAPE COAST) KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI FACULTY OF AGRICULTURE AND NATURAL RESOURCES DEPARTMENT OF ANIMAL SCIENCE.

Ghasi, S.; E. Nwobodo and J.O., Ofili (1999). Hypocholesterolemia effects of crude extract of leaf of *Moringa Oleifera* Lam in high-fat diet fed Wister rats. Journal of Ethnopharmacology, 69: 21-25. Greiling H and Gessner A.M. (1995).Lehrbuch der klinischen chemie und pathobiochemie. 3Aufl. Stuttgart: Schattauer.

Gidenne, T. (2000). Recent advances in rabbit nutrition: emphasis on fiber requirements. A review. World Rabbit Sci., 8:23-32.

Gidenne, T. and J.M. Perez (1994). Apports de lignines et alimentation du lapin en croissance. 1. Consèquences sur la digestion et le transit. Ann, zootech., 43:313-321.

Gornall A.G.; C.J., Bardawill and David M.M. (1949). Determination of serum proteins by means of the biuret reaction. J. Biol. Chem., 177:751-759.

Gupta, K.; G.K. Barat; D.S. Wagle and H.K.L. Chawla (1989). Nutrient contents and anti- nutritional factors in conventional and non-conventional leafy vegetables. Food Chem., 31:105-116.

Henery R. J. and R.L. Dryer (1963). In standard methods of clinical chemistry edited by D. Seligon, Vol.4, PP. 205-237.

Lebas, F.; T., Giddene; J.M., Perez and D. Licois (1998). Nutrition and pathology. In: De Blas C. and Wiseman, J. (eds), The nutrition of the rabbit. CABI publishing. Wallingford, U.K.

Lebas, F. and G. Matheron, (1982). Rabbits. Live St. Prod. Sci.,7: 235 – 250.

Leng, R. (1990). Factors affecting the utilization of poor-quality forages by ruminants, particularly under tropical conditions., Nutr. Res. Rev. 44, 277–303.

Mahmoud A.E.M. (2013). Effect of feeding on *Moringa Oleifera* stems on productive performance of growing lambs. Egyptian J. Nutrition and Feeds., 16(2) Special Issue: 281-292

Makkar, H.P.S. and K. Becker (1997). Nutrients and anti-quality factors in different morphological parts of the Moringa oleifera tree. J. Agric. Sci. Camb., 128:311– 332.

Makkar, H.P.S. and K. Becker (1996). Nutritional value and anti-nutritional components of whole and Gidenne, T. and Perez, J.M. (1994). Apports de lignines et alimentation du lapin en croissance. 1. Consèquences sur la digestion et le transit. Ann, zootech., 43:313-321. xtracted Moringa oleifera leaves. Anim. Feed Sci. Technol., 63:211–228.

Makkar, H.P.S and A.V.,Goodchild (1996). Quantification of tannins, a laboratory manual., International for

Agricultural Research 128:311-322

Malik, M.Y.; A.S. Abhtar and W.H. Shah (1967). Chemical composition of indigenous fodder leaves (M. peterygosperma). Pak. J. Sci., 19:171–174

Mertens D.R. (2002). Gravimetric determination of amylase-treated neutral detergent fiber in feeds with refluxing in beakers or crucibles: collaborative study. J AOAC ;85(6):1217-40.

Mohammed, K.I. (1989). Studies on some production traits in rabbits under the environmental conditions on El-Minia Governorate. MSc. Thesis, Faculty of Agriculture, El-Minia University, Egypt.

NRC (1977). National Research Council, Nutrient Rabbits 2nd Rev. Ed. National Academy of Sciences, Washington. D.C., USA.

Nuhu F. (2010). Effect of moringa leaf meal (MOLM) on nutrient digestibility, growth, carcass and blood indices of weaner rabbits. MSc, Faculty of Agriculture and Natural Resources, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Onu, P. N.; F. E., Ude and P. E. Okpaniezeani (2004): Effect of graded levels of dietary penicillin of the growth rate and feed conversion of broiler chicks. Journal of Agriculture and Social Research 4 (2): 25 – 32.

Oforjindu, O. (2006). The toxicity of graded levels of Neem (Azadirachta indica) leaf meal. B.Agric Tech. Project Report, Federal University of Technology, Owerri.

Reitman S. and S. Frankel (1957). A calorimetric method for the determination of serum glutamic oxalactic and glutamic pyruvic transaminase. Am.J. Clin. Path., 28:56-63.

Reyes Sa´nchez, N.; B. Eva Spo¨ rndly and Inger Ledin (2006). Effect of feeding different levels of foliage of *Moringa Oleifera* to Creole dairy cows on intake, digestibility, milk production and composition., Livestock Science 101:24-31

SAS, (2002). Statistical Analysis System, Statistical user,s Guide. Ints. Version 8, Inc., Cary, NC.

Siddhuraju, P and K. Becker (2003). Antioxidant properties of various solvents extracts of total phenolic constituents from three different agro climatic origins of drumsticks tree (*Moringa Oleifera* Lam.) leaves. Journal of agriculture and food chem., 51:2144-2155

Safa M. A. El Tazi (2014). Effect of feeding different levels of *Moringa olifera* leaf meal on the performance and carcass quality of broiler chicks. International journal of science and research (IJSR). ISSN (Online):2319-7064. Impact factor (2012):3.358.

Stein, E. A. (1986). Textbook of clinical chemistry. (Eds. Saunders, W. B. and Philadelphia, P.), Tietz press, N.W, USA, P. 879-886.

Talha E. (2013). The use of *Moringa Oleifera* in poultry diets. Turky J Vet Anim. Sci., 37:492-496.

Van Soest, P.J.; J.B., Robertson and B.A. Lewis (1991). Methods for dietary fiber, neutral Dairy Sci., 74: 3583-3597.

تأثير العلائق المحتوية على المنتج الثانوى لنبات المورينجا اوليفيرا على نمو الارانب الصغيرة بعد الفطام

عزة محم محمد بدر[1] و احمد عبدالله محمد احمد[1] و فاطمة منصور سالمان[2]

[1]المركز الاقليمى للأغذية و الاعلاف، مركز البحوث الزاعية، جيزة

[2]قسم الإنتاج الحيوانى، المركز القومى للبحوثن الدقى، جيزة

تهدف الدراسة إلى بحث تأثير استخدام مستويات غذائية مختلفة بواسطة احلال المنتج الثانوى للمورينجا كبديل جزئي (0 ، 25 ، 37.5 و 50 ٪) محل تبن البرسيم. واشارت النتائج الى أن التركيب الكيميائي للمنتج الثانوى للمورينجا أوليفيرا يحتوي على محتوى عالية من البروتين والمادة الجافة (DM) والمادة العضوية (OM) والكربوهيدارت عديمة جدر الخلايا (NSC)و لكن حدث أنخفاض لقيمة مستخلص خالى الازوت NFE، والالياف الخام CF و الفسفور .P بالمقارنة بالتحليل الكميائى لتبن البرسيم ، وبدراسة هذة المستويات المختلفة للمنتج الثانوى للمورينجا على اداء النمو ، ومعامل الهضم و القيمة الغذائية ونشاط الأعور وخصائص الذبيحة و الجودة عالية للحوم وبعض مكونات بلازما الدم للارنب الأبيض النيوزيلندي اثناء النمو . التركيب الكيميائي لهذه العلائق بتكون متماثلة للتركيب الكميائى للبروتين والدهن والالياف والطاقة المهضومة.

لوحظ ان أداء نمو المجموعات التجريبية على زيادة وزن الذبيحة والأجزاء الصالحة للاكل ($P < 0.05$) بااحلال المنتج الثانوى *Moringa olifera* محل تبن البرسيم بالمستويات التالية 25 ٪ ، 37.5 ٪ و 50 ٪ بالمقارنة مع عليقة الكنترول ، كانت قيم وزن الذبيحة هى 940.92 ، 966.83 و 1024.33 جم ، وإجمالي الأجزاء الصالحة للأكل هي 52.22 ، 51.83 و 53.44 جم ، على التوالى. وسجلت أفضل النتائج مع العليقة R4 والتى تحتوى على على المنتج الثانوى للمورينغا بنسبة 50 ٪ ، وحدث تحسن معنوى بمعدل 5.25 ٪. قد تعكس هذه الملاحظة على ارتفاع كمية الغذاء الماكول من المنتج الثانوى للمورينجا والذى نتج عنة ارتفاع الزيادة الوزنية اليومية. زادت قيم الرماد و الدهن الخام EE زيادة غير معنوية التاثير على لحم قطعيات الارانب و كانت قيم الرطوبة والمادة الجافة والبروتين الخام معنوية بين القيم ، وكانت أفضل النتائج البروتين الخام والمادة الجافة للحوم سجلت مع العليقة R2 مقارنة مع عليقة الكنترول R1 . فترة النموالكلية من (6-13 أسبوعًا) لوحظ ان معدل التحويل الغذائى الكلى زادت زيادة معنوية بين العلائق وافضل زيادة كبيرة سجلت مع العليقة R4 كبيرة (3.38g/feed /gain). اشارت النتائج ان أفضل عليقة هى العليقة التى تحتوى على احلال للمورينغا محل تبن البرسيم بنسبة 50 ٪ مقارنة بالعلائق الاخرى.

حدثت اختلافات معنوية بين العلائق الثلاث المختبرة بالمقارنة مع عليقة الكنترول والتى اشارت الى أن إحلال المورينغا اوليفيرا محل تبن البرسيم بنسبة 25 ٪ ، 37.5 ٪ و 50 ٪ ادت الى تحسن معنوى ($P < 0.05$). ملحوظ لمكافئ الهضم ، بينما أفضل تحسن للقيم سجل مع المنتج الثانوى للمورينجا بنسبة 50 ٪ مع العليقة R4 يليها R3 العليقةبالمقارنة مع العليقة R2 وعليقة الكنترول (R1). سجلت أفضل النتائج لمكونات جدر الخلية الخلوي المهضومة مع العليقة (R4)، سجل اعلى محتوى من احلال المورينجا بنسبة 50% اعلى مركبات مهضومة كلية (67.41%) وأعلى بوتين خام مهضوم (12.27%) وزيادة ملحوظة فى وزن وطول الاعور والأحماض الدهنية الطيارة الكلية (TVFA، s) فى سائل الاعور. كان هناك اتجاه ضئيل نحو خفض الكوليسترول في مستوى المورينجا مع العليقة R4 بنسبة (3.13 ٪) مقارنة مع اعليقة الكنترول (R1). هذا الانخفاض في السيرم قد يوحي بانخفاض فى تمثيل الدهون. ربما قد يرجع ذلك ، ألى ان العلائق الغذائية المحتوية على المنتج الثانوى لنبات المورينغا ربما يمكن أن تقلل من نسبة الكوليسترول في الدم ، وبالتالي تساعد في خفض وترسب الكولسترول في العضلات. كانت الكفاءة الاقتصادية للعليقة R4 مرتفعة بحوالى 11.31٪ ، وارتفع إجمالي الإيرادات بحوالى 4.45٪ ، وصافي الإيرادات بنسبة 10.35٪ ، وكانت تكلفة التغذية أقل بنسبة 1٪ مقارنةً بعليقة الكنترول. لم تسجل أي وفيات للأرانب أثناء الدراسة على المنتج الثانوى.