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# Effect of raw and processed cowpea on growth and heamatological profile of broiler chicken

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## Abstract

A study was carried out to look at the utilization of cowpea based diets on performance characteristics and haematology of broiler chickens. Raw cowpea, 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 control diet and those fed dehulled cooked cowpea in this study. Birds fed dehulled roasted cowpea also had marginal reductions in 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, broilers, performance, haematology

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## 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 to 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 and 729 kg seeds per hectare with crude protein content of about 25% on dry matter basis (Dillon, 1987). However, the utilization of grain legumes in poultry diets remains limited, due to the variability in their nutritional composition and 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 haemaglutinin and trypsin inhibitors (Buget, 1989; Teguia *et al*. (2003); 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 with 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 the effects of raw, dehulled, dehulled cooked and dehulled roasted cowpea grains on performance characteristics and haematology of broiler chickens.

## Materials and methods

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

**Dehulling**

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

**Cooking**

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

**Roasting**

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

**Experimental diets**:

Five experimental starter (Table 1) and finisher diets (Table 2) were formulated in this study. The starter diets were formulated to contain 23% crude protein (CP) and 3200 Kcal/kg metabolizable energy (ME). The finisher diets were, on the other hand, formulated to have 20% CP and 3000 kcal/kg ME. The control diet contained maize, groundnut cake, fish meal, palm kernel cake. Raw, dehulled cooked and dehulled roasted cowpea grains were incorporated into the diets at 20% level, respectively.

**Table 1.** The ingredients used in starter diets (%)

| | CONTROL | RC | DHC | DHCC | DHRC |
|---|---|---|---|---|---|
| Maize | 53.00 | 50.00 | 49.71 | 49.50 | 49.70 |
| Ground nut cake | 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 protein (%) | 23.09 | 22.76 | 22.69 | 22.51 | 23.04 |
| Calculated ME (kcal/kg) | 3150.15 | 3141.46 | 3149.86 | 3143.65 | 3149.05 |

RC: Raw cowpea, DHC: Dehulled cowpea, DHCC: Dehulled cooked cowpea, DHRC: Dehulled roasted cowpea; 0.50 premix supplied per kilogram of diet mixing 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.

All diets were supplemented with 0.3% methionine to ensure 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 6 to week 8.

**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 at 28 days old. Gumboro vaccine was administered to the birds when they were 10 and 35 days old, respectively. Vitamins were administered to birds before and after each vaccination. Antibiotics were used when the birds were dewormed. 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 8$^{th}$ week.

**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).

**Analytical measurements**

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

**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).

**Table 2.** The ingredients used in finisher diets (%)

| | CONTROL | RC | DHC | DHCC | DHRC |
|---|---|---|---|---|---|
| Maize | 46.00 | 47.00 | 47.71 | 47.50 | 42.70 |
| Ground nut cake | 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 ME (Kcal/Kg) | 3010.09 | 3004.76 | 3001.07 | 3002.43 | 3005.63 |

RC: Raw cowpea, DHC: Dehulled cowpea, DHCC: Dehulled cooked cowpea, DHRC: Dehulled roasted cowpea; 0.50 premix supplied per kilogram of diet mixing 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.

## Results

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

owever, the results showing performance characteristics of broiler chickens fed cowpea diets were presented in Table 4. Feed intake was similar 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. 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 control diet and dehulled cooked cowpea. 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. The feed conversion efficiency (FCE) followed a similar pattern to that of 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. Mortality was higher in birds fed raw cowpea based diet.

Results on haematological studies of broiler chickens were presented in Table 5. Haemoglobin content of 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, but lower than that of control group. The haemoglobin was however, significantly ($P < 0.05$) reduced in birds fed raw and dehulled cowpea, respectively. The RBCs and PCVs of birds also followed a similar pattern like that of haemoglobin. 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 3.** Proximate composition of raw and processed cowpeas (% on dry matter basis)

| | 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.

**Table 4.** Performance characteristics of broiler chickens fed raw and processed cowpea

| | 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 (%) | 5.000 | 15.00 | 10.00 | 5.00 | 5.00 | ± 0.09 |

RC: Raw cowpea, DHC: Dehulled cowpea, DHCC: Dehulled cooked cowpea, DHRC: Dehulled roasted cowpea. FCE: Feed conversion efficiency, PER: Protein efficiency ratio. Means with different Superscripts along rows are significantly different ($P < 0.05$).

## Discussion

The results obtained on proximate composition of raw cowpea, dehulled cowpea, dehulled cooked cowpea and dehulled roasted cowpea grains studied were similar to the reports of Henry *et al.* (2008). The data obtained on performance characteristics in this study agreed with findings that cooking and dry heating improves intake of diets containing grain legumes (Essein and Udedibie, 2007). The findings of Borget (1989), Amaefule and

Osuagwu (2005) and Teguia and Beynen (2005) attributed to 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 supported 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 and dehulled cowpea. This can however, be attributed to the combined effects of anti-nutritional factors on reduction of protein metabolism and absorption and utilization of minerals. D′Mello (1991) reported that trypsin inhibitor adversely influenced utilization of protein in rats by increasing amount of cysteine and methionine requirement. Akanji (2002) 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 factors resistant to proteolytic digestion and thereof, tends to accumulate in the animals by binding to intestinal wall, thereby reducing the efficiency of feed utilization. The results on the haematology of 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.

**Table 5.** Haematological profile of birds

| | Control | RC | DHC | DHCC | DHRC |
|---|---|---|---|---|---|
| Hb (g/dl) | 9.54$^{a}$ | 6.23$^{c}$ | 6.53$^{c}$ | 8.99$^{ab}$ | 8.02$^{b}$ |
| RBC (x$10^{12}$/L) | 3.91$^{a}$ | 2.73$^{c}$ | 2.81$^{c}$ | 3.43$^{a}$ | 3.01$^{b}$ |
| WBC (x$10^{9}$/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 (pg/cell) | 26.26$^{c}$ | 30.86$^{a}$ | 29.11$^{a}$ | 27.14$^{b}$ | 29.78$^{a}$ |

RC: Raw cowpea, DHC: Dehulled cowpea, DHCC: Dehulled cooked cowpea, DHRC: Dehulled roasted cowpea, Hb: Haemoglobulin, RBC: Red blood cells, WBC: White blood cells, PCV: Packed cell volume, MCV: Mean corpuscular volume, MCH: Mean corpuscular haemoglobin. Means with different Superscripts along rows are significantly different ($P < 0.05$).

## 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 anti nutritional factors without necessarily leaching the food nutrients.

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