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Growth and Heamatological Profile Of Broiler Chickens Fed Raw And Processed Cowpea Based Diets

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ABTRACT

A study was carried out to look at the utilization of cowpea – based diets on performance characteristics and haematology of broiler chickens. Raw cowpea (*Vigna unguigulata* L.Walp), dehulled – cowpea, dehulled – cooked cowpea and dehulled – roasted cowpea grains were fed to broiler chickens in an eight week feeding trial. A total of two hundred (200) day old unsexed broiler chicks of Marshall strain were allotted into five dietary treatments .Feed intake and growth were significantly (P<0.05) reduced in birds fed raw cowpea and dehulled – cowpea respectively. The feed conversion efficiency (FCE) and protein efficiency ratio (PER) also followed a similar pattern. Non – significant (P>0.05) differences were however obtained in weight gain ,FCE and PER of birds fed the control diet and those fed dehulled – cooked cowpea in this study. Birds fed dehulled – roasted cowpea also had marginal reductions the weight gain , FCE and PER when compared to those fed dehulled – cooked cowpea based diet. The haematological studies showed lower (P<0.05) values of haemoglobin, red blood cells, packed cell volume and white blood cells of birds fed raw cowpea and dehulled cowpea respectively. The best significant indices in this study were however obtained in birds fed dehulled – cooked cowpea.

Key words: Cowpea, processing, broilers, performance, haematology

1. INTRODUCTION

Grain legumes are moderate to good sources of protein, containing 150 to 400 g/kg crude protein (Hedley, 2001). The seeds of these legumes contain moderately high levels of protein and their amino acid profiles are generally comparable to that of soy bean meal, with the exception of sulphur-containing amino acids. When processed into meal, soybean has about with 44-48% crude protein, and is the major source of plant protein in poultry diets. However, the price of soybean meal was forecasted to increase higher on the international market due to the high demands in China and the emergent countries of Asia (Robinson and Singh, 2001). As a consequence, there is the risk that this traditional source of protein for poultry would become too expensive and scarce in the years to come, particularly in low-income . It is, therefore, necessary to search for good substitutes using readily available local feedstuffs. Among the potential sources of vegetable proteins are the cowpea grains (*Vigna unguiculata)* which serve as alternative to fat-extracted soybean meal because they have similar amino acid profiles (Wiryanwan, 1999).

Cowpea grains are cheap and readily available leguminous seeds that thrive well where others fail due to their excellent adaptability to extreme climatic conditions (FAO, 1999).Cowpea yields about 633 and729 kg seeds per hectare with crude protein content of about 25% on dry matter basis (Borget, 1989; Dillon, 1987).

However, the utilisation of grain legumes in poultry diets remains limited, due to the variability in their nutritional composition and the presence of a variable amount of anti-nutritional factors. It is well documented that feeding poultry with diets containing raw legumes can cause a number of nutritional disturbances (Farrell *et al*., 1999; Olkowski *et al*., 2001; Rubio *et al*., 2003; Teguia and Beynen., 2005; Wiryawan and Dingle, 1999). Just like any other grain legume, cowpea grains have been reported to contain anti-nutritional factors particularly haemagglutinin and trypsin inhibitors (Buget,1989; Teguia and Beynen,2005; Amaefuil *et al.*, 2005) which limit their utilization in animal feeding. Wiryawan and Dinlge (1999), Bressani(2002) and Teguia *et al*. (2003) reported poor performance of birds when fed raw cowpea. Anti-nutritional factors are known to exert deleterious effect on protein metabolism, nutrient absorption, feed intake, poor growth rate, feed conversion efficiency in monogastric animals (Emiola *et al*. 2003). These toxic compounds have been reported to cause poor growth, endogenous loss of essential amino acids, pancreatic hypertrophy in monogastric animals (Akanji *et al*., 2007). Aletor and Fetuga (1998) also reported disruption of the intestinal microvilli in rat fed wit raw lima bean. Moreover, studies have shown that when properly processed, grain legumes can be utilized by monogastric animals.

This study was therefore aimed at looking at the effects of raw, dehulled, dehulled- cooked and dehulled-roasted cowpea grains on performance characteristics and haematology of broiler chickens.

1.1 Materials and Methods

Raw cowpea grains were purchased from open market at Ayetoro, Ogun State, South – western Nigeria. The grains were air dried, dehulled, cooked and roasted using methods prescribed by Apata (1990) and Akanji (2002) with slight modifications

1.1.1 Dehulling

Air-dried cowpea grains were soaked in water for 15mins, after which their coats were removed manually by hand. The grains were then oven - dried, bagged and labelled dehulled cowpea (DHC)

1.1.2 Cooking

A batch of the dehulled cowpea grains were added to boiling water (250g seed /littre of water) and allowed to cook for 40 mins. Thereafter, the cooking water was decanted, and the cooked seeds were oven - dried, bagged and labelled dehulled- cooked cowpea (DHCC)

1.1.3 Roasting

Another batch of dehulled cowpea grains were roasted in oven at 130^{0}C for 25 mins. The seeds were stirred at interval of 5 mins in the oven to allow for uniform dry heating. The seeds were considered roasted when they became crispy to touch. Thereafter, the roasted seeds were air-dried, bagged and labelled dehulled-roasted cowpea (DHRC)

1.1.4. Experimental Diets:

Five experimental starter and finisher diets (Table 1 and 2) were formulated in this study. The starter diets were formulated to contain 23 % crude protein (CP) m and 3200kcal/kg metabolizable energy(ME). The finisher diets were on the other hand formulated to have 20% CP and 3000kcal/kg ME. The control diet contained maize, groundnut cake, fish meal, palm kernel cake. Raw, dehulled, dehulled – cooked and dehulled – roasted cowpea grains were incorporated into the diets at 20% level respectively. All diets were supplemented with 0.3% methionine to ensure the amino acid was not limiting for the chicks. The starter diets were given to the broiler chickens from week 1 to week 5, while the finisher diets were administered to the bird from week six to week 8.

Table 1 The ingredients and chemical composition of starter diets

	CONTROL	RC	DHC	DHCC	DRCC
Maize	53.00	50.00	49.71	49.50	49.70
GNC	30.00	12.50	12.64	12.74	12.54
Cowpea	-	20.00	20.00	20.00	20.00
Fish meal	8.50	9.00	9.15	9.26	9.26
Wheat bran	1. 50	1.20	1.20	1.20	1.20
Palm Oil	3.0	3.0	3.0	3.0	3.0
Bone meal	2.50	2.50	2.50	2.50	2.50
Oyster Shell	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50
Premix	0.50	0.50	0.50	0.50	0.50
Methionine	0.30	0.30	0.30	0.30	0.30
Calculated crude Crude protein(%)	23.09	22.76	22.69	22.51	23.04
Calculated metabolizable energy(kcal/kg)	3150.15	3.141.46	3149.86	3143.65	3149.05

Table 2.0 The ingredients and chemical composition of finisher diets

	CONTROL	RC	DHC	DHCC	DRCC
Maize	46.00	47.00	47.71	47.50	42.70
GNC	30.00	12.50	12.64	12.74	12.54
Cowpea	-	20.00	20.00	20.00	20.00
Fish meal	8.50	9.00	9.15	9.26	9.26
Wheat bran	8. 50	3.15	2.14	2.13	02.14
Palm Oil	3.0	3.0	3.0	3.0	3.0
Bone meal	2.50	2.50	2.50	2.50	2.50
Oyster Shell	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50
Premix	0.50	0.50	0.50	0.50	0.50
Methionine	0.30	0.30	0.30	0.30	0.30
Calculated Crude protein(%)	20.09	20.76	20.69	20.51	20.04
Calculated metabolizable energy(MJ)	3010.09	3004.76	3001.07	3002.43	3005.63

RC = Raw cowpea, **DHC** = Dehulled cowpea, **DHCC** = Dehulled cooked cowpea, **DHRC =** Dehulled roasted cowpea,GNC= Groundnut cake

0.50 premix supplied, per kilogram of diet: vitamin A, 12,000 IU; vitamin D3, 2,000 IU; vitamin E, 50 IU; vitamin B1, 1 mg; vitamin B2, 3 mg; vitamin B6, 1 mg; vitamin B12, 10 µg; vitamin K, 2 mg; copper (cupric sulphate), 75 mg; nicotinic acid, 12 mg; pantothenic acid, 10 mg; iron, 200 mg; cobalt, 0.5 mg; manganese, 40mg; zinc, 90 mg, iodine, 1 mg; selenium, 0.2 mg; calcium, 31.25 g; sodium, 10 g

1.1.5. Birds and Management

200 day-old unsexed broiler chicks (Marshal strain) were purchased at Obasanjo Farms, Abeokuta, Nigeria. The birds were divided into five groups at 40 birds per group. Each group was replicated four times at 10 birds per replicate group. Feed and water were supplied ad - libitum. Vaccines against New Castle disease were administered to the birds immediately after hatching and when they were 28 days old respectively. Gumboro vaccine was administered to the birds when they were 10 and 35 days old respectively. Vitamins were administered to the birds before and after each vaccination. The birds were dewormed adequately, while antibiotics were also given. Average weekly feed intake , body weight gain, feed conversion efficiency and protein efficiency ratio were used as measures of bird performance. The experiment was terminated at the end of the eighth week.

1.1.6. Proximate analyses

The proximate composition of the raw cowpea, dehulled – cowpea, dehulled – cooked cowpea and dehulled – roasted cowpea grains were determined using the analytical procedures of AOAC (1990) respectively.

1.1.7. Analytical Measurements

In the eighth week of the experiment, blood samples were collected from eight (8) live birds per group (2 per replicate group) through the use of syringe with needle into tubes for hematological examination. Hematological parameters including red blood cells (RBC), hemoglobin (Hb), packed cell volume (PCV) and white blood cells (WBC) were determined by procedure outlined by Dacie and Lewis, (1977).

1.1.8. Statistical analysis: All data were analyzed using the analysis of variance. Where significant treatment effects were obtained, their means were compared using Duncan Multiple Range Test (Steel and Torrie, 1980).

1.2. RESULTS

The proximate composition of the raw and differently processed cowpea grains are shown in Table 3. A crude protein (CP) content of 23.78%, crude fibre(CF) (2.45%), ether extract(EE) (1.27%) and ash (3.21%) were obtained in the raw cowpea grains. Marginal reductions in the CP, CF, EE and ash were however obtained in the dehulled cowpea and dehulled – cooked cowpea grains respectively. The dehulled – roasted cowpea gave slight increases in the proximate composition.

Table 3. Proximate composition of raw, dehulled, dehulled- cooked and dehulled- roasted cowpeas(% dry matter)

	RC	DHC	DHCC	DHRC
Dry matter	**96.91**	**95.09**	**94.02**	**97.06**
Crude protein	23.78	22.54	21.03	24.89
Crude Fibre	2.45	2.34	2.17	2.54
Ether Extract	1.27	1.20	1.09	1.34
Ash	3.21	3.16	2.78	3.24
Nitrogen free extract	66.20	65.85	66.95	65.05

RC = Raw cowpea, **DHC** = Dehulled cowpea, **DHCC** = Dehulled cooked cowpea, **DHRC =** Dehulled roasted cowpea

The results showing performance characteristics of broiler chickens fed cowpea diets are presented in Table 4. Feed intake was similar ($P>0.05$) between birds fed control diet and dehulled – cooked cowpea diet, but significantly ($P<0.05$) reduced in those fed raw cowpea, dehulled cowpea and dehulled – roasted cowpea respectively. The feed intake was however similar ($P>0.05$) between birds fed raw cowpea and dehulled – cowpea based diets respectively. The weight gain was significantly ($P<0.05$) higher in birds fed the control diet and dehulled – cooked cowpea respectively. Birds fed dehulled – cooked cowpea and dehulled – roasted cowpea followed with similar ($P>0.05$) values of weight gain. Marked ($P<0.05$) reductions in weight gain were however obtained in birds fed diets containing raw cowpea and dehulled – cowpea respectively. The feed conversion efficiency (FCE) followed a similar pattern to that of the weight gain. Higher ($P<0.05$) values of protein efficiency ratio (PER) were obtained in birds fed control diet , dehulled – cooked cowpea and dehulled – roasted cowpea respectively. However, the PER was similar ($P>0.05$) between birds fed control diet and dehulled – cooked cowpea diet. Significant ($P<0.05$) reductions were however obtained in PER of birds fed raw cowpea and dehulled – cowpea grains respectively. Mortality was higher in birds fed raw cowpea – based diet.

Table 4. Performance characteristics of broiler chickens fed raw, dehulled, dehulled- cooked and dehulled- roasted cowpea based diets

	Control	RC	DHC	DHCC	DHRC	SEM
Feed Intake (Kg/wk)	0.297^{a}	0.234^{c}	0.244^{c}	0.287^{a}	0.269^{b}	± 0.05
Weight Gain (Kg/wk)	0.186^{a}	0.103^{d}	0.117^{d}	0.170^{b}	0.158^{c}	± 0.04
Average FCE/wk	0.626^{a}	0.440^{d}	0.480^{c}	0.592^{b}	0.572^{b}	± 0.07
Average PER/wk	2.717^{a}	1.873^{c}	1.918^{c}	2.617^{ab}	2.588^{b}	± 0.23
Mortality	5.00	15.00	10.00	5.00	5.00	± 0.09

Means: with different Superscripts along rows are significantly different ($P<0.05$).

RC = Raw cowpea, **DHC** = Dehulled cowpea, **DHCC** = Dehulled cooked cowpea, **DHRC =** Dehulled roasted cowpea FCE= Feed conversion efficiency, PER= Protein efficiency ratio

Results on haematological studies of the broiler chickens are presented in Table 5. Haemoglobin content of the blood was similar (P>0.05) between birds fed control diet and those fed dehulled – cooked cowpea – based diet. Those fed on dehulled – roasted cowpea also had similar haemoglobin with birds fed dehulled – cooked cowpea, but however lower than that of the control group. The haemoglobin was however significantly (P<0.05) reduced in birds fed raw cowpea and dehulled cowpea respectively. The red blood cells and packed cell volume of the birds also followed a similar pattern like that of the haemoglobin. The white blood cells of the birds were not significantly (P>0.05) across the groups. Higher significant (P<0.05) increases in mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) were however obtained in birds fed raw cowpea and dehulled cowpea diets respectively.

Table 5. Haematological indices of birds fed raw, dehulled, dehulled- cooked and dehulled- roasted cowpea based diets

	Control	**RC**	**DHC**	**DHCC**	**DHRC**
Hb (g/dl)	9.54^{a}	6.23^{c}	6.53^{c}	8.99^{ab}	8.02^{b}
RBC($x10^{12}$/L)	3.91^{a}	2.73^{c}	2.81^{c}	3.43^{a}	3.01^{b}
WBC($x10^{9}$/L)	2.34	2.11	2.09	2.14	2.16
PCV(%)	32.71^{a}	26.11^{c}	27.23^{c}	31.11^{ab}	29.76^{b}
MCV(g/100ml)	84.11^{c}	92.11^{a}	91.71^{a}	85.11^{c}	88.34^{b}
MCH(ps/cell)	26.26^{c}	30.86^{a}	29.11^{a}	27.14^{b}	29.78^{a}

Means: with different superscripts along rows are significantly different (P<0.05).

RC = Raw cowpea, **DHC** = Dehulled cowpea, **DHCC** = Dehulled cooked cowpea, **DHRC =** Dehulled roasted cowpea, **Hb**= Haemoglobin, **RBC**= Red blood cell, **WBC**=White blood cell, **PCV**= Packed cell volume, MCV = Mean Corpuscular Volume , MCH = Mean Corpuscular Haemoglobin

1.3 DISCUSSION

The results obtained on the proximate composition of the raw , dehulled cowpea, dehulled – cooked cooked cowpea and dehulled – roasted cowpea grains in this study are similar to the reports of Henry *et al.,* (2008). The data obtained on the performance characteristics in this study agree with established findings that cooking and dry heating improves the intake of diets containing grain legumes (Essein and Udedibie , 2007). The poor feed consumption observed in birds fed raw cowpea and dehulled cowpea in this study agrees with the findings of Borget (1989), Amaefule and Osuagwu (2005) and Teguia and Beynen (2005). These authors observed poor feed intake of broiler birds fed raw Bambara groundnut (*Vigna subterranean*(L) Verdc), cowpea and black common bean and attributed the poor feed intake to the presence of anti – nutritional factors (ANFs) in the legume grains .However, the major reason adduced for the poor feed intake of birds fed raw cowpea and dehulled – cowpea – based diets in this study is in their content of high amounts of heamagglutinin located much in the seed cotyledons. Dehulling was reported to be effective at reducing heat – stable toxic factors, oxalate, phytate and tannin, located much in the seed coat of benne seed (Akanji 2002) . An earlier report by Apata(1990) also showed that the addition of 1% of heamagglutinin to a diet containing autoclaved soybeans reduced the feed intake in rats.

Moreover, the higher feed intake obtained in birds fed dehulled – cooked cowpea and dehulled – roasted cowpea can be attributed to the effects of the heat treatments. Apata (1990) reported that breaking grain legumes into smaller sizes has a tendency to eliminate heat labile toxic factors when subjected to aqueous heating treatment.

Weight gain was was poorer in groups of birds fed raw cowpea and dehulled cowpea. This can be attributed to the poor accessibility of nutrients in the diets by enzymes. Essein and Udedibie (2007) were of the opinion that haemagglutinins in raw jack been caused alterations in some enzyme systems and loss of weight in growing rabbits. Emiola *et al.*, (2003) also reported poor growth of broiler chickens fed raw kidney beans. However, the improved weight gain in birds fed dehulled – cooked cowpea and dehulled – roasted cowpea in this study support earlier studies that cooking and roasting improves the nutritive value of grain legumes (Ologbobo, 1992) The FCE and PER were markedly reduced in birds fed raw cowpea and dehulled cowpea. This can however be attributed to the combined effects of the anti-nutritional factors on reduction of protein metabolism and absorption and utilization of minerals. D'Mello (1991) reported that trypsin inhibitor adversely influenced the utilization of protein in rats by increasing the amount of cysteine and methionine requirement. Akanji (2002) had earlier reported significant correlations between feed conversion efficiency and each of haemagglutanin and trypsin inhibitor in adult cockerels fed raw jackbeans, bambara groundnut and benne seed. Udedibie and Carlini (1998) were of the views that even minute amounts of residual haemagglutinin in processed jack bean could constitute a problem to birds on ad-libitum feeding system, and that the anti-nutritional factor is resistant to proteollytic digestion and thereof tends to accumulate in the animals by binding to the intestinal wall, thereby reducing the efficiency of feed utilization.

The results on the haematology of the birds showed lower values of haemoglobin, red blood cells, packed cell volume and white blood cells of birds fed raw cowpea and dehulled cowpea respectively. This observation support the report of Apata (1990) that haemagglutinins in raw or partially detoxified grain legumes have the ability to agglutinate the erythrocytes of numerous animal species, thus leading to dysfunction of red blood cell haematopoesis and a toxic induced red blood cell heamolysis and increase in the plasma volume. Akanji *et al.,* (2007) reported a progressive degradation of the erythrocytes of adult cockerels during intoxication of lectins from edible legumes

1.4. CONCLUSION: In this study, better response indices were obtained in the birds fed diets containing dehulled - cooked cowpea. This signified a better detoxification of the inherent heat stable and heat labile anti-nutritional factors when compared to the other treatment methods used in this study. However, despite the better response indices, the combination of dehulling and cooking led to leaching of some water - soluble food nutrients. Hence, more studies still need to be carried out especially at other processing methods that can drastically reduce the anti – nutritional factors without necessarily leaching the food nutrients.

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