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Effect of Substituting Soybean Meal with Cowpea (*Vigna unguiculata* WAL) Supplemented with Natural Plant Charcoals in Broiler Diet on Growth Performances and Carcass Characteristics

Research Article

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ABSTRACT

A total of 280 unsexed broiler chicks, 21 days-old and weighing 580 g on average were randomly distributed into 28 experimental units of 10 birds each. Seven experimental diets containing respectively 0% (T0 control), 20% raw cowpeas (T1), 20% raw cowpeas + 0.2% of *Canarium charcoal* (T2), 20% raw cowpeas + 0.2% maize cob charcoal (T3), 20% cooked cowpeas (T4), 20% cooked cowpeas + 0.2% *Canarium charcoal* (T5) and 20% cooked cowpeas + 0.2% maize cob charcoal (T6) were each fed to 4 experimental units in a completely randomised design. The T3 and T6 rations containing respectively raw and cooked cowpeas supplemented with maize cob charcoal were the most consumed (P<0.05). Birds fed T1 with raw cowpea (1287g) and T2 fed with raw cowpea supplemented with *Canarium charcoal* (1280 g) recorded the lowest weight gain, with the control birds (1536 g) and birds fed T6 containing cooked cowpea supplemented with maize cob charcoal (1490 g) recording the highest body weight gain. Feed conversion ratio (FCR) was significantly poorer (P<0.05) for the birds fed raw cowpea supplemented with *Canarium charcoal* (3.23), those on the control diet without cowpea recorded the best FCR (2.74). There was no significant difference among treatment groups for carcass yield and the lowest (P<0.05) liver and pancreas relative weight recorded for the birds on the cooked cowpea supplemented with charcoals diets was not significantly different from that of control birds. The lowest gizzard relative weight was recorded with control birds as compared with all other groups. The intestine density (weight/length) was significantly lower (P<0.05) with raw cowpea supplemented with *Canarium charcoal* (0.19 g/cm), and the highest recorded with cooked cowpea (0.27 g/cm) and control diet (0.25 g/cm).

KEY WORDS broiler chickens, *Canarium schweinfurthii*, cowpeas, maize cob, plant charcoal.

INTRODUCTION

In most African countries south of the Sahara, high animal feed cost is in general associated with high cost of imported protein concentrates, soybean meal and fish meals. The restriction of animal meal in livestock feed worldwide has added additional constraints to poultry production in central African sub-region. According to Robinson and Singh (2001), it is predicted that soybean which is the major source of plant protein in poultry diets will be scare and expensive due to the expanding economies in emerging Asian and south American countries. It is therefore, necessary to search for readily available local feedstuffs to replace imported protein sources during period of soybean shortage (Teguia *et al*. 2007; Teguia and Fon Fru, 2007). Among the potential sources of plant protein, grain legumes could be good alternatives to soybean meal because they are known to have a similar amino acid profile (Ugwu and Onymonyi, 2008; Defang *et al*. 2008).

Recent works have revealed that cowpea has promising potential as feeding stuff for poultry. Its incorporation in diets of these species has reduced the cost/kg of feed and improved growth and production parameters (Teguia *et al*. 2007; Defang *et al*. 2008; Chakam *et al*. 2008). However, the utilization of row cowpeas (*Vigna unguiculata*) was limited by the presence of antinutritional factors that negatively affect broilers' performances, thus confirming previous reports (Teguia *et al*. 2007; Defang *et al*. 2008; Chakam *et al*. 2008) on the necessity to detoxify cowpea grain before their inclusion in monogastric animals diets. Among the proposed numerous treatment methods for detoxifying the grains, physical and / or chemical treatments seem to be the most promising. Some plants charcoals have shown to have absorbent properties of a wide variety of toxic agents (Ramos *et al*. 1996). Kana *et al*. (2010) reported that the inclusion of charcoal from *Canarium schweinfurthii* seeds and maize cob could be used as feed additives to absorb aflatoxin B1 and promote growth performance of broiler chickens.

The objective of the present study was to investigate the effect of cooking and plant charcoal supplementation on the utilization of cowpeas grains by broiler chickens.

MATERIALS AND METHODS

The study was conducted at the University of Dschang Research and extension Farm located in the western Highland of Cameroon, at altitude 1420 m above sea level, receiving 1900-2000 mm rainfall per annum over a 9-month rainy season (March-November) and with temperature between 10 and 25 ˚C.

Cowpea (*Vigna unguiculata*) was bought from local markets, cooked (boiled) for 30 minutes. Cooked grains were sun-dried for 5 days. Seeds of *Canarium schweinfurthii* Engl. and maize cob collected in villages around the University experimental Farm were burnt each to black charcoal, quenched with water and dried. After drying, each charcoal was sieved to pass 1-mm mesh.

The experimental birds were from a flock of 280 unsexed 21-days all Starbro broiler chicks with an average body weight of 550 g. They were vaccinated in drinking water against Newcastle disease and infectious bronchitis at 7 days and 23 days and against Gumboro disease at 10 days of age. In addition to a control diet containing soybean meal as plant protein source (T0), six experimental diets were formulated to contain 20% raw cowpeas (T1), raw cowpea + 0.2% of *Canarium charcoal* (T2), raw cowpea + 0.2% maize cob charcoal (T3), cooked cowpeas (T4), cooked cowpeas + 0.2% *Canarium charcoal* (T5) and cooked cowpeas + 0.2% maize cob charcoal (T6) (Table 1). Each of the experimental diets (T0, T1, T2, T3, T4, T5 and T6) was fed randomly to 4 experimental units, corresponding to a completely randomized design with 7 treatments replicated 4 times each.

Data were collected every week on body weight and feed consumption. Feed conversion ratio (FCR) was calculated. At the end of the trial at 49 days, 10 birds per treatment were starved for 12 hours and slaughtered for carcass evaluation according to Jourdain (1980). Length of the intestine was measured with the cut done from the start of the duodenal loop to the end of the cloaca. The density of the intestines was calculated as the ratio of the weight / length of the intestine. All data collected or calculated were submitted to analysis of variance in a completely randomized design. Where necessary, means were separated using Duncan's new multiple range test.

RESULTS AND DISCUSSION

The mean performances of broilers as affected by the presence of cowpeas or the methods used to detoxify the grains are summarized in Table 2. Feed consumption was significantly (P<0.05) affected by cowpeas, with the raw (T3) or cooked (T6) supplemented with 0.2% maize cob charcoal birds consuming the most. Feed consumption for the T0, T1, T2, T4 and T5 birds was not significantly different (P>0.05). Feed consumption was significantly higher for the raw and cooked cowpea supplemented with maize cob charcoal suggesting that cooking and maize cob charcoal succeeded in eliminating the antinutritional factors (ANFs) contained in the cowpea. According to Wiryawan and Dingle (1999) and, Teguia and Beyenen (2005), the ANFs present in legumes grains depress feed consumption in chickens. A combination of treatments normally improves palatability and feed consumption (Wiryawan and Dingle, 1999). The body weight of the control birds (T0) and those fed cooked cowpea supplemented with maize cob charcoal (T6) were significantly higher (P<0.05) than those of the other groups of birds throughout the experimental period. There was no significant (P>0.05) difference between the T2, T3 and T5 for body weight. Birds fed T1 with raw cowpea (1287 g) and T2 fed with raw cowpea supplemented with *Canarium charcoal* (1280 g) recorded the lowest weight gain, with the control birds (1536 g) and birds fed T6 containing cooked cowpea supplemented with maize cob charcoal (1490 g) recording the highest body weight gain.

These results are in agreement with Wiryawan (1997), Teguia *et al*. (2007), Chakam *et al*. (2008) and Defang *et al*. (2008) who reported that cooking reduces ANFs in legumes

Table 1 Composition of experimental diets

Ingredients (%)	Diets						
	T0 (Control)	T1	T2	T3	T4	T5	T6
Maize	65	50	50	50	50	50	50
Wheat bran	5	9	9	9	9	9	9
Soybean meal	18	12	12	12	12	12	12
Cowpeas	-	20	20	20	20	20	20
Cottonseed meal	3	-	-	-	-	-	-
Fish meal	3	3	3	3	3	3	3
Bone meal	1	1	1	1	1	1	1
Premix (5%)[1]	5	5	5	5	5	5	5
Total	100	100	100	100	100	100	100
Calculated chemical composition							
Crude protein (CP)	20.06	20.10	20.10	20.10	20.10	20.10	20.10
Metabolizable energy (kcal/kg)	3022.95	3100	3100	3100	3100	3100	3100
Calcium	1.03	1.04	1.04	1.04	1.04	1.04	1.04
Non-phytate phosphorus	0.42	0.5	0.5	0.5	0.5	0.5	0.5
Lysine	1.16	1.21	1.21	1.21	1.21	1.21	1.21
Methionine	0.43	0.56	0.56	0.56	0.56	0.56	0.56

[1] Premix 5%: CP= 40%; Lysine= 3.3%; Methionine= 2.40%; Ca= 8%; P= 2.05%; Metabolizable energy= 2078 kcal/kg.

Table 2 The effect of cooked and supplementation of cowpeas with plant charcoals on the average performance (means±standard deviation) of broiler chickens

Parameters	Diets						
	T0 (Control)	T1	T2	T3	T4	T5	T6
Feed consumption (g)	4215.00± 103.31[a]	4090.50± 157.40[a]	4026.66± 34.03[a]	4441.66± 136.80[b]	4087.50± 162.61[a]	4207.56± 76.63[a]	4501.66± 92.37 [b]
Body weight (g)	2445.83± 59.40[c]	2107.29± 46.90[a]	2125.00± 59.62[a]	2209.37± 154.64[ab]	2284.37± 143.51[b]	2214.58± 57.65[ab]	2350.00± 113.40[bc]
Body weight gain (g)	1536.13± 66.11[b]	1287.85± 79.94[a]	1280.55± 91.34[a]	1389.10± 196.26[ab]	1441.88± 92.94[ab]	1379.63± 55.44[ab]	1490.00± 119.53[b]
FCR (g feed/g gain)	2.74 ± 0.57[a]	3.18± 0.31[ab]	3.15± 0.25[ab]	3.23± 0.36[b]	2.83± 0.07[ab]	3.05± 0.13[ab]	3.03± 0.19[ab]

The means within the same row with at least one common letter, do not have significant difference (P>0.01).

grains, therefore improving protein utilization. Activated charcoal has been shown to be a tenacious absorbent of a wide variety of toxic agents (Ramos *et al.* 1996; Ruttanavut *et al.* 2009), and thus seemed a likely candidate for the study of ANFs. Feed conversion ratio (FCR) was significantly poorer (P<0.05) for the birds fed raw cowpea supplemented with *Canarium charcoal* (3.23), those on the control diet without cowpea recorded the best FCR (2.74). The T4, T5 and T6 fed cooked cowpea (2.83-3.05) supplemented with charcoals recorded a better FCR than those with raw cowpea (3.15-3.23) supplemented or not with charcoals. These results are in agreement with Wiryawan and Dingle (1999) that a combination of treatment methods improves feed utilization more than a single method.

These results are also in agreement with Teguia *et al.* (2007), Chakam *et al.* (2008) and Defang *et al.* (2008) who reported that cooking improves feed conversion by broilers. The lowest gizzard relative weight was recorded with birds fed with cooked cowpea supplemented with charcoals as compared to birds fed with raw cowpea supplemented or not with charcoals (Table 3).

However, the lowest gizzard relative weight was recorded with control birds as compared with all other groups.

The present results contradict the previous findings of Kana *et al.* (2011) who report that birds fed diet supplemented with graded level of plants charcoals had smaller gizzards.

Table 3 The effect of cooked and supplementation of cowpeas with plant charcoals on the digestive organ development and the carcass yield (Means±Standard deviation) of broiler chickens

Parameters	Diets						
	T0 (Control)	T1	T2	T3	T4	T5	T6
Gizzard (% of LW)	1.13±0.08^{a}	1.39±0.09^{c}	1.32±0.07^{b}	1.37±0.02^{c}	1.33±0.05^{b}	1.27±0.06^{b}	1.23±0.08^{b}
Intestine length (cm)	205.37±10.30^{a}	215.62±19.20^{ab}	211.62±17.20^{a}	213.25±13.30^{ab}	225.75±24.30^{b}	211.75±19.70^{a}	215.75±14.10^{ab}
Intestine density (weight/Length)	0.27±0.44^{a}	0.22±0.05^{ab}	0.19±0.02^{b}	0.28±0.08^{a}	0.27±0.04^{a}	0.22±0.05^{ab}	0.24±0.07^{a}
Carcass yield (%)	72.13±4.22^{a}	74.30±4.55^{a}	71.43±6.55^{a}	72.98±3.45^{a}	73.25±5.10^{a}	72.02±1.39^{a}	73.12±2.21^{a}
Liver (% of LW)	1.62±0.17^{a}	1.88±0.50^{b}	1.72±0.19^{a}	1.68±0.14^{a}	1.77±0.23^{ab}	1.62±0.17^{a}	1.63±0.03^{a}
Pancreas (% of LW)	0.18±0.02^{a}	0.23±0.03^{c}	0.22±0.02^{bc}	0.21±0.01^{b}	0.21±0.01^{b}	0.20±0.02^{a}	0.20±0.01^{a}
Abdominal fat (% of LW)	0.89±0.27^{ab}	0.77±0.20^{a}	0.71±0.35^{a}	1.03±0.32^{b}	0.81±0.21^{a}	0.95±0.25^{ab}	0.99±0.42^{ab}

The means within the same row with at least one common letter, do not have significant difference (P>0.01).

The intestine density (weight/length) which is considered as an indication of the intestinal villi size of the mucosa layer (Abdel-Fattah *et al.* 2008) was significantly lower (P<0.05) with raw cowpea supplemented with *Canarium charcoal* (0.19 g/cm), and the highest recorded with cooked cowpea (0.27 g/cm) and control diet (0.25 g/cm). Supplementing diets with plants charcoal increased intestine density as compared with control.

The present results confirmed the findings of Abdel-Fattah *et al.* (2008) and Kana *et al.* (2011) who reported that supplementing diet with organic acids and plant charcoals respectively improved the intestinal length and weight.

There was no significant difference among treatment groups for carcass yield. The lowest (P<0.05) liver and pancreas relative weight recorded for the birds on the cooked cowpea supplemented with charcoals diets was not significantly different from that of control birds. Kana *et al.* (2010) and Kana *et al.* (2011) also found that dietary plant charcoals had no effect on carcass characteristics of broilers.

REFERENCES

Abdel-Fattah S.A., El-Sanhoury M.H., El-Mednay N.M. and Abdel-Azeem F. (2008). Thyroid activity, some blood constituents, organs morphology and performance of broiler chicks fed supplemental organic acids. *Int. J. Poult. Sci.* **7,** 215-222.

Chakam V.P., Teguia A. and Tchoumboue J. (2008). Performance of finisher broiler chickens as affected by graded levels of cooked cowpeas (*Vigna unguiculata)* in the grower-finisher diet. *Bull. Anim. Prod. Afr.* **56,** 251-258.

Defang H.F., Teguia A., Awah-Ndukum J., Kenfack A., Ngoula F. and Metuge F. (2008). Performance and carcass characteristics of broilers fed boiled cowpea (*Vigna unguiculata* Wal*)* and or black common bean (*Phaseolus vulgaris*) meal diests. *Afr. J. Biotechnol.* **7,** 1351-1356.

Kana J.R., Teguia A., Mungfu B.M. and Tchoumboue J. (2011). Growth performance and carcass characteristics of broiler chickens fed diets supplemented with graded levels of charcoal from maize cob or seed of *Canarium schweinfurthii* Engl. *Trop. Anim. Health. Prod.* **43,** 51-56.

Kana J.R., Teguia A. and Tchoumboue J. (2010). Effect of dietary plant charcoal from *Canarium schweifurthii* Engl. and maize cob on aflatoxin B1 toxicosis in broiler chickens. *Livst.Res. Rural. Dev*. http://www.lrrd.org/lrrd22/4/kana22077.htm.

Ramos A.J., Johana F.G. and Hernandez E. (1996). Prevention of toxic effects of mycotoxins by means of non-nutritive absorbent compounds. *J. Food Protect.* **59,** 631-641.

Robinson D. and Singh N.D. (2001). Alternative Protein Sources for Layers. Rural Industries Research and Development Corporation, Australia.

Ruttanavut J., Yamauchi K., Goto H. and Erikawa T. (2009). Effects of dietary bamboo charcoal powder including vinegar liquid on growth performance and histological intestinal change in Aigamo ducks. *Int. J. Poult. Sci.* **8,** 229–236.

Teguia A. and Beynen A.C. (2005). Alternative feedstuffs for broilers in Cameroon*. Livest. Res. Rural. Dev*. http://www.cipav.org.co/lrrd/lrrd17/3/tgu173.htm.

Teguia A., Chakam V.P. and Tchoumboue J. (2007). Effets de la cuisson ou de l'extrusion du niébé (*Vigna unguiculata*) nsur les performances de production des poulets de chair en finition. *Bull. Anim. Prod. Afr.* **55,** 118-126.

Teguia A. and Fon Fru S. (2007). The growth performances of broiler chickens as affected by diets containing common bean (*Phaseolus vulgaris*) treated by different methods. *Trop. Anim. Health. Prod.* **39,** 405-410.

Ugwu S.O.C. and Onyimonyi A.E. (2008). Carcass, organ and organoleptic characteristics of spent layers fed Bambara nut sievates. *Int. J. Poult. Sci.* **7,** 81-84.

Wiryawan K.G. (1997). Grain Legumes for Poultry. University of Queensland, Autralia.

Wiryawan K.G. and Dingle J.G. (1999). Recent research on improving the quality of grain legumes for chicken growth. *Anim. Feed Sci. Tech.* **76,** 185-193.