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Research Article

Studies on Haematology and Serum Biochemistry of Broiler Chickens Finished on an Unprocessed and Processed Velvet Bean (*Mucuna Pruriens* (L.)) as Dietary Protein Sources

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ABSTRACT: The effects of different processed velvet seed on haematology and serum indices of Broiler chickens was studied using 150 four weeks old broiler chicks. The birds were randomly assigned to five treatment groups of 30 birds with three replications of 10 birds each. The chickens were finished on five dietary treatments formulated to contain 5% raw, soaked and boiled, cracked and boiled and roasted velvet bean seed meal as protein source in diets 1, 2, 3, 4 and 5 respectively. The haematological parameters indicated no significant difference ($P > 0.05$) among treatment groups for PCV, Hb, RBC, WBC, MCHC and PLT while MCV and MCH differ significantly ($P < 0.05$) where chickens on treatment T₃ (boiled) had the highest values of 133.33 fl and 42.80 pg while lower values were chickens in T₄ (cracked and boiled) 123.90 fl and 39.80 pg as the lowest. Urea concentration range of 7.88-10.08 mmol/l obtained with significant difference ($P < 0.05$) among treatment groups with T₅(roasted) having value of 10.08 mmol/l and T₂ (soaked) having least value of sodium 7.88 mmol/l. Serum electrolytes such as Sodium (Na⁺), Chloride (Cl⁻) and bicarbonate showed significant ($P < 0.05$) difference among treatment groups. The study concluded that, on account of adequate haematocrit and immune statuses, in addition to its hypoglycaemic ability, boiling mucuna seed meal with 5.00 % level of inclusion can be used without any deleterious effect on haematological and serum biochemical assay parameters of broiler chickens.

KEYWORDS: Velvet bean seeds, Haematology, Biochemistry Assay, Carcass Characteristics.

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INTRODUCTION

Prices of plant protein ingredients for livestock feeds have been on the increase in Nigeria. This has resulted in the increasing cost of livestock production and consequent increase in the cost of livestock products. The need to find alternative and cheaper ingredients to replace the expensive ones is inevitable since cost of feed accounts for 70-80% of the cost of poultry production in the country (Ogunfowora 1984 and Oluyemi 1984). Velvet bean (*Mucuna pruriens*) has been considered as a possible source of cheap feed. Seed Meal (MSM) may be an option. In spite of the scanty nature of literature on this test material, some researchers (Pugalenti *et al.*, 2005; Siddhuraju *et al.*, 2000) reported that, the seeds are rich in (24-30 %) protein and an essential amino acid compositions that compares favourably to that of an ideal protein. Similarly, Vadivel and Pugalenti (2007) in their research pointed that, the seeds are very rich in fatty acids and have a good mineral composition.

Blood parameters are major indices of physiological, pathological and nutritional status of an organism; changes in the constituent compounds of blood when compared to normal or reference values could be used to interpret the metabolic stage of an animal as well as quality of feed (Wheater *et al.*, 1987). Such practice has long been quite documented. Generally, inadequate intake of energy and protein decreases packed cell volume (PCV) and haemoglobin (Hb) concentration which indicates anaemia (Maxwell, 1982; Rastogi, 2007; Muhammad and Oloyede, 2009). Earlier, Anon (1980) reported normal range of Red Blood Cell (RBC), White Blood Cell (WBC) and Hb as 2 to $4 \times 10^6/\text{mm}^3$, 9 to $31 \times 10^3/\text{mm}^3$ and 7 to 13g/dl respectively. Similarly, Kwari *et al.* (2008) reported normal range of PCV for broilers fed different levels of raw sorrel meal as 24.50 to 30.00% while the Hb ranged between 7.83 to 8.50 g/dl in the north east of Nigeria. Normal to high level of RBC is an indication of concentration of haemoglobin owing to the fact that, RBC carries the Hb which is the oxygen-carrier pigment as reported by (Jain, 1986).

Iyayi and Tewe (1998) showed that serum urea and total protein depend mainly on the quality and quantity of protein in the diet. Increased level of serum urea could be due to the presence of anti-nutritional factors which lower the quality of protein indicating imbalances in amino acids (Kaneko, 1989) in addition to kidney malfunction which is known to raise the level of serum urea (Nworgu *et al.*, 2007). Anon (1980), showed that healthy range of serum cholesterol for chickens is 52 to 148 mmol/l. The report revealed that elevated level of cholesterol is principally associated with liver dysfunction and depicts *Hyperlipaemia* which is a higher likelihood of having heart disease. Therefore, the objective of this study was to *investigate* the effect of feeding unprocessed and differently processed *mucuna* seed meal (MSM) on the haematology and serum biochemistry of Broiler Finisher chickens, thereby assessing the suitability or otherwise of the test material as a close substitute to soya beans.

MATERIALS AND METHODS

Study site

The study was conducted at poultry unit of the Teaching and Research Training Farm, College of Agriculture, Bauchi, Bauchi State, Nigeria. Bauchi is located between latitudes $9^{\circ} 3'$ and $12^{\circ} 3'$ North and longitudes $8^{\circ} 50'$ and 11° East ("C – GIDD, 2008 and Encarta, 2007), and at elevation of 537 m above sea level in the North Eastern Nigeria.

Experimental Stock and Design

A total of 150 straight run *CHI* strain of Broiler chicks aged 28 days were used in this study. The birds were randomly allotted to five treatment groups of 30 birds, with three replications i.e. 10 birds per replicate. They were finished on five diets with T₁ as control (raw), T₂, T₃, T₄ and T₅ containing soaked, boiled, cracked and boiled and roasted velvet bean seeds as a replacement for soybean meal, respectively (Table 1). Birds were fed daily and given access to water *ad libitum* in the study which lasted 35 days.

Blood collection and Response Criteria.

At the end of the feeding trial, three birds were randomly selected from each replicate. The ventral part of the left wing was carefully defeathered to locate the veins. About 7 ml of blood was collected via the left wing vein of each of the representative birds using a 10ml gauge syringe and scalp vein needle. About 3ml of the blood was fed in to a sterile bottle containing Ethylene Diethyl Tetra Acetic acid (EDTA), as anticoagulant for haematology Assay. It was placed in an ice-moist jute material to avoid Haemolysis. The remaining 4ml was fed in to yet another sterile but plain bottle. This was later spun in a haematocrit centrifuge for about 6 minutes at 200 *rpm* to separate serum from the plasma. It was then allowed to stand for 2 hrs at room temperature.

Sample of the blood with EDTA was drowned in a heparinised capillary tube and PCV was determined by microhaematocrit method. Determination of RBC and WBC (along with DLC) were carried out according to Docie and Lewis (1991) while MCV, MCH and MCHC were deduced according to Jain (1986) as follows:

$$\begin{aligned} \text{MCV (fl)} &= \text{PCV} \times 10 / \text{RBC} \times 10^6; \\ \text{MCH (pg)} &= \text{Hb} \times 10 / \text{RBC} \times 10^6; \\ \text{MCHC (\%)} &= \text{Hb} \times 100 / \text{PCV}. \end{aligned}$$

From the centrifuged blood sample in plain bottles, serum was collected for biochemical assay. Blood glucose was determined using *Hexokinase method*. Total protein and albumin were determined by *Biuret method* and *Bromocresol Green method* respectively. Blood Urea Nitrogen (BUN), Creatinin as well as activities of the liver enzymes (ALK-PO₄⁻, ASAT and ALAT) were determined by Standard Enzymatic method as outlined by Bush (1991). Serum Cholesterol was determined by *Burchad reaction*.

Table 1: Ingredients and analyzed chemical composition of broiler finisher experimental diets

Ingredients	Treatments				
	T ₁ (5%raw)	T ₂ (5%soaked)	T ₃ (5%boiled)	T ₄ (5%cracked and boiled)	T ₅ (5%roasted)
Maize	46.64	46.66	46.98	46.44	47.86
Soybean meal	19.16	19.14	18.82	19.36	17.94
Local groundnut cake	05.00	05.00	05.00	05.00	05.00
Mucuna seed meal	05.00	05.00	05.00	05.00	05.00
Wheat offal	15.00	15.00	15.00	15.00	15.00
Fish meal	05.00	05.00	05.00	05.00	05.00
Limestone	01.00	01.00	01.00	01.00	01.00
Bone meal	02.50	02.50	02.50	02.50	02.50
Min-vit-premix ^c	00.25	00.25	00.25	00.25	00.25
Methionine	00.10	00.10	00.10	00.10	00.10
Lysine	00.10	00.10	00.10	00.10	00.10
Salt (NaCl)	00.25	00.25	00.25	00.25	00.25
Total	100	100	100	100	100
Analyzed chemical composition (%)					
Dry matter	97.27	97.11	97.56	97.18	97.31
Crude protein	21.00	20.08	20.90	20.01	20.81
Crude fibre	04.05	04.15	04.12	04.11	04.14
Ether extract	03.99	03.88	03.67	03.76	03.78
Ash	4.01	4.10	4.00	3.97	3.95
NFE	45.09	46.75	50.61	50.79	48.57
Metabolizable energy (Kcal/kg)	2871.99	2870.63	2873.43	2879.52	2950.34

* = Bio Mix Broiler Finisher Premix supplying the following per Kg of feed: Vitamin A=3,400,000IU, Vitamin D₃=600,000IU, Vitamin E=4,000mg, Vitamin K₃ = 600mg, Vitamin B₁=640mg, Vitamin B₂ = 1600mg, Niacin=8,000mg, Pantothenic=2000mg, Vitamin B₆ = 600mg, Vitamin B₁₂ =4mg Folic acid =200mg, Biotin H₂=300mg, Choline Chloride=70,000mg, Cobalt=80mg, Copper=1200mg, Iodine=400mg, Iron=8,000mg, Manganese=16,000mg, selenium=80mg, Zinc=12,000mg and Antioxidant=500mg. LGNC= local groundnut cake, MSM= mucuna seed meal. ME= Metabolizable energy

Carcass Measurements, Cut-up parts, Organs and other visceral components

At the end of the feeding trial, three birds were randomly selected from each replicates. Live weight and slaughter weight was taken immediately after slaughter. Defeathering follows by dipping in hot water at 80⁰ C for 10-15 minutes. Then cut-up parts and visceral organs were later weighed. Dressing percentage was calculated using the relationships:

$$\text{Dressing \%} = \frac{\text{Carcass weight} \times 100}{\text{Live weight}}$$

The cut up parts include: shanks, head, breast, neck, drumsticks, thighs, wings, back and thorax. The weights were taken using electronic sensitive balance.

Table 2. Haematological indices of broiler finisher chickens fed diets containing differently processed mucuna seed meal

Indices	T ₁ (5%Raw)	T ₂ (5%soaked)	T ₃ (5%Boiled)	T ₄ (5%Cracked + Boiled)	T ₅ (5%Roasted)	SEM
(%) PCV	30.47 ^a	26.60 ^a	27.20 ^a	28.77 ^a	29.10 ^a	0.71 ^{NS}
Haemoglobin concentration (Hb) (g/dl)	9.63 ^a	8.48 ^a	8.73 ^a	9.23 ^a	9.37 ^a	0.33 ^{NS}
Red blood cells (RBC) (x10 ⁶ /mm ³)	2.37 ^a	2.19 ^a	2.05 ^a	2.32 ^a	2.32 ^a	0.08 ^{NS}
MCV (fL)	127.33 ^{ab}	122.44 ^b	133.33 ^a	123.90 ^b	125.50 ^b	0.91 [*]
MCH (pg)	41.30 ^{ab}	40.33 ^{ab}	42.80 ^a	39.80 ^b	40.37 ^{ab}	0.35 [*]
MCHC (%)	32.47 ^a	32.33 ^a	32.10 ^a	32.10 ^a	32.13 ^a	0.94 ^{NS}
White Blood Cell (x10 ³ /mm ³)	24.84 ^a	23.07 ^a	22.90 ^a	24.47 ^a	23.50 ^a	3.03 ^{NS}
Plateletes (PLT) (x10 ³ /μl)	1.50	0.37	2.60	1.33	0.47	0.27 ^{NS}
Differential Counts (%)						
Neutrophils(%)	1.50 ^b	1.67 ^b	4.47 ^{ab}	4.53 ^{ab}	5.97 ^a	0.46 [*]
Monophils (%)	0.00	0.00	0.00	0.00	0.00	0.00
Eosinophils (%)	0.00	0.00	0.00	0.00	0.00	0.00
Basophils (%)	0.00	0.00	0.00	0.00	0.00	0.00
Lymphocytes (%)	98.50 ^a	98.33 ^a	95.53 ^{ab}	95.47 ^{ab}	94.03 ^b	0.46 [*]

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

They were later expressed as percentage of the slaughter weight. The organs and other visceral components such as liver, gizzard, proventriculus heart, crop and abdominal fat were weighed using electronic sensitive balance and the weights expressed as percentage of the slaughter weight.

Statistical Analysis

All data collected were subjected to Analysis of Variance (ANOVA) of Completely Randomised Design of the SAS package (SAS, 1999). Where treatment effect differed significantly, means were separated using Duncan Multiple Range Test (Duncan, 1955). All statements of significance were based on 5% level.

RESULTS AND DISCUSSION

Haematological Assay

The result of haematological indices is presented in Table 2. The birds did not differ significantly in their PCV and RBC values. The values ranged from 26.60% to 30.47% and 2.05x10⁶mm³ to 2.37x10⁶mm³ for PCV and RBC respectively. All the PCV values were within the normal range of 25 to 45% reported by Mitruka and Rawnsley (1977), Ross *et al.* (1978), Anon (1980) and 26.1 to 29.5% reported by Ikhimioya *et al.* (2000), which implied that, irrespective of the processing effect, the diets were nutritionally adequate in providing a sound plane of nutrition.

Table 3. Serum biochemical indices of broiler finisher chickens fed diets containing differently processed mucuna seed meal

Parameters	T ₁ (5%Raw)	T ₂ (5%soaked)	T ₃ (5%Boiled)	T ₄ (5%Cracked+ Boiled)	T ₅ (5%Roasted)	SEM
Total Protein (g/l)	4.03 ^a	3.53 ^a	3.83 ^a	3.83 ^a	4.03 ^a	0.17 ^{NS}
Albumin (g/l)	2.42 ^a	2.16 ^a	2.30 ^a	2.32 ^a	2.42 ^a	0.10 ^{NS}
Globulin (g/l)	1.61 ^a	1.37 ^a	1.52 ^a	1.55 ^a	1.63 ^a	0.07 ^{NS}
Glucose (mmol/l)	15.00 ^b	14.33 ^b	14.00 ^b	14.33 ^b	14.00 ^b	0.35 ^{NS}
Urea (mmol/l)	8.04 ^b	7.88 ^{bc}	8.53 ^b	9.52 ^{ab}	10.08 ^a	0.15 [*]
Creatinine (µmol/l)	23.90 ^b	27.67 ^a	20.90 ^a	18.67 ^a	29.23 ^a	1.77 ^{NS}
Sodium (Na ⁺)(mmol/l)	151.00 ^{ab}	151.33 ^{ab}	148.67 ^b	154.33 ^a	150.00 ^b	0.53 [*]
Chlorine (Cl ⁻) (mmol/l)	86.97 ^b	89.60 ^b	93.10 ^{ab}	81.83 ^c	85.33 ^b	1.12 [*]
Hydrogen carbonate (HCO ₃ ⁻) (mmol/l)	14.93 ^{ab}	15.97 ^{ab}	17.87 ^a	13.13 ^b	13.97 ^b	0.49 [*]
Potassium (K ⁺)(mmol/l)	3.00 ^a	3.73 ^a	3.83 ^a	2.67 ^a	3.30 ^a	0.19 ^{NS}
ALAT (µm/l)	240.33	233.00	214.33	232.33	261.00	9.25 ^{NS}
ASAT (µm/l)	113.67	113.33	101.33	111.00	126.00	4.65 ^{NS}

a, b, c: Means in the same row bearing different superscripts differ significantly ($P < 0.05$). SEM: Standard error of mean, NS: Not significant ($P > 0.05$), *: Significant ($P < 0.05$), ALAT: Alanine amino tranferase. ASAT: Aspartate amino tranferase

Furthermore, none of the five treatment groups was found to be prone to anaemia. There were no significant ($P > 0.05$) differences among the treatment groups in haemoglobin (Hb) which ranged between 8.48 and 9.63%. The haemoglobin concentration (Hb) values obtained in this study are within the accepted range of 7.0 – 13.0 (g/dl) for broiler chickens (Anon, 1980; Swenson, 1999). This further indicated that, all the birds had higher tendency to resist respiratory stress, owing to the fact that, the Hb, which is carried on the RBC, is the O₂ –carrying pigment as earlier observed by Muhammad and Oloyede (2009). The RBC values were lower than the $3.3 \times 10^6 \text{mm}^3$ reported by Afolabi *et al.* (2011).

There were significant differences ($P < 0.05$) among treatment groups with respect to mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH). The result of MCH, which is the average amount of Hb in each RBC measured, followed the same pattern as MCV. The significant differences noticed in MCV and MCH in this study could be attributed to effect of processing on the test material in the experimental diets. The MCV and MCH values in all the treatment groups in this study fall within the normal range of 90 to 140 fl and 16 to 53 pg, respectively as earlier reported by Mitruka and Rawnsley (1977) and Anon (1980). This finding is in line with what has been earlier reported by Tuleun *et al.* (2007) in broiler chickens and that of Adenkola *et al.* (2009) in rabbits that nutrient is an important factor in haemopoiesis. The MCHC, WBC and platelates revealed no significant ($p > 0.05$) difference among the various groups.

The result of WBC count showed no significant ($p > 0.05$) difference among treatment means (Table 2). In other words, processing the test material exerted no significant effect on the Leukocytes. However, the differential count of these cells indicated that in treatment group with roasted test material, Neutrophil count was significantly ($p < 0.05$) higher than raw and soaked but similar with boiled and dual (cracked and boiled) processed test material (Table 2). Champe *et al.* (2008) observed neutrophils and microphages (monocytes) are components of WBC that are involved in both oxygen-independent and oxygen-dependent mechanism for combating viral, killing and engulfing bacteria. The lymphocytes appeared to have similar variations between the treatment groups. The highest and least values of 98.50 and 94.03% were recorded for the raw and roasted test material, respectively. These values were above the 40 to 48% reported by Bhatti *et al.* (2002). This implied that, all the treatment groups had adequate immune response status. The result also implied that, none of the processing methods predisposes Broiler chickens to infection, as higher count than normal may mean that, the birds immune system may be combating some kind of infection, as earlier reported by Frandson (1986) and Adeyemo and Longe (2007). Monocytes, Eosinophils and Basophils count were found none in all the treatment groups. Basophils contain the anticoagulant, *Heparin*, which is normally releases in areas of inflammation to prevent clotting and stasis of blood and lymph (Frandson, 1986). Therefore, no inflammation was encountered in both the control and treatment groups.

Table 4. Carcass characteristics and organ weights of broiler finisher chickens fed diets containing differently processed mucuna seed meal

Parameters	T ₁ (5%Raw)	T ₂ (5%soak)	T ₃ (5%Boiled)	T ₄ (5%Cracked+Boiled)	T ₅ (5%Roasted)	SEM
Live weight (g)	1822.00 ^a	1438.00 ^a	1577.00 ^b	1233.00 ^d	1490.00 ^c	105.36*
Blood drained weight (g)	1774.00 ^a	1415.00 ^a	1553.00 ^b	1203.00 ^c	1470.00 ^b	102.37*
Blood as % weight	2.89 ^a	1.53 ^{ab}	1.48 ^{ab}	2.27 ^{ab}	1.31 ^b	0.21*
Dressed weight (g)	1253.00 ^a	1142.00 ^b	1252.00 ^a	966.68 ^c	1127.00 ^b	78.90*
Dressing percentage	69.50 ^a	76.61 ^{ab}	80.60 ^a	78.44 ^{ab}	76.2 ^{ab}	2.34*
	weight of cut up parts		(% slaughter weight)			
Head	32.67	33.33	31.67	30.00	33.33	1.37 ^{NS}
Shanks	73.33	72.67	74.33 ^a	73.33	71.67	5.09 ^{NS}
Drum stick	101.67 ^b	121.67 ^a	112.33 ^b	83.33 ^c	111.67 ^b	9.01 [□]
Thighs	136.67 ^a	126.67 ^b	139.67 ^a	96.67 ^c	125.00 ^b	10.43 [□]
Wings	110.00	108.33	106.00	109.67	111.00	8.16 ^{NS}
Breast	181.67 ^a	211.67 ^a	171.00 ^a	127.33 ^a	144.00 ^a	20.88 [□]
Back	101.67 ^a	105.00 ^a	90.33 ^a	77.67 ^a	95.00 ^a	7.64 [□]
Thorax	100.00	116.67	112.67	101.33	100.00	9.25 ^{NS}
Neck	66.00	65.00	62.00	65.00	67.33	3.86 ^{NS}
	Organ weight (% slaughter weight)					
Gizzard	53.33 ^a	39.00 ^a	41.33 ^b	50.00 ^a	45.00 ^b	2.52 [*]
Liver	30.00 ^a	29.00 ^a	26.33 ^a	29.00 ^a	36.00 ^a	1.40 ^{NS}
Heart	13.33 ^a	11.67 ^a	12.33 ^a	13.00 ^a	12.67 ^a	1.66 ^{NS}
Abdominal Fat	13.33 ^b	15.67 ^b	13.33 ^b	16.33 ^{ab}	25.00 ^a	3.95 [□]
Proventriculus	16.33 ^a	18.33 ^a	18.67 ^a	17.67 ^a	17.67 ^a	1.58 ^{NS}
Crop	19.00 ^a	9.67 ^c	14.33 ^{bc}	13.00 ^{bc}	9.00 ^{bc}	1.18 [*]

a, b, c: Means on the same row with different superscripts differ significantly ($P < 0.05$), SEM: Standard Error of Means, *: Significant ($P < 0.05$), NS: Not Significant ($P > 0.05$).

Furthermore, Adeyemo and Longe (2007) reported Eosinophil was known to phagocytise particles formed when an antigen and antibodies react, a strategy for combating disease infection by chickens.

Serum Biochemistry

The results obtained from the serum biochemical indices are presented in Table 3. There were significant differences ($P < 0.05$) among treatment groups in urea, sodium ion, chloride ion and bicarbonate. However, total protein, albumin, globulin, glucose, creatinine, potassium ion, Alanine amino transferase (ALAT) and Aspartate amino transferase (ASAT) did not differ ($P > 0.05$) significantly among treatment groups. The range of 3.53 – 4.03 g/l for total protein which was observed in this study is in agreement with the normal range of 5.00 to 8.00 g/l/bird and 3.31 to 5.39 g/l reported by Anon (1980) and Mitruka and Rawnsley (1997), respectively. However, the values indicated nutritional adequacy of the test material in respect of protein hence, high serum protein and albumin values are reflection of better quality and amount of protein in the diets (Eggum, 1970 and Omoikhoje *et al.*, 2004).

The albumin values range of 2.16 to 2.42 g/dl showed no significant differences ($P > 0.05$) among the treatment groups but they are within the reference values of 2.0 – 3.5 g/l reported by Anon (1980) and Jain (1986). The globulin values range of 1.37 to 1.63 g/l observed in this experiment are low compared with the normal ranges of 2.33 – 3.33 g/l. Globulins are the main sites of the antibodies (immunoglobulin) (Peters *et al.*, 1982). However, Melluzzi *et al.* (1991) reported that changes in nutritional protein status are better shown in the albumin than in the globulin content of the blood. Processing methods had no effect on globulin. The glucose range of 14.00 – 15.00 mmol/l obtained in this study was within the range of 125 – 200 IU/l reported by Anon (1980) and Jain (1986). The findings of Balogun (1982) and Melluzzi *et al.* (1991) showed that low blood glucose could be an indication of inadequate intake or incipient problem with ketosis.

Urea was significantly higher in the roasted group than cracked and boiled, boiled, raw and soaked treatment groups. The values recorded (7.88 to 10.08 mmol/l) are within the acceptable range for broiler chickens. Serum urea originates from the diet and tissue deamination of proteins and it also indicates the good quality of dietary protein (Awosanya *et al.*, 1990; Altama, 1979; Ewulola and Egbunike, 2008). Serum creatinine values which ranged from 18.67 – 29.23 μ mol/l were not significantly ($P > 0.05$) different among the treatment groups. All the values observed were within the normal range of 44 to 135mmol/l. Higher values than normal indicates kidney malfunction (Champe *et al.*, 2008). The values of sodium and potassium ions recorded during this study ranged from 148.67 – 154.33 mmol/l and 2.67 – 3.83mmol/l, respectively. The values of sodium ion differed significantly ($P < 0.05$), while potassium ion did not differ ($P > 0.05$) significantly among the treatment groups. Sodium and potassium ions are known to regulate osmotic pressure, maintain membrane potential, acid base equilibrium and transmission of impulses in the body system. Their deficiencies in the body of animals adversely affect the tune time of the tubules of the kidneys and also cause alteration of gastric secretions as an internal motility (Mitruka and Rawnsley, 1997; Melluzi *et al.*, 1991).

The values of chloride ion differed significantly ($P < 0.05$) among the treatment groups. These values obtained are lower than the 400.00 mmol/l reported for chickens (Oluyemi and Roberts, 2000). Chloride ion form part of hydrochloric acid, secreted by the cells of pancreas, which is used in proventriculus (true stomach of chicken) to activate pepsinogen (inactive form of pepsin) to pepsin. This is responsible for initiation and digestion of protein and maintenance of acid-base balance. The variation might be due to effect of differently processing methods on the test material which was used in formulating experimental diets. The values of Alanine amino transferase (ALAT) and Aspartate amino transferase (ASAT) recorded during this study ranged between 214.33 – 261.00 μ mol/l and 101.33 – 113.67 μ mol/l, respectively. The enzymes assay showed that Alanine amino transferase (ALAT) and Aspartate amino transferase (ASAT) did

not differ ($P > 0.05$) among the treatment groups. These are liver enzymes that have linkages between the liver and the blood. Since there was no significant difference in both ALAT and ASAT in all treatment groups. This could suggest that dietary treatment did not adversely affect the functions of the liver.

Carcass Components

The carcass measurements are summarized in Table 4. There were significant differences ($P < 0.05$) in cut-up parts (head, shanks, wings, thorax and neck), some organ weights (liver, heart, proventriculus). These were expressed as percentage of slaughter weight and did not differ significantly ($P > 0.05$) among the treatments while others like gizzard, abdominal fat and crop were significant ($P < 0.05$) affected. The final live weight for the treatment groups ranged from 1233 g to 1822 g with the raw having significantly ($P < 0.05$) higher value.

Slaughter weights of 1203 g to 1774 g were obtained in this experiment and these are lower than 1695 g to 2050 g reported by Onifade and Tewe (1993) for growing rabbits. The dressed weight of 966.68 g to 1253 g recorded for the treatment groups in this study were significantly ($P < 0.05$) different. These values are slightly lower than 991.02 g to 1754 g reported by Amaefule *et al.* (2006) when urea-treated and non treated rice milling waste was used to feed growing broiler chickens since dressed weight is a reflection of the slaughter weights of the birds. The dressing percentage obtained ranged from 69.50 % to 80.60 % with boiled having the highest value. This shows that boiling of the mucuna seeds had a positive influence on the carcass yield of the broiler chickens as reflected by the dressing percentage. The values obtained in this study are in line with the range reported by Leeson and Summer (1980) Njoku (1986) and Adenkola *et al.* (2007).

The values for cut-up parts express as percentage of slaughter weight shown in Table 4 indicated that there were no significant difference ($P > 0.05$) among treatment groups in respect of head, shanks, wings, thorax and neck. The weight of drum stick, thighs, breast and back showed that there were significant differences ($P < 0.05$) among treatment groups. The weight of organs/body components expressed as percentage of slaughter weight indicated that there were no significant differences ($P > 0.05$) among the various treatment groups. The values for liver, heart and proventriculus as percentage of slaughter weight were equally similar in all the treatments. The non-significant difference ($P > 0.05$) in the organ weights investigated could also mean that none of the visceral organs was a direct target organ or the inclusion of the bean did not cause any toxicity or abnormal activities in the organ systems and therefore, safe for use in broiler feed production. The values of the organ weight are in consonance with the findings of Akpodiete *et al.* (1997) and Fanimo *et al.* (2005) who observed no gross morphological manifestation in the organs

of the birds fed with feeds compounded from various feed ingredients.

Conclusion

Results obtained from this study revealed that boiling as a processing method, is the best for improving the nutritional value of mucuna seed meal as no deleterious effects has been elicited on broiler chickens as evidenced by the haematological (MCV, MCH, neutrophils and lymphocytes) and serum biochemical indices in finisher phase. This establishes its potential usefulness as an alternative protein source in the diet of broiler chickens thereby reducing/minimizing competition between human being and livestock for conventional protein sources like soya bean and GNC. However, it also speed up the development of poultry industry. From this study, it can be recommended that boiling mucuna seed meal at 5.00% level of inclusion can be used without any deleterious effect on the hematological and serum assay of broiler chicken. However, further research are required by using other, processing techniques such as fermentation and sprouting (germination) and using other classes of birds.

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