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EFFECTS OF SUBSTITUTING GROUNDNUT CAKE WITH MORINGA (*Moringa oleifera*) LEAF MEAL  
ON GROWTH PERFORMANCE, CARCASS YIELD AND HAEMATOLOGICAL PROFILE OF  
WEANER RABBITS

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Yakubu, B., Nathan, J. M. and M. S. Yahya

Department of Animal Science and Range Management, Federal a University of Technology, Yola, Nigeria

Corresponding author: bobboiyakubu@yahoo.com

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**Abstract**

The effects of *Moringa oleifera* leaf meal (MOLM) on growth performance, carcass yield and haematological profile of weaner rabbits were evaluated. Five diets were formulated using MOLM to substitute groundnut cake (GNC) at 0, 25, 50, 75 and 100% which were designated treatments 1, 2, 3, 4 and 5 respectively. Thirty weaner rabbits were assigned to the five dietary treatments of six rabbits per treatment and replicated three times with 2 rabbits per replicate in a completely randomized design. Results showed all the growth parameters measured were significant ( $P < 0.05$ ) across the dietary treatments. Feed intake ranged from 105.22g to 138.35g while the average daily weight gain ranged from 22.67g to 35.31g. Superior feed conversion ratio was observed in treatment 4 (3.4) while inferior FCR was observed in treatment 1 (4.64). There was significant difference ( $P < 0.05$ ) in final weight, carcass weight and dressing percent. The results of internal organs were similar ( $P > 0.05$ ) across the treatments except for the caecum which was significantly ( $P < 0.05$ ) higher. Significantly ( $P < 0.05$ ) higher dietary influence was obtained on packed cell volume and haemoglobin while serum biochemical indices were not affected by the dietary treatments. It can be concluded that MOLM can be used to substitute groundnut cake at 75% without adverse effect on the performance of weaner rabbits.

**Key words:** Performance, groundnut cake, *moringa* leaf, haematology and serum biochemistry

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**Introduction**

Rabbit production has considerable potentials in the developing countries for the supply of the much needed animal protein due to its low capital investment, short generation interval, rapid growth rate, high reproductive potentials and ability to utilize the abundant forages. Rabbit meat production has been on the increase in Nigeria in recent years (Odeyinka *et al.* 2008). Rabbit production is very promising given the fact that it provides good quality meat to man (Djakalia *et al.* (2011). Rabbit production plays a major role in bridging the protein gap in developing countries where average consumption is still far below the recommended standards (FAO, 1989). Currently, rabbit meat consumption is increasing due to its low cholesterol and sodium content (Ensminger, 1991). The meat does not form uric acid during metabolism and hence is recommended for diabetic, hypertensive patients and the middle aged.

Despite these advantages, rabbit production has not been explored to any great extent as animal protein source in Nigeria. This has been attributed to the high cost of conventional feedstuffs especially the conventional protein and energy sources like soya bean cake, groundnut cake and maize. The nutrition of rabbit in Nigeria is also primarily based on *Tridax procumbens* and or *Centrosema pubescens* whose growth and availability in the dry season cannot sustain all-year rabbit production (Odeyinka *et al.*, 2008).

Recently there has been increasing interest in the utilization of *moringa* leaf (*M. oleifera*) as protein source for animals (Sarwat *et al.*, 2002). *Moringa* is a multipurpose tree and one of the fastest growing trees. The leaves are high in crude protein, and with negligible antinutritive compounds. Makker and Becker (1996) reported that *moringa* leaf is rich in carotene, ascorbic acid, iron, methionine and cystine.

Even though *moringa* leaf has a lot of nutritional advantages, there is little or no information on the effects of substituting groundnut cake with *moringa* leaf on performance, carcass yields and haematological parameters of weaner rabbits particularly in the guinea savannah zone of Nigeria. The objective of this study therefore is to determine the effects of substituting groundnut cake with *moringa* leaf meal on the performance carcass and internal organs weight and haematological characteristics of weaner rabbits.

**Materials and Methods**

**Experimental site**

The experiment was conducted at the Rabbitary Teaching and Research Farm of the Federal University of Technology, Yola. Yola lies between latitude 7° and 11° N and longitude 11° and 14°E. Temperature in this climatic region is high in February, March and April because of high radiation, which is evenly distributed throughout the year. Maximum temperature in the state can reach up to 40°C particularly in April, while minimum

temperature can be as low as 18°C between December and January. Mean monthly temperature range from 26.7°C in the South to 27.8°C in the North Eastern part of the state (Adebayo and Tukur, 1999).

#### Processing of Moringa leaves.

*Moringa* leaves were obtained in Jimeta from farmers and some households that use it in fencing their houses. The leaves were harvested and the stems removed, and later dried in a well ventilated room for 4 days until they were crispy to touch. The leaves were later milled using a hammer miller to obtain the *moringa* leaf meal which was stored in polythene bags for subsequent use.

#### Experimental animals and their management

Thirty (30) weaner rabbits of mixed sexes and aged between 4-5 weeks old and with an average weight of 505g were used for the study. The rabbits were obtained from small-scale producers in Jimeta- Yola. They were randomly divided into five groups of six animals per treatment with two rabbits in three replicates in a completely randomized design. Feeders and drinkers were provided in each of the cages. Five experimental diets were formulated using MOLM at 0, 25, 50, 75, and 100% which were designated as diet1, 2, 3, 4 and 5 respectively (Table 1). Treatment1 served as the control and was devoid of MOLM. The experiment lasted for eight (8) weeks.

**Table 1: Ingredients composition of the experimental diets (%)**

| Ingredients              | Diets     |            |            |            |             |
|--------------------------|-----------|------------|------------|------------|-------------|
|                          | 1<br>(0%) | 2<br>(25%) | 3<br>(50%) | 4<br>(75%) | 5<br>(100%) |
| Maize offal              | 75.00     | 75.00      | 75.00      | 75.00      | 75.00       |
| Maize                    | 10.00     | 10.00      | 10.00      | 10.00      | 10.00       |
| Groundnut cake           | 10.00     | 7.50       | 5.00       | 2.50       | 0.00        |
| MOLM                     | 0.00      | 2.5        | 5.00       | 7.50       | 10.00       |
| Fish meal                | 2.00      | 2.00       | 2.00       | 2.00       | 2.00        |
| Bone meal                | 2.50      | 2.50       | 2.50       | 2.50       | 2.50        |
| Salt                     | 0.50      | 0.50       | 0.50       | 0.50       | 0.50        |
| <b>Total</b>             | 100       | 100        | 100        | 100        | 100         |
| <b>Chemical analysis</b> |           |            |            |            |             |
| Crude protein            | 9.40      | 9.60       | 10.20      | 10.40      | 10.50       |
| Ether extract            | 3.60      | 3.20       | 3.00       | 2.80       | 2.60        |
| Crude fibre              | 7.20      | 7.20       | 7.40       | 7.45       | 7.50        |
| NFE                      | 71.60     | 72.00      | 71.50      | 71.55      | 71.70       |
| Ash                      | 6.00      | 6.00       | 5.80       | 5.80       | 5.70        |

MOLM = Moringa leaf meal    NFE = Nitrogen free extract

#### Data collection

##### Growth performance evaluation

The experimental diets were offered *ad libitum* in the morning at about 07.00hr in metallic containers attached to the individual cages. The quantity of feed offered daily and leftover were weighed to determine the daily feed intake while FCR was determined by dividing the total feed intake by the total weight gain. Water was provided *ad libitum* in plastic containers. At the start of the experiment, all the rabbits were weighed before allotting them to their treatments. The rabbits were weighed weekly to determine the weight gain.

##### Haematological and serum biochemical analysis

At the end of the experiment, three (3) rabbits from each treatment were randomly selected and starved for 8hrs before blood samples were collected. 2.0ml of blood samples were collected from external ear vein into specimen bottle containing an anticoagulant, Ethylene –Diamine-Tetra- Acetic acid

(EDTA) using sterile hypodermic syringe for haematological parameters. Another 2.0 ml of blood was also collected into sterile bottle without an anticoagulant for serological studies. All the parameters were determined according to the procedures described by Sirios (1995).

##### Carcass yield and internal organs measurement

One rabbit from each replicate was randomly selected and slaughtered by severing the jugular vein to allow for proper bleeding. Thereafter, it was eviscerated and all the internal organs were removed to obtain the carcass weight. Dressing percent was calculated by dividing the carcass weight by the live weight and multiplying it by 100. All the internal organs weight were measured on a digital scale while the length was measured using a ruler.

##### Chemical analysis

The proximate composition of the experimental diets and *moringa* leaf were determined in the Laboratory

of the Department of Animal Science and Range Management using the procedures described by AOAC (1990).

### Statistical analysis

Data obtained in this study were subjected to analysis of variance (Steel and Torrie, 1980) using SPSS Version 13. Differences between the treatment means were separated by Duncan Multiple Range Test (Duncan, 1955).

### Results

#### Proximate composition of moringa leaf meal.

The result of chemical analysis of MOLM is shown in Table 2. MOLM had CP content of 26.80% while the crude fibre was 18.50%. The ether extract, nitrogen free extract and ash contents were 2.20, 45.20 and 2.40% respectively.

**Table 2: Proximate composition of MOLM**

| Nutrient              | Percentage composition |
|-----------------------|------------------------|
| Crude protein         | 26.80                  |
| Crude fibre           | 18.50                  |
| Ether extract         | 2.20                   |
| Nitrogen free extract | 45.20                  |
| Ash                   | 2.40                   |

#### Performance of weaner rabbits fed moringa leaf meal

The performance of weaner rabbits fed diets containing varying levels of *MOLM* is presented in Table 3. Significant differences ( $P < 0.05$ ) were observed in all the parameters measured for growth performance. The final body weight was significantly ( $P < 0.05$ ) higher in treatment 4 and showed a progressive increase from 1875.33g in treatment 1 to

2750.g in treatment 4. The final body weight however declined to 2566.72g in treatment 5.

Daily feed intake increased significantly ( $P < 0.05$ ) from 105.22g in treatment 1 to 138.35g treatment 5. The daily weight gain also increased from 22.67g in treatment 1 to 35.31g in treatment 4 and thereafter declined to 31.67g in treatment 5. Feed conversion ratio was superior (3.41) in treatment 4 while inferior FCR was observed in treatments 1 (4.64) and 2 (4.48).

**Table 3: Performance of weaner rabbits fed moringa leaf meal**

| Ingredients        | Diets                |                      |                      |                      |                      |
|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                    | 1<br>(0%)            | 2<br>(25%)           | 3<br>(50%)           | 4<br>(75%)           | 5<br>(100%)          |
| Initial weight (g) | 452.66               | 480.33               | 467.00               | 451.00               | 441.00               |
| Final weight (g)   | 1875.33 <sup>c</sup> | 2185.33 <sup>d</sup> | 2333.66 <sup>c</sup> | 2750.00 <sup>a</sup> | 2566.72 <sup>b</sup> |
| Feed intake (g)    | 105.22 <sup>c</sup>  | 119.45 <sup>b</sup>  | 118.35 <sup>b</sup>  | 120.66 <sup>b</sup>  | 138.35 <sup>a</sup>  |
| DWG (g)            | 22.67 <sup>d</sup>   | 26.65 <sup>d</sup>   | 27.35 <sup>c</sup>   | 35.31 <sup>a</sup>   | 31.67 <sup>b</sup>   |
| FCR                | 4.64 <sup>c</sup>    | 4.48 <sup>c</sup>    | 4.32 <sup>b</sup>    | 3.41 <sup>a</sup>    | 4.36 <sup>b</sup>    |

abcde, Means on the same row with different superscript are significantly different \* =  $P < 0.05$  ns = not significant DWG = Daily weight gain, FCR = Feed conversion ratio, SEM = Standard error of mean

#### Carcass yield and internal organs weight

Table 4 shows the results of carcass yield and internal organs of weaner rabbits fed varying levels of MOLM. All carcass yield parameters were significantly ( $P < 0.05$ ) influenced by dietary level of MOLM. However, rabbits fed diet 4 (1680g) had higher carcass weight than those on the other diets. Similarly, the dressing percent was higher (61.09%) in rabbits on diet 4 and lowest in diet1 (51%). The values for racks/ribs of rabbits on diets 3, 4 and 5 were 78.30g, 80g, and 79g respectively and were

higher than the values obtained on those fed diets 1 (62.50g) and 2 (67.30g). The weight of the loin was also higher in rabbits fed diet 4 (1300g) and those on diets 2 (127.50), 3(126.70) and 5(125.75) were similar. The weight of the pelt was observed to be higher in rabbits fed diets 4 (80g), and rabbits on diets 2 (75g) and 5 (75.85g) were similar. Body lengths were also influenced ( $P < 0.05$ ) by dietary levels of MOLM. The body length of rabbits in fed diet 4 (36cm) was longer than those in the other diets

while the lowest value was observed in rabbits fed the control diet.

The parameters measured for the internal organs were not affected by the dietary levels of MOLM, except

the weight of the caecum which was significantly ( $P<0.05$ ) affected.

**Table 4: Effect of MOLM on carcass yield and internal organ characteristics of weaner rabbits**

| Parameters                 | Diets               |                         |                      |                      |                      | SEM                 |
|----------------------------|---------------------|-------------------------|----------------------|----------------------|----------------------|---------------------|
|                            | 1<br>(0%)           | 2 <sup>a</sup><br>(25%) | 3<br>(50%)           | 4<br>(75%)           | 5<br>(100%)          |                     |
| Live weight (g)            | 1875 <sup>d</sup>   | 2185 <sup>c</sup>       | 2333.6 <sup>c</sup>  | 2750 <sup>a</sup>    | 2566.73 <sup>b</sup> | 34.53*              |
| Carcass weight (g)         | 956.25 <sup>d</sup> | 1135.00 <sup>c</sup>    | 1253.00 <sup>c</sup> | 1680.00 <sup>a</sup> | 1507.00 <sup>b</sup> | 22.48*              |
| Dressing %                 | 51.00 <sup>d</sup>  | 54.22 <sup>c</sup>      | 53.69 <sup>c</sup>   | 61.09 <sup>a</sup>   | 58.71 <sup>b</sup>   | 0.04*               |
| Racks/ribs (%)             | 62.50 <sup>b</sup>  | 67.30 <sup>b</sup>      | 70.30 <sup>a</sup>   | 80.00 <sup>a</sup>   | 79.00 <sup>a</sup>   | 8.18*               |
| Loin (g)                   | 110.50 <sup>c</sup> | 127.50 <sup>b</sup>     | 126.70 <sup>b</sup>  | 130.00 <sup>a</sup>  | 125.75 <sup>b</sup>  | 5.91*               |
| Pelt (g)                   | 65.00 <sup>d</sup>  | 70.00 <sup>c</sup>      | 75.00 <sup>b</sup>   | 80.00 <sup>a</sup>   | 76.85 <sup>b</sup>   | 13.39*              |
| Body length (cm)           | 28.50 <sup>b</sup>  | 30.00 <sup>b</sup>      | 32.00 <sup>b</sup>   | 36.00 <sup>a</sup>   | 31.80 <sup>b</sup>   | 0.67*               |
| <b>Internal organs (%)</b> |                     |                         |                      |                      |                      |                     |
| Heart                      | 9.40                | 8.50                    | 8.33                 | 10.00                | 10.00                | 0.78 <sup>ns</sup>  |
| Liver                      | 35.00               | 40.00                   | 40.00                | 38.33                | 41.67                | 3.80 <sup>ns</sup>  |
| Kidney                     | 9.00                | 8.00                    | 7.00                 | 8.50                 | 7.95                 | 1.75 <sup>ns</sup>  |
| Lungs                      | 10.00               | 15.00                   | 13.50                | 10.00                | 18.50                | 3.33 <sup>ns</sup>  |
| Caecum                     | 33.50 <sup>c</sup>  | 35.00 <sup>c</sup>      | 40.50 <sup>b</sup>   | 36.50 <sup>c</sup>   | 45.00 <sup>a</sup>   | 1.91*               |
| GIT length (cm)            | 215.00              | 264.00                  | 217.00               | 252.00               | 242.00               | 22.43 <sup>ns</sup> |

abcd means on the same row with different superscript are significantly different ( $* = P<0.05$ ),

ns = not significant, SEM = standard error of mean, GIT = gastro intestinal tract

#### Haematological parameters

Table 5 shows the result of haematological profile of rabbits fed varying levels of MOLM as substitute for groundnut cake. The PCV and Hb were significantly ( $P<0.05$ ) affected by the diets. Other parameters studied showed no significant difference ( $P>0.05$ )

among the dietary treatments. The RBC values ranged from 4.00 in diet 5 to 4.97 in diet 4 and WBC values ranged from 8.30 to 13.33%. The MCH, MCV and MCHC were 41.90 to 44.57, 38.88 to 81.80 and 0.44 to 2.91 respectively.

**Table 5: Effect of moringa leave meal on hematology of weaner rabbits**

| Parameters              | Diets              |                    |                    |                    |                    | SEM                 |
|-------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|
|                         | 1<br>(0%)          | 2<br>(25%)         | 3<br>(50%)         | 4<br>(75%)         | 5<br>(100%)        |                     |
| PCV %                   | 30.00 <sup>c</sup> | 34.67 <sup>b</sup> | 36.00 <sup>b</sup> | 34.33 <sup>b</sup> | 39.67 <sup>a</sup> | 2.68*               |
| Hb %                    | 13.28 <sup>b</sup> | 13.77 <sup>b</sup> | 18.64 <sup>a</sup> | 16.37 <sup>a</sup> | 17.63 <sup>a</sup> | 1.53*               |
| RBC $10^6 \text{ mm}^3$ | 4.08               | 4.29               | 4.42               | 4.97               | 4.00               | 0.91 <sup>ns</sup>  |
| WBC (%)                 | 13.33              | 8.30               | 10.20              | 9.37               | 9.23               | 4.10 <sup>ns</sup>  |
| MCH (pg)                | 43.03              | 41.90              | 42.13              | 42.97              | 44.57              | 1.62 <sup>ns</sup>  |
| MCV (fl)                | 66.23              | 38.80              | 81.80              | 55.07              | 66.80              | 40.56 <sup>ns</sup> |
| MCHC (g/dl)             | 0.44               | 2.91               | 1.70               | 0.50               | 0.44               | 1.33 <sup>ns</sup>  |

abc means on the same row with different superscript are significantly different ( $P<0.05$ ). SEM = standard error of mean, PCV = packed cell volume, Hb = haemoglobin, RBC = red blood cell, WBC = white blood cell, MCH = mean corpuscular haemoglobin, MCV = mean corpuscular volume, MCHC = mean corpuscular haemoglobin concentration

#### Serum biochemical indices

The results of the serum biochemical indices is presented in Table 6 and it showed no significant ( $>0.05$ ) dietary influence, however, glucose level showed an increase with increasing levels of MOLM

from 6.80 to 7.30mg/dl. Other parameters such as urea, creatinine, albumin, globulin, triglyceride and total protein did not show a particular pattern. The values for cholesterol declined with an increasing level of MOLM from 28.50 to 26mg/dl.

**Table 6: Effect of *moringa* leaf meal on serum biochemical indices of weaner rabbits**

| Parameters            | Diets      |             |             |             |              | SEM                 |
|-----------------------|------------|-------------|-------------|-------------|--------------|---------------------|
|                       | 1<br>1(0%) | 2<br>2(25%) | 3<br>3(50%) | 4<br>4(75%) | 5<br>5(100%) |                     |
| Glucose (mg/dl)       | 6.80       | 7.15        | 7.00        | 7.13        | 7.30         | 0.74 <sup>ns</sup>  |
| Urea (mg/dl)          | 7.77       | 6.85        | 5.50        | 6.80        | 6.53         | 1.34 <sup>ns</sup>  |
| Creatininie (mg/dl)   | 75.20      | 79.60       | 73.70       | 82.50       | 85.40        | 9.07 <sup>ns</sup>  |
| Cholesterol mg/dl)    | 28.50      | 28.00       | 27.00       | 26.00       | 26.00        | 25.14 <sup>ns</sup> |
| Albumin (mg/dl)       | 40.70      | 41.60       | 43.10       | 40.00       | 40.90        | 2.04 <sup>ns</sup>  |
| Globulin (mg/dl)      | 19.30      | 21.50       | 18.30       | 19.50       | 14.90        | 3.61 <sup>ns</sup>  |
| Tryglyceride (mg/dl)  | 241.30     | 320.20      | 216.40      | 254.40      | 231.00       | 69.18 <sup>ns</sup> |
| Total protein (mg/dl) | 60.00      | 64.10       | 61.40       | 59.30       | 55.80        | 3.67 <sup>ns</sup>  |

Ns = not significant, SEM = standard error of the means,

### Discussion

The CP content of *Moringa oleifera* leaf obtained in this study was higher than the values reported by Booth and Wickens (1988); Ogbe et al., (2011) and Djakalia *et al.*, (2011) but lower than the values reported by Kakengi *et al.* (2007) and Melesse *et al.* (2011). The CF and ash content were also much higher than the values reported by Ogbe *et al.* (2011) but lower than the values reported by Odeyinka *et al.* (2008). These variations in the nutrient content therefore suggest that environmental factors such as season, geographical location and stage of maturity plays a major role in the nutrient content of *moringa* leaf.

The daily feed intake was significantly ( $P<0.05$ ) influenced by inclusion level of MOLM. There was a progressive increase in feed intake as the level of MOLM increases in the diet. Odeyinka *et al.* (2008) also observed a significant ( $P<0.05$ ) difference in feed intake when they conducted a 20-week trial to evaluate the reproductive performance of rabbits fed *Moringa olifera* leaf meal as a replacement for *Centrosema pubescens*. Aduku *et al.* (1988) also reported higher feed intake with increasing levels of crude fibre in the diets of rabbits. This trend in feed intake can be explained by the fact that leaf meals contain relatively high fibre which tends to increase the total fibre content of the diet and result in dilution of other nutrients. Rabbits like any other monogastric animal must eat to meet their energy requirement for a sustained growth and development. Nworgu et al. (1999) however reported a reduction in feed intake by rabbits on increased forage meal in the diet.

There was significant ( $P<0.05$ ) difference in daily weight gain. The results showed a progressive increase in DWG as the level of MOLM was increased. The high performance of weaner rabbits on MOLM diets could be explained by the reports of D'Mello *et al.* (1987 and Fasuyi et al. (2005) that leaf meals do not only serve as protein source but also provide some necessary vitamins and minerals. Makar and Becker (1997) in their study concluded that *M. olifera* leaf meal has nutritional advantages

over other leafy meals as they contain high pepsin soluble nitrogen, low acid detergent insoluble protein and low antinutritional factors. This suggests that the protein in *M. oleifera* leaf is readily available to monogastric animals (Kakengi et al., 2003).

The feed conversion ratio was significantly ( $P<0.05$ ) influenced by the treatment diets. Superior FCR was observed in weaner rabbits fed treatment 4. FCR however became poorer in treatment 5 when GNC was totally substituted with MOLM.

The carcass weight and dressing percentages were significantly ( $P<0.05$ ) influenced by the substitution levels of MOLM in the diets. MOLM significantly improved the proportion of the carcass weight, dressing percent, and body length. Although the result from this study shows variations in the dressing percent when compared to other studies, it is still within the range of 50 to 57% recommended by Aduku and Olukosi (1990) for rabbits under tropical condition.

The internal organs were similar across the treatments accept for the weight of the caecum which was significantly ( $P<0.05$ ) affected by dietary levels of MOLM. This could possibly be as a result of relatively higher crude fibre content of *moringa* leaf. The present study therefore shows that MOLM is safe for rabbit consumption since it has low antinutritive factors and toxic substances (Makkar and Backer, 1997). Ahamefule *et al.* (2006) reported that the weights of some organs like kidney and liver of animals may be used in animal feeding experiments as evidence of toxicity. In the present study, dietary levels MOLM did not affect the size of the liver and kidney which are involved in detoxification. Also, the heart, lung, and GIT length were not affected by the diets, an indication that MOLM is a safe ingredient for rabbit feed formulation (Melesse *et al.*, 2011).

Haematological and serological profile of animals may suggest their physiological disposition to the plane of nutrition (Madubuike and Ekenyen, (2006). Though there were variations ( $P<0.05$ ) in the values obtained for PCV and Hb, they were all within

the normal physiological ranges for rabbits as reported by Jenkins (1993). Similarly, erythrocytic indices which include the MCV, MCH, and MCHC were also not affected by the levels of substitution of groundnut cake by MOLM diets. Studies by Makkar and Becker (1997) and Sarwat *et al.* (2002) showed that *Moringa* leaf meal has negligible amounts of tannin and condensed tannins were not detected by Makkar and Becker (1996) that may interfere with haemopoiesis or cause haemolysis of the blood cells. Similarly, Negesse *et al.* (2009) reported that leaves from *Moringa stenopetala* did not show any haemolysis activity of saponin. It is apparent that MOLM did not affect the biochemical indices of weaner rabbits studied. There was a progressive reduction in cholesterol level with increase in MOLM. This suggests that MOLM has a cholesterol depressing effect. All the parameters measured for serum biochemistry were within the normal physiological range for rabbits as reported by Jenkins (1993). This also suggests that the MOLM is a safe feed ingredient.

### **Conclusion**

It can be concluded therefore that MOLM possess a good dietary quality and can be used in weaner rabbit's diet to substitute groundnut cake up to a level of 75% without any detrimental effect on growth performance, carcass and internal organs characteristics, haematological and biochemical indices.

## References

- Adebayo, A. A. & Tukur, A. L. (1999). Adamawa State in Maps. Paraclete publishers. Yola.
- Aduku, A. O., Dim, N. J. & Agange, A. A. (1988). Note on comparative evaluation of palm kernel meal, peanut meal and sunflower meal diets for weanling rabbits. *Journal of Applied Rabbit Research*. 11(5): s264-265
- Aduku, A. O. & Olukosi, J.O. (1990). Rabbit management in the tropics. G. U. Publishers, Zaria Nigeria.
- Ahamefula, F. O., Eduok, G. O., Usman, A., Amaefula, K. U., Obua, B. E. & Ogunike, S. A. (2006). Blood biochemistry and haematology of weaner rabbits fed ensiled and fermented cassava peel based diets. *Pakistan Journal of Nutrition*. 5(3):248-253
- AOAC (1990). Association of Official Analytical Chemist. Official Methods of analysis 17<sup>th</sup> edition, Washington DC.
- Booth, F. E. M. & Wickens, G. E. (1988). Non-timber uses of selected arid zone trees and shrubs in Africa. FAO conservation guide. Rome p92-101
- Duncan, D. B. (1955). Multiple Range Tests and Multiple F. Tests. Biometrics. 11K1-42
- Djakalia, B., Louis, B. & Soumalia, D. (2011). Effects of *Mangifera oleifera* on growth performance and health status of young post weaning rabbits. *Research Journal of Poultry Sciences*. 4:(1) 7-13
- D'Mello, J. P. E. T. Acamovoric & A. G. Walker (1987). Evaluation of leucerna leaf meal for broiler growth and pigmentation. *Tropical Agriculture* (Trinidad). 64:33-35
- Ensminger, M. E. ( 1991). Animal Science Digest. Animal Agricultural Series). Interstate Publil. Inc.Daminle Illinois, USA.
- Fasuyi, A. O. & aletor, W. A. (2005). Varietal composition and functional properties of cassava leaf meal and leaf protein concentrates. *Pakistan Journal of Nutrition*. 4:43-49
- Jenkins, J. R. (1993). In: Jenkins, J. R. & Brown, S. A. (ed) Practioners guide to Rabbits and Ferrets, American Animal Hospital Association, Lake Wood, USA, pp 1-42
- Kakengi, A. M. V., Shem, M. N., Sarwatt, S. V. & Fujiharaa, T. (2003). Can *Moringa oleifera* be used as a protein supplement to ruminants. *Asian-Australian Journal of Animal Sciences*. 18 (1): 42-47
- Kakengi, A. M. V., Kaijage, I. T., Sarwatt, S. V., Matayoba, S. K. & Shem, M. V. and Fujihana, T. (2007). The effects of Moringa oleifera leaf meal as a substitute for sunflower seed meal on performance of laying hens in Tanzania. *Livestock Research for Rural Development*. 19 (8) 2007. [Http://www.irrd/irrd/19/8/kake1:120.htm](http://www.irrd/irrd/19/8/kake1:120.htm)
- Madubuike, F. N. & Ekenyen, B. U. (2006). Heamatology and serum biochemistry characteristics of broiler chicks fed varying dietary levels of *Impomea osarifolia* leaf meal. *International Journal of Poultry Science*. 5: 9-12
- Makkar, P. S. & Becker, K. (1996). Nutritional value and anti nutritional components of whole and ethanol extracted *Moringa oleifera* tree. *Journal of Agricultural Sciences* (Cambridge)/ 128:311-322
- Makkar, P. S. & Becker, K. (1997). Nutrient and antiquality factors in different morphological parts of *Moringa oleifera* tree. *Journal of Agricultural Science*. 128: 311-322
- Melesse, A., W. Tiruneh & T. Negesse (2011). Effects of feeding Mango stenopetala leaf meal on nutrient intake and growth performance of Rhode Island Red chicks under tropical condition. *Tropical and Sub-Tropical Agroecosystems*. 14:485-495
- Negesse, T., Makkar, H. P. S. & Becker, K. (2009). Nutritive value of some non-convention feed resources of Ethiopian determined by chemical analyses and an In vitro gas method. *Animal Feed Science and Technology*. 154: 214-217
- FAO (1989). Food and Agriculture Organization Rome. Production year book vol 42

- Nworgu, F. C., Egbuinike, G. N., Abu, O. A., Fapohunda, J. B. & Omola, A. J. (1999). Effects of concentrate and leaf meals on the performance of rabbits. In: Ologholo, A. D., Egbuinike, G. N., Adewumi, M. K., Bamgbose, A. M., Iyayi, E. A. and Adesehinwa, A. O. K. (eds). Sustainability of the Nigerian Livestock industry in 2000 AD. Proceedings of 4<sup>th</sup> Annual conference of Animal Science Association of Nigeria. IITA Conference center, Ibadan, Nigeria. September 14<sup>th</sup>-16<sup>th</sup> 1999. Pp150-153
- Ogbe, A. O. & J. P. Affika (20011). Proximate study, mineral and anti-nutrient components of *Moringa oleifera* leaves harvested in Lafiya Nigeria. *Journal of Microbiology, biotechnology and food science*. 1(3):296-348
- Odeyinka, S.M., Oyedele, O.J. & Odedire, J.A. (2008). Reproductive performance of rabbits fed *Moringa oleifera* as a replacement for *Centrosema pubescens*. 9<sup>th</sup> World Rabbit Congress. June, 10<sup>th</sup>-13<sup>th</sup> 2008, Verona-Italy
- Sarwat, S. V., Kapenge, S. S. & Kakengi, A. M. (2002). Substituting sunflower cake with *Moringa oleifera* leaves as supplemental goat feed in Tanzania. *Agro-forestry systems*. 56:240-247
- Sirios, M. (1995). Mosbys Fundamentals of Veterinary Techniques. Veterinary Clinical Laboratory Procedures. Mosby year Books Inc.
- Steel, R. G. D. & Torrie, J. H. (1980). Principles and procedures of statistics. 2<sup>nd</sup> edition. McGraw-Hill Incorporated. Tokyo Japan pp633