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# Nutrient Utilization and Blood Profile of Broilers Fed with Unpeeled Yellow Cassava Root Meal (UMUCASS-46 or TMS01/0539)

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**ABSTRACT**

*An eight-week old experiment was conducted to investigate the nutrient utilization, haematological and serum biochemistry of broilers fed with unpeeled yellow cassava root meal (UYCRM). The unpeeled yellow cassava root was harvested, washed, ground and toasted. This was incorporated in graded levels of 0% (control), 25%, 50% and 75% into the diets designated $T_1$, $T_2$, $T_3$ and $T_4$ respectively. One hundred and twenty Anak, day old broiler chicks were randomly allotted to the four dietary treatments in a Completely Randomized Design (CRD). Each treatment consisted of 30 birds, replicated three times with 10 birds per replicate. Nutrient digestibility of the birds revealed a significant ($P<0.05$) variation in all parameters with the exception of dry matter and ash. Digestibility values for crude protein (9.083%), ether extract (0.047%), crude fibre (8.163%) and metabolisable energy (1938.747kcal/kg) were observed to highest in birds fed 75% UYCRM. Haematology and serum biochemistry values, although higher in the control, were in conformity with standards for healthy broiler birds. Up to 75% of UYCRM can be incorporated into broiler diet without negative effect on the digestibility, haematology and serum chemistry. Diet T4 was then recommended.*

***Keywords***: *Digestibility, haematology, serum profile, umucass-46, broiler chickens*

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## INTRODUCTION

In poultry production, feed ingredients represent about 65 to 70% of the total cost of production in Nigeria as in many developing countries (Mallick, 2023). Energy source constitutes between 40 and 60% of finished feed and at present, maize is the commonly used source of energy in poultry feed (Stefanello *et al.,* 2022). Maize for example is a major feedstuff and it is in high demand for consumption for both human and livestock.

The competition and inadequate supply have invariably led to their constant increasing market price. The high cost of maize is a major contribution to the increasing cost of poultry production. This has made many poultry keepers to reduce their flock or completely shift to other business with lesser financial involvement Nnodim and Jaiyeola (2023). The current trend in poultry industry is on alternative feedstuff; mainly those that can either directly replace maize or can be incorporated at certain levels in the diet to achieve a considerable worth (Adedokun *et al*., 2018). One of such alternative feedstuff is unpeeled yellow cassava root meal.

Cassava (*Manihot esculenta*) is a major carbohydrate rich stable cultivated in the tropics. Otekunrin (2024) reported Nigeria as the leading producer, producing about 63 million tonnes which makes 31% of Africa's production and 20% of Global production. There are many pioneering studies Saroeun (2010) which highlighted on the suitability of cassava root meal for broiler feeding and its potential as a good substitute for maize. Otekunrin (2024) had advocated that the future market for increased production of this important crop lies with its use as livestock feed. Cassava products and by products are locally valuable and have low cost for farmers to use as feed for animals (Saroeun, 2010).

In order to achieve maximum utilization of this feed resource by farm animals, the effect of feeding these tropical plants to farm animals should be assessed as it has been reported that dietary components have measurable effect on blood constituents which is an indicator to the health status of the animal Astuti *et al*. (2022). That way, an insight into its suitability for use in diets of livestock, especially of monogastric animals at low cost can be gained. Efforts therefore are made in this study to assess the effect of unpeeled yellow whole cassava root meal on nutrient digestibility, haematological and serum biochemistry on broiler chicken.

## MATERIALS AND METHODS

### Experimental site

This research was conducted at the Poultry Unit of the Teaching and Research Farm of the College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike, Abia State. The area is located in the South-Easthern part of Nigeria on latitude $05^0 29^{'}$ N and longitude $07^0 33^{'}$ E, an altitude of 123m above sea level with an annual rainfall of 2177mm, temperature of $22^0$C – $36^0$C and relative humidity of 50 – 90%. It is situated within the humid rain forest zone of West Africa, characterized by long duration of rainy season (March-October) and short period of dry season (November - February). Climatic data were collected from the Meteorological Center of National Root Crop Research Institute, Umudike, Abia State (NRCRI, 2022).

### Experimental animal and management

One hundred and twenty (120) day old broiler chicks of Anak strain were used for the study. They were procured from a recognized hatchery. Prior to the arrival of the birds, the brooder house was washed, disinfected, dried and the floor of the brooder house covered with wood shaving as litter materials evenly spread on the floor. The feeders and drinkers were washed and dried properly. Kerosene stove, electric bulbs and lantern were provided as heat sources during brooding. On arrival, the birds were given glucose and multivitamin as anti-stress preparations to recover from the stress of transportation. They were brooded for two weeks before randomly allocating them to treatment pens. They were managed in deep litter pens throughout the experimental period and were fed test diet and water *ad libitum.* Routine management practices were also carried out appropriately. The study lasted for 8 weeks.

### Preparation of unpeeled yellow cassava root meal (UYCRM)

The unpeeled yellow cassava root meal was harvested manually at the National Root Crops Research Institution (NRCRI) cassava farm. The washed roots were ground, drained and toasted. The toasted root meal was packaged into polythene bags, ready for use. Four diets were compounded for this study; diet 1 which was the control had 0% of unpeeled yellow cassava root meal (UYCRM) while diets 2, 3 and 4 had UYCRM incorporated in graded levels of 25%, 50% and 75%. Other ingredients were added to make a complete feed as shown in (Table 1).

**Table 1:** Percentage Composition of Experimental Diets containing Graded Levels of Processed Unpeeled Yellow Cassava Root Meal (UMUCASS-46 or TMS01/0539) fed to Broiler Chickens.

| | Diets | | | |
|---|---|---|---|---|
| **Ingredients (%)** | **$T_1$ (0%)** | **$T_2$ (25%)** | **$T_3$ (50%)** | **$T_4$ (75%)** |
| Maize | 42.00 | 31.50 | 21.00 | 10.50 |
| UYCRM | 0 | 10.50 | 21.00 | 31.50 |
| Soy bean meal | 34.00 | 34.00 | 34.00 | 34.00 |
| Maize offal | 11.80 | 11.80 | 11.80 | 11.80 |
| Palm kernel cake | 6.00 | 6.00 | 6.00 | 6.00 |
| Palm oil | 0.50 | 0.50 | 0.50 | 0.50 |
| Fish meal | 2.00 | 2.00 | 2.00 | 2.00 |
| Bone meal | 3.00 | 3.00 | 3.00 | 3.00 |
| Salt | 0.25 | 0.25 | 0.25 | 0.25 |
| *Premix | 0.25 | 0.25 | 0.25 | 0.25 |
| Lysine | 0.10 | 0.10 | 0.10 | 0.10 |
| Methionine | 0.10 | 0.10 | 0.10 | 0.10 |
| Total | 100 | 100 | 100 | 100 |
| Calculated Composition | | | | |
| Metabolizable energy (Kcal/g) | 2883.90 | 2859.33 | 2834.76 | 2810.19 |
| Crude protein | 22.22 | 21.54 | 20.85 | 20.17 |
| Energy: Protein | 130:1 | 133:1 | 136:1 | 139:1 |

UYCRM: Unpeeled Yellow Cassava Root Meal **To provide the following per Kg. of feed: Vitamin A 10,000iu; Vitamin D3, 2000iu; Vitamin B1 0.75mg; Nicotinic acid, 2.5mg; vitamin E, 2.5mg; cobalt, 0.40mg; Biotin, 0.50mg; Folic acid, 1.00mg; Cholin chloride, 2.5mg; Copper, 8.00mg; Manganes, 64mg; Iron, 32mg; Zinc, 40mg; Iodine, 0.8mg; Flavomycin, 100mg; Spiromycin, 5mg; DL – methionine, 56mg; L.Lysine, 120mg and Selenium, 0.16mg.*

**Data collection**

**Determination of nutrient digestibility**

Digestibility trial was conducted at the end of the seventh week. Two birds per replicate were transferred to metabolic cages and allowed three days adjustment period. Faecal droppings were collected and weighed, oven dried and re-weighed for four days. The faecal collection per replicate was bulked, milled and analyzed for proximate constituents using standard methods of Association of Official Analytical Chemist (AOAC, 2000). Nutrients digestibility was calculated as follows:

$$ND = \frac{(\text{Nutrient in feed X FI}) - \text{Nutrient in faeces X FO X 100\%}}{\text{Nutrient in feed X FI}}$$

Where: ND = Nutrient Digestibility; FI = Feed intake; FO = Faecal output

**Haematological analysis**

At the end of the feeding trial, six (6ml) of blood was collected from the jugular vein of the birds using hypodermic needles and sterile syringes. Then 3ml was immediately transferred to sample bottles containing Ethylene diamine tetra – acetic acid (EDTA), an anti-coagulant to prevent blood clotting and used for hematological analyses. The remaining 3ml was immediately transferred to EDTA-free sample bottles and used for biochemical analyses. The blood samples collected were analyzed within 2 hours of collection for packed cell volume (PCV) using microhaematocrit method and haemoglobin using the Sahli method. Haemoglobin (Hb), White blood cell counts (WBC) and Red blood cell counts (RBC) were determined using improved Neubauer Haemocytometer method as described by Feldman (2000). The various Red cell indices; Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration were calculated from RBC, Hb and (PCV) as described by Feldman (2000).

The MCV, MCHC and MCH were calculated thus:

$$\text{Mean Corpuscular Haemoglobin (MCH)} = \frac{\text{Hb x 10}}{\text{RBC}}$$

$$\text{Mean Corpuscular Volume (MCV)} = \frac{\text{PCV x 10}}{\text{RBC}}$$

$$\text{Mean Corpuscular. Haemoglobin Conc. (MCHC)} = \frac{\text{Hb x 100}}{\text{PCV}}$$

**Serum biochemistry**

The bottles of the coagulated blood were subjected to standard methods of serum separation and the harvested sera were used for evaluation of total protein as described by Coles (1986). The standard flame photometry was used to determine the albumin, globulin, glucose, urea and creatinine and cholesterol.

**Experimental design and model**

The experimental design was a Completely Randomized Design (CRD) of 4 dietary treatments and replicated three times with 10 birds per replicate making 30 birds per treatment. The treatments were designated: $T_1$, $T_2$, $T_3$ and $T_4$. $T_1$ served as the control.

The experimental model is as follows: $Y_{ij} = U + T_i + e_{ij}$

Where;

$Y_{ij}$ = individual observation on the broiler characteristics.
$\mu$= overall mean
$T_i$ = treatment effect
$e_{ij}$ = random error assumed to be independently, identically and normally distributed with zero means and constant variances (i i n d (0, $\sigma^2$).

**Statistical analysis**

All data obtained were subjected to Analysis of Variance (ANOVA) Steel and Torrie (1980). Significant difference between treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955).

**RESULTS**

**Effect of unpeeled yellow cassava root meal on the digestibility of broiler chickens**

The nutrient digestibility coefficients of birds placed on unpeeled yellow cassava root meal were as shown in (Table 2). There were significant differences ($P<0.05$) among the treatment groups for crude protein (CP), ether extract (EE), crude fibre (CF), Nitrogen Free Extract (NFE) and metabolizable energy (ME). The results from the study showed that dry matter (DM) and ash were not influence by the dietary treatments. The CP digestibility increased with increase in the level of inclusion of UYCRM. Birds on treatment T4 (9.08%) had the highest digestibility percentage which was significantly ($P<0.05$) different from the digestibility of birds on T3 (8.76%), T2 (8.80%) and T1 (8.58%) though CP digestibility of birds on T3 and T2 were similar. The EE digestibility of broiler chickens fed diet T2 (0.96%) and T4 (0.94%) were statistically similar to each other but significantly ($P<0.05$)

**Table 2:** Digestibility of Broiler Chickens fed Unpeeled Yellow Cassava Root Meal.

| Parameters (%) | T1 (0%) | T2 (25%) | T3 (50%) | T4 (75%) | SEM |
|---|---|---|---|---|---|
| DM | 79.297 | 79.290 | 79.317 | 79.407 | 0.750 |
| CP | 8.583$^{c}$ | 8.803$^{b}$ | 8.767$^{b}$ | 9.083$^{a}$ | 0.056 |
| EE | 0.800$^{c}$ | 0.940$^{a}$ | 0.900$^{b}$ | 0.947$^{a}$ | 0.018 |
| CF | 8.020$^{b}$ | 8.067$^{b}$ | 8.063$^{b}$ | 8.163$^{a}$ | 0.018 |
| Ash | 18.943 | 19.123 | 18.383 | 18.617 | 0.601 |
| NFE | 43.867$^{a}$ | 43.283$^{b}$ | 43.280$^{b}$ | 42.757$^{c}$ | 0.120 |
| ME(kcal/g) | 1937.950$^{a}$ | 1939.000$^{a}$ | 1934.010$^{b}$ | 1938.747$^{a}$ | 0.694 |

DM: dry matter (%); CP: crude protein (%); CF: crude fiber (%); EE: ether extract (%); NFE: nitrogen free extract; ME: metabolizable energy; SEM: standard error of means

**Table 3:** Haematological Parameters of Broiler Chickens fed Unpeeled Yellow Cassava Root Meal.

| Parameters | T1 (0%) | T2 (25%) | T3 (50%) | T4 (75%) | SEM |
|---|---|---|---|---|---|
| PCV (%) | 29.333$^{a}$ | 27.333$^{b}$ | 26.000$^{c}$ | 25.667$^{c}$ | 0.452 |
| Hb (g/dl) | 12.033$^{a}$ | 10.500$^{b}$ | 9.767$^{c}$ | 9.700$^{c}$ | 0.288 |
| RBC (x10$^{6}$/mm$^{3}$) | 3.140$^{a}$ | 2.937$^{b}$ | 2.923$^{b}$ | 2.883$^{b}$ | 0.031 |
| WBC (x10$^{3}$/mm$^{3}$) | 20.650$^{a}$ | 19.517$^{b}$ | 19.433$^{b}$ | 19.150$^{b}$ | 0.181 |
| MCV (fl) | 93.423$^{a}$ | 93.080$^{a}$ | 88.950$^{b}$ | 89.013$^{b}$ | 0.746 |
| MCH (pg) | 38.323$^{a}$ | 35.750$^{b}$ | 33.410$^{c}$ | 33.643$^{c}$ | 0.613 |
| MCHC (g1/dl) | 41.017$^{a}$ | 38.417$^{b}$ | 37.563$^{b}$ | 37.800$^{b}$ | 0.433 |

$^{a\text{-}b\text{-}c}$:Means along the same row with different superscripts are significantly ($p<0.05$) different. SEM= Standard Error of Mean. Hb=Haemoglobin, RBC=Red Blood Cell, WBC= White Blood Cell, PCV=Packed Cell Volume, MCV=Mean Corpuscular Volume, MCH= Mean Corpuscular Haemoglobin, MCHC= Mean Corpuscular Haemoglobin Concentration.

different from T1 (0.80%) and T3 (0.90%). The CF of birds fed diet T4 (0.94%) was significantly (P<0.05) different from the other treatments which were similar to one another. The NFE digestibility of the birds fed the control diet (43.83%) were significantly higher (P<0.05) than T2, T3 and T4 (42.28%). The ME of birds fed diets T1, T2 and T3 were statistically similar but different (P<0.05) from T3.

**Effect of unpeeled yellow cassava root meal on haematological profile of broiler chickens**

The haematological parameters of broiler chickens fed unpeeled yellow cassava root meal were presented in (Table 3). The results obtained in this study showed significant differences (P<0.05) in all the haematological indices studied. Different levels of unpeeled yellow cassava root meal in the diets affected the haematological profile of broiler chickens. As the level of UYCRM increased the values of the haematological parameters decreased. Birds fed the control diet had significantly (P<0.05) higher PCV (29.33%) while birds fed diets T3 and T4 recorded the least values. This pattern was observed throughout all the parameters considered. Birds on diet T1 (control) had the highest haemoglobin (Hb) value (12.03g/dl), while birds on diets T4 and T3 had the least values of 9.70 and 9.76 g/dl, respectively. There were also significant (P<0.05) differences in the RBC values of the broiler chickens fed the treatment diets. The birds fed the control diet T1 (3.14 x10$^{6}$/mm) was significant (P<0.05) different from those on T2 (2.93 x10$^{6}$/mm), T3 (2.92 x10$^{6}$/mm) and T4 (2.88 x10$^{6}$/mm) which were similar. The WBC values also followed the same trend as RBC with the birds fed the control diet having the highest WBC value of 20.65 x10$^{3}$/mm. The MCV values of birds on T1 (93.42 and T2 (93.08) were significantly (P<0.05) different from those of T3 (88.95) and T4 (89.01) but similar to each other. The values of MCH obtained from this study ranged from 38.32pg in birds on diet T1 – 33.41pg in birds on T3. For MCHC, the values ranged from 37.57g/dl in birds on T3 – 41.01g/dl in the control (T1). Birds fed diet 1 recorded significantly (P<0.05) different values when compared with the other treatment groups. Although the values obtained in this study where within the normal range for healthy birds, the birds fed the control diet (T1) had the best values for all the haematological parameters evaluated.

**Effect of unpeeled yellow cassava root meal on serum chemistry of broiler chickens**

The serum biochemical profile of broiler chickens fed unpeeled yellow cassava root meal were as presented in (Table 4). Significant differences (P<0.05) were observed in all indices studied. All the birds fed the test diets showed relatively lower levels of total protein when compared with the control. The control had significantly higher value of total protein (3.78g/dl). Total protein and albumin concentration which followed the same trend of decreasing with increase in the inclusion level of unpeeled yellow cassava root meal. Albumin concentration fell within the range of 1.30-2.80g/dl with birds on diet T1 having the highest value of 1.98g/dl

**Table 4:** Serum Profile of Broiler Chickens fed Unpeeled Yellow Cassava Root Meal.

| Parameters | T1 (0%) | T2 (25%) | T3 (50%) | T4 (75%) | SEM |
|---|---|---|---|---|---|
| TP (g/dl) | 3.783[a] | 3.580[b] | 3.553[b] | 3.500[b] | 0.034 |
| ALB (g/dl) | 1.987[a] | 1.887[ab] | 1.817[b] | 1.770[b] | 0.030 |
| GLO (g/dl) | 1.797[a] | 1.693[b] | 1.737[ab] | 1.730[ab] | 0.015 |
| GLU (mg/dl) | 172.000[b] | 185.000[a] | 191.667[a] | 193.000[a] | 2.776 |
| Cholesterol (mg/dl) | 126.777[a] | 125.207[ab] | 125.473[ab] | 122.817[b] | 0.612 |
| Creatinine (mg/dl) | 0.897[c] | 0.923[bc] | 0.957[ab] | 0.987[a] | 0.012 |
| Urea (mg/dl | 18.777[c] | 19.773[b] | 20.150[ab] | 20.580[a] | 0.225 |

[a-b-c]: Means along the same row with different superscripts are significantly (P<0.05) different. SEM= Standard Error of Mean. TP=Total protein; ALB=Albumin; GLO=Globulin; GLU=Glucose

which was significantly higher than birds on T3 and T4 but not significantly different (P>0.05) from those on diet T2. Birds on T4 had the least value of 1.77g/dl for albumin. The serum globulin concentration for the control birds (1.797g/dl) was significantly (P<0.05) different from T2 (1.69g/dl), but similar to T3 (1.73g/dl) and T4 (1.73g/dl).

The glucose values obtained in this study ranged from 172.00 – 193.00mg/dl. The glucose levels of birds fed diets T2, T3 and T4 were not significantly (P>0.05) different between each other but higher (P<0.05) than that of birds on diet T1. The glucose level of birds fed diet 4 had the higher value (P<0.05) than others, as it recorded the highest value of 193.00mg/dl. However, birds fed diet 1 had the least glucose level of 172.00mg/dl. It is observed that increasing the level of the test material increases the glucose levels. Therefore, unpeeled yellow cassava root meal may be said to increase the blood glucose level in broiler chickens. The cholesterol value was significantly (P<0.05) different in the control birds (126.77mg/dl) but similar to that on T2 (125.20 mg/dl) and T3 (125.47 mg/dl).

Creatinine concentration for birds fed diets T3 and T4 were statistically similar. However, birds on diet T3 was significantly (P>0.5) different from those on T2. Birds fed diet T4 had the highest creatinine concentration (20.58mg/dl) while the lowest concentration was seen in the control. The urea concentration of birds fed diet T4 was significantly different (P<0.05) than birds fed diets T1 and T2 but similar to birds fed diet T3. The highest urea value (20.58mg/dl) was recorded in birds fed diet T4.

## DISCUSSION

This findings were similar to the reports of Emami (2013) who reported that broilers fed the control diet had the lowest ether extract digestibility and were improved by the addition of organic acid to the control diet. The improved digestibility of CP, EE and CF of birds fed unpeeled yellow cassava root meal (UYCRM) could be attributed to the degrading the feed anti-nutritional compounds when toasting which subsequently released trapped nutrients, thereby making more nutrients available for utilization by the birds. The PCV of normal birds are within the reference range of 25-45.00% (Mitruka and Rawnsley, 1977) which was in line with the values obtained in this study. The evaluation of the PCV is essential as it involved in conjunction with the haemoglobin and red cell count in the transport of oxygen and absorbed nutrients (Isaac *et al.,* 2013) The Hb values obtained in this study were within the normal range of 7.0-13.0g/dl as reported by (Mitruka and Rawnsley, 1977). The standard range of RBC for normal birds is 2.0-4.00 $x10^6$/mm (Mitruka and Rawnsley, 1977) which was consistent with the findings of this study. The values obtained in this study were within the normal range of 9-31 $x10^3$/mm as reported by (Mitruka and Rawnsley, 1977). The test diet had no negative effects on the haematological parameters as they were within the normal range.

Banerjee, (2007) reported 90-140 as the normal range of MCV for healthy birds. MCV of broiler chickens on diets T3 and T4 were lower than the values reported by Banerjee, (2007). Low MCV may indicate iron deficiency, chronic disease, haemoglobin disorder such as anaemia due to blood cell destruction or bone marrow disorders (Omoikhoje *et al.,* 2021). However, the values for MCH obtained fell within the range of 32.00-43.90pg reported by Harrison and Lightfoot (2013) and 33.00- 47.80pg as normal range for broiler chickens. Although birds fed diet 1 had the highest concentration of total protein, all the treatment values were within the reference range of 3.25-7.61g/dl as reported by Aiello and Mays (1998) and 3.30-5.50g/dl for healthy chickens. Son *et al.* (2024) reported that increased level of serum total protein and albumin is positively related to high quality of the dietary components, protein synthesis and health of many tissues of birds. Globulins, especially gamma globulins are antibodies that fight against infection (Wlazlak *et al.,* 2023). The globulin level in normal birds as reported by Aiello and Mays (1998) ranged from 1.50-4.10g/dl which was within the range obtained in this work.

The creatinine concentration was in consonance with the report of Adedokun *et al*. (2017). Creatinine values for birds fed diets T2, T3 and T4 were within the normal range of 0.90 - 1.80mg/dl for healthy chickens except for

T1 which was slightly lower. Adedokun *et al*. (2017) reported that high serum creatinine value suggested the extent of muscular wastage showing that the animal was surviving at the expense of body reserve and could result to weight loss.

However, the concentration of serum urea for all the treatment means was above the normal range of 2.50-8.10mg/dl when compared with the report of (Aiello and Mays, 1998). Since the increased urea level was observed in all the treatment groups, it shows that this effect cannot be attributed to the test feedstuff (Kalita *et al*., 2018) stated that age and presence of anti-nutritional factors in diets may influences urea level in birds and might act as contributors for increased serum urea level observed in all the treatments.

The results of the serum biochemical profile showed no divergence from the normal physiological process in the broiler chickens fed the test ingredients as they all fall within the acceptable range. However, birds fed diet T1 seemed the best in the biochemical profile among the treatments as it showed good glucose metabolism (with a moderately low glucose level), low urea level, and good total protein, albumin and globulin metabolism.

## Conclusion and recommendations

The results of this study showed that birds fed UYCRM diets utilized the nutrients better than those on the control diets in all the parameters investigated with the exception NFE and ME. The findings also showed that 75% inclusion level of UYCRM can be incorporated in broiler finisher diets without any adverse effect on the digestibility of broiler chickens. Although birds on T1 had the best haematological and serum properties, the inclusion levels of the test ingredient used in this study had no adverse effect on the chickens as reflected in the haematological and serum biochemical indices. The use of unpeeled yellow cassava root meal 75% should be encouraged in order to improve the digestibility and blood profile of broiler chickens.

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