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Effect of Pelletized Cassava Peel -Based Diets on Haematological Parameters of Broiler Starter Chicken

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ABSTRACT

This study investigates the hematological response of broiler chicken to varied levels of cassava peel as a replacement for maize. Three experimental diets were formulated; T1 (0% cassava peel), T2 (10% cassava peel inclusion) and T3 (20% cassava peel inclusion) respectively. On last day of a 30-day feeding and growth trial, a set of 2ml blood samples were taken from 3 broilers per treatment into plastic tubes containing the anti-coagulant ethylene diamine tetra-acetic acid (EDTA) for the determination of hematological parameters: PCV, Hb, RBC, WBC, MCHC, MCH and MCV. Results on the blood parameters of broilers fed the experimental diets showed normal range of blood values: PCV-36.50-37.50%; Hb-12.10-13.30g/dl; RBC- $2.6 \times 10^6/\text{mm}^3$; WBC- $5.00-9.15 \times 10^3$; MCV-14.05-15.30fl; MCHC-3.30-3.40% and MCH-4.63-5.10pg recommended for healthy birds. The significant difference was observed in the WBC alone in T3 ($p < 0.05$). Therefore, cassava peel replacement at varying levels with maize as prescribed in this study can serve as an alternative energy source in broiler feed, with minor difference on the hematological responses of broiler starters at 20% inclusion.

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INTRODUCTION

Cassava (*Manihot esculenta*) represents a significant human food resource and, in many regions, an underutilized animal feed ingredient on a worldwide scale. It has been extensively cultivated as an animal crop in tropical and subtropical regions for its edible underground tuberous root, acknowledged as one of the highest yielders of starch and third largest source of food carbohydrates in the tropics, following rice and maize (Lukuyu *et al.*, 2014). For instance, cassava has been described as a major staple for in the developing world, providing a base diet for over 800 million people (Lebot 2009). Cassava peels are the outer protective layers of the cassava root, consisting of the skin and the fibrous under layer. These peels are rich in carbohydrates, primarily in the starch, and contain varying levels of proteins, fibers, vitamins, and minerals. However, they also contain anti-nutritional factors, including cyanogenic glycosides, which can be toxic to animals if ingested in large quantities (Akinfala *et al.*, 2002). Evaluation of the nutritive value of the whole cassava plant as replacement for maize in the starter diets for broiler chicken. Studies by Kana *et al.* (2012) evaluated the effect of cassava meal supplemented with a combination of palm oil and cocoa husk as alternative energy source on broiler growth and reported that substituting up to 75% of maize with cassava meal supplements with mixture of palm oil and cocoa husk seems profitable for productive performances. Nwokoro and Ekhoehi (2005). Effect of replacement of maize with cassava peel in cockerel diets on performance and carcass characteristics. Tropical Animal Health Production and reported that cassava peels have been revealed to be a viable ingredient at up to 15% inclusion in diets fed to broilers with a variety of locally available protein sources (I.e. groundnut cake, cashew nut meal, palm oil and methionine). Egbunike *et al.*, (2009) studied the effects of protein on performance and hematology of broilers fed cassava peel based diets and reported that hematological responses are good indicators of the physiological status and acts as a pathological reflector of the status of exposed animals to toxicant and other conditions, hence animals with good blood composition are likely

to show good performance as well as provides a good nutritional assessments of diets.

A broiler is any chicken (*Gallus gallus domesticus*) that is bred and raised specifically for meat production. Most commercial broiler birds attain table size between 4-7 weeks of age, although slow growing breeds achieve this at approximately 14 weeks of age. Broiler chicken are typically characterized by their fast growth rate and efficient conversion of feed into muscle tissue. Broiler chickens were developed in the early 20th century through selective breeding programs aimed at producing chickens with desirable traits for meat production (Moran, 2007). The process involved crossbreeding different chicken breeds to enhance growth rate feed efficiency, and muscle development. Broiler chickens are known for their rapid growth and ability to reach market weight in a relatively short period (Karnuah and Sebastian 2010). They have a high feed conversion ratio, meaning they efficiently convert feed into muscle tissue (Shivaprasad 2000). These chickens have a broad and muscular breast, large legs, and relatively short feathers compared to other chicken breeds.

Hematological responses are good indicators of the physiological status (Khan *et al.*, 1994) and acts as a pathological reflector of the status of exposed animals to toxicant and other conditions (Olafedehin *et al.*, 2010), hence animal with good blood composition are likely to show good performance (Isaac *et al.*, 2013) as well as provide a good nutritional assessments of diets (Egbunike *et al.*, 2009). This study therefore investigated the hematological responses of broiler chicken fed varied levels of cassava peel meal as a replacement for maize. The objective of the study is to evaluate the impact of pelletized cassava peel-based diets on hematological indices of broiler chicken.

MATERIALS AND METHODS

Site of the Study

The experiment was carried out at the poultry unit of the Olusegun Agagu University of science and Technology (OAUSTECH), Okitipupa, Ondo State, Nigeria. It is located on 6°27'11.5''N 4°46'05.0''E.

Processing of cassava peels for inclusion in composite broiler diets

Cassava peels were collected from cassava processing farms around Okitipupa between the month of December and January. The peels were sun dried for an average of 4-5 days depending on the intensity of sunlight and grinded using local hammer mill to fine particles and stored in sealed nylon bags. Other feed ingredients were bought from commercial feed mill in Akure.

Experimental Birds and Management

A total of 90-day-old Broiler chicks of 0.355 ± 0.5kg were used for the experiment. The birds were randomly allocated to deep litter brooder pens. They were raised for a period of 30 days. All the vaccinations and medications schedules were observed on treatment basis.

Experimental Diets

A total of three (3) experimental diets were formulated. The diets were fed to the broilers for weeks. Diet 1 contained maize as the main energy source, Diet 2 contained 10% cassava peel, Diet 3 contained 20% cassava peel as the main source of energy and were given as T1, T2, T3 respectively. Thirty birds were allocated to each treatment in a completely randomised design. The composition of the experimental broiler starter diets is shown in Table 1.

Sample collection, handling and analysis

Blood samples were collected from the brachial wing vein, which is located between the bicep and tricep at the underside of the wing by using 5ml syringe and blood were transferred into EDTA bottles for laboratory analysis. Haematological parameters were evaluated on the blood samples. The samples were placed in a sample container labeled and carried in a flask (cooler) with ice packs and taken to heamatology laboratory.

Blood sampling and heamatology measurements

Blood sampling was drawn from the brachial wing vein, which is located between the bicep and tricep at the underside of the wing using 5ml syringe. Ethylene Diamine Tetra Acetic (EDTA) was used as anticoagulant. Blood profiles were measured to determine the health status of livestock and blood parameters measured were hemoglobin levels, the number of red blood cells and white blood cells, packed cell volume/hematocrit, white blood cells using techniques of Pampori and Iqbai. A counting chamber was used to count the RBC and WBC. The percentage of heamoglobin was measured by using 0.1N HCL and distilled water that converted the haemoglobin into acid haematin.

Hematological analysis

Procedure:

1. **Sample collection:** Collect a blood sample from birds using a sterile needle and syringe or blood collection tube.
2. **Sample preparation:** Process the blood sample by:
 - i. Centrifuging to separate blood components
 - ii. Aliquoting for specific tests
 - iii. Storing samples appropriately
3. **Complete Blood Count (CBC):** Perform a CBC using an automated hematology analyzer to measure:
 - i. Red Blood Cell Count (RBC)
 - ii. White Blood Cell Count (WBC)
 - iii. Platelet Count
 - iv. Hemoglobin (Hb)
 - v. Hematocrit (Hct)
4. **Blood Smear Preparation:** Prepare blood smears for microscopic examination by:
 - i. Spreading a thin layer of blood on a glass slide
 - ii. Staining with Wright's or Giemsa stain
 - iii. Allowing the stain to dry

Statistical Analysis

Data were subjected to One-way Analysis of Variance (ANOVA) using general linear model (GLM) procedure of SAS 9.13 (2004). Treatment means were separated using Duncan Multiple Range Test at 5% level of significance.

Table 1: Composition of experimental broiler starter diets (in kg)

INGREDIENTS (%)	T1	T2	T3
Maize	46	36	26
Cassava peel	0	10	20
Soybean	21.1	20.1	19
Groundnut cake	15	15	15
Fish meal	2	2	2
Wheat offal	10.95	11.95	11.95
Bone meal	2	2	2
Oyster shell	2	2	3
Salt	0.25	0.25	0.25
Premix	0.25	0.25	0.25
Methionine	0.2	0.2	0.3
Lysine	0.25	0.25	0.25
Total	100	100	100

Diet T1: Control (maize-based); Diets T2 and T3: 10% and 20% replacement of maize with CPM

RESULTS

The proximate composition of the experimental diets was assessed based on ash content, moisture, ether extract, crude fibre, crude protein, and nitrogen-free extract (N.F.E) across the three treatment groups (Table 2). Mean

values with standard errors are provided, along with p-values indicating statistical differences among treatments. These parameters reflect the nutritional variation in the diets due to different levels of cassava peel inclusion.

Table 2: Proximate composition of experimental diets fed to broiler chickens

Parameter (%)	T1	T2	T3	SEM	p-value
Ash	10.70 ^b ±0.09	9.58 ^c ±0.02	11.84 ^a ±0.03	0.41	0.0002
Moisture	7.27 ^b ±0.22	7.07 ^b ±0.04	10.69 ^a ±0.18	0.75	0.0009
Ether Extract	8.33 ^a ±0.10	8.65 ^a ±0.14	7.57 ^b ±0.18	0.21	0.026
Crude fibre	6.65 ^b ±0.20	7.93 ^b ±0.01	18.69 ^a ±0.56	2.42	0.0003
Crude Protein	20.40 ^a ±0.11	17.60 ^b ±0.01	15.68 ^c ±0.05	0.86	0.0001
N.F.E	46.65 ^a ±0.32	49.19 ^a ±0.10	35.55 ^b ±0.93	2.66	0.0009

Means on the same row with different superscripts differed significantly (P<0.05).

Diet T1: Control (Maize based); Diet T2 and T3; 10% and 20% replacement of maize with CPM; N.F.E (nitrogen free extract).

The hematological parameters of broiler chickens, including Packed Cell Volume (PCV), Hemoglobin concentration (Hb), Red Blood Cell count (RBC), White Blood Cell count (WBC), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Mean Corpuscular Hemoglobin Concentration (MCHC), were evaluated across three dietary

treatments involving different levels of cassava peel inclusion (Table 3). The values are expressed as means with their respective standard errors, and the table also presents p-values to indicate the level of statistical significance observed among the treatment groups.

Table 3: Effect of different levels of cassava peel inclusion on hematological parameters of broiler chicken

Parameters	T ₁	T ₂	T ₃	SEM	p-value
PVC (%)	37.50 ^a ±1.44	36.50 ^a ±0.87	37.50 ^a ±1.44	0.66	0.82
Hb (g/dl)	12.35 ^{ab} ±0.50	12.10 ^b ±0.29	13.30 ^a ±0.00	0.25	0.09
RBC (x 10 ⁶ /μ/L)	2.60 ^a ±0.00	2.60 ^a ±0.00	2.60 ^a ±0.00	0.00	0.003
WBC (x 10 ³ /μ/L)	7.00 ^b ±0.58	5.00 ^b ±0.58	9.15 ^a ±0.66	0.67	0.009
MCV (fl)	14.30 ^a ±0.58	14.05 ^a ±0.32	15.30 ^a ±0.00	0.27	0.12
MCH (pg)	4.78 ^{ab} ±0.19	4.63 ^b ±0.10	5.10 ^a ±0.00	0.10	0.08
MCHC (g/dl)	3.30 ^a ±0.06	3.40 ^a ±0.12	3.30 ^a ±0.00	0.04	0.82

Means on the same row with different superscripts differed significantly (P<0.05).

Diet T1: Control (Maize based); Diet T2 and T3; 10% and 20% replacement of maize with CPM; SEM: Standard Error of Means; CPM: Cassava Plant Meals Treatment effect)

DISCUSSION

The PVC values in this study ranged from 36.50% to 37.50%, with no significant difference among the groups. This is consistent with previous findings by Esonu *et al.* (2001), who reported that the inclusion of cassava peel meal in broiler diets did not significantly alter PVC values, suggesting that cassava peel does not negatively impact the erythropoietic function of the birds. In contrast, Osei and Duodu (2016) observed a slight decrease in PVC when higher levels of cassava peel were included in the diet, possibly due to reduced nutrient availability leading to slight anemia. The variations in hemoglobin levels in this study between 12.10 g/dL to 13.30 g/dL. This range was similarly reported by Aro *et al.* (2013) and could be due to the hemoglobin concentration which did not significantly change with the inclusion of up to 20% cassava peel in the diet. However, some studies, such as that of Teguia *et al.* (2004), noted a slight reduction in hemoglobin levels when cassava peel was included at higher levels, which they attributed to the presence of cyanogenic glycosides in cassava that might affect iron absorption. The values of RBC reported in this study was in line with the findings of Dada *et al.* (2017), who found RBC counts to not significantly affect the dietary inclusion of cassava peel. The consistency in

RBC values suggests that cassava peel can be included in broiler diets without negatively affecting red blood cell production, confirming Adeyemi *et al.* (2008) who also observed no significant changes in RBC counts. The WBC count showed significant variation, with a decrease in WBC count in the T2 group and an increase in the T3 group. A similar trend was reported by Olukosi *et al.* (2018), where the immune response was modulated by varying levels of cassava peel, leading to changes in WBC counts. High WBC counts could indicate an immune response to potential antinutritional factors in cassava peel, as suggested by Nworgu *et al.* (2007), who observed similar responses in broilers.

MCV and MCH values in this study ranged between 14.05 fl to 15.30 fl and 4.63 pg to 5.10 pg, respectively. These values are comparable to those reported by Odukoya *et al.* (2012), who found that cassava peel inclusion did not significantly affect MCV and MCH, suggesting that the erythrocytes' size and hemoglobin content remained stable. Nkwocha *et al.* (2014) also observed no significant changes in MCV and MCH with up to 20% cassava peel inclusion, further supporting the idea that moderate inclusion of cassava peel does not impair erythrocyte function.

MCHC values remained relatively stable across treatments, ranging from 3.30 g/dL to 3.40 g/dL, which is consistent with findings by Ajayi *et al.* (2007). They reported that the inclusion of cassava peel did not significantly alter the MCHC, indicating that hemoglobin saturation in red blood cells was unaffected.

CONCLUSION

The hematological responses observed in this study suggest that cassava peel can be included in broiler diets at varying levels (10% and 20% replacement of maize) without significantly affecting hematological parameters. The slight variations in WBC counts and the potential impact on hemoglobin levels at higher inclusion rates should be considered, particularly in relation to the presence of anti-nutritional factors like cyanogenic glycosides in cassava peel.

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