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Implications of Replacing Varying Dietary Levels of Maize with Cassava Root-Leaf Meal Mixture on Haematology and Carcass Characteristics of Broiler Chickens

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ABSTRACT

In a feeding trial that lasted 56 days (8 weeks), cassava root-leaf meal mixture (CRLMM) was evaluated as a replacement for maize in broiler starter and finisher diets. Five experimental diets were formulated in which maize was replaced with 0%, 25%, 50%, 75% and 100% CRLMM for treatments 1, 2, 3, 4 and 5 respectively. All the experimental diets were pelletised. Thirty (30) birds were assigned to each of the treatment diets in randomised complete block design and each treatment was replicated thrice with 10 birds per replicate. The birds (Marshall Broiler chicks) were 7 day old at the inception of the experiment. The experimental starter and finisher diets were fed *ad libitum*. Data were collected for blood parameters and Carcass characteristics. The haematological indices showed a significant difference ($P<0.05$) in mean corpuscular haemoglobin concentration (MCHC). The carcass characteristics showed a significance difference ($P<0.05$) in slaughter weight, plucked weight, dressing percentage, thigh cut, back cut and in organs such as heart, lungs, spleen, gut weight, gut length and caecal length. The remaining body components and organs did not show any significant difference ($P>0.05$). CRLMM showed a good promise when included in the diets of broiler starter and finisher up to 75% without a harmful effect on haematology and carcass characteristics of broilers reared in the northern guinea savannah. It can be recommended that 75% of maize can be replaced with CRLMM in broiler diets in Mubi and environs.

Key words: *Implications; replacing; varying dietary levels; maize; cassava root-leaf; haematology; carcass characteristic, broiler chicken*

1. INTRODUCTION

Maize serves as staple food stuff for a good proportion of Nigerians. The ever growing demand for maize for human consumption, livestock feed and some industrial use has pushed its market price to an alarming height (Odukwe, 1994). Energy and protein feedstuffs have been the major hindrances to effective poultry production in Nigeria. This is mainly because of the high cost of these feedstuffs (Anyaegbu, 2001). In poultry, feed cost accounts for up to 80% of the total cost of production and is a very important component in determining the extent of poultry survival and profitability (Olugbemi *et al*., 2010). Its important role as a human and industrial food ingredient coupled with drought in some parts of Africa has sometimes caused relative scarcity of the ingredient and an attendant increase in price invariably leading to an increase in feed costs. Maize, on the other hand, has been playing a key role as a source of energy in poultry diets in the country. Church *et al.*, (1984), Fanimo (1991), Fashina (1991), and Adesehinwa (1997) have demonstrated that the ingestion of numerous dietary components has measurable effects on blood constituents.

The blood contains several metabolites which provide useful information on nutritional status and clinical investigation of an individual hence WHO recommended the use of blood parameters for medical and nutritional assessments (WHO,1963, Egbunike *et. al*.,2009). The analysis of normal haematological parameters of chickens is very much essential in diagnosing the various pathological and metabolic disorders. It can also be used as a diagnostic tool in order to assess the health status of an individual or flock (Islam *et al*., 2004). Furthermore, Madubuike and Ekenyem (2006) reported that haematological and serum biochemistry assay of livestock suggests the physiological disposition of the animals to their nutrition. Haematological changes are routinely used to determine various status of the body and to determine stress due to environmental, nutritional and pathological factors (Islam *et al*., 2004).

Proper utilization of a feed is reflected in the carcass yield or output because carcass yield is an indication of quality and utilization of ration (Bamgbose and Niba, 1998). Works on carcass characteristics of poultry have been well documented. Siegel *et al*. (1984) and Young *et al*. (2001) reported that, strain, sex, age, health and nutrition have been shown to affect yield of parts. Ugwu and Onyimonyi (2008) reported that dressing percentage increased with increase in age. Okonkwo *et al.* (2001) found that dressed weight of broiler chicken was significantly affected by feed restriction. However, feed restriction did not significantly affect the weight of heart, liver, spleen, gizzard and abdominal fat. Cassava root meal (CRM) is basically an energy source its greatest advantage being the high caloric value yield per unit area (Igwebuike and Okonkwo, 1993). Cassava root meal is low in crude protein (about 4%), also contains toxic substance- linamarin which produces hydrogen cyanide when acted upon by linamarase (Mc-Donald *et al.*, 1988). This situation therefore calls for investigation into locally available alternative source of energy like cassava root meal for commercial poultry enterprise to investigate its effect on growth and haematology of broiler. This study was therefore designed with the aim of assessing the haematological indices and carcass quality of broiler chickens.

2. MATERIALS AND METHODS

Study Area

The study was conducted at Livestock Teaching and Research Farm, Adamawa State University Mubi, Nigeria. Mubi is situated within the northern guinea savannah on a latitude 10.00^0N and longitude 13^030E and about 305 metres above sea level. It has a tropical climate marked by rainy and dry seasons. Rainfall commences in April and ends in late October. The dry season starts in November and ends in March. Annual rainfall is about 900 mm to 1050 mm per annum. The relative humidity is extremely low about 20 – 30% between January and March and starts increasing as from April and reaches a peak of about 80% in August and September and later declines from October following the cessation of rains. The average minimum temperature is about 12^oC in December and January and maximum of 40^oC in April (Adebayo and Tukur, 1999).

Preparation of Cassava Root and Leaves

Fresh cassava roots (sweet variety) were procured from Mubi market, and Leaves were harvested from farms near Mubi Metropolis after harvesting the cassava. The cassava roots were washed and cut into small pieces. The leaves were chopped into smaller pieces using kitchen knife. The root and leaves were sun-dried on a tarpaulin sheet for about 5 days with regular turning. The chopped root and the leaves were milled separately using a hammer mill before mixing. The cassava flour and leaf meal was mixed in a ratio of 2.6:1. The proximate composition of the cassava root, cassava leaf and cassava root-leaf meal mixture are presented in Table 1.

Experimental Animals

A total of 150 day-old broiler chicks were randomly allotted to the five (5) experimental diets. They were subdivided into three replicates of ten (10) birds each. They were housed in a deep litter pens. Routine vaccinations and medication schedule were adhered to strictly. The birds were allowed access to dietary treatments and fresh clean water *ad libitum* for a period of eight weeks.

Experimental Diets

Isonitrogenous diets containing 22% CP and 20% CP were formulated for the broiler starters and finishers respectively. Maize was replaced with the cassava root and leaf meal mixture at 0, 25, 50, 75 and 100% levels coded as diets 1, 2, 3, 4 and 5 respectively. All the diets were pelletised. The ingredient composition of the starter and finisher diets are shown in Tables 2 and 3 respectively.

Experimental Design

The design used for the experiment was randomised complete block design. There were five treatments and three replicate. Ten birds were randomly allotted to each replicate.

Data Collection

The following data were collected:-

Blood parameters

At the end of the eight (8) week of the feeding trial, six birds each from the five treatment groups were randomly selected, two from each replicate for blood sample collection and subsequent carcass analysis. The birds were fasted overnight before blood collection and slaughtered. The blood samples were collected in ethylene diamine tetra acetate (EDTA) tubes for the haematological indices determination. The haematological indices determined were packed cell volume (PCV), haemaglobin (Hb) concentration, red blood cells (RBC) counts and white blood cells (WBC) counts. Others such as mean corpuscular volume (MCV), mean corpuscular haemaglobin (MCH) and mean corpuscular haemaglobin concentration (MCHC) were calculated according to standard formula (Schalm *et al*., 1975):

i) Mean corpuscular volume (MCV) is a measure of RBC size and represented the volume of a single RBC.

$$\text{MCV (fentolitre, (fl)} = \frac{\text{PCV (\%)} \times 10}{\text{RBC count } (10^6/\text{mm}^3)}.$$

ii) Mean corpuscular haemaglobin (MCH) represents the haemoglobin content of the RBC's (i.e. weight of haemoglobin in an average RBC).

MCH (pictograms, (Pg) = $\frac{Hb(g/100ml \times 10}{RBC (10^6/mm^3)}$

iii) Mean corpuscular haemaglobin concentration (MCHC) which is the measure of the concentration of haemoglobin in the red blood cells (RBC). It indicates the weight of haemoglobin (g/100 ml) of RBCs.

MCHC (%) = $\frac{Hb (g/100 ml) \times 100}{PCV (\%)}$

Carcass Evaluation

For the carcass measurements, the birds were randomly selected and starved over night. The birds were weighed individually before slaughter. The slaughter weight, plucked weight and dressed weight were determined. The dressing percentages were calculated and cut-up parts and organ measurements were carried out and expressed as percentages of the slaughter weights.

Chemical Analysis

Chemical analysis of the cassava root, cassava leaf meal and cassava root and leaf meal mixture diets and faecal samples were subjected to proximate analysis according to Association of Official Analytical Chemist (AOAC). Similarly the anti-nutritional factor (cyanogenic glucosides) was determined using AOAC (2002) methods.

Statistical Analysis

The data obtained were subjected to two – way analysis of variance (ANOVA) of the randomised complete block design using the General Linear Model procedure of Statix 8.0 U. S. A. version 2004 to assess the main effect of treatments. Differences between treatment means were separated using the least significant difference (LSD).

3. RESULTS

The results of the proximate composition of cassava root, cassava leaf and cassava root-leaf meal mixture (CRLMM) showed the leaves contain higher crude protein, crude fibre, ash and cyanogenic glucosides than the roots and the CRLMM. Cassava roots had higher dry matter and nitrogen-free extract compared to the leaves and CRLMM, while it had the least crude protein, ether extract and ash content. The proximate composition of the starter and finisher diets are presented in Table 4. The crude protein and crude fibre contents of the five experimental diets (starter) are similar, with slight increase in crude protein and crude fibre as the levels of CRLMM increased. Similarly the five experimental diets for the finisher are similar as formulated. Crude protein and crude fibre increased, while nitrogen-free extract content of the diets decreased as the levels of CRLMM increased.

Table 1: Proximate Composition of the Cassava Roots, Leaves and Cassava Root-Leaf Meal Mixture (CRLMM)

Nutrients (%)	Cassava root	Cassava leaves	CRLMM
Dry Matter	92.50	90.90	91.70
Crude Protein	5.60	26.70	18.90
Crude Fibre	2.75	14.50	12.60
Ether Extract	0.85	2.50	3.50
Nitrogen-Free Extract	79.10	37.00	61.60
Ash	4.20	10.20	5.10
Cyanogenic glucosides (mg/HCN/kg)	13.40	22.10	18.30

Means of three (3) determinations

Table 2: The Composition of the Experimental Broiler Starter Diets

Level of maize replaced by cassava root-leaf meal mixture (%)

Ingredient	0	25	50	75	100
Maize	50.00	37.50	25.00	12.50	0.00
CRLMM	0.00	12.50	25.00	37.50	50.00
Groundnut cake	27.00	27.00	27.00	27.00	27.00
Maize offal	13.00	12.00	11.50	10.50	10.00
Fishmeal	6.00	6.00	6.00	6.00	6.00
Palm Oil	0.00	1.00	1.50	2.50	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.50	0.50	0.50	0.50	0.50
Premix+	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
Crude Protein (%)	22.09	22.10	22.16	22.23	22.23
ME (kcal/kg)	2871.00	2838.00	2781.00	2749.00	2692.00
Protein: Energy Ratio	1:130	1:128	1:125	1:124	1:121
Calcium (%)	1.55	1.56	1.67	1.73	1.79
Phosphorus (%)	0.93	0.91	0.90	0.89	0.86

+Supreme Vitamin – Mineral Premix contains per 1.25 kg of the following: Vitamin A, 15,000,000 I. U; Vitamin D_3, 3,500,000 I. U; Vitamin E, 30,000 I. U; Vitamin K, 3,000 mg; Thiamine B_1, 3,000 mg; Riboflavin B_2 8,000 mg; Pyridoxine B_6, 4,000 mg; Niacin, 4,000 mg; Vitamin B_{12}, 20 mg; calpan 10,000 mg; Folic acid, 1,000 mg; Biotin, 30 mg; Antioxidant, 125 g; Choline Chloride, 500 g; Manganese, 96 g; Zinc, 80 g; Iron, 40 g; Copper, 6 g; Iodine, 1.4 g; Selenium, 300 mg; Cobalt, 240 mg.
CRLMM = Cassava root-leaf meal mixture

Table 3: The Composition of the Experimental Broiler Finisher Diets

	Level of maize replaced by cassava root-leaf meal mixture (%)				
Ingredient	0	25	50	75	100
Maize	56.00	42.00	28.00	14.00	0.00
CRLMM	0.00	14.00	28.00	42.00	56.00
Groundnut cake	22.00	22.00	22.00	22.00	22.00
Maize offal	13.00	12.00	11.50	10.50	10.00

Fishmeal	5.00	5.00	5.00	5.00	5.00
Palm Oil	0.00	1.00	1.50	2.50	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.50	0.50	0.50	0.50	0.50
Premix+	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
Crude Protein (%)	19.78	19.80	19.88	19.90	20.00
ME (kcal/kg)	2924.00	2882.00	2815.00	2774.00	2708.00
Protein: Energy Ratio	1:148	1:145	1:141	1:139	1:135
Calcium (%)	1.47	1.55	1.62	1.68	1.75
Phosphorus (%)	0.89	0.87	0.86	0.84	0.83

+Supreme Vitamin – Mineral Premix contains per 1.25 kg of the following: Vitamin A, 15,000,000 I. U; Vitamin D_3, 3,500,000 I. U; Vitamin E, 30,000 I. U; Vitamin K, 3,000 mg; Thiamine B_1, 3,000 mg; Riboflavin B_2 8,000 mg; Pyridoxine B_6, 4,000 mg; Niacin, 4,000 mg; Vitamin B_{12}, 20 mg; calpan 10,000 mg; Folic acid, 1,000 mg; Biotin, 30 mg; Antioxidant, 125 g; Choline Chloride, 500 g; Manganese, 96 g; Zinc, 80 g; Iron, 40 g; Copper, 6 g; Iodine, 1.4 g; Selenium, 300 mg; Cobalt, 240 mg.
CRLMM = Cassava root-leaf meal mixture

Table 4: Proximate Composition of the Experimental Broiler Starter and Finisher Diets

	Level of maize replaced by cassava root-leaf meal mixture (%)				
Nutrients (%)	**0**	**25**	**50**	**75**	**100**
Starter diet (1-28 days)					
Dry matter	94.80	94.60	94.60	94.90	95.15
Crude protein	21.00	21.02	21.12	21.25	21.30
Crude fibre	3.90	4.62	5.54	6.40	7.10
Ether extract	3.20	2.80	2.70	3.00	3.20
Nitrogen-free extract	57.60	56.56	56.14	55.05	54.05
Ash	9.10	9.60	9.10	9.20	9.50
Finisher diet (29-56 days)					
Dry matter	94.70	95.35	95.30	95.00	94.80

Crude protein	19.62	19.65	19.67	20.12	20.25
Crude fibre	3.95	5.02	5.74	6.42	7.70
Ether extract	3.40	2.40	2.60	2.40	2.20
Nitrogen-free extract	60.93	61.38	59.59	58.16	55.05
Ash	6.80	6.90	7.70	7.90	9.60

These are means of three (3) determinations

Blood Parameters

Means of haematological parameters are presented in Table 5. There was no significant difference (P>0.05) among the treatments for packed cell volume (PCV), haemoglobin concentration (Hb), red blood cell (RBC) and white blood cell (WBC) counts and haematological indices, namely mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH). However, significant difference (P<0.05) was recorded for mean corpuscular haemoglobin concentration (MCHC). The MCHC values of birds on diets 3 (50% CRLMM) and 4 (75% CRLMM) were better than the control group (0% CRLMM).

Table 5: Haematological Parameters of Broilers Fed Varying Levels of Cassava Root-Leaf Meal Mixture (CRLMM)

	Level of maize replaced by cassava root-leaf meal mixture (%)					
Parameters	**0**	**25**	**50**	**75**	**100**	**SEM**
Packed cell volume (%)	28.93	30.52	29.62	28.30	28.42	0.45 ^{NS}
Haemoglobin (Hb, g/dl)	8.30	8.88	8.78	8.32	8.33	0.25 ^{NS}
Red blood cell (x 10^6/mm^3)	2.07	2.19	2.19	2.00	2.03	0.12 ^{NS}
White blood cell (x10^3/mm^3)	2.30	2.33	2.34	2.28	2.30	0.88 ^{NS}
Mean corpuscular volume (fl)	140.38	139.90	135.42	141.88	140.30	1.52 ^{NS}
Mean corpuscular haemoglobin (pg)	40.18	40.58	40.13	41.68	41.20	0.29 ^{NS}
Mean corpuscular haemoglobin concentration (g/dl)	28.68^{b}	29.08^{ab}	29.67^{a}	29.47^{a}	29.37^{a}	0.16*

a, b – Means in the same row bearing different superscripts differ significantly (P< 0.05)
NS – Not Significant (P> 0.05). SEM – Standard error of the mean. * Significant (P< 0.05)

Carcass Characteristics

The results of carcass characteristics are presented in Table 6. Significant differences (P<0.05) were observed in slaughter weight, plucked weight, dressing percentage, thigh cut, back cut, lungs, gut weight, spleen, gut length and caecal length. There was no significant difference (P>0.05) among the treatment means for carcass weight, head, shanks, neck, wing, thorax cut, breast cut, pancreas, heart, kidney, liver, gizzard, abdominal fat and caecal weight.

The result of slaughter weight revealed that a significant difference (P<0.05) was recorded among the treatment means. Treatment 5 (100% CRLMM) recorded the highest weight (2217 g) and treatment 4 (75% CRLMM) recorded the lowest weight (2042 g).

Treatment 1 (0% CRLMM), 2 (25% CRLMM) and 3 (50% CRLMM) recorded similar weights of 2192 g, 2108 g and 2158 g respectively. The plucked weights showed a significant difference (P<0.05) with birds on treatment 1 (0% CRLMM) recording the highest (1982 g) plucked weight. Birds fed with treatment 4 (75% CRLMM) recorded the lowest weight (1777 g) while the rest of the treatments 2 (25% CRLMM), 3 (50% CRLMM) and 5 (100% CRLMM) which recorded 1878 g, 1895 g and 1863 g respectively were similar.

The dressing percentage showed a significant difference (P<0.05) with birds on 100% CRLMM recording the lowest value of 69.34%. Thigh cut was higher in treatments 1 (0% CRLMM) and 4 (75% CRLMM) 22.14% and 21.96% respectively than treatment 5 (100% CRLMM) which recorded the lowest value (20.13%). Treatments 2 (25% CRLMM) and 3 (50% CRLMM) recorded similar weights of 21.19%, and 21.63% respectively. There was no significant difference (P>0.05) among the treatment means for pancreas, heart, kidney, liver, gizzard, abdominal fat and caecal weight. However, proportion of lungs to body weight was highest in treatment 2 (25% CRLMM) followed by the 75% CRLMM and 50% CRLMM diets (0.64 and 0.56%) respectively. The lowest proportion was observed in 0% CRLMM (0.51%). Similarly, the gut weight and gut length were higher in groups on CRLMM-based diets than the control (0% CRLMM). Treatment 1 (0% CRLMM) recorded the highest percentage (0.12%) of spleen while treatment 5 (100% CRLMM) recorded the lowest (0.07%).

Table 6: Carcass characteristics of broilers fed varying levels of cassava root-leaf meal mixture (CRLMM)

	Level of maize replaced by cassava root-leaf meal mixture (%)					
Parameters	**0**	**25**	**50**	**75**	**100**	**SEM**
Slaughter weight (g)	2192[ab]	2108[ab]	2158[ab]	2042[b]	2217[a]	2.63*
Plucked weight (g)	1982.00[a]	1878.00[ab]	1895.00[ab]	1777.00[b]	1863.00[ab]	2.38*
Carcass weight (g)	1599.00	1528.00	1537.00	1527.00	1536.00	2.18[NS]
Dressing percentage	72.97[ab]	72.49[ab]	71.24[bc]	74.77[a]	69.34[c]	0.36*
Body components and organs as percentage of slaughter weight (%)						
Head	2.33	2.38	2.66	2.47	2.36	0.14 [NS]
Shanks	3.87	3.95	4.32	4.14	4.07	0.22 [NS]
Neck	5.16	6.04	5.41	5.50	5.63	0.20 [NS]
Wing	8.26	8.10	8.04	8.58	8.58	0.19 [NS]
Thigh cut	22.14[a]	21.19[ab]	21.63[ab]	21.96[a]	20.13[b]	0.26*
Thorax cut	7.23	6.52	6.81	8.30	6.88	0.33 [NS]
Breast cut	19.35	18.56	19.05	17.70	16.16	0.39 [NS]
Back cut	9.33[a]	9.24[ab]	8.95[ab]	8. 49[ab]	8. 17[b]	0.22 *
Pancreas	0.19	0.16	0.16	0.15	0.15	0.05 [NS]
Heart	0.56[a]	0.52[ab]	0.49[ab]	0.47[b]	0.47[b]	0.06 *
Lungs	0.51[c]	0.67[a]	0.56[bc]	0.64[ab]	0.54[c]	0.06*
Kidney	0.56	0.59	0.53	0.48	0.51	0.09 [NS]
Liver	1.26	1.47	1.49	1.51	1.64	0.14 [NS]

Gizzard	2.17	2.34	2.38	2.47	2.55	0.18 NS
Gut weight	2.41[b]	3.26[a]	3.26[a]	3.32[a]	3.61[a]	0.16*
Spleen	0.12[a]	0.11[ab]	0.09[bc]	0.09[bc]	0.07[c]	0.02*
Abdominal fat	2.32	2.17	2.11	1.70	1.62	0.23 NS
Caecal weight	0.52	0.57	0.59	0.61	0.82	0.15 NS
Gut length (cm)	197.50[b]	204.00[ab]	205.33[ab]	208.67[ab]	223.00[a]	0.98*
Caecal length (cm)	15.67[b]	18.68[ab]	18.83[ab]	19.78[ab]	24.50[a]	0.55*

a, b, c – Means in the same row bearing different superscripts differ significantly (P< 0.05)
NS – Not Significant (P> 0.05). SEM – Standard error of the mean. * Significant (P< 0.05)

4. DISCUSSION

The observed value of 91.70% dry matter for CRLMM was higher than that contained in cassava plant meal (CPM) as reported by Akinfala *et al.* (2011). Ash and ether extract recorded similar values but nitrogen free-extract values were lower than that reported by same authors. The proximate composition of cassava roots and leaves revealed a higher crude protein and lower crude fibre values of 5.6 and 2.75% respectively for roots and 14.5% for leaves compared with the values of 3.22 and 5.0% reported by Uchegbu *et al.* (2011) for roots. Okorie *et al.* (2011) reported 23.66 and 15.72% for leaves. However, the proximate composition of CRLMM revealed a higher crude protein and crude fibre values of 18.90 and 12.60% compared to CPM used by Akinfala *et al.* (2011) who reported 9.4 and 4.96% values respectively. The same authors however reported higher HCN content values of 33.5 mg/HCN/kg compared with 18.30mg/HCN/kg obtained in this study. This difference could be as a result of bitter variety of cassava used compared with the sweet variety used in this study.

The diets formulated were adequate in crude protein according to the recommendation of Aduku (1990) who reported 22 and 20% CP for starter and finisher diets. The metabolizable energy content of the diets were quite similar to that reported by the same author, except treatments 4 and 5 (75 and 100% CRLMM) which recorded slightly lower values. These diets contained higher fibre levels (Table 4) which diluted the energy concentration of the diets.

Blood Parameters

The results obtained in the present study for packed cell volume (PCV), haemoglobin (Hb), red blood cell (RBC), white blood cell (WBC), mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) showed no significant difference (P>0.05) among the treatment means. The improvement in the haematological indices indicates that the cyanide content of cassava leaf meal was reduced to a tolerable level so that the nutrients were used to build the blood components unhindered. All the values obtained for the haematological indices fell within the normal ranges of 30-40% for PCV; 9-13g/dl for Hb and 29g/dl for MCHC (Merck, 1979). Other researchers like Mitruka and Rawnsley (1977) reported 7.018.6g/dl for haemoglobin concentration in poultry. Adejumo (2004) reported that haematological traits especially PCV and Hb were correlated with the quality of the diets and the nutritional status of the animals. The normal values obtained in the present study are indications of the good qualities of the experimental diets. This observation is corroborated by the moderate daily weight gain and feed conversion ratio of the birds in the various groups.

Carcass characteristics

Results of carcass characteristics showed significant differences (P<0.05) in slaughter weight, plucked weight, dressing percentage, back cut, thigh cut, heart, lungs, spleen, gut weight, gut length and caecal length. The remaining body parts (head, shanks, neck, wing, thorax and breast cuts) and organ weights (pancreas, kidney, liver, gizzard, abdominal fat and caecal weight) were not significantly different (P>0.05).

The significant difference (P<0.05) in slaughter weight and plucked weight of Broilers fed CRLMM significantly (P<0.05) recorded lower slaughter and plucked weights (2042 g and 1777 g) respectively in treatment 4 (75% CRLMM) while the other treatments were similar to the control diet (0% CRLMM). Treatment 5 (100% CRLMM) had lower dressing percentage than the other treatments. The dressing percentage decreased as the level of CRLMM increased but treatment 5 (100% CRLMM) was inferior to the control (0% CRLMM). This could be associated with the higher weight of the gut and increased gut length which was due to high fibre content of the treatment diets compared to the other treatment groups; intestines are not considered as edible part of the chicken during dressing. This trend have been reported by Aina (1990) and Atuahene *et al.* (1986) who observed depressed dressed weights but higher viscera weights for cockerels and broilers respectively fed higher percentages of cassava peels and raw cotton seed meals in their diets.

There was no significant difference (P>0.05) for carcass weight between the treatment means. Osei and Duodu (1988) reported that there was no influence on carcass quality characteristics such as dressed weight and eviscerated weight when varying levels of cassava peel meal were fed to broilers. The percentage of thigh cut, one of the most expensive commercial cuts of the chicken, and back cut compared favourably with the control (0% CRLMM) as birds fed 0%, 25%, 50% and 75% CRLMM were similar to the control for thigh and back cuts respectively. This observation was in agreement with the findings of other workers (Havorsan *et al*., 1991; Bartov, 1998 and Agunbiade, 2000; Adeyemi *et al*. 2008) who fed cassava products to broilers.

The body components (Head, shanks, neck, wing, thorax, breast cuts) expressed as percentage of slaughter weight were not affected (P>0.05) by the treatments. This indicated that the CRLMM did not adversely affect these components in the course of the study. This is in agreement with Okorie *et al*, (2011) who fed varying cassava leaf meal to broilers and Egbunike *et al*, (2009) who fed cassava peel-based diet to broilers. Similarly, the yield of the organs (pancreas, kidney, liver, gizzard, abdominal fat and caecal weight) were not affected (P>0.05) by the dietary treatments. This suggests that the dietary treatments did not result in any significant negative metabolic reactions or disorders that could affect muscle growth, lipogenesis/lipolysis or organ activities (Taylor *et al*., 2003).

The significant difference (P<0.05) among the treatment groups in weight of spleen and heart are consistent with results of Akinfala *et al*. (2011) who observed that there appeared to be a relationship between the body weight of the birds/chickens and the weight of the organs. They observed that as the level of cassava plant meal in the diet increased, the dressed weight and organ weights decreased with the exception of small intestine and caecum. This may be due to high fibre content of cassava plant meal compared to maize and this agreed with the findings of Akintola and Abiola (1999). This is also in agreement with the result of this study where the highest gut weight, gut length and caecal length were recorded in treatment 5 (100% CRLMM) and the lowest in birds on 0% CRLMM. Other workers (Jamroz *et al*., 1992; Jorgensen *et al*. 1996; Jamroz *et al*., 2001; Khieu Borin, 2005 and Tang *et al*., 2012) reported that high levels of cassava products in the diet increased the fibre content and had considerable influence on the weight and length of most parts of the intestine and associated organs.

5. CONCLUSION

The results of this study revealed that haematological indices and carcass characteristics of the test diets compared favourably with the control diet at the finisher phase. The low mortality rate at both phases showed that the test diet had no deleterious effect on the broilers. It can be concluded that CRLMM could completely (100%) replace maize in the diets of broilers without adverse effects on haematological indices and carcass yield.

Recommendation

The result of this experiment showed that CRLMM can completely replace maize at 100% level of inclusion in the diet of broiler starter and finisher without any negative metabolic reactions or disorders that could affect the performance of the birds. Pelletising and inclusion of the cassava leaf will improve the quality of the feed as well as the quality of the protein of the cassava mixture. It can be recommended that poultry farmers can incorporate up to 75% inclusion level of CRLMM to replace maize in broiler diets with concomitant reduction in feed cost.

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