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HEMATOLOGICAL AND SERUM BIOCHEMICAL PARAMETERS OF WEANED PIGS FED MAIZE COB-CASSAVA PEEL MIXTURE AS PARTIAL REPLACEMENT FOR MAIZE

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Abstract. This study was carried out to investigate the haematological and serum biochemical parameters of weaned pigs fed maize cob-cassava peel mixture as partial replacement for maize. A total of 36 crossbreed male piglets with initial body weight (6.07±0.02 kg) of about 7-8 weeks' old were randomly distributed into four groups of nine animals per treatment. Each treatment was further divided into three replicates consisting of three pigs in a completely randomized design. Pigs in treatment 1 were fed 0 % maize cob-cassava peel mixture (CPMCM) while CPMCM was used to replace maize at 10 % (T2), 20 % (T3) and 30 % (T3). Phytochemical evaluation of CPMCM revealed the presence of alkaloids (19.10 mg/kg), tannins (8.17 mg/kg), saponins (9.11 mg/kg), cyanide (16.50 mg/kg), flavonoids (12.86 mg/kg) and phenol (7.72 mg/kg). All the haematological parameters: red blood cell, pack cell volume, haemoglobin, mean corpuscular haemoglobin, mean corpuscular volume, mean corpuscular haemoglobin concentration, white blood cell, monocytes, basophils and lymphocytes were significantly ($P<0.05$) influenced by the treatment except for platelet values ($P>0.05$). Similarly, total protein, total bilirubin and gluscose levels were significantly different ($P<0.05$) among the treatments except for cholesterol, urea, creatinine, activities of alkaline phosphatase, alanine transaminase and aspartate transaminase were not influenced by the treatment ($P>0.05$). However, values were within the normal range for heathy weaner pigs. It was concluded that CPMCM can be used to partially replace maize up to 30 % without having any negative effect on the health status of pigs.

Keywords: *Maize cob, cassava peel, heamatology, serum, phytochemicals, pigs.*

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1. Introduction

In Nigeria, pig enterprise is faced with myriad of problems which have resulted to a gross shortage of meat to meet up the population challenge in the country. These are attributed to the escalating cost of conventional feedstuffs, which are the major sources of energy and protein in poultry diets. There is also stiff competition between human, industries and livestock, fluctuations in prices and unavailability of the feed ingredients for the formulation of animal feeds (Duru & Dafwang, 2010; Alagbe, 2018). This has resulted in high cost of swine feed, causing economic losses in pig production in Nigeria. Profit maximization cannot be attained unless the pigs are fed well-formulated diets at reasonable costs (Alagbe & Anuore, 2023).

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The major interest of the farmer is to reduce feed cost, which usually accounts for 60 to 70% of the total cost of production (Ogundipe *et al*., 2003). Research efforts are now geared towards evaluating alternative feed ingredients for pigs. According to Atteh & Ologbenla (1993), such alternatives should have comparative nutritive value but cheaper than the conventional protein and energy sources and should also be available in large quantities. Maize is used for other purposes such as biofuel, brewing, starch industries and for human consumption. However, inadequate production of this grain and the intense competition for maize between man, industries and livestock especially in the drier areas of the tropics has made poultry rations to be expensive (FAO, 2006). Scarcity and sometimes non-availability have led to increase in the prices of conventional feedstuffs (maize) (Defang *et al*., 2008). Cereal grains especially maize which forms the bulk of energy in swine feeds are in short supply as a result of industrial, livestock and human needs (Slavin, 2010).

Peels from cassava (Manihot esculenta) are one of the many agro-industrial by-products that show potential for usage as a substitute feed substance. It is an essential waste or agricultural by-product that is left over after cassava is processed to make food. Cassava peels weigh between 100 and 130 kg per tonne of tuber weight, in accordance with Oyebimpe et al. (2006). However, if the little roots and the woody portion of the tuber seemed to be tossed in the trash, it might be between 250 and 290 kg per tonne of tuber weight (Okike *et al*., 2015). Currently, the cob is utilized whole or ground into smaller pieces after the grain is eliminated. Maize cobs can be burned for cooking or heating purposes, ploughed back into fields for cultivation, or thrown away (Bozovic *et al*., 2004).

According to Ziemer et al. (2012), pigs fed high-fiber diets are probably going to have higher serum glucose concentrations because the fermentation of fibre increases the availability of sugars. However, in cross-bred pigs fed diets with incremental levels of 7.5 percent and 15% maize cobs as fibre sources, Frank et al. (1983) observed a linear drop in plasma glucose concentrations and an increase in plasma urea concentrations.

Previous studies have shown that a drop in glucose was ascribed to the inclusion of maize cobs in the diet instead of grains, while the increase in urea was a result of intestinal microorganisms producing more ammonia (Weber & Kerr, 2012). According to Kohn et al. (2005), blood urea is a primary byproduct of protein catabolism and its level can serve as a gauge for the body's protein status. Unigwe et al. (2016) investigated the effects of an enzyme-supplemented diet and fermented cassava peels substituted with corn on the serum biochemistry and haematology of female cross-bred pigs. Despite the extensive research on the effect of dried cassava peel meal on the performance of pigs. Presently, there is insufficient information on the effect of maize cob-cassava peel mixture as partial replacement for maize on the blood parameters of weaned pigs.

2. Materials and Methods

Location of the experiment

This study was conducted at the University of Abuja Teaching and Research Farm, Main Campus, along Airport Road, Gwagwalada, Abuja, Nigeria; the Department of Animal Science, Faculty of Agriculture. Gwagwalada, situated between latitudes 8o571 and 8o551N and longitudes 7o051 and 7o061E, serves as the headquarters of the

Gwagwalada Area Council. Within the Federal Capital Territory (FCT) are six (6) area councils, one of which is Gwagwalada. With a population of more than 157,770, Gwagwalada is the largest settlement in the study area and one of the FCT's fastest expanding urban centres. It is also the third largest urban centre and one of the major satellite towns (NPC, 2006).

Collection and preparation of test ingredients

Fresh corn cobs and cassava peels were gathered from several Gwagwalada processing facilities. For a duration of 14 days, the samples were exposed to sunlight in order to lower their anti-nutritional factor levels and prevent microbial responses that could cause spoiling and nutrient leaching. After being individually ground into meals in a hammer mill, the dried cassava peels and maize cobs were brought into the laboratory for additional examination.

Quantitative analysis of phytochemicals and proximate of dried maize cob and cassava peels

Phenolic compounds

Using Folin-Ciocalteu's reagent (FCR), the total phenolic content of dried maize cob-cassava meal was ascertained. 0.4 mL of FCR (diluted 1:10 v/v) was combined with 2 g of each sample during the process. 4 mL of the sodium carbonate solution were added after 5 minutes. The tubes were filled to the brim with 10 millilitres of distilled water and left to stand at room temperature for ninety minutes. Using a spectrophotometer, the sample's absorbance was measured at 750 nm in relation to the blank. The total phenolic content of the sample was represented in milligrammes of catechol per dry gramme of dry weight and the standard graph was created using catechol solution as the standard.

Flavonoids estimation

Using catechin as a standard, the total flavonoid content was calculated using the aluminium chloride method. 0.2 mL of 5 percent sodium nitrite, 5 g of maize cob and cassava peel meal and 0.1 mL of aluminium chloride were added in that order. The reaction mixture was mixed with 2 mL of 1 M sodium hydroxide after it had been incubated for 6 minutes at room temperature. The final collection was quickly increased to 10 mL using distilled water. Using a spectrophotometer, the absorbance of the reaction mixture was measured at 510 nm in comparison to a blank.

Saponins

The colorimetric method of concentrated sulfuric acid and vanillin was used to detect saponins. 0.5 millilitres of fifty percent ethanol, 4.0 mL of 77% sulfuric acid and 0.5 mL of freshly made vanillin solution were mixed with 2 g of dried maize cob and cassava peel meal. The mixture was allowed to cool to room temperature and then heated in a water bath for fifteen minutes at 60 ^{o}C. A UV/Vis spectrophotometer was used to detect the absorbance at 545 wavelengths. The amount of saponin was determined and represented as mg tea saponin equivalent per gramme using a tea saponin calibration curve.

Cyanide

A 10 mL volumetric flask was filled with fifty milligrams of cassava peel meal. Potassium hexacyanoferrate (III) solution (0.5 percent w/v, 0.5 percent w/v, 2 millilitres) was added after that. Before being mixed with distilled water to the

appropriate concentration, the entire mixture was heated for thirty seconds at 70 ^{o}C in a water bath with intermittent shaking. The absorbance was measured at 780 nm and compared to a blank for the reagent.

Alkaloids analysis

The gravimetric method was used to determine the alkaloids content of dried maize cob and cassava peel meal. The alkaloids were precipitated by placing droplets of highly concentrated ammonium hydroxide on a water bath after mixing 1 g of the maize cob and cassava peel meal with twenty millilitres of acetic acid solution in ten percent w/v. After being transferred to desiccators, the precipitate was weighed again until it reached a steady weight.

Estimation of tannins

The Folin-Ciocalteau method was used to measure the concentration of total tannins. A volumetric flask (100 millilitres) containing 1 g of cassava peel and maize cob meal, 1.5 mL of 75 per cent ethanol, 0.1 mL of metaphosphoric acid, 3 mL of 1.0 mol/mL Na2CO3 and 1.5 mL Folin-Ciocalteau were diluted with 15 mL of distilled water. The mixture was given a 15-minutely rest at room temperature once it had been fully blended.

Pre-experimental operations, animals and their management

Two weeks prior to the start of the experiment, pens were cleaned with Morigad. Water and feeding troughs were cleaned thoroughly and pens were marked for convenience of identification. In order to maintain appropriate biosecurity, a foot bath was also supplied at the pen's entrance. A total of 36 crossbreed male piglets with initial body weight (6.07±0.02 kg) of about 7-8 weeks' old were purchased from a reputed breeding farm in Abuja. The animals were placed in quarantine for a period of two weeks, given a basal diet designed to fulfil the nutritional needs of weaned pigs in accordance with the NRC's (2012) recommendation and given preventive treatment, which included injections of long-acting oxytetracycline at a rate of 1 mL/10 kg body weight and subcutaneous Ivermectin® at a rate of 0.25 mL/12.5 kg of body weight to control ecto and endo parasites. Pigs were divided into four treatment groups according to their body weight and each treatment was fully randomized and repeated three times with three animals in each replicate. Feeding was place twice a day at 8:00 and 16:00 and everyday access to clean, fresh water was provided.

Experimental diets and design

Four experimental diet were formulated to meet the nutrient requirements for swine according to NRC (2002). Enzyme supplemented sundried cassava peel and maize cob meal (CPMCM) at ratio 1:1 was incorporated into the experimental diet to replace maize as follows: treatment 1 (T1) control diet (0 % CPMCM), T2 (10 % CPMCM with enzymes), T3 (20 % CPMCM with enzymes), T4 (30 % CPMCM with enzymes) as presented in Table 1. A completely randomized design was adopted.

Blood collection and analysis

Six pigs per treatment were chosen on the twelfth week of the experiment for haemo-biochemical measurement. During the blood collection process, a stress-free environment was maintained for a selected group of animals to avoid deoxygenating the oxygenated blood. The pigs under study had their jugular veins bled in order to extract 4 millilitres of blood per animal. Of this volume, 2 millilitres were placed in a bijou bottle and subjected to ethylene diamine tetra acetate treatment for haematological testing,

while the remaining 2 millilitres were utilised for serum analysis. The Sysmex XN-3100 automated analyzer equipment was utilised to perform haematological analysis on red blood cells, haemoglobin, pack cell volume, white blood cells and their respective differentials. Reflex testing, reflexive slide preparation and optional digital cell imaging are all offered by the system. Reflex testing, reflexive slide preparation and optional digital cell imaging are all offered by the system. Prior to usage, the equipment was calibrated in accordance with the manufacturer's instructions. Samples are set up in the infrared column chamber and each result is thereafter shown individually on the monitor.

Two millilitres of blood were drawn and placed into bottles free of ethylene, diamine, tetraacetic acid and then subjected to tests for serum biochemical indices, including total protein, creatinine, uric acid, bilirubin, lipoproteins, cholesterol, glucose and enzymes. The Analytica 705 clinical diagnostics system was used for the analysis. The technical specifications included optical flow (30 µL quartz), reaction volume (350–1000 µL), photometric range (-0.1 to 3.0 absorbance) and filter (7 interference filters: 340, 405, 505, 546, 578, 620 and 670 nm).

Proximate composition of experimental diets

Proximate composition of experimental diets was carried out according to the standard laboratory procedures outlined by AOAC (2000).

Statistical analysis

All the data collected were statistically analyzed using the General Linear Model Procedure of Statistical Analysis (SAS, 2002) software package. Significant difference between treatments means were separated by Duncan's Multiple Range Test.

The model used for this design is as follows: $Y_{ij} = +t_i + e_{ij}$ Where Y_{ij}= Individual observation. = Overall mean. t_i = Effect of treatment diets. e_{ij} = Experimental error.

Table 1. Ingredient and chemical composition of the experimental diets (%DM)

Ingredients	T1 (0 %)	T2 (10 %)	T3 (20 %)	T4 (30 %)
Maize	55.00	49.50	44.00	38.50
Wheat offal	6.97	6.97	6.97	6.97
Soya beans	24.00	24.00	24.00	24.00
Groundnut cake	7.00	7.00	7.00	7.00
CPMCM	0.00	5.50	11.00	16.50
Bone meal	3.00	3.00	3.00	3.00
Limestone	1.50	1.50	1.50	1.50
Methionine	0.20	0.20	0.20	0.20
Lysine	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Enzymes	0.00	0.03	0.03	0.03
Salt	1.80	1.80	1.80	1.80
Total	100.0	100.0	100.	100.0
Determined analysis (%)				
Crude protein	18.30	18.00	17.90	17.80
Crude fibre	4.00	4.38	4.50	4.71
Ether extract	3.00	2.92	2.90	2.87
Calcium	0.45	0.45	0.45	0.45
Phosphorus	0.30	0.30	0.30	0.30
Energy (Kcal/kg)	2601.8	2558.7	2556.0	2550.1

*****vitamin A, 13,000 I.U., vitamin E, 5 mg, vitamin D3, 3000 I.U., vitamin K, 3 mg, vitamin B2, 5.5 mg, niacin, 25 mg, vitamin B12, 16 mg, choline chloride, 120 mg, Mn, 5.2 mg, Zn, 25 mg, Cu, 2.6 mg, folic acid, 2 mg, Fe, 5 mg, pantothenic acid, 10 mg, biotin, 30.5 mg and antioxidant, 56 mg are provided

3. Result

Phytochemical composition of test ingredients

The phytochemical makeup of corn cob and cassava peels is shown in Table 2. Alkaloids (8.60 mg/kg), tannins (4.40 mg/kg), saponins (2.15 mg/kg), cyanide (16.50 mg/kg), flavonoids (7.18 mg/kg) and phenols (4.00 mg/kg) were found in cassava peel, whereas flavonoids, tannins, saponins and phenols were found in maize cob at 9.77 mg/kg, 3.76 mg/kg, 6.60 mg/kg, 4.71 mg/kg and 2.88 mg/kg, respectively.

Haematological parameters of weaned pigs fed maize cob-cassava peel mixture as partial replacement for maize

Haematological parameters of weaned pigs fed maize cob-cassava peel mixture as partial replacement for maize is presented in Table 3. Pack cell volume, haemoglobin, platelet, mean platelet volume, red blood cell (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), white blood cell (WBC), neutrophils, basophils, monocytes and lymphocytes values varied from 27.10 to 31.70 %, 90.88 to 100.80 g/L, 120.9 to 126.1 ($\times10^9$/L), 4.70 to 9.85 fl, 6.84 to 9.12 ($\times10^{12}$/L), 35.61 to 47.00 fl, 13.16 – 21.19 pg, 41.84 – 55.80 g/L, 7.89 – 10.99 ($\times10^9$/L), 5.80 – 8.80 ($\times10^9$/L), 0.20 to 0.26 ($\times10^9$/L), 0.25 – 0.31 ($\times10^9$/L) and 7.71 to 11.09 ($\times10^9$/L) respectively. All values were significantly ($P<0.05$) influenced by the treatments except for basophils and platelets ($P>0.05$)

Serum biochemical indices of weaned pigs fed maize cob-cassava peel mixture as partial replacement for maize

Serum biochemical indices of weaned pigs fed maize cob-cassava peel mixture as partial replacement for maize is presented in Table 4. Total protein, albumin, globulin, cholesterol, urea, creatinine, total bilirubin, direct bilirubin, glucose, alanine transaminase (ALT), aspartic transaminase (AST) and alanine phosphatase (ALP) values varied from 5.88 to 7.15 g/dL, 3.45 – 3.86 g/dL, 2.43 – 3.29 g/dL, 2.06 to 2.38 mmol/L, 3.30 – 3.44 mmol/L, 76.18 to 77.74 µmol/L, 6.74 – 8.17 µmol/L, 2.11 – 2.87 µmol/L, 2.93 to 4.32 mmol/L, 70.89 to 74.08 (U/L), 56.72 to 61.22 (U/L) and 117.2 – 123.9 (U/L) respectively. All values recorded were significantly ($P<0.05$) influenced by the treatments except cholesterol, urea, creatinine, ALP, AST and ALT. Total protein, glucose and total bilirubin values were higher ($P<0.05$) in T2, T3 and T4 relative to the other treatment.

Table 2. Phytochemical composition of test ingredients

Specifications (mg/kg)	Cassava peel	Maize cob	Cassava peel-maize cob mixture
Alkaloids	8.60	9.77	19.10
Tannins	4.40	3.76	8.17
Saponins	2.15	6.60	9.11
Cyanide	16.50	-	16.50
Flavonoids	7.18	4.71	12.86
Phenols	4.00	2.88	7.72

Table 3. Haematological parameters of weaned pigs fed maize cob-cassava peel mixture as partial replacement for maize

Specifications	T1	T2	T3	T4	SEM	**Reference range
Pack cell volume (%)	27.02[b]	29.10[a]	30.45[a]	31.70[a]	0.02	25.00 – 39.00
Haemoglobin (g/L)	90.88[b]	91.28[b]	102.31[a]	100.80[a]	1.10	45.00 – 137.1
Platelet ($\times10^9$/L)	120.9	121.4	125.8	126.1	1.56	36.4 – 200.0
Mean platelet volume (fl)	4.70[c]	6.51[b]	8.72[a]	9.85[a]	0.01	1.22 – 10.40
Red blood cell ($\times10^{12}$/L)	6.84[b]	8.00[a]	8.10[a]	9.12[a]	0.01	6.40 – 10.30
Mean corpuscular volume (fl)	35.61[b]	37.10[b]	40.07[a]	47.00[a]	0.62	23.0 – 51.0
MCH (pg)	13.16[b]	14.50[b]	20.23[a]	21.19[a]	0.18	17.0 – 24.0
MCHC (g/L)	41.84[b]	53.19[a]	55.17[a]	55.80[a]	0.76	22.0 – 60.9
White blood cell ($\times10^9$/L)	7.89[b]	10.10[a]	10.50[a]	10.99[a]	0.02	8.70 – 11.0
Neutrophils ($\times10^9$/L)	5.08[b]	6.14[b]	8.70[a]	8.80[a]	0.01	0.09 – 9.00
Basophils ($\times10^9$/L)	0.20	0.20	0.20	0.26	0.02	0.0 – 0.50
Monocytes ($\times10^9$/L)	0.25[b]	1.21[b]	1.37[a]	1.31[a]	0.01	0 – 4.00
Lymphocytes ($\times10^9$/L)	7.71[b]	9.14[b]	11.85[a]	11.09[a]	0.01	3.60 – 12.50

[a,b,c]Means in a row without a similar superscripts differ (P<0.05); SEM: standard error of the mean; T1: 0 % CPMCM; T2: 10 % CPMCM; T3: 20% CPMCM; T4: 30% CPMCM**Merck's Veterinary Manual (2011)

Table 4. Serum biochemical indices of weaned pigs fed maize cob-cassava peel mixture as partial replacement for maize

Parameters	1	2	3	4	SEM	**Reference range
Total protein (g/dL)	5.88[b]	7.02[a]	7.08[a]	7.15[a]	0.24	4.40 - 7.40
Albumin (g/dL)	3.45	3.67	3.79	3.86	0.13	1.90 – 3.90
Globulin (g/dL)	2.43[b]	3.35[a]	3.29[a]	3.29[a]	0.52	2.00 – 4.00
Cholesterol (mmol/L)	2.18	2.06	2.33	2.38	0.46	2.00 – 4.20
Urea (mmol/L)	3.44	3.31	3.30	3.37	0.11	2.90 – 8.89
Creatinine (µmol/L)	76.21	76.18	77.74	77.08	2.31	67.0 – 172.0
Total bilirubin (µmol/L)	6.74[b]	6.93[b]	8.08[a]	8.17[a]	0.82	2.00 – 9.10
Direct bilirubin (µmol/L)	2.81	2.11	2.44	2.87	0.10	0 – 3.40
Glucose (mmol/L)	2.93[b]	4.04[a]	4.11[a]	4.32[a]	0.15	3.50 – 7.40
ALT (U/L)	71.23	74.08	72.10	70.89	1.78	15.0 – 76.0
AST (U/L)	56.72	58.09	60.71	61.22	1.55	22.0 – 88.7
ALP (U/L)	117.2	121.0	123.5	123.9	3.03	10.2 – 188.6

[a,b,c]Means in a row without a similar superscripts differ (P<0.05); SEM: standard error of the mean; T1: 0 % CPMCM; T2: 10 % CPMCM; T3: 20% CPMCM; T4: 30% CPMCM**Merck's Veterinary Manual (2011)

4. Discussion

The presence of alkaloids, tannins, saponins, flavonoids and phenolic compound in maize cob-cassava peel mixture (CPMCM) suggests that it possess several therapeutic properties (Singh *et al.*, 2021; 2022). Alkaloids have been reported to function as defensive elements against predators, especially mammals because of their general toxicity and deterrence capability (Hartmann *et al.*, 1991). They also possess

analgesics, antimalarial and anti-inflammatory properties (Adewale *et al*., 2021). Phenolic compounds have antioxidant, anti-inflammatory, anti-carcinogenic and other biological properties and may prevent oxidative stress (Park *et al*., 2001; Alagbe *et al*., 2023). Tannins have antimicrobial and insecticidal properties while flavonoids are well-established chemopreventive, antioxidant, antimicrobial, immunostimlatory, hepato-protective, hypolipidemic and therapeutic agent against tumor cells (Shittu *et al*., 2021). Pharmacologically, saponins have been shown to exhibit antifungal and antibacterial activities (Alagbe, 2023).

Hematological analysis is routinely used in veterinary medicine to evaluate the health status of animals and poultry (Mafuvadze & Erlwanger, 2007). Heamatological values could serve as base line information for comparison in condition of nutrient deficiency, physiology and health status of farm animals (Daramola *et al*., 2005). The results obtained in this study shows that the dietary treatment had significant ($P<0.05$) effect on all the observed hematological parameters of weaner pigs. Togun et al. (2007) state that when an animal's haematological values are within the normal range that has been defined for it, there was no negative effect of the diet during the trial period. In terms of trend, the PCV was greater in T4, closely followed by T3, T2 and T1 (control). The results are consistent with those of Adesehinwa et al. (2011), who observed that weaner pigs fed diets based on cassava peel meal (CPM) and CPM + Farmazyme-3000, the enzyme marginally increased PCV but not above that of a diet based on maize. Increased destruction and subsequent enhanced erythropoiesis in the liver, spleen and kidneys cause macrocytic (regenerative) anaemia, which is indicated by reductions in concentrations of erythrocytic parameters (e.g., pack cell volume (PCV), red blood cell counts (RBC) and haemoglobin (Hb) concentration) and elevations in MCV (Jain, 1986). The study's haemoglobin readings fell between the ideal ranges for developing pigs (Manual, 2010). According to Manual (2010), this further implies that the anti-nutritional components in cassava peel had been reduced to a manageable, non-fatal level, which explains why all the haematological measures were within normal limits.

The CPMCM based diets influenced the serum metabolites of weaned pigs. The values of total protein were within the normal range for weaner pigs that is 3.00 to 8.00 g/dL as cited by Elliot et al. (2014). The values of albumin obtained in the control group (T1) and 10 %, 20 % and 30 % CPMCM are similar. However, the values were within the normal range cited by Manual (2010). The total protein, albumin and globulin values obtained in the study attest to the nutritional adequacy of CPMCM in replacing maize in meeting the energy needs of weaned pigs. Moreover, the values of glucose obtained in this study were lower than the normal range (200−500 mg/dL) reported by Klem et al. (2010). The values of cholesterol (2.93−4.32 mmol/L) observed in the study were within the values (3.00−5.60 mmol/L) reported by Martini *et al*. (2012) for weaner pigs dried cassava peels as partial replacement for maize at 20 %, 40 % and 60 % respectively. Creatinine and urea levels were not significantly ($P>0.05$) different among the treatments suggesting the absence of renal failure (Omokore & Alagbe, 2019; Muritala *et al*., 2022). Aspartate transaminase (ALT), alanine phosphatase (ALP) values were not elevated ($P>0.05$) by CPMCC suggesting the absence of hepatotoxicity (Alagbe, 2024).

5. Conclusion

In conclusion, CPMCM contained some phytochemicals which have several therapeutic and beneficial properties to blood parameters. These compounds are within the tolerable levels for pigs when CPMCM was partially used to replace maize up to 30%. Values were also within the normal physiological range for weaner pigs suggesting that the health of the animals were not compromised.

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