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

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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 R₄ containing Moringa by product meal 50%, the significantly improved up to 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 R₃ compared with control R₁. 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 R₄ (3.38g/feed/gain)). The result indicated 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% R₄ containing moringa by product followed by R₃ more than other R₂ and control (R₀). In rabbit diet (R₄) 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 R₄ by (3.13%) compared with control (R₀). 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 R₄ 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 Siddharaju *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 nutritional 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. Serum 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;
Badr et al.

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 |  |  |  |
|-------------------------------|-----------------|---|---|---|
|                               | By product      | 0.7 | 0.7 | 0.7 |
|                               | Hay             | 1.07 | 0.27 | 0.125 |
| Digestible energy (DE) Kcal/Kg DM | 1399 | 1281.5 | 403.29 | 403.039 |
| 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 from 16.72 to 16.81 %, ether extract ranged between 3.825 to 3.86 %, crude fiber ranged from 13.94 to 14.16 (%)

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

| Ingredient                  | Ration1 | Ration2 | Ration3 | Ration4 |
|-----------------------------|---------|---------|---------|---------|
| Barley 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 whea8I87989798t 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.
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  |
|-------------------------------------|----------|----------|----------|----------|
| 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). \( NSC = 100 - (CP + EE + Ash + NDF) \). \( DE (Kcal/kg) = 2823 - 40.8 \times ADF - 25.7 ADL + 47.4 CP \) 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 wall constituents may be related to differ in source of by product incorporated in rations formulation.

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 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%)         | 494.75a | 604.83c | 762.83d | 1002.08c| 1233.92d| 1397.75d| 1599.65c| 1761.11b| 1885.93b|
| R2(25%)        | 497.83a | 632.42b | 814.08c | 1033.84c| 1273.08c| 1455.09c| 1610.58b| 1750.69b| 1897.05b|
| R3 (37.5%)     | 496.86a | 644.03ab| 842.20c | 1089.17b| 1321.86c| 1512.00b| 1668.09b| 1798.72ab| 1938.94ab|
| R4(50%)        | 498.33a | 656.67a | 864.67b | 1144.42a| 1370a   | 1576.25a| 1737.66a| 1874.85a| 1991.41a|

**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 |
|------------|---------|---------|---------|---------|
|            | 0       | 25%     | 37.5%   | 50%     |
| The first period (6-9 weeks) |         |         |         |         |
| IBW (gm)   | 494.75a | 497.83a | 496.86a | 498.33a |
| FBW (gm)   | 1233.92d | 1273.08c | 1321.86b | 1370b   |
| BWG (gm)   | 739.17d | 775.25c | 825b | 871.67a |
| FI (gm/D)  | 1539.24c | 1574.84c | 1678.82b | 1784.84a |
| FCR (gm)   | 2.09a | 2.02a | 2.03a | 2.05a |
| The second period (10-13) |         |         |         |         |
| IBW (gm)   | 1233.92d | 1273.08c | 1321.86b | 1370b   |
| FBW (gm)   | 1885.92b | 1897.04b | 1938.94ab | 1991a |
| BWG (gm)   | 652.00a | 623.96a | 617.08a | 621.42a |
| FI (gm)    | 3435.75a | 3211.00b | 3244.78b | 3266.35ab |
| FCR (gm)   | 5.30a | 5.18a | 5.33a | 5.27a |
| The whole period (6-13) |         |         |         |         |
| IBW (gm)   | 494.75a | 497.83a | 496.86a | 498.33a |
| TFBW (gm)  | 1885.92b | 1897.04b | 1938.94ab | 1991.42a |
| TBWG (gm)  | 1391.17a | 1399.21a | 1442.08b | 1493.09a |
| TADG (gm)  | 24.84a | 24.99b | 25.75ab | 26.66a |
| TFI (gm)   | 88.84a | 85.46b | 87.92a | 90.20a |
| TFCR       | 3.56a | 3.42b | 3.42b | 3.38b |

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

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 1024.33 gm, 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<sup>a</sup> | 1975.25<sup>a</sup> | 2048<sup>a</sup> | 2115.08<sup>a</sup> |
| carcass weight                | 854.33<sup>b</sup> | 940.92<sup>ab</sup> | 966.83<sup>a</sup> | 1024.33<sup>a</sup> |
| dressing %                    | 46.19<sup>b</sup> | 47.79<sup>a</sup> | 47.09<sup>a</sup> | 48.43<sup>a</sup> |
| liver (gm)                    | 63.83<sup>a</sup> | 65.33<sup>b</sup> | 74.67<sup>a</sup> | 81.50<sup>a</sup> |
| Kidney (gm)                   | 15.08<sup>a</sup> | 14.67<sup>a</sup> | 15.50<sup>a</sup> | 17.00<sup>a</sup> |
| heart (gm)                    | 5.79<sup>b</sup> | 6.42<sup>b</sup> | 6.75<sup>a</sup> | 8.00<sup>a</sup> |
| edible giblets %              | 4.57<sup>a</sup> | 4.42<sup>a</sup> | 4.74<sup>a</sup> | 5.02<sup>a</sup> |
| total edible parts            | 50.75<sup>a</sup> | 52.22<sup>a</sup> | 51.83<sup>a</sup> | 53.44<sup>a</sup> |
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/100/ml, 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 |
|-----------------------------|---------|---------|---------|---------|
| Caecum PH                   | 7.05ab  | 6.97b   | 6.91bc  | 6.81c   |
| TVFA, s caeca juice (Mg/100ml) | 3.31c  | 3.76b   | 3.85b   | 4.06a   |
| caecum weight (Gm)          | 9.18bc  | 9.37bc  | 9.48b   | 9.92a   |
| Caecum length (CM)          | 10.5b   | 10.60b  | 11.04b  | 11.32a  |

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 |
|------------|---------|---------|---------|---------|
| Moisture   | 68.34b  | 68.12c  | 68.48b  | 68.96a  |
| DM         | 31.66b  | 31.88a  | 31.52b  | 31.04c  |
| CP         | 24.60ab | 24.88a  | 24.48b  | 24.07c  |
| 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.

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

### 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 %      |         |         |         |         |
| 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 (TVFAs) 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.

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تأثر العلاقات المحتوية على المنتج الثانوي لنبات المورينجا إوليفيرا على نمو الأرايب الصغيرة بعد الفطام

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تهدف الدراسة إلى بحث تأثير استخدام مستويات غذائية مختلفة لachable منج الثانوي للمورينجا كيكل جزء من نمو الأرايب الصغيرة والمورينجا، وانتشار الدراسة هذه المستويات المتناوبة للمنتج الثانوي للمورينجا على نمو الأرايب الصغيرة، ومعالج ال偶像 ونوعية الغذاء تنشيط الأرايب الصغيرة.اءتورة عالية للحول ومعادن إلزام، الأرايب الأبيض الثانوي في أيوم النمو، الأرايب كيميائي لهذه العلاجات تكون متأثرة للمورينجا الأرايب، والدهان والأرايب.

الطاقات المحمولة.

لوحظ أن نمو المجموعات الجذورية على وزن النقي الازاء الصغيرة للإثلاك P<0.05، بحال منتج الثانوي للإثلاك Moringa oleifera محلة من البرسيم بالمستويات الثلاث المختبرة بالمقارنة مع علاجات الإثلاك، كانت في وزن النقي 946.92، 904.92، 622.57، 3.37، 5.50, 30، 50 و 50 نسيب، بين البرسيم، والعمودع (OM) والكربوهيدرات الحمض حجم الخلايا (DM) والمادة الدهنية، للمورينجا نسب P<0.05 بالمقارنة بالتحويل الكيميائي في البرسيم، ودراسة هذه المستويات المتناوبة للمنتج الثانوي للمورينجا على نمو الأرايب، و.chomp اليد والفيتامينات.واي الأرايب ونوعية الغذاء تنشيط الأرايب الصغيرة.اءتورة عالية للحول ومعادن إلزام، الأرايب الأبيض الثانوي في أيوم النمو، الأرايب كيميائي لهذه العلاجات تكون متأثرة للمورينجا الأرايب، والدهان والأرايب.

حدث اختلافات معنوية بين العلاجات الثلاث المختبرة بالمقارنة مع إثلاك الإثلاك، وتشير إلى أن إثلاك المورينجا إوليفيرا محل نسبي من البرسيم، ونسبة 25, 50, 75, 50% اي تعثر في معدل نمو الأرايب، رفع (R1) معدل التوريد لوحظ لمكنك ياهض، بينما أفضل نسب للقيم نسب (R2) معدل التوريد للقيمة (R3) معدل التوريد لوحظ لمكنك ياهض، بينما أفضل نسب للقيم نسب (R4) معدل التوريد للقيمة (R5) معدل التوريد لوحظ لمكنك ياهض، بينما أفضل نسب للقيم نسب (R6) معدل التوريد للقيمة (R7) معدل التوريد Lوحظ لمكنك ياهض، بينما أفضل نسب للقيم

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