Nigerian J. Anim. Sci. 2017 (2):123 - 131

Growth Performance, Haematological and Serum Biochemical indices of Broiler Chicken fed Cassava (*Manihot esculentum crantz* var. *UMUCASS 36*) Composite Meal

Adedokun, O.O., Eburuaja, S. A., *Onunkwo, D. N.
College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike, Abia State.

***Corresponding author**: donunkwo1@gmail.com

Target Audience: Animal Nutritionist, farmers, scientist

Abstract

An experiment was conducted to examine the growth performance, haematological indices and serum biochemistry of broiler chicken fed cassava (Manihot esculentum crantz var. UMUCASS 36) composite meal. One hundred and fifty Arbor Acre broiler chickens were randomly assigned to five treatment diets replicated into three of ten birds per replicate in a completely randomized design. The cassava root was washed, peeled and chopped into small pieces. This was oven dried and milled to form cassava root meal. The harvested leaf, petiole and tender stem was chopped, oven dried and milled as cassava foliage meal while the cassava composite meal was a mixture of the root meal and foliage meal at the ratio of 10:1. This was used to formulate straight diets designated A, B, C, D and E at levels of inclusion of 0, 5, 10, 15 and 20% respectively. The final weight and total weight gain were significantly (P<0.05) different across the diets but followed the same pattern with broilers on diet B having superior weights (1865.33g and 1740.67g) while others decreased as level of inclusion increased. Broilers on diet B had the least feed conversion ratio (1.89) followed by broilers on diet A (2.15) while others were comparable, The haematological indices fell within the normal range, except mean corpuscular haemoglobin. The serum biochemistry differed significantly (P<0.05) in all the measured parameters. Total protein (4.03g/l) and globulin (2.63g/dl) were highest in broilers on diet B and least values of urea (16.00 mg/dl) and alkaline phosphatase (64.75µ/l). In conclusion diet B was best considering the growth performance, haematology and serum biochemistry of the broiler chickens fed cassava composite meal.

Keywords: haematology, serum, digestibility, cassava composite

Description of Problem

Chicken production helps in reducing the problems caused by food insecurity, poverty and un-ecological management of natural resources. The total poultry population in Nigeria has been estimated at between 133 – 165 million (1). Poultry, which is next only to ruminants as a source of animal protein in Nigeria, accounts for almost 25% of local meat production (1).

Due to the high cost of maize and soybeans used as conventional feedstuffs for broilers which is becoming inaccessible to poultry farmers, cassava can be said to be an alternative feed material that is readily available, cheap and less competitive with man (2). Cassava is widely grown in Nigeria and can serve as an alternative feed stuff especially as energy and protein sources (2). Nigeria is the largest cassava producing nation in the world and produces up to 50 million tons yearly (3,4). UMUCASS 36 is a new variety of cassava that was bred and introduced in 2011. The price is very low compared to price of maize and soya beans hence it is affordable. UMUCASS 36 is a pro-vitamin cassava with high β carotene content which makes it more preferable to other existing varieties of cassava.

The use of blood examination to assess physiological, pathological and nutritional and health status animals have been well documented. The routine collection and processing of blood sample allow the evaluation of serum biochemical and haematological response to nutrition and disease (5). Blood examination can be used to detect nutritional disorder since it provides information on animal health, nutritional deficiency and changes in growth with time.

The potential of UMUCASS 36 is yet to be fully explored for animal feed stuff. There is therefore the need to examine the effect of this cassava composite meal on the growth performance, haematology and serum biochemisrty of broiler chicken which will be the aim of this study.

Materials and Methods

Experimental site

The research was conducted at the Poultry unit of the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State between April and May 2016. Umudike lies on latitude $05^{0}29^{'}$ N and longitude $07^{0}33^{'}$ E with an elevation of 122m above sea level and is located in the tropical rainforest zone of Nigeria. This zone is characterized by annual rainfall of about 2177 mm, monthly ambient temperature range of 22°C - 36°C and relative humidity of 50-95 % depending on the season and location. (6)

Procurement and processing of experimental material

Cassava roots meal

The pro-vitamin variety of cassava roots (UMUCASS 36) was harvested manually at the National Root Crops Research Institutes (NRCRI) cassava farm. These was washed and peeled. The roots were then cut into small chips and oven dried at 70^{0} C for two days before milling. The milled flour was packed into polythene bags, ready for use.

Cassava foliage meal

The leaves, petioles and tender stems of UMUCASS 36 cassava were collected at the point of harvest from cassava farm of National Root Crops Research Institute (NRCRI). They were then chopped into smaller sizes and then oven dried at 70^{0}C before milling. The cassava foliage meal was packed into polythene bag ready for use.

Proximate compositions and gross energy of UMUCASS 36 cassava root meal, cassava foliage meal, cassava tender stem meal and cassava composite meal

Samples of test ingredients were

analyzed for proximate constituents according to the methods of (7). The gross energy was determined using adiabatic bomb calorimeter. The proximate composition and gross energy of the various parts of the UMUCASS 36 is shown in Table 1 below.

Table 1: Proximate composition and gross energy of various parts of UMUCASS 36

Parameters (%)	CRM	CFM	CTSM	CCM	SEM
Dry matter	91.07^{b}	90.42^{d}	90.84^{c}	92.82^{a}	0.02
Crude protein	2.29^{d}	21.79^{a}	5.93^{c}	19.83^{b}	0.04
Ether extract	4.10^{b}	2.36^{d}	2.71^{c}	7.67^{a}	0.00
Crude fibre	6.45^{b}	19.77^{a}	19.74^{a}	5.87^{c}	0.00
Ash	7.56^{b}	8.70^{a}	6.33^{c}	4.74^{b}	0.02
NFE	70.67^{a}	37.80^{d}	56.13^{b}	54.71^{c}	0.05
Gross energy (Kcal/g)	3.66^{b}	3.42^{c}	2.89^{d}	3.77^{a}	0.00

CRM-cassava root meal, CFM -cassava foliage meal, CTSM - cassava tender stem meal, CCM - cassava composite meal, SEM - Standard Error of Mean. Means within the same row with different superscript ($^{a-d}$) are significantly ($P < 0.05$) different

Experimental diets

The processed cassava root meal and cassava foliage meals were used in ratio 10:1. The one percent of the foliage meal comprised of cassava leaf meal and cassava tender stem meals in ratio 4:1. These were used to formulate five diets, at 0, 5, 10, 15 and 20% levels designated A, B, C, D and E respectively to replace maize and soya bean meal as a straight diet. The ingredients and composition of the experimental diets were as shown in Table 2.

Experimental birds and management

A total of one hundred and fifty (150) Abor Acre strains of broiler chicks were purchased from a reputable source and were raised at Michael Okpara University of Agriculture, Umudike, Abia State. The birds were housed in a deep litter brooding pen at day old. The chicks were brooded for one week and reared to eight weeks of age by conforming to standard management procedures: the birds were fed *ad libitum* with commercial starter diet (crude protein, 23%; metabolizable energy of 3000kcal/g) from day old to one week of age before introducing the test diets. Clean drinking water was provided for the birds *ad libitum*. Proper sanitation and routine medication was maintained to forestall any outbreak of disease.

Data collection

Growth parameters

Data were collected for a period of seven weeks. The following parameters were measured:

Initial body weight: this was assessed by weighing the birds at the beginning of the experiment using single pan electronic balance (3 decimal places in grammes) to weigh the chicks.

Final body weight: this was assessed by weighing the birds at the end of the experimental period using triple beam balance (kg).

Feed intake/bird/day (g) =

$$\frac{\text{Quantity of feed given} - \text{Quantity not eaten}}{\text{No. of bird x 49 days}}$$

Daily weight gain/bird (g) =

$$\frac{\text{Final live weight} - \text{Initial weight}}{\text{No. of bird x 49 days}}$$

Feed conversion ratio =

$$\frac{\text{Quantity of feed consumed}}{\text{Weight gain}}$$

$$\text{\% mortality} = \frac{\text{Number died}}{\text{No. Stocked}} \text{ x}$$

Table 2: Composition of experimental diets containing graded levels of processed UMUCASS 36 cassava composite meal fed to broiler chickens (%)

	Diets				
Ingredients (%)	A (0%)	B (5%)	C (10%)	D (15%)	E (20%)
Maize	40.00	37.18	34.36	31.55	28.73
CRM	-	2.82	5.64	8.45	11.27
SBM	22.00	21.72	21.44	21.15	20.87
CFM	-	0.28	0.56	0.85	1.13
GNC	12.00	12.00	12.00	12.00	12.00
Maize offal	19.80	19.80	19.80	19.80	19.80
Palm oil	0.50	0.50	0.50	0.50	0.50
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
Calculated	Composition				
ME (kcal/g)	2877.52	2864.58	2851.44	2838.26	2825.32
Crude protein	22.26	21.98	21.70	21.42	21.15
Energy: Protein	129 : 1	130 : 1	131 : 1	132 : 1	133 : 1
Determined	Composition				
Dry matter	90.31	90.27	90.31	90.23	90.17
Crude protein	22.84	21.21	21.11	20.88	20.63
Crude fibre	4.55	4.63	4.68	4.72	4.76
Ether extract	3.68	3.74	3.82	3.78	3.84
Ash	5.26	5.41	5.26	5.57	5.52
NFE	53.99	55.28	55.45	55.30	55.56
GE (kcal/g)	4.374	4.381	4.373	4.388	4.384

CRM-cassava root meal, CFM -cassava foliage meal, CTSM - cassava tender stem meal, CCM - cassava composite meal, SBM-soyabean meal, GNC - Groundnut cake, ME- Metaboilzable energy, GE- *Gross Energy *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.*

Haematological Parameters and Serum Chemistry

Blood samples were drawn from two birds per replicate through the jugular vein using a 12ml gauge (6cm) needle to draw 10ml of blood. The blood samples were divided into two; first lot (5ml) was emptied into heparinized packs containing about 40mg of anti-coagulant, Ethyl diamine tetra acetic acid (EDTA) to determine the haematological components. The second lot (5ml) was collected into anti-coagulant' ' free bottles, and was used to determine blood biochemical components. Packed cell volume (PCV), the ratio of volume of cells to the volume of plasma, was determined by the capillary haematocrit centrifuge as described by (8). White blood cell (WBC) was determined according to the procedure by Wintrobe (8) while

Haemoglobin (Hb) by Cyanomethaemoglobin method (8) and red blood cells (RBC) also by (8) method The Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin concentration (MCHC) were calculated as shown below.

$$MCV (\%) = PCV \times \frac{10}{RBC}$$

$$MCH (\%) = Hb \times \frac{10}{RBC}$$

$$MCHC (\%) = Hb \times \frac{100}{PCV}$$

Biochemical components such as total protein, urea, creatinine, alkaline phosphatase, and albumin were determined using the method of Coles (8). The blood collection was done at the fourth and eighth weeks of the experiment but the average of the result was reported.

Experimental design and statistical analysis

The experimental design was Completely Randomized Design using five treatments with three replicates of ten birds each. All data collected were subjected to analysis of variance (9), and significant differences between treatments means were separated using Duncan's multiple range test of the same software package (10).

RESULTS AND DISCUSSION

Growth performance of Broiler Chicken fed graded levels of processed UMUCASS 36 Composite meal is presented in Table 3. There were significant differences (P<0.05) in the entire parameters considered with the exception of initial weight. The broilers on 5% inclusion level had superior weight compared to broilers on other diets. Next to it were broilers on diet A (1553.33g), there was reduction in final weight as the level of composite meal increased from diets C to E. Total weight gain followed the pattern of final weight. Broilers on diet D ate most followed by those diet E while the feed intake of broilers on diets A, B and C were comparable.

Table 3: Growth performance of broiler chicken fed graded levels of proces sed UMUCASS 36 composite meal

	DIETS					
Parameters	A (0%)	B (5%)	C (10%)	D (15%)	E (20%)	SEM
Initial wt. (g)	124.67	124.67	124.67	124.67	124.67	0.33
Final wt. (g)	1553.33^{b}	1865.33^{a}	1356.00^{c}	1323.33^{cd}	1188.67^{d}	42.92
Total wt. gain (g)	1423.67^{b}	1740.67^{a}	1231.33^{c}	1198.67^{cd}	1064.00^{d}	42.84
Total feed intake (g)	3052.43^{ab}	3296.70^{ab}	3113.50^{ab}	3596.67^{a}	2879.75^{b}	166.47
Ave. feed intake/bird/day (g)	62.29^{bc}	67.28^{a}	63.54^{ab}	67.28^{a}	58.77^{c}	1.20
Ave. wt. gain (g)	29.17^{b}	35.50^{a}	25.10^{c}	24.47^{c}	21.57^{d}	0.87
Feed Conversion Ratio	2.15^{b}	1.89^{c}	2.54^{a}	2.75^{a}	2.72^{a}	0.08
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00

Means within the same row with different superscript ($^{a-d}$) are significantly (P< 0.05) different. SEM-Standard Error of Mean

The average feed intake of broilers on diets B and D were equal (67.28g) but comparable with broilers on diet C (63.54g). Average feed intake of broilers on diets A and E were similar but statistically different (P<0.05) from others which were similar. Broilers on diet B had superior average weight gain of 35.50g followed by broilers on diet A with 29.17g though statistically different (P<0.05) from one another; broilers on diets C (25.10g) and D (24.47g) were similar; the least was broilers on diet E (21.57g). Broilers on diet B had the least feed conversion ratio; followed by broilers on diet A while others were similar statistically. No mortality was recorded in this experiment. The progressive decrease in final weight, total weight gain, average weight gain and feed conversion ratio observed in this experiment is in line with the report of (11) who recorded a decline as level of composite meal increased. The average feed intake recorded in this experiment did not totally agree with the submission (12) who reported an increase in feed intake with increase in composite meal level because broilers ate to meet their nutrient requirement. The variance observed could be as a result of different composition of the composite meal used for the experiments. It could be concluded that broilers on diet B having 5% inclusion level of cassava composite meal gave the best performance considering its final weight, total weight gain, average feed intake, average weight gain and feed conversion ratio.

The haematological parameters of broiler chicken fed graded levels of processed UMUCASS 36 Composite meal is presented in Table 4. There were significant differences (P<0.05) in all the parameters considered except mean corpuscular volume (MCV) and mean corpuscular haemoblobin (MCH). The white blood cells count was significantly different (P<0.05) across the diets with broilers on diet B recording the least value (225.95 $x10^6mm^3$) but generally low compared to the normal range reported by (13). This low count could not be attributed to diet effect but strain effect. Broilers on diet B had the highest red blood cells count (3.60 $x10^6mm^3$) while others were comparable. Mean values of 2.88 – 4.12 x $10^6/mm^3$ of red blood cells of broiler chickens was reported by (14). (12) observed no significant difference in the red blood cells of broiler chicken fed varying levels of cassava root leaf meal mixture.

Table 4: Haematological parameters of Broiler Chicken fed graded levels of processed UMUCASS 36 Composite meal

	DIETS					
Parameters	A (0%)	B (5%)	C (10%)	D (15%)	E (20%)	SEM
WBC ($x10^6mm^3$)	259.50^b	225.95^d	245.00^c	272.30^a	249.00^{bc}	3.83
RBC ($x10^6mm^3$)	2.31^b	3.60^a	2.21^b	2.00^b	2.19^b	0.15
Hb (g/dl)	9.40^b	12.65^a	9.05^b	8.35^c	7.35^d	0.22
PCV (%)	31.10^c	41.05^a	32.85^b	30.55^c	29.75^c	0.55
MCV (%)	134.74	129.89	148.98	161.77	136.18	12.81
MCH (%)	40.69	40.04	41.11	44.47	33.68	3.99
MCHC (%)	30.27^a	30.86^a	27.59^{ab}	27.33^{ab}	24.74^b	1.07

Means within the same row with different superscript (a-d) are significantly (P< 0.05) different. SEM-Standard Error of Mean, WBC- white blood cells, RBC- red blood cells, PCV- packed cell volume, Hb- haemoglobin, MCV- mean corpuscular volume, MCH- mean corpuscular haemoglobin, MCHC- mean corpuscular haemoglobin concentration

The packed cells volume of broilers on diet B (41.05%) was the highest among the treatment groups followed by broilers on diet C (32.85%) while other diet groups were similar. Mean corpuscular haemoglobin concentrations were comparable among the diets. The heamatological parameters were within the normal range of (13). (15) reported that haematological traits especially PCV and Hb were correlated with the quality of the diets and the nutritional status of the animals. Haematocrit, erythrocytes and haemoglobin are known to be positively correlated with protein quality and protein level. PCV is an indicator of blood dilution (16), haemoglobin measures the ability of an animal to withstand some level of respiratory stress (17). With the superior values of red blood cells, haemoglobin and packed cells volume; broilers on diet B appeared to be better than other diets.

The serum biochemistry of broiler chicken fed graded levels of processed UMUCASS 36 composite meal is shown in Table 5. There were significant differences across the entire diets. The highest total protein was recorded in broilers on diet B (4.03g/l) followed by broilers on diet A (3.20g/l) while broilers on diets C to E were comparable. The significant reduction in serum total protein of birds on cassava based diet may be a reflection of the inadequacy of dietary protein. This was in line with the report of (18). Albumin and globulin did not follow a particular pattern. Broilers on diet B had the least urea value of 16.00mg/dl while the urea level steadily increased with increasing level of composite meal. This could be as a result of poor dietary protein or liver dysfunction (19)

Table 5: Serum biochemistry of Broiler Chicken fed graded levels of processed UMUCASS 36 Composite meal

	DIETS					
Parameters	A (0%)	B (5%)	C (10%)	D (15%)	E (20%)	SEM
Total Protein (g/l)	3.20^{b}	4.03^{a}	2.69^{c}	2.63^{c}	2.45^{c}	0.09
Urea (mg/dl)	18.88^{bc}	16.00^{c}	23.50^{a}	23.75^{a}	20.75^{ab}	1.35
Alkaline phosphatase (µ/l)	81.00^{bc}	64.75^{c}	137.75^{a}	107.50^{b}	160.50^{a}	2.71
Albumin (g/l)	1.15^{bc}	1.40^{ab}	1.20^{bc}	0.95^{c}	1.63^{a}	0.08
Creatinine (mg/dl)	0.93^{ab}	0.78^{b}	1.03^{a}	0.93^{a}	0.98^{a}	0.05
Globulin (g/dl)	2.05^{b}	2.63^{a}	1.50^{c}	1.68^{c}	0.8^{d}	0.9

Means within the same row with different superscript ($^{a-d}$) are significantly ($P< 0.05$) different. SEM-Standard Error of Mean

The alkaline phosphatase values were higher for broilers on diets containing higher levels of composite meal and broilers on diet D was similar to broilers on diet A. Broilers on diet B had the least alkaline phosphatase. Alkaline phosphatase level increases due to increased generalized tissue damage (19). The values of creatinine and that of alkaline phosphatase did not follow a particular pattern. 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 a weight loss (20). In summary, diet B seemed to be better than others because of the quality of the total protein, globulin and lower values of urea and creatinine.

Conclusion and Application

The findings of the study suggest that broilers can be placed on 5% level of inclusion of cassava composite diet good growth performance without detrimental health challenges.

The cassava leaves and tender stem that normally litter the farm land will henceforth be sold to poultry farmers which will increase the cassava farmer income and could even be exported to increase the national income. This clean farm will give a clean environment for healthy living.

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