



**Response of Weaner Rabbits Fed Diets Containing Varying Levels of Raw Okra (*Abelmoschus esculentus*) Seed Meal as Replacement for Groundnut Cake**

**<sup>1</sup>Wafar, R.J. and <sup>2</sup>Tarimbuka, L. I.**

<sup>1</sup>Department of Animal Production and Health, Federal University, Wukari, Taraba State, Nigeria

<sup>2</sup>Department of Animal Health and Production Technology, Adamawa State College of Agriculture, Ganye, Adamawa State, Nigeria.

Corresponding author Phone: 07031320840. Email: [litarimbuka@gmail.com](mailto:litarimbuka@gmail.com)

**Abstract**

*This study was conducted to determine the effect of feeding varying levels of raw okra (*Abelmoschus esculentus*) seed meal on the growth performance of weaner rabbits. Eighteen (18) weaner rabbits with average weight of  $500 \pm 0.10$ g were used for the study. The experimental animals were randomly allotted to three dietary treatments in a completely randomized design. Three experimental diets were compounded using raw Okra seed meal (ROSM). Treatment 1 contained (0%ROSM) which served as the control, while treatments '2 and 3 contained 10% and 20% ROSM, respectively. Data collected during the experiment were final body weight, total body weight gain, total feed intake, daily feed intake, feed conversion ratio, carcass characteristics, internal organ weights and blood parameters. Data obtained during the experiment were subjected to one way analysis of variance (ANOVA). The results of the growth performance showed that there were significant ( $p < 0.05$ ) differences across dietary treatments. Final body weight (FBW), average daily weight gain (ADWG), average daily feed intake (ADFI) and feed conversion ratio of Rabbits fed T1 (0%ROSM) recorded significantly ( $p < 0.05$ ) higher values compared to other treatment diets. Among the raw okra seed meal (ROSM) base diets, rabbits fed T3 (20%ROSM) diet recorded significantly lower final body weight gain, average daily feed intake and average daily weight gain. The dressing percentages varied from 71.45 (T1) to 47.26% in (T3) and were significantly ( $p < 0.01$ ) affected by the dietary treatments. There were significantly ( $P < 0.01$ ) difference in the organ weights among the treatment groups. Rabbit fed T3 (20%ROSM) recorded relative highest lungs (0.79) heart (0.65) and kidney (0.61) weights. The result for large intestine length (103.67), small intestine length (201.89) were all significantly ( $P < 0.01$ ) different across the treatment groups. Haematological and serum biochemical indices showed that haemoglobin, and white blood cell count varied significantly ( $P < 0.01$ ) among treatment groups. It was concluded that inclusion of ROSM beyond 10% in the diet of weaner rabbits adversely affected their growth performance. Therefore, it was recommended that rabbit farmers should include ROSM in the diet of rabbits up to 10% in weaner rabbit diets*

**Keywords: Weaner Rabbit, Raw okra seed meal**

**Introduction**

Rabbit production is one of the attractive livestock subsector in Nigeria with numerous advantages over other species of livestock (Oladunjoye *et al.*, 2014). These attributes include; prolificacy, short generation interval, low feed consumption, its ability to

efficiently utilized high levels of roughage and forage materials (Biobaku and Oguntona, 1997) thereby reducing the pressure on cereal grains and pulses (legumes) as sources of energy and protein respectively (Alade *et al.*, 2001). High demand on the use of soybean meal, fish meal and other conventional

sources of protein for animal feeding in most developing countries has led to high costs of conventional feeds (FAO, 2014).

Feeds constitute about 60%-80% total cost of production monogastric production (Lawrence *et al.*, 2008). This has greatly reduced profit margin as well as expansion of the subsectors. One of the approaches towards solving the problem of high cost of feed is the use of readily available and under-utilized non- conventional feed ingredients such as seed meals. The use of non-conventional feedstuff in rabbit diet is well documented (Wafar *et al.*, 2017). One of the under-utilized seeds focused in this study is the use of okra seeds.

The seed have been reported to contain moisture (6.96%), total carbohydrates (30.81%), protein (22.14%), oil (14.01%) and crude fiber (27.30%) (Habtamu *et al.*, 2018). The seed also contain K, Na, Mg, Fe, Zn, Mn and Ni. Despite the potentials of this seed, there is scanty information on the utilization of raw okra seed in weaner rabbits' diet. The study was therefore carried out to evaluate the effects of raw okra seed meal on the growth performance, haematological parameters and carcass characteristics of weaner rabbits.

## Materials and Methods

### Study site

The study was carried out at the Rabbit Unit of Teaching and Research Farm of the Department of Animal Production and Health, Federal University Wukari, Taraba State. The site is located at longitude 9°47'0 " E and latitude 7°51' 0 " N. It is on an average elevation of 189m above sea level and annual average temperature of 26.8°C. The annual precipitation is about 1,205mm. The vegetation type is guinea savannah (Taraba State Diary, 2008).

### Source and Processing of okra Seeds Meal

The seeds were purchased from Mutum-biyu local market, Taraba State Nigeria. The seeds were screened of stones and dirt. The seeds were milled using 2mm sieve hammer mill to form ROSM.

### Experimental Diets

Three treatment diets were compounded using raw okra seed meal (ROSM). Diet 1 served as control (% ROSM<sub>0</sub>), while diets 2 and 3 contain ROSM at 10.00% and 20.00% inclusion levels respectively (Table 1).

### Experimental Design and Animal Management

Eighteen (18) weaner rabbits with an average weight of 500±0.10g were purchased from Correctional Centre Wukari, Taraba State, Nigeria. The experimental animals were randomly assigned to the three treatment groups of 6 rabbits per treatment replicated three times with 2 rabbits per replicate in a completely randomized design. The rabbits were housed in cage measuring 60cm x 80cm x 70 cm in a three-tier hutch system raised 90cm above the floor. The cages were fitted with aluminum feeders and drinkers. The animals were treated against internal and external parasites using Endovef® (Ivermectin) at the dose of 0.3 mg/kg subcutaneously and also treated prophylactically against coccidiosis with Amprole 200® according to the manufacturer's prescription.

### Data Collection

Data were collected on initial body weight, daily body weight gain, final body weight, daily feed intake, and feed conversion ratio. The rabbits were weighed prior to the commencement of the experiment to obtain their initial body weights. Daily feed intake was determined by subtracting the weight of left over feed from the weight of the feed offered. Feed intake and weight gain recorded were used to calculate feed conversion ratio.

10mls of Blood was collected through the jugular vein puncture method into two sample bottles using a sterilized needle and syringe (Jain, 1986). The blood samples used for serum analysis were allowed to clot before centrifuging to obtain the serum then decanted into sterile bottles and stored at  $-20^{\circ}\text{C}$  before being analyzed. The serum indices analyzed were total protein, cholesterol, glucose, albumin, globulin, creatinine and urea. The blood samples for the haematological studies were collected in sample bottles containing EDTA before analyzing the haematological parameters using standard procedures as described by Jain, (1986). The hematological parameters analyzed were red blood cells (RBC), packed cell volume (PCV), haemoglobin and white blood cells (WBC) counts (Tripathi *et al.*, 2008)

At the 56<sup>th</sup> day of the experiment, three rabbits per treatment (one per replicate) were randomly selected, starved overnight to clear the gut, while water was offered without restriction. The following morning, the rabbits were weighed to determine their live

weight then slaughtered, skinned, eviscerated and dressed. Internal organs were carefully removed, weighed and expressed as percentage of the live weight.

#### Laboratory analysis

The proximate composition of raw okra seed meal was determined for dry matter (DM), Crude protein (CP), crude fibre (CF), ether extracts (EE) ash and nitrogen free extracts were determined by the method described by AOCA, (2000). Total oxalate was determined according to Day, (1986) procedure. Phytate was determined using the method described by Reddy and Love, (1999). Saponin was determined using the method of Hudson and EL-Difrawi, (1979). While tannin and phenol were determined using the method of Trease and Evans, (1978).

#### Statistical Analyses

All the data collected were subjected to one-way analysis of variance of JMP SAS software (2013) and where statistical significance ( $P < 0.05$ ) exit, the means were compared using Least Significant differences option of same software.

**Table 1. Ingredients Composition of the Experimental Diets**

| Ingredients                | Dietary treatments |              |              |
|----------------------------|--------------------|--------------|--------------|
|                            | T1(0%ROSM)         | T2 (10%ROSM) | T3 (20%ROSM) |
| Maize                      | 46.55              | 46.55        | 46.55        |
| Raw Okra seed meal         | 0.00               | 2.50         | 5.00         |
| kapok seed meal            | 3.00               | 3.00         | 3.00         |
| Groundnut cake             | 25.00              | 22.50        | 20.00        |
| Maize offal                | 12.00              | 12.00        | 12.00        |
| Rice bran                  | 11.00              | 11.00        | 11.00        |
| Bone meal                  | 2.00               | 2.00         | 2.00         |
| Methionine                 | 0.10               | 0.10         | 0.10         |
| Salt                       | 0.25               | 0.25         | 0.25         |
| Lysine                     | 0.10               | 0.10         | 0.10         |
| Total                      | 100                | 100          | 100          |
| <b>Calculated analysis</b> |                    |              |              |
| Crude protein              | 17.71              | 17.56        | 17.49        |
| Crude fibre                | 9.45               | 9.34         | 9.35         |
| Ash                        | 6.45               | 6.38         | 6.37         |

|   |         |         |         |
|---|---------|---------|---------|
| Metabolisable energy  | 2735.70 | 2736.78 | 2733.70 |
| <p>premix composition (per kg of diet): vitamin A, 12500 IU; vitamin D<sub>3</sub>, 2500 IU; vitamin E, 50.00 mg; vitamin K<sub>3</sub>, 2.50 mg; vitamin B<sub>1</sub>, 3.00 mg; vitamin B<sub>2</sub>, 6.00 mg; vitamin B<sub>6</sub>, 6.00 mg; niacin, 40 mg; calcium pantothenic, 10 mg; biotin, 0.08 mg; vitamin B<sup>12</sup>, 0.25 mg; folic acid, 1.00 mg; chlorine chloride, 300 mg; manganese, 100 mg; iron, 50 mg; zinc, 45 mg; copper, 2.00 mg; iodine, 1.55 mg; cobalt, 0.25 mg; selenium, 0.10 mg; and antioxidant, 200 mg</p> |         |         |         |

**Results and Discussion**

**Proximate and anti-nutritional composition of raw okra seed meal**

The proximate composition and anti-nutrients contents of raw okra seed meal are shown in Table 2. The high dry matter (89.80%) content of the ROSM is an indication that the meal can be stored for a long time and less prone to microbial attack during storage. Ether extracts content (6.34%) is lower than the 18-27% value reported by Habtamu *et al.* (2018). The crude protein content recorded is higher than (22.30 - 26.81%) reported by Manal and Hend (2015). The observed variations in proximate composition compare to other study could be attributed to climatic conditions, edaphic factors as well as methods of processing and laboratory analysis (Igene *et al.*, 2001). The tannin content (1.03 mg/100g) of ROSM is higher than some tropical seed meals 0.34mg/100g in African oil bean seeds reported by Enujugh and Agbede, (2001) and 0.42% in raw lablab seed as reported by Osman, (2002). The value of saponin recorded in the present study is lower than the 1.1% observed in

mucuna seed Abeke *et al.*, (2008). The concentration of tannins implies possibilities of poor protein digestibility caused by formation of protein tannin complexes which irreversibly bind digestive enzymes, thus inhibiting the activities of the enzymes making them unavailable for breaking down proteins and other nutrients (Wafar *et al.* 2017). Saponin in seeds imposes an astringent taste that affects feed palatability, reduce feed intake, utilization of protein and consequently body growth Aletor *et al.* (2008). Total oxalate content is lower than the 1.95% found in raw mucuna seed (Tuleum and Patrick, 2017). Ladeji *et al.* (2004) reported that high concentration of oxalates bind calcium present in feed thereby rendering calcium unavailable for normal physiological and biochemical roles. The phytate concentration of ROSM is 0.42mg/100g. High phytate contents have been reported to retard growth, cause abnormalities in the intestinal histology, reduce the bioavailability of dietary phosphorus, inhibit dietary proteins and activity of trypsin and pepsin and reduces the solubility of starch (Ahamefule, 2005).

**Table 2: Proximate composition and Anti-nutritional factors levels of Raw Okra Seed Mea**

| Parameter                                     | % composition |
|---|---------------|
| Dry matter                                    | 89.80         |
| Crude protein                                 | 29.03         |
| Crude fibre                                   | 18.25         |
| Ether extracts                                | 6.34          |
| Ash   | 7.32          |
| Nitrogen free extracts                        | 36.11         |
| ME Kcal                                       | 2869.55       |
| <i>Anti-nutritional composition (mg/100g)</i> |               |
| Tannin  | 1.03          |
| Saponin                                       | 0.15          |
| Phytate                                       | 0.42          |
| Oxalate                                       | 0.72          |
| Phenol  | 0.11          |

### Growth Performance of weaner rabbits fed varying levels of raw okra seed meal as Replacement of Groundnut cake

The growth performance of weaner rabbits fed raw okra seed meal is presented in Table 3. There were significant ( $P<0.05$ ) differences among the treatments groups for final body weight (FBW), average daily weight gain (ADWG), average daily feed intake (ADFI) and feed conversion ratio. Rabbits fed T1 (0%ROSM) recorded significantly ( $P<0.05$ ) higher values compared to those on ROSM base diets. Rabbits on T3 (20%ROSM) had significantly ( $P<0.05$ ) lower FBW, ADWG and ADFI. The values of ADWG obtained in this study are higher than the value (14.0-23.05g) reported by Amaefule and Nwaokoro (2002) but lower than the value (12.03-20.07g) reported by Arijenwa and Igene (2002). This tends to suggest that the inclusion of 20%ROSM in diet of growing rabbits depress growth. The rabbits might not have obtained enough nutrients from the feed consumed for normal growth due to the presence of anti-nutritional factors in the diets such as saponin and

tannins. The total feed intake of rabbits fed T3 (20%ROSM) was significantly ( $P<0.05$ ) lower compared to the other treatment diets. This could be attributed to the amount of anti-nutritional factors in the seed meal which lowered the feed intake. Several studies have shown that the presence of anti-nutritional factors such as saponin and tannins, in the diet resulted in poor palatability and consequent decreased feed intake due to the astringent properties (Olomu, 2011) and Wafar *et al.* (2017). Ogbu *et al.* (2015) reported that phytate also reduce the bio availability of divalent cations as a result of insoluble complexes formed. This implies that rabbit fed T3 (20%ROSM) diet had low efficiency in the absorption of dietary minerals, protein digestibility and digestive enzymes in the gastrointestinal tract as a result of high concentration of phytate. There were also significant ( $P<0.05$ ) difference among the treatments in feed conversion ratio (FCR) which ranges from 3.31-4.55. Rabbit fed T1 had the best FCR (3.31) while rabbit fed T3 (20%ROSM) had the poorest.

**Table 3. Growth Performance of Weaner Rabbits Fed Diets Containing Varying Levels Raw Okra Seed Meal as Replacement for Groundnut cake**

| Parameters                    | Dietary treatments   |                      |                      | SEM    | P-value |
|-------------------------------|----------------------|----------------------|----------------------|--------|---------|
|                               | T1(0% ROSM)          | T2(10% ROSM)         | T3 (20% ROSM)        |        |         |
| Initial body weight(g)        | 500.00               | 483.33               | 500.00               | 25.45  | 0.45    |
| Final body weight(g)          | 2041.90 <sup>a</sup> | 1743.10 <sup>b</sup> | 1119.80 <sup>c</sup> | 57.41  | 0.015   |
| Total body weight gain(g)     | 1541.90 <sup>a</sup> | 1259.80 <sup>b</sup> | 619.80 <sup>c</sup>  | 55.64  | 0.015   |
| Average daily weight gain (g) | 31.46 <sup>a</sup>   | 25.71 <sup>b</sup>   | 12.64 <sup>c</sup>   | 1.13   | 0.031   |
| Total feed intake(g)          | 5104.70 <sup>a</sup> | 4357.80 <sup>b</sup> | 2799.50 <sup>c</sup> | 143.55 | 0.041   |
| Average daily feed intake(g)  | 104.18 <sup>a</sup>  | 88.93 <sup>b</sup>   | 57.13 <sup>c</sup>   | 2.92   | 0.021   |
| Feed conversion ratio         | 3.31 <sup>b</sup>    | 3.46 <sup>b</sup>    | 4.55 <sup>a</sup>    | 0.12   | 0.049   |

Means on same row bearing different superscript differ significantly.  
SEM standard Error Mean

### Haematological and Serum Biochemical indices of Weaner Rabbit Fed varying Levels of raw okra seed meal Replacing Groundnut cake.

The haematological and serum biochemical indices of weaner rabbits fed raw okra seed meal at varying level are presented in Table 4. Haemoglobin varied significantly ( $P<0.01$ )

among treatment groups. The value obtained in the control diet T1 (0%ROSM), T2 (10%) and T3 (20%) are within the range of (9.4-17.4g/dl) reported by Jenkins (1993). The lower Hb (8.67g/dl) value observed in T3 (20%) implies that the dietary protein was not of high quality. This could probably be due to the traces of ANF's in the treatment diet (Abu *et al.*, 1988). This agrees with the finding of Wafar, (2017) that the presence of anti-nutritional content affect the concentration of haemoglobin. The PCV values for control diet T1 (0%ROSM), T2 (10%ROSM) and T3 (20% ROSM) are within the normal range for physiological function of rabbits however, the rabbit fed T3 recorded numerically lower PCV. Reduction in the concentration of PCV suggests the presence of a toxic factor such as haemagglutinin, which had adverse effect on blood formation Oyawoye and Ogunkunle (1998). The quantity of haemagglutinin in the raw okra seed meal may perhaps have been responsible for the observation of the reduction in the PCV of the group on T3. White blood cell (WBC) count differed significantly ( $P<0.01$ ) among treatment groups. The values obtained for T1 and T2 were within the normal range in rabbits except T3 that recorded higher value of 10.89%. High WBC count is usually

associated with microbial infection or the presence of the foreign body or antigen in the circulating system. Total protein showed no significant ( $P<0.01$ ) differences in the dietary treatments groups. However, the TP value of rabbits in T3 was numerically than the range 5.5-8.0% normal range for rabbits suggesting that the rabbit on T3 diet survived at the expense of body reserves. However, it is possible that the dietary protein was not fully utilized by the rabbits on T3 diet probably because of accumulated anti-nutrients in the raw okra seed, which did not facilitate total protein availability. The neutrophils values obtained were significantly ( $P<0.01$ ) different among treatment groups with none of the values outside the normal range of 35-55.00% for rabbits Jenkins, (1993) and Hillyer (1994). Conversely, the lymphocyte concentration, except for rabbit fed T3 (20% ROSM) were within normal range 25.00-50% reported by Jenkins, (1993) and Hillyer, (1994). Blood urea though varied significantly ( $P<0.01$ ) for all treatment groups, but is within the normal range (30.0-37.3mg/dl). Higher value was observed in rabbit fed T3 (20% ROSM) diet. Studies have attributed high blood urea levels to poor protein quality or excess tissue catabolism associated with protein deficiency Amaefule and Obioha, (2001).

**Table 4. Haematological and biochemical indices of weaner rabbit fed with graded levels of okro seed meal.**

| Parameter                           | Dietary treatments |                    |                    | SEM    | P-value |
|-------------------------------------|--------------------|--------------------|--------------------|--------|---------|
|                                     | T1(0%ROSM)         | T2(10%ROSM)        | T3(20%ROSM)        |        |         |
| Packed cell volume (%)              | 31.89              | 32.65              | 30.54              | 0.6849 | 0.1682  |
| Haemoglobin (g/dl)                  | 10.78 <sup>a</sup> | 11.56 <sup>a</sup> | 8.67 <sup>b</sup>  | 0.5216 | 0.0191  |
| White blood cell ( $\times 10/mm$ ) | 7.98 <sup>b</sup>  | 8.67 <sup>b</sup>  | 10.89 <sup>a</sup> | 0.5574 | 0.0237  |
| Red blood cell ( $\times 10/mm$ )   | 8.09 <sup>b</sup>  | 8.76 <sup>a</sup>  | 6.45 <sup>c</sup>  | 0.1693 | 0.0002  |
| Lymphocyte (%)                      | 36.89 <sup>b</sup> | 37.56 <sup>b</sup> | 45.89 <sup>a</sup> | 0.9144 | 0.0007  |
| Neutrophil (%)                      | 39.56 <sup>b</sup> | 41.89 <sup>b</sup> | 52.89 <sup>a</sup> | 0.9804 | 0.0002  |
| Eosinophil (%)                      | 2.56 <sup>b</sup>  | 2.67 <sup>b</sup>  | 3.65 <sup>a</sup>  | 0.2502 | 0.0403  |
| Total protein (g/dl)                | 6.66               | 6.17               | 4.65               | 0.3304 | 0.1777  |
| Cholesterol (g/dl)                  | 43.89 <sup>a</sup> | 44.87 <sup>a</sup> | 32.89 <sup>b</sup> | 1.3721 | 0.0015  |
| Urea (g/dl)                         | 31.78 <sup>b</sup> | 33.67 <sup>b</sup> | 40.90 <sup>a</sup> | 1.2316 | 0.0044  |
| Glucose (g/dl)                      | 89.69 <sup>a</sup> | 87.67 <sup>a</sup> | 71.89 <sup>b</sup> | 3.2548 | 0.0158  |
| Globulin (g/dl)                     | 3.01               | 3.03               | 2.87               | 0.1039 | 0.5311  |
| Albumin (g/dl)                      | 3.65 <sup>a</sup>  | 3.14 <sup>ab</sup> | 2.78 <sup>b</sup>  | 0.2269 | 0.0892  |

Means on same row bearing different superscript differ significantly. ( $p<0.01$ )

### Carcass Characteristics and Internal Organ Weights of Weaner Rabbit Fed Varying Levels of raw okra seed meals Replacing Groundnut Cake

The carcass and internal organs weights of weaner rabbits fed ROSM are presented in Table 5. The result showed significant differences across the dietary treatments. The dressing percentages varied from 47.26% in T3 (20%ROSM) to 71.45 % in T1 (0%ROSM) and were significantly ( $p<0.01$ ) affected by the dietary treatments. There were significant ( $P<0.01$ ) difference in the organ weights among the treatment groups. Rabbit fed T3 (20%ROSM) recorded relative highest lungs (0.79%) heart (0.65%) and kidney (0.61%) weights. The results of large intestine and small intestine lengths were also significantly ( $P<0.01$ ) different across the treatment groups. Rabbit fed T3 (20%ROSM) recorded longer small and large intestine lengths. The dressing percentage were similar to the range of (56.26 to 58.35%) reported by Adama *et al.*, (2014) and Jiya, (2012). The significant ( $p<0.01$ ) effects on the weight of

the lung, heart and kidney agreed with the reports of Wafar *et al.*, (2017), who observed variation in internal organs weights of rabbit fed alternative sources of protein in the tropics. Rabbit fed T3 (20%ROSM) recorded relatively higher lung, heart and kidney weights. This is an indication that there is element of toxic substance present in the diets. In feeding trials, liver or kidney are used to study toxicity rates. Higher weight would arise because of an increase in the metabolic rate of this organs in an attempt to convert toxic elements or anti-nutritional factors to non-toxic metabolites (Bone, 1975). The higher weight of heart and kidney in rabbit fed T3 (20%ROSM) could be contributed to this increase in the metabolic rate. Higher weight and elongation of small intestine of rabbits fed T3 (20%ROSM) could be as a result of impact of anti-nutritive factors, which inhibit proper digestion of the diet as such, resulted in to accumulation of too much of feed consumed in the small intestine and resulted in to its elongation.

**Table 5 Carcass and internal organs of weaner rabbit fed with varying level of okro seed meals.**

| Parameters                      | Dietary treatments   |                      |                      | SEM    | P-value |
|---------------------------------|----------------------|----------------------|----------------------|--------|---------|
|                                 | T1(0%ROSM)           | T2(10%ROSM)          | T3(20%ROSM)          |        |         |
| Live weight (g)                 | 2029.10 <sup>a</sup> | 1730.40 <sup>b</sup> | 1107.10 <sup>c</sup> | 57.418 | 0.0001  |
| Slaughter (g)                   | 1972.10 <sup>a</sup> | 1673.40 <sup>b</sup> | 1050.10 <sup>c</sup> | 57.418 | 0.0001  |
| Carcass weight (g)              | 1450.40 <sup>a</sup> | 1151.60 <sup>b</sup> | 528.30 <sup>c</sup>  | 57.418 | 0.0001  |
| Dressing (%)                    | 71.45 <sup>a</sup>   | 66.46 <sup>a</sup>   | 47.26 <sup>b</sup>   | 2.1064 | 0.0004  |
| Pelt weight (g)                 | 107.19 <sup>a</sup>  | 99.70 <sup>a</sup>   | 70.90 <sup>b</sup>   | 3.1599 | 0.0004  |
| Head weight (g)                 | 96.64 <sup>a</sup>   | 89.15 <sup>a</sup>   | 60.36 <sup>b</sup>   | 3.1599 | 0.0004  |
| Internal organ as % Live weight |                      |                      |                      |        |         |
| Lungs                           | 0.25 <sup>b</sup>    | 0.32 <sup>b</sup>    | 0.79 <sup>a</sup>    | 0.0474 | 0.004   |
| Heart                           | 0.18 <sup>b</sup>    | 0.23 <sup>b</sup>    | 0.65 <sup>a</sup>    | 0.0413 | 0.004   |
| Kidney                          | 0.15 <sup>b</sup>    | 0.19 <sup>b</sup>    | 0.61 <sup>a</sup>    | 0.0391 | 0.003   |
| Small intestine length          | 167.78 <sup>b</sup>  | 189.67 <sup>a</sup>  | 201.89 <sup>a</sup>  | 5.2838 | 0.010   |
| Large intestine                 | 78.45 <sup>c</sup>   | 87.67 <sup>b</sup>   | 103.67 <sup>a</sup>  | 1.3284 | 0.003   |
| Ceacum                          | 0.78 <sup>b</sup>    | 0.85 <sup>b</sup>    | 0.97 <sup>a</sup>    | 0.0275 | 0.007   |

Means on same row bearing different superscript differ significantly ( $P<0.01$ )  
SEM standard Error of Mean.

**Conclusion and recommendation**

From the results of this study, it was concluded that inclusion of more than 10 % ROSM in the diet of weaned rabbits had adverse effect on growth performance, carcass characteristics and blood profile. Therefore, it was recommended that rabbit farmers should only include 10% ROSM in the diet of weaned rabbits.

**References.**

Adama, T. Z., Adekojo, S. A., Aremu, A., Ijaiya, A. T., Owoleke O. E., Ibrahim A. (2014). Effects of Dietary Inclusion of Differently Processed *Leucaena leucocephala* Leaf Meal on Carcass Characteristics of Rabbits (*Oryctolagus cuniculus*). *International Journal of Food Science and Nutrition Engineering* 4(5): 118-127

Abeke, F.O., Ogundipe S.O., Dafwang I.I., Sekoni, A.A., Abu, A. and Adeyinka, I. (2008). Effect of duration of cooking on the level of some anti-nutritional factors of nine varieties of *Lablab purpureus* bean. *Nigerian Journal of Animal Production*, 35(2):217-223

Abu, O.A., Rabo, J.S., Onifade, A.A. and Danny, C.B. (1988). *Blood composition and histological changes in the gastrointestinal tract of rabbits fed untreated rice husk based diets. Proceedings of Annual Conference of Nigerian Society for Animal Production. 23:144-147*

Ahameful F.O. (2005). Evaluation of pigeon peacassava peel based diets for Goats production in South-eastern Nigeria. Ph.D. Thesis. College of Animal Science and Animal Production, MOUAU, Umudike, Nigeria

Alade, N. K., Kwaji, D. T and Igwebuike, J. U. (2001). Growth performance and blood constituents of rabbits fed graded levels of poultry waste. *Annals of Borno* (17/18): 217–225.

Amaefule, K.U. and C.C. Nwaokoro (2002). The effect of graded levels of raw pigeon pea (*Cajanus cajan*) seed meal on the performance of weaner rabbits. Proceedings of the 27th Annual Conference Nigerian Society for Animal Production (NSAP), March 17-21, 2002, Fed Univ. of Tech., Akure, Nigeria, pp: 113-115

Amaefule, K.U and Obioha, F.C. (2002). Performance of broiler starters fed raw and boiled pigeon pea seed meal. *Nigerian Journal Animal of Production*, 28:34-39.

AOAC. (2000.) Association of Official Analytical Chemists. *Official methods of Analysis* (Vol. II 17th edition) of AOAC International. Washington, DC, USA. Official methods 925.09, 923.03, 979.09, 962.09, 4.5.01 and 923.05.

Arijeniwa, A. L. and Igene, F. U. (2002). Evaluation of the nutritive value of some tropical legumes in raw state for weaner rabbits: performance, carcass and organ weights. Proc. 7th Ann. Conf. Animal Science Association of Nigeria (ASAN), University of Agriculture, Abeokuta, Nigeria. 124-125

Biobaku, W.O. and Oguntona, E.B. (1997): The effects of feeding multi nutrient mini blocks and pelleted diet on the growth of rabbits. *Nigerian. Journal of Animal. Production*, 24(2): 147-149



- Bone, F.J. (1979). Anatomy and physiology of farm animals. 2nd Edn. Reston Publishing Comp, Inc Virginia, USA. 560
- Day, R. A. (1986). Underwood AL. Quantitative analysis. 5th ed. Prentice-Hall publication.701.
- Enujiugha V.N and Agbede J.O. (2005) Nutritional and anti-nutritional characteristics of african oil bean (*Pentaclethra macrophylla Benth*) Seeds. *Appl. Trop. Agric.*;5(1):11-14
- FAO (2014). Food and Agriculture Organization. Protein Sources for the Animal Feed Industry.
- Habtamu, F.G, Haki G. D., Fekadu B., Rakshit S.K and Ashagrie, Z.A (2018). Nutritional and Antinutritional Evaluation of Indigenous Ethiopian okra (*Abelmoschus esculentus*) seed accession. *African Journal of Food Agric. Nutrition Dev.* 18(1):13019-13033
- Hillyer, E.V. (1994). Rabbits. *Small Animal Practices* 24:25-65.
- Hudson B.J, EL-Difrawi E.A. (1979). The sapogenins of the seeds of four lupin species. *Journal of Plant Food* 3:181-86.
- Igene F.U, Agbede J.O, Omueti J.O, Aletor V.A. (2001). Nutrient and anti-nutrient composition of raw and processed winged bean seeds (*Psophocarpus tetragonolus*). *Journal of Applied Science* 4(4):2305-2318.
- Jain, NC. (1986). Schalm's Veterinary Hematology 4th edition, (ed. N.C. Jain), Philadelphia: Lea & Febiger, pp. 20-86
- Jenkins, J R (1993). Rabbits. In: Jenkins, J.R and Brown, S.A.(ed.) Practitioner's Guide to Rabbits and Ferrets. American Animal Hospital Association, Lake wood, U.S.A. pp 1-42
- Ladeji O, Akim C.U and Umaru H.A. (2004). Levels of anti-nutritional factors in vegetables commonly eaten in Nigeria. *African Journal of Natural Sciences*; 7:71-73. 33.
- Lawrence, J.D., Mintert, J., Anderson, J.D and Anderson, D.P. (2008). Feed grains and livestock. Impacts on meat supplies and prices. *Choice Magazine*, 2<sup>nd</sup> quarter 23 (2): 11-15
- Manal, A.M.H and Hend, M.A. (2015). The Nutritional Composition of Three Cultivars of Okra (*Abelmoschus esculentus L.*) Seeds Flour. *World Journal of Dairy & Food Sciences.* 2015; 10(2): 122-131.
- Ogbu N.N., Ogbu C.C. and korie A.U. (2015).Growth Performance of Broiler Chickens Fed Raw and Processed Pigeon Pea (*Cajanus cajan*) Seed Meal. *Journal Animal Science Advances*, 5(7): 1350-1356
- Oladunjoye, I.O., Ojo, A.J and Jamiu, B.A. (2014). Evaluation of baobab seed meal as feed for growing rabbits. *International Journal of Current Microbiology and applied sciences Vol 3 (6) 971-977.*
- Olomu, J.M. (2011). Monogastric Animal Nutrition: Principles and practice. 2nd edn. A Jachem publication, Benin city, Nigeria. 157
- Osman, M.A (2002). Effect of different processing methods, on nutrient composition, antinutritional factors, and in vitro protein digestibility of dolichos lablab bean (*Lablab purpureus* (L) Sweet). *Pakistan Journal of Nutrition* 6(4):299-303.
- Oyawoye E.O, Ogunkunle M (1998). *Physiological and biochemical effects of raw jack beans on broilers.* Proceedings of annual Conference of Nigerian Society of Animal Production. 23: 141-142.

- Reddy M. B, Love M. (1999). The impact of food processing on the nutritional quality of vitamins and mineral. *Adv. Exp. Med. Biol.* 459:99-106.
- Taraba State Diary. (2008). State Annual Official Diary Reports; Pp 34.
- Tripathi, M. K., D. Mondal and S. A. Karim. (2008). Growth, haematology, blood constituents and immunological status of lambs fed graded levels of animal feed grade damaged wheat as substitute of maize. *Journal Animal Physiology and Animal Nutrition* 92:75–85
- <https://doi.org/10.1111/j.1439-0396.2007.00712.x>
- Tuleun C.D and Patrick J.P. (2017). Effect of Duration of cooking *Mucuna utilis* seed on proximate analysis, levels of anti-nutritional factors and performance of broiler chickens. *Nigerian Journal of Animal Production* 34(1):45-53.
- Wafar, R. J., Yakubu, B. and Lalabe, B.C. (2017). Effect of Feeding Raw Kapok (*Ceiba pentandra*) Seed Meal on the Growth Performance, Nutrient Digestibility, Carcass and Organ Weights of Weaner Rabbits. *Asian Research Journal of Agriculture* 5(3):1-8