

DIETARY EFFECT OF FLASHED-DRIED CASSAVA PULP ON HAEMATOLOGICAL PARAMETERS, BLOOD SERUM AND SERUM ENZYMES OF EXOTIC GROWING TURKEYS

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Abstract

One hundred and twenty (120) day-old British United Turkey (BUT) poults were sourced from a reputable farm in Nigeria to assess haematological parameters, blood serum, and serum enzymes of grower exotic turkeys fed varying levels of flashed-dried cassava pulp (FDCP). Grower turkeys were carried over from starting phase and randomly assigned into four (4) dietary treatments in a completely randomized design (CRD). Thirty (30) turkey growers were assigned into three (3) treatments and replicated six (6) times with five (5) turkeys per replicate. The test diets (FDCP) were formulated to partially replace maize at level of 0, 5, 10 and 15% in growing phase. Water and feed were supplied *ad-libitum*. At 12th weeks of the experiment, 3mls blood sample was collected via the wing vein into vials containing ethylene diamine tetra-acetic acid (EDTA) for determination of haematological indices. Another set (3 mls) blood sample was collected into heparinized tubes for serum analysis using standard procedures. The results revealed significant effect ($p < 0.05$) on monocytes (0.00-1.00%), mean corpuscular haemoglobin concentration (MCHC, 32.13-34.14g/dl), uric acid (5.00-8.03mg/dl), aspartate transaminase (AST) 994.00-113.00U/L, total bilirubin (0.18-0.53mg/dl), density bilirubin (0.05-0.18mg/dl) and creatinine (1.13-2.26mg/dl). Conclusively, Based on the outcome of this finding, flashed-dried cassava pulp did not pose any adverse effect on blood profiles of turkeys at growing phase of the study. Thus, inclusion of FDCP to replace maize beyond 15% level in the diets of turkey growers should be researched on.

Keywords: *Flashed-dried cassava pulp, growers, turkeys, haematological parameters, serum blood, and serum enzymes*

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Introduction

Poultry farming plays a crucial role in agriculture, especially in developing countries like Nigeria. It provides an essential source of animal protein and is a key contributor to food

security and livelihoods for many low-income households (Birhanu *et al.*, 2023). Poultry birds offer significant economic benefits by supplying meat, eggs, and raw materials (such as feathers and waste products) for industries.

However, high feed cost remains a major inhibition to efficient poultry production. Many convectional ingredients used in poultry diets are forecast to be in short supply mainly as a result of the increase inhuman population and unfavourable climatic conditions (Cribb, 2010). The growing demand for convectional energy feed ingredients as food by the increased growing world's human population and other industrial uses has increased research interest in alternative cheaper ingredients like cassava for poultry feeding. Although cassava root meal has been fed to poultry as a major source of energy with success (Saparattananan *et al.*, 2005). However, during growing and processing of cassava for food or industrial uses several by-products such as cassava peels, cassava pulp etc ensue, which have potential as feed ingredients in poultry diets.

Cassava pulp (CPL) is a solid by-product during starch, production, CPL yields from 10-15% of the root (Khempaka *et al.*, 2014) which is a readily available material in major starch producing countries. Cassava. Pulp is rich in starch ranging from about 54-70%. Adeyey *et al.*, (2024) reported 91.00 (%) dry matter, 3.25 (%) crude protein, 9.00 (%) ether extract, 8.00 (%) crude fibre, 68.25 (%) nitrogen free extract, 1.30 (%) calcium and 0.60 (%) phosphorous and 3279.00 metabolizable energy (MJ/kg) while Hydrocyanide acid 33.75 (mg/kg). Adeyey *et al.*, (2024) submitted that flash dried cassava root pulp (FDCRP) can replace maize up to 10% in the diets of young turkeys without compromising final weight, weight gain and feed conversion ratio while Raji *et al.*, 2025 reported 15% inclusion level of flashed-dried cassava pulp as a replacement for maize in the diet of broiler starters chickens.

Blood is a vital fluid in the body, composed of liquid containing a variety of cells and proteins suspended within it (Etim *et al.*, 2014b). It plays a crucial role in transporting substances to and from tissue cells, including nutrients

like proteins, glucose, vitamins, minerals, and lipids into cells. It also carries oxygen via red blood cells (as oxyhemoglobin) and helps remove waste products, such as urea and carbon dioxide, from cells (Khan and Zafar, 2005). Hematological values can provide a useful benchmark for assessing conditions related to nutrient deficiencies, toxicity, and the overall health status of farm animals (Daramola *et al.*, 2005). Serum biochemistry is valuable in monitoring disease progression before conducting more definitive evaluations, such as assessing the pathology of organs and arteries (Garacyk *et al.*, 2003). Hematological parameters include red blood cells, packed cell volume, hemoglobin, white blood cells (leukocytes), mean corpuscular volume, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration. Serum biochemical indices, on the other hand, encompass albumin, globulin, cholesterol, urea, creatinine, bilirubin, and triglycerides (Alagbe *et al.*, 2018). Dietary intake has been recognized as the major factor affecting the blood composition of animals because blood transports nutrients and other materials to different parts of the body (Olabanji *et al.*, 2007). Consequently, whatever affects the blood such as feeding will certainly affect the health of an animal (Oluwafemi *et al.*, 2021).

Materials and methods

Location of the study

The study was conducted at the Federal University of Agriculture, Abeokuta, Ogun, State, Nigeria, at the Poultry Unit of the Directorate of University Farms (DUFARM). The farm is located at an elevation of 415 feet and altitude of 700 feet, on Latitude 7°13'35.48'' N and longitude 3° 26' 12.38''E respectively. The latter is at Latitude 7° 13' 57.53'' N., at an elevation of 1141 feet and longitude 3° 26' 12.38''E (Google Earth, 2020). The climate is humid with an average annual rainfall of 1,037 mm, a mean

temperature and humidity of 43.7°C and 83%. It is situated in the rainforest vegetation zone.

Sourcing of test ingredient

The test ingredient (FDCP) was obtained from Psaltry industry, a starch processing industry along Maya Ado-Awaye Road, Iseyin Local government area, Oyo-State, Nigeria. Iseyin geographical coordinates are latitude 7° 58' 0" North and longitude 3° 36' 0" East.

Experimental diets

The test feeds were formulated so that FDCP partially replaced maize at level of 0, 5, 10 and 15% in starter, as shown in the Table 1. Iso-proteinous and iso-caloric diets were formulated in compliance with the NRC 1994 guideline (NRC, 1994).

Table 1: Gross composition (%) of experimental diets for growing turkey (9– 12 weeks)

Ingredients (kg)	FDCP levels of replacement			
	0%	5%	10%	15%
Maize	52.00	47.00	42.00	37.00
FDCP	0.00	5.00	10.00	15.00
Full fat soybean	10.00	11.50	13.00	14.50
Soybean meal	20.00	20.00	20.00	20.00
Wheat offal	8.00	6.50	5.00	3.50
Fish meal (72 %CP)	4.50	4.50	4.50	4.50
Lime stone	2.00	2.00	2.00	2.00
Bone meal	2.30	2.30	2.30	2.30
Lysine	0.20	0.20	0.20	0.20
Methionine	0.50	0.50	0.50	0.50
Vitamin/mineral Premix	0.25	0.25	0.25	0.25
NaCl	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated values				
ME (MJ/kg)	11.96	11.87	11.77	11.68
Crude protein (kg)	22.55	22.42	22.28	22.15
Calcium (%)	1.84	1.84	1.84	1.84
Phosphorous (%)	0.67	0.67	0.66	0.66
Lysine (%)	1.56	1.13	1.08	1.04
Mthionine (%)	0.83	0.81	0.80	0.79

FDCP = Flash Dried Cassava Pulp ME = Metabolizable Energy NaCl = Sodium Chloride

* Vitamin/mineral premixes: Vitamin A – 13,340 iU., Vitamin E – 105 mg, Vitamin K3 – 3 mg, Vitamin B2 – 5 mg, Vitamin B6 – 4 mg, Ethoxyquin – 100 mg, Vitamin B1 – 3 mg, Vitamin D3 – 3,260 iU., Vitamin B12 – 0.04 mg, Niacinamide – 40 mg, Folic acid – 1.5 mg, Ca pantothenate – 12 mg, Biotin – 0.15 mg, Choline-Cl – 250 mg, Copper- 3.3 mg Zinc – 60 mg, Iron – 50 mg, manganese – 80 mg, iodine – 1 mg, and silicon – 0.25 mg

Experimental design and turkeys' management

One hundred and twenty (120) day-old British United Turkey (BUT) poults were sourced from a reputable farm in Nigeria and were brooded for twenty eight (28) days by using commercial pre-starter turkey. A standard deep litter system was used for the experiment (growing phase). Prior to the arrival of turkey poults, brooding pen, environment, facilities, equipment were thoroughly cleaned and properly disinfected. Brooding was done on deep litter pens, each pen (dimension 2.0m x 1.5m) containing 5 birds. Electricity and charcoal pots were the sources of heat. Birds were provided water and feed *ad libitum*. Vaccination and medication protocols were strictly followed. Management was firmly monitored to prevent build up pathogens. At the end of 28-day brooding period, turkey starters were randomly assigned into four (4) dietary treatments in a completely randomized design (CRD) and carried over to growing phase. Thirty (30) growing turkeys were assigned per treatment and replicated six (6) times with five (5) growing turkeys per replicate.

Haematological parameters

At 12th weeks of the experiment, 3 ml blood sample was collected via the wing vein into vials containing ethylene diamine tetra-acetic acid (EDTA) as an anti-coagulant for the determination of haematological parameters (packed cell volume, haemoglobin, white blood cells, red blood cells and differential counts to determine neutrophil, eosinophil and basophil counts) as described by Baker and Silvertom (1985).

Serum biochemistry

Another set (3 mls) blood sample was collected into heparinized tubes for serum

biochemistry measurement (total serum protein, serum albumin, serum globulin, serum uric acid, serum creatinine, serum glucose, aspartate aminotransferase, alanine aminotransferase and alkaline phosphate) using standard procedures.

Statistical analysis

Using SPSS (2021), a one-way analysis of variance (AOAC) was performed on all collected data. Duncan's multiple range test (Duncan, 1955) was used to differentiate significant ($p < 0.05$) means between variables.

Statistical models

$$Y_{ij} = \mu + T_i + \epsilon_{ij}$$

where:

Y_{ij} = Observed value of dependent variable

μ = Population mean

T_i = Effect of treatment (0, 5, 10, 15%)

ϵ_{ij} = Random residual error

Results

The results of the haematological parameters of turkeys growers fed with varied flash-dried cassava pulp are presented in Table 2. The results revealed significant effect ($p < 0.05$) in monocytes and mean corpuscular haemoglobin concentration (MCHC) while non-significant effect ($p > 0.05$) in white blood cells, neutrophils, lymphocytes, eosinophils, basophytes, packed cell volume, haemoglobin, red blood cells (RBC), mean cell volume and mean cell haemoglobin. Monocytes had the higher significant ($p < 0.05$) value of 1.00 (%) from 5% FDCP to 10% FDCP, while 0% FDCP gave (0.00%). The MCHC exhibited highest (34.14 g/dl) significant ($p < 0.05$) effect in growing turkeys fed with 0% FDCP, while the lowest (32.13 g/dl) was recorded in the growing turkeys fed 10% FDCP.

Table 2: Haematological indices of grower turkeys fed experimental diets (9-12 weeks)

Parameters	FDCP levels of replacement				SEM	P-value
	0%	5%	10%	15%		
Packed cell volume (%)	34.33	34.33	37.00	35.67	0.63	0.396
Haemoglobin (g/dl)	11.70	11.10	11.87	11.70	0.17	0.444
Red blood cell ($\times 10^{12}/l$)	3.87	3.33	4.33	3.70	0.15	0.134
White blood cell ($\times 10^9/l$)	13.20	13.50	13.77	14.43	0.27	0.439
Neutrophils (%)	30.67	28.67	30.00	30.00	0.38	0.313
Lymphocytes (%)	69.00	69.00	69.00	69.67	0.36	0.900
Eosinophils (%)	0.00	0.67	0.00	0.00	0.12	0.089
Basophytes (%)	0.33	0.00	0.00	0.00	0.08	0.089
Monocytes (%)	0.00 ^b	1.00 ^a	1.00 ^a	0.33 ^{ab}	0.60	0.045
MCV (fl)	90.86	104.36	87.90	99.93	3.70	0.373
MCH (pg)	31.14	33.87	28.14	32.87	1.28	0.431
MCHC (g/dl)	34.14 ^a	32.28 ^b	32.13 ^b	32.91 ^{ab}	0.30	0.032

^{a,b} Means within the same row with different superscripts are significantly different ($P < 0.05$). SEM= Standard error of the mean, MCV= Mean volume, MCH = Mean corpuscular haemoglobin MCHC=Mean corpuscular haemoglobin concentration.

The serum biochemistry parameters of growers' turkey are shown in Table 3. Uric acid, aspartate transaminase (AST), total bilirubin, density bilirubin and creatinine were significantly ($p < 0.05$) affected by flash-dried cassava pulp, however, total protein, albumin, globulin, glucose, triglyceride, cholesterol, alkaline phosphate (ALP) and alanine transferase (ALT) were not significantly ($p > 0.05$) affected. A highly significant value (113.00 U/L) ($p < 0.05$) of aspartate transaminase (AST) was observed from growing turkeys fed 10% FDCP, while the lowest value (94.00 U/L) was observed from growing turkeys placed on 5% FDCP. Alanine transaminase (ALP) showed a highly (33.00 U/L) significant ($p < 0.05$) value in growing turkeys fed with 15% FDCP while the lowest (10.00 (U/L) significant ($p < 0.05$) difference

was obtained from growing turkeys fed with 5% FDCP. Total bilirubin ranged from 0.18 (mg/d) to 0.53 (mg/dl), with the highest value (0.53 mg/dl) occurred in the growing turkeys treated with 15% FDCP while the lowest significant difference of 0.18 (mg/dl) ($p < 0.05$) was observed at 5% FDCP. Density bilirubin had the highest (0.18mg/dl) significant effect ($p < 0.05$) in growing turkeys fed with 10% FDCP. Growing turkeys fed 5% (FDCP) had the lowest (0.04 mg/dl) significantly different ($p < 0.05$) density bilirubin. Creatinine showed a significant differences ($p < 0.05$) from 1.12 (mg/dl) to 2.26 (mg/dl). Grower turkeys treated with 15% FDCP showed the highest significant value ($p < 0.05$) of 2.26(mg/dl) while those treated with 5% FDCP showed lowest value ($p < 0.05$) of 1.20 (mg/dl).

Table 3: Serum biochemistry of growing turkeys fed experimental diets (9-12 weeks)

Parameters	FDCP levels of replacement				SEM	P-value
	0%	5%	10%	15%		
Total protein, (g/dl)	5.40	6.03	6.20	6.07	0.36	0.878
Albumin (g/dl)	3.47	3.53	4.17	3.80	0.27	0.812
Globulin (g/dl)	1.97	2.50	2.07	2.27	0.16	0.686
Glucose (g/dl)	141.00	141.90	141.37	148.27	4.03	0.921
Triglyceride (mg/dl)	61.43	58.53	67.73	68.23	5.50	0.916
Cholesterol, (mg/dl)	89.97	81.87	84.73	82.97	4.45	0.932
Uric acid (mg/dl)	8.03 ^a	5.00 ^c	7.33 ^{ab}	6.00 ^{bc}	0.38	0.014
AST (U/L)	111.00 ^a	94.00 ^b	113.00 ^a	110.33 ^a	2.60	0.022
ALT (U/L)	24.33	22.00	26.67	25.33	0.80	0.202
ALP (U/L)	20.67	10.00	13.67	33.00	3.36	0.066
TB (mg/dl)	0.28 ^b	0.18 ^b	0.27 ^{ab}	0.53 ^a	0.04	0.014
DB (mg/dl)	0.07 ^b	0.04 ^b	0.18 ^a	0.05 ^b	0.02	0.003
Creatinine (mg/dl)	1.13 ^b	1.20 ^b	1.58 ^b	2.26 ^a	0.13	0.002

^{a,b,c} Means within the same row with different superscripts are significantly different (P<0.05). SEM = Standard error of the mean, AST = Aspartate transaminase, ALT = Alanine transaminase, ALP = Alkaline phosphate, TB = Total bilirubin, DB = Density bilirubin

Discussion

Monocytes and mean corpuscular haemoglobin concentration were significantly affected by the experimental diets. Red blood cells of growing turkeys from this study fluctuated across dietary treatment groups and compared favourably with the control (0% FDCP) diets. The values of non-significant indices observed in the growing phase from this finding fell within the standard ranged reported by Makinde and Inuwa (2015), who opined a non-significant effect of haematological parameters of grower turkeys fed unconventional feed resources. Growing turkeys given varying quantity of FDCP diets showed a significant variation in their monocyte values, with the highest numerical values recorded. This suggested that growers turkeys fed FDCP diets were capable of withstanding infection from any foreign body. This is in agreement with the findings of Ehebha and Eguaoje, (2018), who found significant variants from monocyte counts of broilers' fed sun-dried agro industrial by-

products. The MCHC values verified fall within standard ranges reported by Adediran and Omojola (2021). Overall haematological indices observed in this research indicate good health status of the turkeys at growing phase. This implies that the health status of growing turkeys is not negatively impacted by different degree of FDCP diet substitution for maize in grower turkeys' diets.

Varying levels of inclusion of FDCP diets in grower turkeys showed significant differences, on uric acid, aspartate transaminase (AST), total bilirubin, density bilirubin and creatinine. The low uric acid suggests the physiological tendency of the digestive capacity of the animal to efficiently utilize nitrogen, recycle urea and possibly conserve nitrogen (Rajman *et al.*, 2006). Moreover, the concentration of uric acid is determined by the high protein content (Agboola *et al.*, 2013). It can be inferred that there was no liver or renal malfunction as the uric acid content of growing turkeys fed the dietary treatments (FDCP) was comparable to the control diet.

The similarity in AST of growing turkeys observed from 10% and 15% FDCP diets in this finding revealed that varying levels of FDCP diets did not have any negative influence on liver function, therefore, livers were in good condition. The observed similar ALP values from growing turkeys fed dietary treatments with control diet showed that grower turkeys had sufficient dietary protein absorption and utilization. Both AST and ALP values obtained are consistent with Ogunwale *et al.* (2017) who reported similarity between AST and ALP when broiler chickens were fed cassava grits. Creatinine is the breaking down product of creatine, which is mainly produced relatively continuously by the body and excreted through kidneys (Ojo *et al.*, 2022). According to Nwanjo *et al.* (2005), when the kidneys' capacity to filter chemicals is impaired, blood creatinine levels will rise. Grower turkeys from these findings showed statistically equivalent levels of creatinine throughout dietary treatments, with exception of those fed on 15% FDCP, but all observed values (1.20–2.26 mg/dl) fell within normal values of 0.2–3 mg/dl reported by Mitruka and Rawnsley (1981). This study is an indication of the reduction in the anti-nutritional factor in these diets. This shows no muscular waste at the growing phase of the turkeys in this study. Serum enzymes levels are important for determining if the liver is working properly (Ambrosy *et al.*, 2015) and have proven to be of great value in the assessing clinical and experimental liver injury (Olawale, 2019). An increase in the concentrations of serum enzymes could be caused by damage or injury to the liver. The AST values determined in this study (94.00–113.00 U/L) were below values of 164.75–191.25 (U/L) reported by Okrathok *et al.* (2018) when cassava was substituted for maize in the diets of laying hens. An increase in AST value above the normal range indicates liver injury, shock or chronic liver problems (Basten, 2010), hence, AST observed in this finding showed normal liver function. Therefore, varied flashed-dried cassava pulp

from this finding had no negative effect on health status of the grower turkeys.

Conclusion

Based on the outcome of this finding, flashed-dried cassava pulp up to 15% level of inclusion did not pose any adverse effect on blood profiles of turkeys at growing phase of the study.

Recommendation

Inclusion of FDCP to replace maize beyond 15% level in the diets of turkeys starter should be researched on.

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