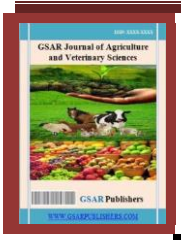

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Physiological Responses of Broiler Chickens to Dietary Inclusion of Provitamin A Cassava Leaf Meal as a Protein Substitute for Groundnut Cake

By

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Abstract

A total of 120 broiler chickens were used to evaluate the physiological response of birds fed diets containing Pro-Vitamin A cassava leaf meal (PVACLM) as a replacement for groundnut cake (GNC) protein. This study aimed to assess the effects of graded levels of PVACLM on hematological and serum indices, as well as the economic implications of using this alternative protein source in broiler nutrition. The research was conducted at the Poultry Unit of the Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike. The birds were weighed at arrival, brooded for two weeks, and randomly assigned to four dietary treatment groups (T1 to T4) with 30 birds per treatment and 3 replicates of 10 birds each. The experimental diets contained 0% (control), 5%, 10%, and 15% PVACLM, formulated to replace groundnut cake either partially or fully. Cassava leaves were harvested from the National Root Crops Research Institute (NRCRI), wilted overnight, air-dried under shade for five days, and milled into meal. Standard poultry management practices, including ad libitum feeding, access to clean water, routine medication, and vaccinations, were followed throughout the 8-week study. At the end of the trial, blood samples were collected for hematological and serum biochemical analysis. The results revealed significant differences ($P<0.05$) in several hematological parameters. Red blood cell (RBC), packed cell volume (PCV), and hemoglobin (HB) increased with rising levels of PVACLM inclusion, while white blood cell (WBC) counts decreased. The highest values for RBC (3.50 ×10⁶/µL), PCV (29.67%), and HB (11.47 g/dL) were recorded in T3, while T1 (control) had the lowest values of 2.79 ×10⁶/µL, 24.66%, and 9.23 g/dL, respectively. No significant differences ($P>0.05$) were observed in platelet counts, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), or mean corpuscular hemoglobin concentration (MCHC) across treatments. Serum biochemical indices showed significant variations ($P<0.05$) in total protein, globulin, cholesterol, and glucose. Total protein and globulin increased with PVACLM inclusion, while cholesterol levels decreased. The highest total protein (3.49 g/dL) and globulin (1.32 g/dL) values were found in T3, whereas the highest cholesterol (85.70 mg/dL) was recorded in T1, with the lowest (74.55 mg/dL) in T4. Serum glucose increased progressively with higher PVACLM levels, with the peak value (172.33 mg/dL) observed in T4. The combination of GNC and PVACLM provided a balanced amino acid profile and enriched the diet with lysine, contributing positively to the health and physiological performance of the birds. The study concludes that Pro-Vitamin A cassava leaf meal is a viable alternative protein source for broiler chickens. Its use can reduce feed costs and enhance sustainability in poultry production without adverse effects on bird health.

Introduction

Poultry, through the provision of meat and egg continue to serve as an excellent and cheap source of animal protein for Nigerians. The full potential of poultry products as a panacea to insufficient animal protein intake of Nigerians has not been achieved principally because of inadequate feeds. Feed cost remains the major factor limiting the development and expansion of poultry farming. The bulk of the feed cost arises from protein concentrates such as fishmeal, soybean meal and groundnut cake. Prices of these conventional protein sources have soared so high in recent times that it is no Longer economical to use them in poultry feeds (Esonu et al., 2001). This perennial problem has necessitated the search for alternatives to the expensive grains and protein concentrates (Adeyemi, 2005). Animal Nutritionists have therefore come to the conclusion that replacement of expensive conventional feed ingredients with cheap and available substitutes represents a suitable strategy at reducing feed cost and encouraging production. Many research efforts were invested in the search for alternatives to soybean in poultry diets. These efforts involve the use of oilseed meals such as Castor

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oil seed (Ani and Okorie, 2009), Mucuna (Abduulazeezi et al., 2016); (Phuc et al., 2000). *Alchonia cordifoli*a seed meal (Steel et al., 1997), rubber seed meal (Iyayi and Taiwo, 2003). The results of some of these efforts are conflicting and variable. Most of the studies conducted on lesser-known oilseed meals indicated the need for further processing as most of them are bedeviled by the presence of antinutritional factors.

Another major problem observed in the search for alternatives to soybean meal is the fact that the alternatives are most often seasonal in production and the quantity available is often too small for large scale utilization. As a result, it stands to reason that a viable alternative to soybean should not only be rich in nutrients, relatively free from anti-feed stuff but must be readily available in large quantities at all times. One possible source of cheap protein is leaf meal from some tropical legume and plants. Leaf meal have been reported to provide protein and also some vitamins, minerals and oxycarotenoids, which cause yellow color of broiler skin, shank and egg yolk (D'Mello et al., 1987).

Cassava is traditionally grown for the production of roots. It yields about 10 – 30 tons/ ha of leaves that is usually wasted or used as manure (Bokanga, 1994). However, the leaves have become increasingly important as a source of protein for monogastric and ruminant animals (Tuleun and Patrick, 2007). Cassava leaves are rich in protein, but they are low in sulfur amino acids (Soetan et al., 2013). The leaf protein is reported to be limiting in methionine and tryptophan but rich in lysine, with overall biological value of 49-57% (Wanapat, 2002). By the addition of Cassava leave??meal to Groundnut cake, the biological value of the protein (especially the amino acid) lysine level could be increased. Cassava leave meal is a plant protein source that is readily available everywhere at no cost. It contains high levels of protein and lysine. However, it is not popular in chicken diets because of its amino acid imbalance, low availability of its sulfur amino acid, (Mitruka and Rawnsley, 1997; Emenalom et al., 2011). Groundnut cake is readily available and has a comparable crude protein content with SBM, though deficient in lysine and methionine (Ijaiya et al., 2011) which can be balance with CLM mix. The combination of Groundnut cake meal (GNC) and cassava leaf meal (CLM) is expected to give a good protein concentrates with a good balance of amino acid and also enriches the diet with lysine. This study is therefore designed to determine the physiological response, reproductive performance and cost implication of pullets fed diets containing grade levels of CLM to substitute GNC meal protein

Materials and Methods

Location

The study was conducted at the Poultry Unit of the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. Umudike lies on latitude 05°29′N and longitude 07°32′E, with an elevation of approximately 123 meters above sea level. The area experiences an annual rainfall of 2,177 mm, relative humidity ranging from 50% to 90%, and ambient temperatures between 22°C and 36°C (Meteorological Station, NRCRI, Umudike, 2021).

Experimental Birds and Management

A total of 120day-old broilers was used in the study. The birds were divided into 4 treatment groups of 30 birds per treatment group. Each treatment group was further divided into 3 replicates of 10 birds per replicate. The birds were housed and reared deep litter poultry house. The experimental feed is shown in Table 1 (Starter) and Table 2 (Finisher): Treatment $_1$ (T_1) = 0% Pro-Vit-A- CLM, T_2 = 5% Pro Vit-A-CLM, T_3=10%, Pro Vit-A-CLM, and T_4=15% Pro Vit-A-CLM, respectively.

Table 1: Gross Composition of the Experimental Starter Broiler Chicken Diets (% as-fed basis)

Ingredient	T1 (%)	T2 (%)	T3 (%)	T4 (%)
White maize	51.30	51.30	51.30	51.30
Soybean meal	17.00	17.00	17.00	17.00
Fishmeal	5.00	5.00	5.00	5.00
Groundnut cake (GNC)	18.00	16.80	15.60	14.40
Wheat offal	5.00	5.00	5.00	5.00
PVACLM[1]	0.00	1.20	2.40	3.60
L-Lysine	0.10	0.10	0.10	0.10
DL-Methionine	0.10	0.10	0.10	0.10
Common salt	0.25	0.25	0.25	0.25
Premix[2]	0.25	0.25	0.25	0.25
Bone meal	3.00	3.00	3.00	3.00
Total	**100.00**	**100.00**	**100.00**	**100.00**

Calculated Nutrient Composition

Parameter	T1	T2	T3	T4
Crude protein (%)	23.23	22.98	22.74	22.50
ME (kcal/kg)	2770.30	2744.11	2717.92	2691.73

Table 2: Gross Composition of the Experimental Finisher Broiler Chicken Diets (% as-fed basis)

Ingredient	T1 (%)	T2 (%)	T3 (%)	T4 (%)
White maize	59.30	59.30	59.30	59.30
Soybean meal	16.00	16.00	16.00	16.00
Fishmeal	4.00	4.00	4.00	4.00

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Ingredient	T1 (%)	T2 (%)	T3 (%)	T4 (%)
Groundnut cake (GNC)	13.00	12.35	11.70	11.05
Wheat offal	4.00	4.00	4.00	4.00
PVACLM[1]	0.00	0.65	1.30	1.95
L-Lysine	0.10	0.10	0.10	0.10
DL-Methionine	0.10	0.10	0.10	0.10
Common salt	0.25	0.25	0.25	0.25
Premix[2]	0.25	0.25	0.25	0.25
Bone meal	3.00	3.00	3.00	3.00
Total	**100.00**	**100.00**	**100.00**	**100.00**

Calculated Nutrient Composition

Parameter	T1	T2	T3	T4
Crude protein (%)	20.06	19.95	19.83	19.71
ME (kcal/kg)	2831.60	2817.43	2803.23	2789.0

RESULTS AND DISCUSSION

The result of the haematological parameters of broilers fed graded levels of Pro-Vit-A Cassava leaf for replacement to groundnut cake protein.?? Is presented in Table 3. The results showed that there were significant differences (P<0.05) in most of the parameters measured. The red blood cell (RBC) increased with increase in the Pro-Vit-A Cassava leave meal. Parked cell volume, PCV and Hb, followed the same trend with RBC while WBC reduced with increase in PVACLM inclusion level. There were no significant differences (P>0.05) in the treatment groups in, MCVC (MEAN CORPSULAR VOLUME CONCENTRATION), MCH, and MCHC. The highest value recorded in RBC, PCV and Hb were 3.5, 29.67, and 11.47 respectively all in T1. While the lowest value recorded where?? recorded in T1 as follows: 2.79, 24.66, and 9.23 for RBC, PCV and HB respectively. The highest values in WBC 19.03 was recorded in T1 while the lowest value was recorded of 15.95 was recorded in T4 However, all values fall within the normal range for healthy chickens as was reported by Esonu et al., 2001 but higher than the range reported by Esonu et al., 2001 .The values of packed cell volume (PCV) recorded in this work did not tally with the report by Udedibia and Opara, 1998 who recorded high values between 32.95 and 33.27 for broilers fed BSM but tallied wit report of Adedokun et al., 2017 who reported range of 29.7 and 31,6.But recorded similar values with (16) in HB .who recorded the following values 11.81 and 11.68 g/dl obtained at different levels of BSM inclusion. PCV and Hb concentration are generally affected by inadequate intake of energy and protein with lower values which indicating anaemia. The result obtained in this study suggests the nutritional adequacy of the test material. Red blood cell (RBC) counts recorded in T4 (3.35 x 106 /mm3) was higher (p< 0.05) than the values obtained for birds in T1 (2.79x 106 /mm3) and (2.96x 106 /mm3) T2 group. Thus, animals with low white blood cell count are exposed to high risk of disease infection, while those with high counts are capable of generating antibodies in the process of phagocytosis and have higher degree of resistance to diseases (Onunkwo et al., 2021).

Table 3: Haematological Indices of Broiler Chickens Fed Diets Containing Graded Levels of Pro-vitamin A Cassava Leaf Meal as Replacement for Groundnut Cake Protein

Parameter	T1	T2	T3	T4	SEM
Red Blood Cells (×10⁶/µL)	2.79^{c}	2.97^{bc}	3.19^{ab}	3.35^{a}	0.07
Packed Cell Volume (%)	24.66^{c}	25.67^{bc}	27.67^{ab}	29.67^{a}	0.67
Haemoglobin (g/dL)	9.23^{b}	9.60^{b}	10.83^{a}	11.47^{a}	0.31
White Blood Cells (×10³/µL)	19.03^{a}	16.03^{b}	18.77^{a}	15.93^{b}	0.48
Platelets (×10³/µL)	93.33	103.67	97.67	98.33	1.74
Mean Corpuscular Volume (fL)	88.51	86.41	86.64	88.44	0.55
Mean Corpuscular Haemoglobin (pg)	33.15	32.29	33.61	34.20	0.39
Mean Corpuscular Haemoglobin Concentration (g/dL)	37.46	39.22	39.17	38.68	0.52

Values within a row with different superscripts (a, b, c) differ significantly (**P** < 0.05). SEM: Standard Error of the Mean..,

T1 to T4 represent diets with increasing levels of pro-vitamin A cassava leaf meal replacing groundnut cake protein

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The result of the serum indices of broiler chickens fed diet containing Pro Vit A cassava leaf meal in replacement of Groundnut cake protein. (P<0.05) at??s shown in Table 4. The result shows significant differences (P<0.05) in total protein, globulin, and cholesterol. Total Protein and Globulin increased with increased levels of PVACLM while Cholesterol decreased with increased levels of PVACLM. The highest values 3.49, and 1.32 recorded in total protein and Globulin respectively were found in T_3, while the least values were recorded in T1 for both, However, reverse was the case in Cholesterol that recorded the highest value of 85.70 in T1 and the least value of 74.55 in T4 respectively. There was significant difference in Glucose that increased with increased levels of PVACLM with highest value of 172.33 recorded in T4 while the least value of 95.67 was recorded in T1. The value recorded in total protein in this work tallied with the record reported by Onunkwo et al., 2021. The Albumin value recorded in this work was within the range of 0.08 and 1.15 recorded by Esonu et al., 2001 but lower than values recorded by Onunkwo et al., 2021 on Globulin level who recorded between 0.9 and 2.05. The results also showed decrease in the cholesterol level as the level of the PVACLM which indicate a healthy status of the birds. The combination of Groundnut cake meal (GNC) and Pro-Vit-A cassava leaf meal (CLM) gave a good protein concentrate with a good balance of amino acid and also enriches the diet with lysine. The result of this study showed that feeding diets containing Pro Vitamin-A-Cassava Leaf Meal can lead to reduction in the cost of feed and poultry production since the high cost of feed is mostly hinged in the high cost of major fed ingredient like the Soybean, Groundnut Cake etc. and also availability of feed at all season since cassava leave is readily available at all seasons and its use has no deleterious effect on broilers rather it enhanced the health status of the birds

Table 4: Serum Indices of Broiler Chickens Fed Diets Containing Graded Levels of Pro-vitamin A Cassava Leaf Meal as Replacement for Groundnut Cake Protein

Parameter	T1	T2	T3	T4	SEM
Total Protein (g/dL)	3.22^{b}	2.98^{c}	3.49^{a}	3.21^{b}	0.06
Albumin (g/dL)	2.15	1.95	2.17	2.15	0.04
Globulin (g/dL)	1.07^{b}	1.03^{b}	1.32^{a}	1.06^{b}	0.04
Cholesterol (mg/dL)	85.70^{a}	79.56^{b}	79.90^{b}	74.55^{c}	1.32
Urea (mg/dL)	10.07	10.63	11.07	10.65	0.32
Creatinine (mg/dL)	0.87	0.73	0.68	0.78	0.03
Glucose (mg/dL)	95.67^{c}	166.67^{ab}	157.00^{b}	172.33^{a}	9.42

Values within a row with different superscripts (a, b, c) differ significantly (**P** < 0.05). SEM: Standard Error of the Mean. T1 to T4 represent increasing inclusion levels of pro-vitamin A cassava leaf meal replacing groundnut cake protein in broiler diets

CONCLUSION AND RECOMMENDATION

Pro vitamin A Cassava leaf meal is a good source of protein, high in lysine but deficient in methionine and tryptophan, and are rich in vitamins and minerals. Cassava leaf meal can replace other ingredients as a protein source at inclusions of 10 to 15% in broiler species. The findings of my study suggest that broilers can be placed at 15% level of inclusion of pro vitamin A cassava Leaf meal in their diet without detrimental health challenge while at 5%, the haematological and serum indices was not encouraging which could be as a result of the deficiency of the nutrient contained in the pro vit A cassava leaf meal. Recommendation of pro vitamin A cassava leaf meal vary within wide ranges according to several research carried out by several authors. Protein quality can be improved by further processing cassava leaves into leaf protein concentrate. The price for cassava leaves is generally low when compared to the price of protein sources used in feed formulation. Therefore, could be easily affordable and accessible as protein source for broiler birds, which will aid to improve the bird's physiological performance.

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