



# **Haematological and Serum Biochemical Indices of Broiler Chickens fed Varying Dietary Levels of Sundried Cassava (*Manihot esculenta*) Peel Meal Supplemented with Enzyme (MAXIGRAIN®)**

**E. T. E. Ehebha<sup>1</sup> and A. S. Eguaoje<sup>1\*</sup>**

<sup>1</sup>*Department of Animal Science, Faculty of Agriculture, Ambrose Alli University, Ekpoma, Edo State, Nigeria.*

## **Authors' contributions**

*This work was carried out in collaboration between both authors. Author EETE designed the study, performed the statistical analysis, wrote the protocol and first draft of the manuscript. Author EAS managed the analyses of the study. Author EAS managed the literature searches. Both authors read and approved the final manuscript.*

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## **ABSTRACT**

An eight week feeding trial was conducted at the Poultry Unit of the Teaching and Research Farm, Ambrose Alli University Ekpoma to evaluate the haematological and serum biochemical indices of broiler chickens fed varying levels of sundried cassava peel meal supplemented with enzyme (MAXIGRAIN). A total of one hundred and twenty day-old Anak 2000 broiler chicks was used for this experiment. Forty chicks were randomly selected based on their average initial weights to each of the four treatment diets. (T<sub>1</sub> to T<sub>4</sub>) with T<sub>1</sub> serving as a control and T<sub>2</sub> to T<sub>4</sub> having an inclusion level of Sundried cassava peel meal (SDCPM) at 20, 40, and 60% replacement levels for maize with Maxigrain® enzyme supplementation at the rate of 100mg/kg in a complete randomized design (CRD). The chicks were brooded and fed for four weeks with commercial starter diet. Thereafter they were fed formulated finisher diets for 4 weeks. The result on the haematological parameters revealed that haemoglobin was significantly (P<0.05) higher from birds fed 40% sundried cassava

\*Corresponding author: E-mail: [eguaojeabiodunstanley@gmail.com](mailto:eguaojeabiodunstanley@gmail.com);

peel meal plus maxigrain supplement (SDCPM + Maxg) with the mean value of 41.68g/dl. Red blood cell was also significantly ( $P<0.05$ ) highest ( $7.35 \times 10^6/\text{ml}$ ) from birds fed 40% (SDCPM + Maxg). MCV and Platelet values were also significantly ( $P<0.05$ ) influenced by the treatment diets with highest values of 59.58fl and  $3.21 \times 10^3/\text{mm}^3$  respectively. Neutrophil and monocyte values were significantly ( $P<0.05$ ) higher from birds fed 40% (SDCPM + Maxg) with an average values of (29.02% and 4.33%). Serum biochemical indices of broiler chickens fed the treatment diets showed that glucose and cholesterol were significantly ( $P<0.05$ ) influenced by the various dietary treatments with highest values of 113.68mmol/L and 116.20mmol/L recorded from birds placed on the control diet the values were within the normal range. The overall result in this study showed that sundried cassava peel meal supplemented with maxigrain can successfully be included in broiler ration up to 40% level without any adverse effect on the blood quality of broiler chickens.

**Keywords:** *Haematology; serum biochemistry; maxigrain; broiler chicken; sundried cassava peel meal.*

## 1. INTRODUCTION

Feed is of utmost importance in broiler chicken production [1] it amounts to about 60-75% of the total cost of production for intensively reared stocks [2]. This has been attributed to the trend of competition between humans and livestock as a result of high cost of conventional feed stuff which in turn affects animal protein intake by man [3]. In an attempt to combat the challenges of feed, researchers have stressed the need for utilization of cheaper, locally available and nutritionally viable alternative feedstuffs far removed from human and industrial interests, thereby limiting the dependence on maize for livestock [4,5]. The effort has also been geared towards the utilization of relatively cheaper and available root and tubers in recent years. Example of such root and tuber is cassava.

Cassava (*Manihot esculenta* Crantz) is a tuber crop widely cultivated in Nigeria with an average annual production estimate of 45 million tonnes [6]. It is the highest supplier of carbohydrate among energy staple food stuff [7]. Also, it offers a great potential as cheap, alternative energy feedstuff in rations for livestock [8]. Cassava peel is an abundant and less expensive agro-industrial by-product, farm waste or crop residue resulting from the processing of cassava roots for human consumption which can be exploited as alternative feed resource in the diets of monogastric stocks to high energy cereals particularly maize [9]. However, the use of cassava peel has largely remained under utilized as livestock feed due to its high cyanide and fibre content, poorer protein quality and powdery nature of its meal compared to cereal grains. As a cyanide-bearing waste, fresh cassava peel has to be processed in order to reduce its cyanide

level which is deleterious to growth and development of poultry [10] and promote its acceptability and utilization in finished feeds. As a result, several processing methods such as sun-drying, ensiling and fermentation have been reported to effectively reduce the concentration of the anti-nutritional factors in cassava meal to tolerable levels [11].

Fermentation technology has been used as a method of improving the nutritional value of cassava peel meal by reducing the anti-nutritional factors, high crude fibre content and enriching the protein content in livestock feeds [12,13]. An improvement was also reported in the crude protein concentration of cassava root meal when fermented with fresh rumen filtrate with source of nitrogen or the use of other synthetic enzymes [14,15]. Feed enzyme such as maxigrain application in farm animal diet supplements the enzyme complement of young animals in which the rate of endogenous enzyme production may be limiting [16]. Phytase supplementation of P-deficient diets resulted in improved growth performance of pigs [17] and improved P and Ca utilization [18,19]. Enzyme supplementation has also been reported to improve average daily weight gain and feed intake of young pigs and poultry [20]. It also enhances total tract digestibility of dry matter and nitrogen [21]. The various functions of the blood are made possible by the individual and collective actions of its constituents the haematological and biochemical components. Generally speaking, both the haematological and biochemical blood components are influenced by the quantity and quality of feed and also the level of anti-nutritional elements or factors present in the feed [22]. Biochemical components are sensitive to elements of toxicity in feeds [23]. Haematological components of blood are also

valuable in monitoring feed toxicity especially with feed constituents that affect the formation of blood [24]. This study is therefore aimed at investigating the haematological and serum biochemical indices of broiler chickens fed varying dietary levels of cassava peel meal supplemented with enzyme (MAXIGRAIN®)

## 2. MATERIALS AND METHODS

### 2.1 Location and Duration of the Study

The experiment was carried out at the Poultry Unit of the Livestock, Teaching and Research Farm, Ambrose Alli University, Ekpoma, Edo State, Nigeria for a period of eight (8) weeks.

### 2.2 Sourcing and Processing of Cassava Peel

Fresh cassava (*Manihot esculenta*) peels was collected from local cassava processing centers or in-house cassava processors in Ekpoma Esan west local government area of Edo state. The cassava peels were soaked in water inside a metal drum for three (3) days, after which they were removed and drained with a basket and sun-dried for five (5) days before milling to fine particles of 2 mm in diameter, using a hammer mill. The resultant product was incorporated into broiler's diets at varying levels stipulated in the study.

### 2.3 Chemical Analysis

Feed samples were analyzed for proximate composition according to the method of [25] as shown in Table 1.

### 2.4 Management of Experimental Birds and Design

A total of one hundred and twenty (120) day old Anak 2000 broiler chickens were used for the experiment. They were randomly sub-divided into 4 dietary treatments of three replicates, with ten birds each in a completely randomized design. Feed and water was given to the birds' *ad-libitum*. Lighting source was provided using electricity bulbs during the night. The birds were administered anti-stress and vitamin/mineral premix orally at the recommended dosage after randomization before the commencement of the experiment. The birds were reared on deep litter in an open-sided wire mesh constructed poultry house to allow for adequate ventilation.

Medications, vaccinations and other routine management practices were strictly followed. The birds were offered experimental diets and cool, clean water *ad-libitum* throughout the eight weeks period of the experiment.

### 2.5 Experimental Diets and Treatments

Four experiment diets were formulated to contain Maxigrain enzyme supplemented cassava peel meal to replace maize at 0, 20, 40 and 60% as T1, T2, T3 and T4 respectively. Treatment 1 was the control diet with no cassava peel meal and enzyme inclusion while diets 2, 3 and 4 contained Maxigrain® enzyme supplementation at the rate of 100 mg/kg. The experimental diets composition is presented in Table 2.

### 2.6 Haematological and Serum Biochemical Studies

At about 8 weeks, 3 over night fasted birds were selected per treatment making a total of 12 birds and blood samples were collected through wing veins of the birds. A set of samples were collected into sterilized tubes containing ethylene diamine tetra-acetic acid (EDTA) labeled bottle for haematological studies, while another set of blood samples were collected from the same birds into heparinised tubes for serum chemistry determination. Packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC) and haemoglobin (Hb) was determined using improved Neubauer's haemometer after dilution, and cyanomethamoglobin methods as described by [26], mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), Mean corpuscular haemoglobin concentration (MCHC) and serum metabolites such as total protein, albumin, creatinine, and urea was determined by the method of [27], while globulin was estimated by the subtraction of albumin value from serum total protein value [26].

**Table 1. Proximate composition of sundried cassava peel**

Parameters	SCPM	Maize
Moisture	10.03	10.09
Crude protein	4.80	9.80
Crude fibre	16.91	2.70
Ether extract	1.38	2.40
Crude ash	5.52	5.57
NFE	61.36	69.44
Carbohydrate	22.23	43.21
ME(Kcal/kg)	3015.40	3315.45

**Table 2. Gross composition of experimental broiler finisher diets**

	Inclusion levels of SDCPM+Maxg (%)			
	0	20	40	60
	Diets			
Ingredients	1	2	3	4
Maize	40.00	30.00	20.00	10.00
SCPM	0.00	10.00	20.00	30.00
Soya bean meal	25.00	25.00	25.00	25.00
Wheat offal	10.00	10.00	10.00	10.00
Palm kernel meal	18.00	16.00	17.00	16.00
Fish meal	1.00	2.00	3.00	5.00
Oyster shell	1.50	1.50	1.50	1.50
Bone meal	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50
Premix	0.50	0.50	0.50	0.50
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Crude protein	21.00	21.00	21.00	21.00
ME (Kcal/kg)	2902	2895	2896	2893

## 2.7 Statistical Analysis

All the data collected were subjected to analysis of variance (ANOVA) and differences between means and treatments were determined using Duncan's multiple range test (DMRT) at 5 percent level of probability. All statistical procedures were according to [28] using [29] package.

## 3. RESULTS

### 3.1 Haematological Indices of Broiler Chickens Fed Sundried Cassava Peel Meal with Maxigrain Supplementation

Haematological indices of broiler finisher as influenced by the dietary treatments are depicted in (Table 3). Haematological parameters such as Haemoglobin, red blood cell, mean corpuscular volume, platelet and neutrophil were significantly ( $P<0.05$ ) influenced by the dietary treatment while packed cell volume, Mean corpuscular haemoglobin, Mean corpuscular haemoglobin concentration, White blood cell, lymphocyte and monocytes were not significantly ( $P>0.05$ ) affected by the treatment diets. Mean corpuscular volume (MCV) was Significantly ( $P<0.05$ ) highest in birds fed 40% (SDCPM + Maxg) with a mean value of 59.58 fl, followed by those placed on 60% (SDCPM + Maxg) with the value 58.23 fl and least value of 56.92 fl was obtained in birds fed the control diet. Platelet

values were Significantly ( $P<0.05$ ) highest in birds fed 40% (SDCPM + Maxg) with a mean value  $3.21 \times 10^3/\text{mm}^3$ , followed by those placed on 0% (SDCPM + Maxg) with the value  $2.38 \times 10^3/\text{mm}^3$ , and least value of  $1.37 \times 10^3/\text{mm}^3$  was obtained in birds fed 20% (SDCPM + Maxg) based diet. Neutrophil values were Significantly ( $P<0.05$ ) highest in birds fed 40% (SDCPM + Maxg) with a mean value 29.02%, followed by those placed on 60% (SDCPM + Maxg) with the value 19.21%, and least value of 16.68% was obtained in birds fed 0% (SDCPM + Maxg) based diet. Monocytes values were Significantly ( $P<0.05$ ) highest in birds fed 40% (SDCPM + Maxg) with a mean value 4.33%, followed by those placed on 60% (SDCPM + Maxg) with the value 2.66%, while least value of 1.68% was obtained in birds fed 20% (SDCPM + Maxg) based diet. However, PCV, MCH, MCHC, lymphocyte and eosinophils values were not significantly ( $P>0.05$ ) different among the birds fed the dietary treatments.

### 3.2 Serum Biochemistry of Broiler Chickens Fed Sundried Cassava Peel Meal with Maxigrain Supplementation

Table 4 shows the serum biochemical indices of broiler chickens as influenced by the treatment diets. The result revealed that total protein, Globulin, albumin, urea and creatinine were not significantly ( $P>0.05$ ) affected by the treatment diet. However, significant ( $P<0.05$ ) variation

were observed in the values of glucose and cholesterol. Glucose values were significantly ( $P<0.05$ ) influenced by the treatment diets with highest value (120.32 mmol/L) from broiler chickens maintained on 0% (SDCPM + Maxg), followed by (113.68 mmol/L) from birds fed 40% (SDCPM + Maxg) while least value of (106.26 mmol/L) was recorded from birds placed on 20% (SDCPM + Maxg). Cholesterol values showed significant ( $P<0.05$ ) variation among the treatment diets with highest value (116.20%) from broiler chickens maintained on 0% (SDCPM + Maxg), followed by (98.26%) from birds fed 60% (SDCPM + Maxg) while least value of (95.67) was recorded from birds placed on 60% (SDCPM + Maxg).

## 4. DISCUSSION

### 4.1 Haematological Indices of Broiler Chickens Fed Sundried Cassava Peel Meal with Maxigrain Supplementation

Blood is important and reliable medium for assessing the physiological and health status of individual animals [30,31]. According to [32], the life of all flesh is the blood and it is useful for atonement for human soul. Blood is useful for assessing the health status, clinical evaluation for survey of physiological/pathological conditions and diagnostic and prognostic evaluation of various types of diseases in animals [33,34,35]. The similarity ( $P>0.05$ ) recorded in the packed cell volume of broiler fed varying levels of cassava peel meal with maxigrain supplementation made it obvious that their was an effective use of the energy sources. This finding is in agreement with reported of [36] who reported a no significant difference in the Packed Cell Volume value of local grower chickens fed palm kernel cake meal. The values however fall below the normal range of (31-33.5%) reported by [37]. There were significant ( $P<0.05$ ) differences in Haemoglobin, red blood cell and mean corpuscular volume, the values of Hb obtained were slightly higher than the normal range for chickens (7-13 g/l) as stated by [38]. This result indicated that the nutrients were adequately utilized by the broilers and posed no problem to the birds. It explains why the birds were healthy, not anaemic and were capable of withstanding stress. This finding negate the report of [39] who observed no significant ( $P>0.05$ ) difference in the Hb, RBC and MCV values of cockerel chickens fed varying levels of Cassava grit supplemented with moringa leaf meal. The similarity in the Mean corpuscular

haemoglobin and Mean corpuscular haemoglobin concentration values. The normal MCH and MCHC indicated the absence of normocytic anaemia which was reported to be characterized by a normal PCV and only detected by a decreased number of RBC or PVC [40]. The values of MCH and MCHC were not significantly different ( $P>0.05$ ) and fell within the normal physiological ranges for broilers [36,41]. The MCV, MCH and MCHC values though favoured birds on 40% SDPCM + Maxg, the normal ranges nevertheless suggested the absence of hypochromasia, because under this condition, MCHC is lower than normal [42]. There was also no macrocytic (regenerative) or microcytic (non-regenerative) anaemia since the MCV was normal [43]. The significant variation in the platelet, neutrophil and monocytes values with highest numerical values recorded among broiler chickens fed 40% SDPCM + Maxg indicated that the bird on this diet has the ability to withstand infections or infestation of any foreign bodies. This agrees with the finding of [44]. Who reported a significant variation in the platelet values of broiler chickens fed cassava grit based diet. The higher white blood cell, lymphocyte and eosinophil values recorded among birds fed 40% SDPCM + Maxg suggested adequate defense against infectious agents [45]. This is probably due to adequate protein in the diets. It suffices to say that the nutrient profiles of the diets were adequate to support the performance of the pigs based on the comparable results obtained since [43] reported that nutritional deficiency particularly that of protein reduced most haematological and serum parameters. The blood trait findings in this study were similar to the reports of [46,47] and [44], all gave diets with varying levels of cassava root meal to broiler chickens and found no significant difference ( $P>0.05$ ) in their haematological parameters and as well fell within the physiological normal ranges.

### 4.2 Serum Biochemistry of Broiler Chickens Fed Sundried Cassava Peel Meal with Maxigrain Supplementation

The use of chemical indices as a pointer or indicator to conditions that can not be readily noticed by performance indices can not be over emphasized. Serum protein albumin and globulin synthesis is related to the availability of protein and micro-nutrient [48]. The highest total Protein value recorded in birds placed on 40% SDPCM + Maxg may be due to the

supplementary role of Maxigrain in the diet being an enzyme breaks fibrous materials to generate energy and protein and makes it available for the use of the animal it also catalyzes some metabolic activities in the body of the animal that enhances the blood quality in the long run. The significant increase in the glucose and cholesterol level among the broiler chicken fed the control diet compared to those on diets containing maxigrain is a pointer to the fact that those on control diet has tendencies for fat accumulation compared to those on other treatment diets. This finding agrees with the report of [49] who reported a significant variation in the glucose and cholesterol levels of weaner pigs fed varying levels of cassava peel meal supplemented with

maxigrain. Serum urea is known to be a function of the protein quality ingested by the animal, energy deficiency and disease condition which impair protein utilization. When diet is deficient in essential amino acid, the amino acid present will be deaminated resulting in an increase in urea excretion [50]. In this present study, the inclusion of SDCPM + Maxg gave a comparable urea value in birds fed the treatment diets. Reported that creatinine is an indirect measure of protein utilization in poultry birds the non significantly differences observed in the Creatinine values in the broiler finisher has suggested protein utilization as sundried cassava peel replaced maize. It is noted that high level of Creatinine could lead to tissue wastage.

**Table 3. Haematological indices of broiler finisher Fed the treatment diets**

	Inclusion levels of SDCPM+Maxg (%)				
	0	20	40	60	
	Diets				
Parameters	1	2	3	4	SEM±
Packed cell volume (%)	12.24	12.33	13.12	12.26	0.19
Haemoglobin (g/dl)	13.33 <sup>c</sup>	11.24 <sup>c</sup>	14.68 <sup>a</sup>	13.67 <sup>b</sup>	0.34
Red blood cell (x 10 <sup>9</sup> /L)	6.28 <sup>c</sup>	6.60 <sup>b</sup>	7.35 <sup>a</sup>	6.26	0.09
White blood cell(x10 <sup>3</sup> /mm <sup>3</sup> )	14.11	14.33	14.67	14.26	1.82
MCV (fl)	56.92 <sup>c</sup>	57.25 <sup>c</sup>	59.58 <sup>a</sup>	58.23 <sup>b</sup>	2.52
MCH	16.28	16.54	17.44	16.72	0.27
MCHC	30.32	31.07	32.67	31.56	0.38
Platelet	2.38 <sup>b</sup>	1.73 <sup>d</sup>	3.21 <sup>a</sup>	2.24 <sup>c</sup>	0.61
Neutrophil	16.68 <sup>c</sup>	17.24 <sup>c</sup>	29.02 <sup>a</sup>	19.21 <sup>b</sup>	1.15
Lymphocytes	62.24	63.68	74.21	62.26	7.05
Monocytes	2.04 <sup>c</sup>	1.68 <sup>a</sup>	4.33	2.66 <sup>b</sup>	0.04
Eosinophilb	<b>1.68</b>	<b>1.72</b>	<b>2.03</b>	<b>1.69</b>	<b>0.37</b>

abcd: means in the same row with varying super script differ significantly (P>0.05)

SEM±: standard error of means

SDCPM+Maxg: Sundried cassava peel meal + Maxigrain

**Table 4. Serum biochemical indices of Broiler finisher fed experimental diets**

	Inclusion levels of SDCPM+Maxg (%)				
	0	20	40	60	SEM±
	Diets				
	1	2	3	4	
Total protein(g/dl)	6.29	6.80	7.09	6.83	0.08
Globulin (g/dl)	4.45	4.36	4.28	4.02	0.15
Albumin (g/dl)	2.74	2.44	2.81	2.63	0.27
Glucose (mmol/L)	120.32a	106.26c	113.68b	108.30c	1.72
<b>Cholesterol (mmol/L)</b>	116.20a	95.67c	96.33b	98.26b	6.46
<b>Urea (g/dl)</b>	12.24	13.06	14.75	13.12	0.38
<b>Creatinine (g/dl)</b>	1.08	1.03	1.53	1.58	0.04

abc: means in the same row with varying super script differ significantly (P<0.05),

SEM±: standard error of mean

SDCPM+Maxg: sundried cassava peel meal + maxigrain

## 5. CONCLUSION

The overall result in this study showed that sundried cassava peel meal supplemented with maxigrain can successfully be included in broiler ration up to 40% level without any adverse effect on the blood quality of broiler chickens.

## ETHICAL APPROVAL

As per international standard or university standard was written ethical approval has been collected and preserved by the authors.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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