



Serum Biochemical Composition of Broiler Chickens Fed Biodegraded Cassava Root Meal

¹Abang, F. B. P., Archibong¹, E. E., ¹Uday, M. A.¹, ¹Nsa, E. E., Afunogu, P. O.²

¹Department of Animal Science, Faculty of Agriculture, University of Calabar, Calabar, Cross River State, Nigeria.

²Department of Animal Production, College of Animal Science, University of Agriculture, Makurdi, Makurdi, Benue State, Nigeria

ABSTRACT

An experiment was conducted at the poultry unit of the Livestock Teaching and Research Farm, University of Agriculture, Makurdi, Nigeria, to assess the health status of broiler chickens fed a diet containing biodegraded cassava root (BDCR) over an eight-week period. One hundred and sixty (160) day-old CHI strain broiler chicks were randomly assigned to four (4) treatments with five (5) replicates, and each replicate consisted of eight (8) birds. The experiment followed a Completely Randomized Design. Three of the dietary treatments included various durations of BDCR at a 20% inclusion level, while one treatment served as the control. The broiler chickens were intensively raised in three-tiered cages, with wooden separators and wire mesh walls and doors to ensure proper ventilation and lighting. Strict biosecurity and biosanitary measures were implemented throughout the study. After eight weeks, forty (40) birds were randomly selected for analysis of serum biochemical composition, including sodium (Na⁺), potassium (K⁺), chloride (Cl⁻), calcium (Ca²⁺), cholesterol, bilirubin, aspartate aminotransferase (AST), and alanine aminotransferase (ALT). The data obtained were subjected to one-way Analysis of Variance, and mean values were compared using Duncan's Multiple Range Test. The results indicated that the diets significantly ($P < 0.05$) influenced serum potassium, chloride, and calcium levels. However, the treatments did not have a significant impact ($P > 0.05$) on sodium, chloride, bilirubin, AST, and ALT levels. All the parameters examined fell within the normal reference ranges, except for serum sodium and chloride, which were slightly below normal in all treatments, and serum potassium, which was slightly above the normal reference range in birds fed the control diet. In conclusion, biodegraded cassava root meal proved to be a suitable alternative energy source in broiler chicken diets, as its inclusion at 20% levels did not adversely affect the serum biochemical indices.

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INTRODUCTION

Corn (maize) serves as the major energy ingredient in the diets of most livestock and especially non-ruminants like poultry. In broiler production, corn accounts for approximately 55% of the feed (Abang *et al.*,

2013; 2016; 2018). A decrease in the availability of corn and an increase in the price for feed have a direct impact on the broiler industry, and in some cases, production output reduced (Donohue and Cunningham, 2009; Abang *et al.*, 2023; NSA *et al.*, 2023). An increase in the price

Corresponding author: Abang, F. B. P.

✉ abang.favour2@gmail.com

Department of Animal Science, Faculty of Agriculture, University of Calabar, Calabar, Nigeria.

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of grains and the cost of producing poultry meat and eggs increased significantly resulting in a decreased ability of some of the world's population to purchase and consume chicken meat [8]. In order to compensate for this change, alternative feed ingredients must be identified (Adeyi *et al.*, 2021; Nsa *et al.*, 2019; Achibong *et al.*, 2023). The new ingredients must be able to substitute for corn totally or partially and not have a negative impact on the efficiency of broilers; that is, it must not reduce feed efficiency, dressing percentage, and must produce a product of the same or superior quality (Abang *et al.*, 2023; Abang *et al.*, 2015; Gyang *et al.*, 2021; Bishop *et al.*, 2021).. One possible alternative is cassava (*Manihot esculenta Crantz*). Cassava is a high energy feedstuff that is available throughout the year in Nigeria. Nigeria is now ranked as the world's largest producer of cassava with a production capacity of 40 million metric tonnes (Abang *et al.*, 2023; Okoli, 2008). According to Calpe (1991), the use of cassava in animal feed accounts for only 2% of cassava utilization in Africa. Smith (2003) stated that, the chemical composition of cassava varies according to variety, plant age and processing technology. It should be noted that its protein content (2.5%) is lower than that of yellow maize (9-10%). However, Oruwari *et al.* (2003) stated that, with proper protein balance, cassava meal could completely replace maize in poultry diets. The major limitation on the use of cassava is that of the presence of anti-nutrients (anti-nutritional factors) such as; hydrogen cyanide (HCN), saponins, phytate and tannins (Abang *et al.*, 2023; Olafedehan *et al.*, 2010 ; Nsa *et al.*, 2016). These anti-nutrients may interfere with the absorption of some vitamins and minerals and may cause digestive distress. The presence of these anti-nutritional factors necessitated the need for serum biochemical assay as these anti-nutrients interfere with nutrients bioavailability and utilization. Blood tests via haematology and serum biochemistry can be used to assess the health status and the state of organs of farm animals.

The objective of the study was to determine the serum biochemical indices of

broiler chickens fed diets containing varying hours of biodegraded cassava root (BCDM) as a replacement for maize.

MATERIALS AND METHODS

The study was conducted at the poultry unit of the Livestock Tead'ching and Research Farm University of Agriculture, Makurdi. Makurdi is located on latitude 7° 14 N¹ and longitude 8° 31' and a height of 90 meters above sea level in the Southern Guinea Savannah ecological zone of Nigeria. Cassava roots purchased from farmers around the university premises were peeled and chopped with a knife into chips varying with thickness of about 5mm. The ratio of rumen content to water was 5kg: 20liters. The rumen content was soaked in the water for some hours for proper extraction and the filtrate was used for the biodegradation of the cassava. The chopped cassava roots were washed and separated into three equal parts (T2 ,T3 and T4) which were biodegraded for 24, 48, and 72 hours respectively. The biodegraded cassava roots were sun-dried for seven (7) days for prolonged storage. Cassava root and other ingredients were ground into grits and bagged separately. Varying hours of BCRM replaced maize at 20% in each of the treatments which was replicated five (5) times with eight (8) birds per replicate, giving the total of forty (40) birds per treatment. There were four treatments in all including control experiment (T1). Each treatment was subjected to proximate analysis according to the methods of AOAC, (2006). A total of 160 day old CHI strain of broiler chicks purchased from Sabtech Farms Oluyole extension, Ibadan, Oyo State were assigned to one of the four dietary treatments comprising of a total of forty (40) birds per treatment and administered for eight weeks. Birds were housed in deep litter cages; the cages were constructed with wooden floor and wire mesh. Routinely operations were carried out timely. Biosecurity and bio sanitary activities were adhered strictly. At the end of the experiment (8 weeks of age) two broiler chickens per replicate (amounting to 10 birds per treatment) were randomly selected. Broilers were slaughtered by cutting the jugular vein with a

Corresponding author: Abang, F. B. P.

✉ abang.favour2@gmail.com

Department of Animal Science, Faculty of Agriculture, University of Calabar, Calabar, Nigeria.

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sharp knife. Blood sample was collected into bottles without EDTA (ethylene diamine tetracetic acid) for blood serum biochemical evaluation. The serum was separated by centrifuge at 750g for 15minutes and stored in a deep freezer until time of use for serum biochemical analysis. The Standard Flame Photometer (Gallen Clamp) was used to determine serum electrolyte: Sodium, Potassium, Calcium and Chloride. Lipid

Panel Test was also conducted for Cholesterol and Liver Function Test for Bilirubin, Aspartate Aminotransferase (AST), and Alanine Aminotransferase (ALT) according to the methods of (Evans, 2009) and (Meyer *et al.*, 1992). These tests were carried out at the Physiology and Biochemistry laboratory, College of Veterinary Medicine, Federal University of Agriculture, Makurdi.

Table 3: Composition of Starter Diet with Biodegraded Cassava Root.

Ingredients	T ₁ (Control)	T ₂ (24hrs)	T ₃ (48hrs)	T ₄ (72hrs)
Maize	48.00	38.40	38.40	38.40
Cassava	0.00	9.60	9.60	9.60
Full fat soya bean	37.00	37.00	37.00	37.00
Fish meal	8.00	8.00	8.00	8.00
Rice bran	4.00	4.00	4.00	4.00
Bone meal	2.50	2.50	2.50	2.50
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Analyzed Nutrients:				
Metabolizable energy (kcal/kg)	3215.10	3119.05	3201.50	3119.98
Crude protein (%)	23.35	23.10	23.40	23.22
Calculated Nutrients:				
Metabolizable energy (kcal/kg)	3211.50	3182.62	3182.62	3182.62
Crude Protein (%)	23.27	23.04	23.22	23.05

Table 4: Gross Composition of Finisher Diet with Biodegraded Cassava Root.

Ingredient	T ₁ (Control)	T ₂ (24hrs)	T ₃ (48hrs)	T ₄ (72hrs)
Maize	58.16	46.53	46.53	46.53
Cassava	0.00	11.63	11.63	11.63
Full fat soya bean	30.04	27.63	27.63	27.63
Fish meal	5.00	7.21	7.21	7.21
Rice bran	4.00	4.00	4.00	4.00
Bone meal	2.50	2.50	2.50	2.50
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated Nutrients:				
Metabolizable energy(kcal/kg)	3200.05	3197.05	3197.05	3197.05
Crude Protein (%)	19.98	19.78	20.03	19.82
Analyzed Nutrients:				
Metabolizable energy (kcal/kg)	3201.56	3119.20	3198.15	3199.38
Crude protein (%)	20.00	19.77	20.04	19.85

Experimental Design

Corresponding author: Abang, F. B. P.

✉ abang.favour2@gmail.com

Department of Animal Science, Faculty of Agriculture, University of Calabar, Calabar, Nigeria.

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The four (4) treatment groups were assigned the four (4) experimental diets in a Completely Randomized Design (CRD). Each treatment was replicated five (5) times with eight (8) birds per replicate, giving the total of forty (40) birds per treatment. Each treatment was fed an assigned diet which lasted for eight (8) weeks.

Management of Birds

On arrival, birds were given anti stressor (vitalytes). Drinkers and feeders were well positioned. Water and feed were served *ad libitum*. Bio security and bio sanitary measures were strictly adhered with to prevent disease outbreak. Proper vaccination programme was designed and followed. Prophylaxis was administered when necessary.

Housing

Birds were grown intensively in cages of three tiers. Each tier was separated with wood. Wire mesh was used for the walls and doors to allow adequate ventilation/lighting. Wood shavings was used as litter materials. Artificial lighting was provided with the use of one battery lantern for each tier to ensure adequate feeding.

Feed Intake Determination

A known quantity of feed was weighed daily and served to the birds. The ration was increased on weekly basis by hundred grams (100g). The left over feed was also collected the following day and recorded. The quantity of leftover was subtracted from the amount offered to the birds to determined feed intake.

BLOOD SAMPLE COLLECTION AND ANALYSIS

At the end of the experiment (8 weeks of age) two (2) broiler chickens per replicate (amounting to 10 birds per treatment) were randomly selected. Broilers were slaughtered by cutting the jugular vein with a sharp knife. The first set of blood sample was collected into bottles containing EDTA (ethylene diamine tetracetic acid) for haematological evaluation; while another set of blood samples were collected without anticoagulant for blood serum

biochemical evaluation. The serum was separated by centrifuge at 750g for 15minutes and stored in a deep freezer until time of use for serum biochemical analysis. The Standard Flame Photometer (Gallen Clamp) was used to determine serum electrolyte: Sodium, Potassium, Calcium and Chloride. Lipid Panel Test was also conducted for Cholesterol and Liver Function Test for Bilirubin, Aspartame Aminotransferase (AST), and Alanine Aminotransferase (ALT) according to the methods of (Evans, 2009) and (Meyer *et al.*, 1992).

Statistical Analysis

Collected data were analyzed using Analysis of Variance (ANOVA) using Minitab statistical software version 14 and means that differed significantly were separated using Duncan's Multiple Range Test as outlined by Steel and Torrie (1980).

RESULTS AND DISCUSSION

The result of serum biochemical parameters of control birds and those fed varying hours of biodegraded cassava root meal are presented in Table 5. Biochemical indices are a reflection of animal responsiveness to the external and internal factors which include feeds and feeding Adekunle, and Omohm (2014). Among the serum biochemical parameters assayed, only the mean values obtained for potassium, calcium and cholesterol showed significant ($p < 0.05$) differences between treatments. However, sodium, chloride, bilirubin, aspartate aminotransferase (AST), and alanine aminotransferase (ALT) were not significantly different. The level of serum electrolytes (sodium, potassium, chloride and calcium) in this study were similar to the normal values for broilers as reported by Melody and Sudipto (2012), except sodium and chloride that had slightly lower values in all treatments and this may be due to the occurrence of diarrhoea affecting majority of the flock prior to blood sample collection. Serum sodium is a major component of the cations of the extracellular fluid and is largely associated with chloride

Corresponding author: Abang, F. B. P.

✉ abang.favour2@gmail.com

Department of Animal Science, Faculty of Agriculture, University of Calabar, Calabar, Nigeria.

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and bicarbonate in regulation of acid-base balance. It is important in the maintenance of osmotic pressure of body fluid, thus protecting the body against excess fluid loss (dehydration). Chloride is the major extracellular anion found outside the cell. It plays a critical role in keeping proper balance of body fluids and maintaining the body acid-base balance (Abang *et al.*, 2018). Low levels of sodium (hyponatremia) and chloride (hypochloremia) affect growth in animals and reduce digested protein utilization (Kolo *et al.*, 2020) and are usually caused by prolonged diarrhoea or vomiting, gastric suction etc. (Ghassan and Kianoush, 2017). Serum potassium gives a true picture of the heart condition, it controls the heart beat rate and blood pressure and also assist in the regulation of acid base balance of cellular exchange within hydrogen (El-boushy and Vander Poel, 1990; Diarra and Usman, 2008). Potassium is also essential for the proper functioning of the kidneys, nerves, muscles and digestive system. The values were within the normal range of 3.5 -5.0 mEq/L in all the treatments according to Melody and Sudipto (2012), except for treatment one (control) that had its value at 6.65 mEq/L.

The fact that this diversion from the normal range was only observed with the control experiment reveals that the anomaly was not associated with the treatment; it is likely a technical error. However, high levels of serum potassium also known as hyperkalemia may be associated with higher pH (i.e alkalosis) as reported by Mushtaq and Pasha (2013). The serum calcium level in all the treatments were within the normal values which agrees with Melody and Sudipto (2012), calcium which is mostly stored in the bones is critical for muscle contraction, nerve signaling, blood clotting, maintaining normal heart function, absorption and utilization of vitamin B12 and inhibits cell membrane permeability of sodium. Broiler chickens fed the control diets (zero biodegraded cassava root meal) showed higher cholesterol levels compared to other treatment groups, this

could be due to the absence of the anti-nutritional factors such as HCN, tannins, saponin, phytates and oxalates. Anti-nutritional factors have been reported to reduce fats and cholesterol levels in tissues (Cooke *et al.*, 1982). Although, excess cholesterol levels can be seen in birds on high-fat diets, obese birds, and birds with hypothyroidism (underactive thyroid gland). Low levels can be seen in birds with liver and kidney disease (Nworgu *et al.*, 2007). The cholesterol values of birds in this study which ranged from 65.80 - 76.38 mg/dL and were within the normal range of 50-350mg/dl as reported by Targema (2018). Total and conjugated bilirubin is indicators of protein adequacy (Ahamefule *et al.*, 2008). The values of serum bilirubin for broiler chickens in all treatments were within the normal ranges; this is in line with Silva *et al.* (2007) who reported similar levels of bilirubin but in contrast with Augustine *et al.*, 2020 and Howard, 2009). According to Robin (2003) high values of bilirubin signifies liver disease such as hepatitis or blockage of tubes (bile ducts) or diagnose conditions that cause increased destruction of red blood cell.

Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) are serum enzymes which provide useful information on hepatocellular damage (Withawaskul *et al.*, 2003). They are also responsible for inter conversion of amino acids through transfer of amino groups *in vivo*. AST is considered one of the most reliable indicators of liver disease in caged birds. In this study, no differences in the activities of AST and ALT were observed among the treatments. The result of AST and ALT ranged from 81.54 to 98.12 U/L and 18.70 to 20.60 U/L, respectively, which were within normal ranges (Cole, 1986). This indicates that feeding varying hours (24, 48 and 72) of biodegraded cassava root meal did not induce toxicological effect (caused by HCN) on broiler chickens and further confirms that biodegradation is a good method to process some unconventional feedstuffs rich in anti-

Corresponding author: Abang, F. B. P.

✉ abang.favour2@gmail.com

Department of Animal Science, Faculty of Agriculture, University of Calabar, Calabar, Nigeria.

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nutrients as the microbes are capable of handling anti-nutrients before being included into the diets of broilers. Serum values greater than 350 U/L are considered abnormal and are often indicative of liver disease. The lack of significant differences in both ALT and AST in all treatment groups, suggest that dietary

treatments did not adversely affect the functions of the liver (Aliyu, 2015). Some researchers have reported hepatocellular and renal damage following the feeding trials which incorporated unconventional feed stuffs (Adekolu *et al.*, 2007).

Table 5: Effect of Biodegraded Cassava (*Manihot esculenta Crantz*) Root Meal on Serum Biochemical Composition of Finisher Broiler Chickens

Parameters	T ₁ (Control)	T ₂ (24hrs)	T ₂ (48hrs)	T ₂ (72hrs)	SEM	P-value	LOS
Sodium (mEq/L)	103.04	105.52	113.28	119.24	2.543	0.082	NS
Potassium (mEq/L)	6.64 ^a	4.32 ^b	4.30 ^b	3.72 ^b	0.326	0.001	*
Chloride (mEq/L)	81.22	62.34	66.08	63.64	3.094	0.101	NS
Calcium (mg/dL)	8.58 ^c	9.24 ^b	9.80 ^{ab}	9.90 ^a	0.152	0.001	*
Cholesterol (mg/dL)	76.38 ^a	74.56 ^a	70.38 ^{ab}	65.80 ^b	1.515	0.048	*
Bilirubin (mg/dL)	0.38	0.32	0.31	0.27	0.014	0.060	NS
AST (U/L)	98.12	85.48	84.24	81.54	3.046	0.228	NS
ALT (U/L)	18.70	19.16	18.98	20.60	0.498	0.572	NS

abc = means in the same row with different superscripts are significantly different ($p < 0.05$)

NS = no significant ($P > 0.05$) difference

***** = significant ($P < 0.05$) difference

SEM = standard error of the mean

LOS = level of significance

AST = Aspartate aminotransferase

ALT = Alanine aminotransferase

CONCLUSION

It was concluded that, biodegraded cassava root meal is a good alternative energy source; 20% inclusion levels did not adversely influence serum biochemical.

48 hours fermented taro cocoyam (*Colocasia esculenta var esculenta*) meal to growing japanese quail (*Coturnix coturnix japonica*). *Indian Journal of Research (PARIPEX)*, 2(8): 286- 288.

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Corresponding author: Abang, F. B. P.

✉ abang.favour2@gmail.com

Department of Animal Science, Faculty of Agriculture, University of Calabar, Calabar, Nigeria.

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Corresponding author: Abang, F. B. P.

✉ abang.favour2@gmail.com

Department of Animal Science, Faculty of Agriculture, University of Calabar, Calabar, Nigeria.

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Corresponding author: Abang, F. B. P.

✉ abang.favour2@gmail.com

Department of Animal Science, Faculty of Agriculture, University of Calabar, Calabar, Nigeria.

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Corresponding author: Abang, F. B. P.

✉ abang.favour2@gmail.com

Department of Animal Science, Faculty of Agriculture, University of Calabar, Calabar, Nigeria.

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Corresponding author: Abang, F. B. P.

✉ abang.favour2@gmail.com

Department of Animal Science, Faculty of Agriculture, University of Calabar, Calabar, Nigeria.

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