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# Comparative evaluation of carcass quality and sensory characteristics of meat of rabbits fed *Vernonia amygdalina a*nd *Mucuna pruriens*

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***Target Audience:*** *Animal Products Processors, Meat scientist, Researchers*

## Abstract

*Reduction of total fat and cholesterol contents as well as alteration of lipid profile to a more unsaturated kind are some methods for improving quality of meat. One of the safest strategies for achieving this is through dietary inclusion of natural occuring herbs. Therefore, a study was conducted to evaluate the effects of Vernonia amygdalina meal (VALM) and Mucuna pruriens meal (MPM) on performance, carcass and sensory quality of rabbits. Seventy-two weaned rabbits were randomly allotted to three dietary treatments, each replicated 3 times with 8 rabbits per replicate. Diet 1 was the control, diets 2 and 3 comprised of 15% each of VALM and MPM respectively each representing a treatment. At the end of 12th week, carcass evaluation, meat lipid profile and sensory evaluation were carried out. Results showed significant (P<0.05) increase in feed intake and daily weight gain for rabbits fed diets 2 and 3 as well as lower feed conversion ratio for rabbits fed diet 3 compared to the control. Rabbits on diet 3 indicated significan (P<0.05) increase in pre-slaughter weight, dressed weight as well as prime cuts (forelegs, thoracic cage, loin and hind legs). Meat lipid profile showed significant (P<0.05) reduction in total cholesterol, triglycerides, LDL, and VLDL while HDL increased for $T_3$ and $T_2$. Meat protein values showed significant (P<0.05) increase in T3 followed by T2 while abdominal fat decreased as against the control. Sensory evaluation showed significant (P<0.05) decline in tenderness from T3 to T2 without adverse effect on overall acceptability. Inclusion of the VALM and MPM in rabbit diets therefore improved performance, carcass quality and sensory characteristics.*

***Key words****: Vernonia amygdalina; Mucuna pruriens; rabbit; carcass; sensory evaluation.*

## Description of Problem

The success in rabbit production is guaranteed when producers give enough attention to the diet and provide wholesome feeds in adequate quantity and quality. Therefore, adopting an alternative and cheaper source of feed to replace or supplement cereals serves as an important strategy in increasing the scale of production of feed. The cholesterol content of meat being a concern to many consumers has led to the reduction in the consumption rate of meat (1). Since Rabbits have the potential as meat-producing animal with such characteristics as rapid growth rate and high reproductive ability compared to other monogastrics, dietary inclusion of certain locally available seeds and leaves suspected to have therapeutic values may achieve this purpose of cholesterol reduction in rabbit meat. Such feedstuff includes *Vernonia amygdalina* and *Mucuna pruriens* which have been reported to be rich in protein, fibre and have fat-lowering effects in livestock nutrition (2,3). Mucuna pruriens and Vernonia amygdalina contain polyunsaturated fatty acids, linoleic and linoleic as well as antioxidants which could boost high density lipoprotein (HDL) while reducing low density lipoprotein (LDL) and total cholesterol (37). This implies that both plants contain several bioactive

components that have antioxidants therefore could prevent accumulation of lipids and cholesterol in meat. Considering these feedstuffs in the feeding of rabbits (a meat producing animal) is therefore apt even as rabbit have higher ability to convert forage, crop residues and agro by-products into meat efficiently than cattle, sheep and goat (2). This study was therefore carried out to evaluate the influence of *Vernonia amygdalina* leaf meal and *Mucuna pruriens* meal on performance, carcass composition and sensory qualities of rabbit.

## Materials and Methods

### Experimental site, animals and management

This research work was carried out in the livestock division of Akwa Ibom State University, Obio Akpa campus. The area lies between latitude $4^{o}58^{/}$ and $5^{o}08^{/}$N and longitude $8^{o}02^{/}$and $9^{o}47^{/}$E. Temperature range between 25.0$^{o}$C and 26.0$^{o}$C with average relative humidity of 75-80% while mean annual rainfall vary from 2250mm to 2926mm. The climate data was supplied by the meteorological unit of the Akwa Ibom State University, Obio akpa campus. A total of seventy-two (72) weaned rabbits of seven weeks, weighing about 450.5g old were purchased from a research farm. The rabbits were pre-conditioned and made to acclimatize for two weeks. The rabbits were raised in individual hutches measuring 70x40x50cm(length x breath x height) in dimension and also placed on experimental diets at different levels of inclusion of VLM and MPM. The animals were randomly assigned to three dietary treatment groups ($T_1$, $T_2$, $T_3$) of 24 rabbits each in three replications of eight rabbits each in a randomized complete design.

### The experimental diet

Test feedstuff (*Vernonia amygdalina* and *Mucuna pruriens*) used in this study were obtained from local markets in Uyo, Akwa Ibom State and Nkwo Ibeagwu, Enugu State respectively. The *Mucuna pruriens* seeds obtained were processed by soaking in water for 48hours. Cooking was carried out on the soaked seeds in a solution of boiled maize cob ash (4). The boiled seeds were sundried and milled into meal before being used in formulating ration. This was to enhance leaching out photochemical compounds such as Levapoda making the product more suitable for consumption (4). The *Vernonia amygdalina* leaves obtained fresh were dried under room temperature while retaining the greenish colouration, before ground into meal (5). The diets were formulated such that they contained 0% (control), 15% of VALM (Diet 2) and 15% of MPM (Diet 3). Feed and water were also provided *ad libitum*, twice daily (8:00am and 4:00pm). The feeding trial lasted 84 days. Ingredient composition of the formulated diet is presented in Table 1.

### Chemical Analysis of the Test Materials

Samples of *Vernonia amygdalina* leaf meal and *Mucuna pruriens* seed meal were analyzed to determine their physicochemical composition using standard procedures (6). The formulated diets were also analyzed. Components determined were dry matter, crude protein, ether extract, ash, nitrogen free extract and metabolizable energy.

### Data collection

Data were collected for 12weeks. Rabbits were weighed at the beginning of the experiment and weekly subsequently. Weight gain was calculated as final body weight minus initial body weight. Feed intake was obtained as the difference between the quantity offered and quantity not consumed. Feed conversion ratio (FCR) was calculated as feed intake divided by weight gain and recorded as they occurred.

**Table 1: Composition of Experimental Rabbit Diets**

| Ingredients (%) | T1 | T2 | T3 |
|---|---|---|---|
| Maize | 45.00 | 45.00 | 45.00 |
| Whole soybean | 15.00 | 10.00 | 10.00 |
| Vernonia leaf meal | 0.00 | 15.00 | 00.00 |
| Mucuna pruriens meal | 0.00 | 00.00 | 15.00 |
| Fish meal | 1.00 | 1.00 | 1.00 |
| Wheat offal | 37.00 | 27.00 | 27.00 |
| Bone meal | 1.50 | 1.50 | 1.50 |
| Vit/min. Premix* | 0.25 | 0.25 | 0.25 |
| Salt | 0.25 | 0.25 | 0.25 |
| Total | 100 | 100 | 100 |
| **Calculated chemical composition of experimental diets (%)** | | | |
| Crude protein | 17.40 | 17.56 | 18.60 |
| Crude fibre | 5.50 | 11.55 | 8.07 |
| Ether extract | 3.28 | 4.04 | 5.10 |
| Ash | 4.86 | 9.89 | 5.98 |
| ME(Kcal/kg) | 2530 | 2410 | 2750 |

*Hi Nutrient international Premix contain following per 25kg;Vit.A, 8,000,000iu; Vit.D3,16,000,000iu; Vit.E, 20,000mg; Vit.K,2000mg; vit.B1,1500mg,vit.B2,4,000mg,vit.B6,2,000mg;vit.B12,10mg;Niacin,15,000mg; Folic acid,500mg;Biotin,20mg Mn, 80,000mg;Zn,50,000mg;
lodine, 1,000mg;Cobalt,500mg;Copper,5,000mg;Iron,20,000mg;Antioxidant,120,00mg,Selenium,200mg

**Carcass Trait**s and **sensory evaluation**

At the end of feeding trial that lasted for 12 weeks, a total of twenty four rabbits (8 rabbits per treatment) were randomly selected, fasted overnight, weighed and stunned to render the rabbit unconsciousbefore slaughtered. Skinning followed immediately even as the carcasses were eviscerated to removse the gastro internal tracts with its content. The eviscerated carcass weights were taken accordingly. While the individual organ (heart, liver, kidney and lungs) weights were taken using an electronic weighing scale (AS3101) and expressed as percentages of live weight Dressing percentage was calculated as the ratio of dressed weight to pre-slaughter weight and multiplied by 100. Abdominal fat pad was removed and weighed using a sensitive electronic weighing balance (AS3101) before carcasses were divided into primal cuts (loin, forelegs, hind legs, thoracic cage) and weighed accordingly. The weighed hind legs and loin cuts were further dissected into separate components of muscles and bones to obtain meat to bone ratio. The breast muscle cut was oven-dried and crushed into powder before used for analyses of the total crude protein and lipid profile (6) Meat crude protein content was measured by Kjeldahl's method (6). Meat total lipid was determined using the methanol: chloroform (2:1) extraction method of Folch as described by (7). After measuring the meat total lipid, 1ml of total solution was used to measure the total cholesterol content by the cholesterol oxidase assay (8) using commercially available reagent kits.

For sensory evaluation, samples of meat from breast part were taken for all the groups. A total of twenty-four (24) untrained panelist were assigned to evaluate the meat samples for colour, flavour, juiciness, tenderness and overall acceptability on a 10 point descriptive scale. The meat samples (200g) without salt were grilled for 15 minutes at $500^{o}$C in an electric oven, sliced into uniform sizes after cooling, and presented to the panel of judges and scorers. Each scorer was provided with water and pieces of bread to serve as

neutralizers between samples.

**Statistical analysis**

Data collected were subjected to analysis of variance (ANOVA) using computer software SPSS 17.0 (34). Differences among means were separated using Duncan's Multiple Range Test using (9).

**Table 2: Proximate Composition and metabolizable energy of experimental diets**

| Parameter | T1(control) | T2 (VALM) | T3 (MPM) |
|---|---|---|---|
| Dry matter | 91.51 | 94.51 | 93.40 |
| Crude protein | 16.00 | 18.05 | 19.45 |
| Crude fibre | 8.43 | 13.66 | 9.56 |
| Ether extract | 3.42 | 4.24 | 6.98 |
| Ash | 5.00 | 11.19 | 6.16 |
| Nitrogen free extract | 58.66 | 47.37 | 51.25 |
| ME (Kcal/kg) | 2951.74 | 2693.35 | 3105.10 |

**Results and Discussion**

The proximate and anti-nutritional compositions of the *Vernonia Amygdalina and Mucuna pruriens* are presented in Table 3. The results showed VALM recorded lower values of crude protein,20.11% compared to MPM (25.45%) and ether extracts (4.32%) compared to (6.98%) respectively. Same trend applied to metabolizable energy (2912.02 Kcal/kg) as against 3330.65Kcal/kg recorded for MPM. Nitrogen free extracts (51.12%) of VALM was comparable to 51.35% of MPM. The results of anti-nutritional factors indicated lower values trend (tannin,0.37; phytate, 2.03; flavonoid, 1.79; saponins, 1.05; alkaloids, 1.15; glycosides, 0.05) for VALM compared to MPM (tannin, 4.80; phytate, 3.08; flavonoid, 3.01; saponins, 2.80; alkaloids, 1.82; glycosides,1.05). This showed that antioxidants were higher in MPM than VALM. The values of crude protein, ether extracts, nitrogen free extracts and anti-nutritional factors obtained in this study for both VALM and MPM were within range reported by (35) and (36) respectively.

The performance of rabbits fed VLM and MPM is shown in table 4. The result revealed that there was significant ($P<0.05$) difference in live weight, weight gain and daily weight gain of rabbits. Rabbits fed diet 2 significantly ($P<0.05$) increased in feed intake than rabbits on diet 1 even though not different ($P>0.05$) from rabbits fed diet 3. The reason for the higher intake of diet 2 might not be unconnected with the higher dietary fibre as well as lower energy content of the VLM based diet (T2). De blas and Wiseman (10) observed that rabbits consume more feed if they are fed low energy diet with higher fibre and consume less if they are fed high energy diet. These results support the observations of (11) and (12) who reported higher feed intake from rabbits fed high dietary fibre diets (cassava peels and cassava leaves) respectively. Result of weight gain indicated highest ($P<0.05$) weight gain for rabbits on diet 3 followed by rabbits fed diet 2 while the lowest was obtained from rabbits on diet 1. The higher weight gain of rabbits fed diet 3 could be attributed not only to the increased dietary energy but also its dietary protein level. This corroborates (13) who reported that dietary protein contributes 15 to 20% of the total body weight of monogastrics. Although rabbit is by nature herbivorous, growth rates on forage-based diets containing high fibre levels such as diet 2 might be drastically reduced due to the animal's inability to obtain sufficient digestible material to satisfy its energy demands (14, 15). Values obtained for feed

conversion ratio also showed that diet 3 had the lowest value of 5.64 which implies that nutrient in diet 3 was better (P<0.05) utilized compared to the other diets due to the nature of the fibre in *Mucuna pruriens* which was highly digestible (37).

**Table 3: Proximate and Phytochemical Composition of MPM and VALM**

| Component | MPM | VALM |
|---|---|---|
| Dry matter% | 92.40 | 91.52 |
| Crude protein | 25.45 | 20.11 |
| Crude fibre | 10.06 | 16.25 |
| Ether extract | 6.98 | 4.32 |
| Ash | 6.16 | 8.20 |
| Nitrogen free extract | 51.35 | 51.12 |
| ME (Kcal/kg) | 3330.65 | 2912.02 |
| L-dopa (%) | 1.88 | ND |
| Tannin (g/100g) | 4.80 | 0.37 |
| Phytate (g/100g) | 3.08 | 2.03 |
| Flavonoid (g/100g) | 3.01 | 1.79 |
| Saponins (g/100g) | 2.80 | 1.05 |
| Alkaloids (g/100g) | 1.82 | 1.15 |
| Glycosides (g/100g) | 1.05 | 0.05 |

MPM= M*ucuna pruriens seed.*VALM= *Vernonia Amygdalina*.ND=not determined

**Table 4: Effect of dietary inclusion of VALM and MPM on growth performance of rabbits**

| Treatment | Initial weight | Final weight (g) | Total weight, (g) | Daily weight gain (g) | Daily feed intake (g) | Feed conversion ratio |
|---|---|---|---|---|---|---|
| T1 | 452.50 | 1332.00$^{c}$ | 879.00$^{c}$ | 10.55$^{c}$ | 70.65$^{c}$ | 6.69$^{a}$ |
| T2 | 446.50 | 1506.50$^{b}$ | 1060.00$^{b}$ | 12.62$^{b}$ | 87.18$^{a}$ | 7.00$^{a}$ |
| T3 | 453.00 | 1700.00$^{a}$ | 1247.00$^{a}$ | 14.84$^{a}$ | 83.78$^{ab}$ | 5.64$^{b}$ |
| SEM | 10.54 | 26.46 | 11.49 | 0.40 | 3.83 | 0.25 |

$^{a,b,c}$Means in the same column bearing different superscripts differ significantly (p<0.05); NS = Not significant

**Table 5: Effect of VALM and MPM on carcass characteristics of rabbits**

| Trt | Preslaughter weight (g) | Dressed weight(g) | Dressing % | Liver (%l.w) | Heart (%l.w) | Lungs (%l.w) | Kidney (%l.w) | Foreleg (g) | Thoracic cage (g) | Loin (g) | Hindleg (g) | Breast muscle |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T1 | 1322.00$^{c}$ | 720.00$^{c}$ | 54.46 $^{b}$ | 2.81 | 0.32 | 0.62 | 1.01 | 137.00$^{c}$ | 120.00$^{c}$ | 227.00$^{c}$ | 250.00$^{c}$ | 4.78$^{b}$ |
| T2 | 1501.00$^{b}$ | 810.00$^{b}$ | 53.96 $^{b}$ | 3.22 | 0.36 | 0.70 | 0.81 | 164.00$^{b}$ | 142.00$^{b}$ | 258.90$^{b}$ | 275.00$^{b}$ | 5.50$^{a}$ |
| T3 | 1698.00$^{a}$ | 940.00$^{a}$ | 55.36 $^{a}$ | 2.91 | 0.27 | 0.63 | 0.72 | 177.00$^{a}$ | 144.00$^{a}$ | 267.00$^{a}$ | 287.00$^{a}$ | 5.52$^{a}$ |
| SEM | 12.55 | 19.45 | 1.31 | 0.88 | 0.34 | 0.07 | 0.08 | 8.54 | 7.05 | 10.01 | 8.02 | 0.57 |

$^{a,b,c}$ Means in the same column bearing different superscripts differ significantly (P<0.05); NS = Not significant Trt = treatment.

From the result shown in Table 5, it is observed that rabbits fed diet T3 had a significantly higher (P<0.05) pre-slaughter weight, dressed weight, fore legs, thoracic cage, loin and hind legs compared to rabbits fed VALM (T2) and the control (T1). The increased dressed weight and live weight gain observed for rabbits fed diet 3 followed by diet 2 is a reflection of the improved weight gain earlier observed which was attributable to the increased dietary protein and energy content of diet 3. This supports the findings of (16) who reported that increase in slaughter yield of rabbit is an indication of synergistic interactive

effect of protein and energy levels Dressing percentage of T3 showed significant (P<0.05) increase than T2 and T1 which were statistically similar (P>0.05). Values obtained for the internal organs (heart, lungs, liver and kidneys) showed no significant difference (P>0.05) among the treatment groups. This implies that the test diets contained no toxic element which could have reflected in abnormal weights of these organs particularly kidney and liver (17). Values obtained for meat protein, abdominal fat, muscle to bone ratio were significantly (P<0.05) affected by dietary treatments presented in table 6 indicate significant (P<0.05) increase in meat protein, muscle percentage, muscle to bone ratio for rabbits fed diet 3 followed by rabbits on diet 2. Bone percentage generally indicated no difference (P>0.05) among the treatment groups. Similarly, muscle percentage as well as muscle to bone ratio also showed no significant (P>0.05) difference between T2 and T1 although values obtained from rabbits in T2 were slightly higher. Values obtained for abdominal fat in T2 and T3 showed significant (P<0.05) reduction. The drastic reduction in fat value as well as the significant increase in protein and muscle suggest that VLM and MPM promote muscularity by channeling nutrients away from fat to muscle formation. This also suggests strong fat-reducing property of VLM and MPM. Probably the high fibre content of diets 2 and 3 might have also contributed to the decline in values of abdominal fat even as (18) observed decreased in fat content of beef and chevon as the level of fiber from wheat and oat bran increased . Report by (19) showed that feeding rabbits with high fibre diets could result in carcasses with less fat. It is also possible that the antioxidants and phenolic compounds present in VLM and MPM must have contributed to the fat reduction observed (20, 21). Even though the value of meat protein obtained in this study fell within the range (20-25%) reported by (22) for normal rabbits, the high dietary protein contents of these test diets may have contributed to the increased meat protein even as (23) reported that protein content in meat increased as fat content reduces and vice versa

T**able 6: Effect of VALM and MPM on abdominal fat, meat protein, muscle to bone ratio of rabbits**

| Treatment | Protein(g) | Abdominal fat (%) | Muscle (%) | Bone (%) | Muscle/bone ratio |
|---|---|---|---|---|---|
| T1 | 21.07$^{c}$ | 10.96$^{a}$ | 66.06$^{bc}$ | 22.98 | 2.87$^{b}$ |
| T2 | 22.82$^{b}$ | 5.93$^{b}$ | 68.00$^{b}$ | 23.06 | 2.95 $^{b}$ |
| T3 | 23.97$^{a}$ | 6.00$^{b}$ | 73.68$^{a}$ | 23.30 | 3.16$^{a}$ |
| SEM | 0.30 | 0.15 | 1.94 | 1.26 | 0.17 |

$^{a,b,c}$ Means in the same column bearing different superscripts differ significantly (P<0.05)

Meat Lipid Profile (total cholesterol (TL), triglyceride TG), high density lipoprotein (HDL), low density lipoprotein (LDL) and very low density lipoprotein (VLDL) results are presented in Table 7. Values obtained showed significant (P<0.05) reduction in values of TC, TG, LDL and VLDL for animals on diets $T_2$ and $T_3$ although the values were within the normal range reported by (24), (25) and (26). The consistent decline in values of the lipid metabolites from rabbits fed diets $T_2$ and $T_3$ indicate that the antioxidants, flavonoids, tannins and saponins abundant in Vernonia amygdalina and Mucuna pruriensa as presented in table 3 are hypocholesterolemic (27,3). This corroborates (28) and (27) who reported that flavonoids, tannins and saponins provide hypolipidaemic effect observed in rats. (29) had earlier asserted that saponins and flavonoid, antioxidants in both VALM and MPM significantly decrease total cholesterol,

LDL, triglyceride and increase HDL cholesterol in hypercholesterolemic rats.

The significant increase in HDL values obtained in $T_2$ and $T_3$ relative to the T1(control) also corroborate (30) who reported that isoflavones increased HDL in rabbits as well as caused the removal of cholesterol from peripheral tissue to the liver for catabolism and excretion. HDL (good cholesterol) is commonly boosted by polyunsaturated fatty such as linoleic and linolenic which are high in VALM and MPM (31). Relative to the control diet is the increased dietary fibre of VALM and MPM which also implies that the rabbits increasing intake of fibre from these test diets might have resulted in drastic reduction of fat and cholesterol levels. This agrees with the findings of (32) that reported a decrease in the cholesterol and fat content of uncooked and cooked chicken with the increase in levels of fibre from wheat and oat bran.

**Table 7: Effect of VALM and MPM on meat lipids profile of rabbits**

| Treatment | Total cholesterol (mg/100g) | Triglyceride (mg/100g) | High density lipoprotein (mg/100g) | Low density lipoprotein (mg/100g) | Very low density lipoprotein (mg/100g) |
|---|---|---|---|---|---|
| T1 | 57.72$^{a}$ | 103.24$^{a}$ | 11.31$^{c}$ | 37.44$^{a}$ | 9.36$^{a}$ |
| T2 | 54.21$^{b}$ | 98.79$^{b}$ | 14.82$^{b}$ | 29.64$^{b}$ | 8.97$^{b}$ |
| T3 | 51.87$^{c}$ | 92.56$^{c}$ | 17.55$^{a}$ | 25.74$^{c}$ | 7.80$^{c}$ |
| SEM | 0.01 | 0.01 | 0.02 | 0.02 | 0.10 |

$^{a,b,c}$ Means in the same column bearing different superscripts differ significantly (P<0.05)

**Table 8: Effect of VALM and MPM on Sensory characteristics of rabbit meat**

| Treatment | Colour | Flavour | Juiciness | Tenderness | Overall acceptability |
|---|---|---|---|---|---|
| $T_1$ | 7.30 | 6.90 | 7.00 | 6.00$^{a}$ | 7.3 |
| $T_2$ | 6.90 | 6.70 | 7.10 | 5.20$^{c}$ | 7.4 |
| $T_3$ | 7.10 | 7.40 | 7.13 | 5.80$^{b}$ | 7.8 |
| SEM | 0.27 | 0.80 | 0.14 | 0.02 | 0.08 |

$^{a,b,c}$ Means in the same column bearing different superscripts differ significantly (P<0.05)

The sensory evaluation of the rabbit meat as presented in Table 8 indicate significant difference (P<0.05) among groups in respect of tenderness. The lowest score was obtained in T2 followed by T3 while the highest was obtained in T1, the control. The lower scores might be attributed to the reduced fat content of meat from rabbits fed diets 2 and 3(table 6) as well as their increased fibre level. A reduction in tenderness value of chevon and beef due to higher levels of fibre from wheat and oat bran was earlier reported by (33). However, the non-significant difference (P>0.05) in terms of colour, flavour, juiciness and overall acceptability among treatment groups indicate that the test diets had no negative effects on those sensory characteristics of rabbit meat.

**Conclusion and Applications**

1. This study revealed that inclusion of VALM and MPM in rabbit diets significantly improved performance of weaned rabbits as well as carcass characteristics, meat lipid profile and sensory quality of rabbit meat.
2. It is therefore recommended that more research should be carried out with higher percentages of the test materials.

**Conflict of interest:** The authors declare no conflict of interests

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