Effect of water treated and urea treated neem (*Azadirachta indica*) kernel cake as protein supplement on haematological, biochemical and carcass characteristics of broiler chickens

O. I. FRIMPONG, C. C. ATUAHENE & M. B. ADJEI*
Department of Animal Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
**Crresponding author's email: badjeimensah@yahoo.com*

ABSTRACT

In a study to evaluate the carcass haematological and biochemical characteristics of broiler birds fed graded levels of water and urea-treated neem kernel cake (NKC), 300 day-old broilers (Cobb, 500) were randomly assigned to five dietary treatments for 56 days. Water and feed were fed *adlibitum*. The diets were formulated to be isonitrogenous to replace soya bean meal at 0 per cent neem kernel cake (NKC), 5 per cent water treated neem kernel cake (WNKC), 10 per cent WNKC, 5 per cent water and urea treated neem kernel cake (WUNKC) and 10 per cent WUNKC for diets 1,2,3,4, and 5, respectively. The results showed that average daily feed intake (ADFI), average body weight gain (ABWG), average daily water intake (ADWI), feed conversion ratio (FCR), and feed cost kg^{-1} live weight gain were significantly (*P* = 0.05) different across dietary treatments. With the exception of the red blood cell (RBC), globulin and total protein, all the haematological parameters (white blood cell, haemoglobin, PCV, MCH, MCHC and MCV) and biochemical parameters (albumen, cholesterol, HDL, LDL and TGS) measured were not significantly (*P* = 0.05) different across the dietary treatments. Results on carcass parameters were significantly (*P* = 0.05) different among the dietary treatments. Liver, gizzard, heart, dressed weight, and intestinal weights of birds on the test diets were significantly (*P* = 0.05) different from those on the control diet.

Original scientific paper. Received 17 Aug 12; revised 01 Nov 13.

Introduction

The current trend in the cost and irregular supply of feed (Uko & Kamalu, 2008), poses a threat to the future of the livestock and poultry industry (Sonaiya, 1990). FAO (2008) report indicated that feed prices have jumped to a record high and further increases are on the horizon due to diminishing supply and increasing demand. According to Kellems (2002), the cost of feeding alone represents approximately 75 per cent of the cost of poultry production. It, therefore, becomes very imperative to intensify efforts in the search for cheaper, abundant and locally available alternatives that have no direct dietary value to man for sustainable production (Odunsi *et al*., 2002). Neem kernel cake (NKC) obtained from the neem seed oil industry is a potential alternative source of non-conventional feed stuff (Odunsi *et al*., 2009). The protein quality of NKC (CP: 30-40%) is close to that of soya bean meal (SBM) (CP: 44%), a highly valued protein ingredient used in poultry diet (Reddy, Rao & Reddy, 1988).

Neem is a fast growing evergreen plant found growing fast in most parts of Africa including Kenya, Nigeria and Ghana (Schmutterer, 1988). In Ghana, the tree is, however, established in the rainforest and in the savanna belt (Schmutterer, 1988). A full-grown tree can produce a total of 30 – 100 kg of fruits depending on rainfall, soil type and ecotype. Fifty kilograms of fruits yield 30 kg of seed giving 6 kg oil and 24 kg of seed cake (Ramesh, 2000). Neem is used as pesticide, antimicrobial, fertilizer, animal feed and as treatment of malaria (Uko & Kamalu, 2008).

Methods such as alkali treatment of neem seed cake (Reddy, Rao & Reddy, 1988), water washing of neem seeds (Ranga, 2002), and urea soaking of neem seeds (Gowda & Sastry, 1998) are consequently used to detoxify and reduce the bitterness of the cake. Ranga (2002) observed that water washing removed 83.53 per cent of azadirachtin, 53.13 per cent of nimbin and 35.89 per cent of salanin. Water washing, followed by urea treatment (at 1 kg : 10 litres concentration of urea and water) removed 83.27 per cent azadirachtin and 100 per cent nimbin and salanin. It is rich in crude protein [CP; 300 - 400 g kg^{-1}], (Paul *et al*., 1996; Elangovan *et al*., 2000). More research works have been done on the use of differently processed neem seed cake as animal feed to assess their effect on biochemical and haematological composition of the blood, but not much has been done on feeding water treated and urea treated neem seed cake to broilers at the same time. The study was, therefore, carried out to assess haematological, biochemical and carcass qualities of broiler birds fed diets containing water-treated and urea-treated neem seed cake.

Materials and methods

Location and period of the experiment

The experiment was conducted at the poultry section of Department of Animal Science, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi for 56 days.

Collection and preparation of neem seeds

The neem seeds were collected from Tamale in the Northern Region of Ghana. The collected seeds were sundried for 6 days to a constant weight. The seeds were decorticated (dehulled) by using a heavy wooding structure to crush the seed coat and winnowed to separate the kernels from the hulls. Both the kernels and the hulls were weighed separately to determine their respective percentage weights in the seeds. The kernels were divided into two equal parts and soaked separately in 250-litter open basin containing water for 72 h. The kernels were poured into jute bags to drain the water after soaking. One part of the kernels was re-soaked in a basin containing urea solution (1 kg urea in 10 *l* of water) for another 72 h. All the kernels were sundried for 5 days after the treatments. The dried kernels were hammer milled to pass through a 2 – mm sieve and, thereafter, sent for oil extraction.

Experimental diets

Five diets were formulated (Table 1). Diet 1, 0 per cent NKC: the control or reference diet. Diets 2 and 3 contained WNKC at 5 per cent and 10 per cent levels, respectively, whilst Diets 4 and 5 contained 5 per cent and 10 per cent levels of WUNKC, respectively, partially replacing SBM. Diets 2-5 were referred to as NKC or test diets. All the experimental diets were isonitrogenous.

Blood collection and analysis

On Day 28 and 56, blood samples meant for the haematological and biochemical analysis were collected from the wing vein of the birds using a sterilised disposable syringe and needle. Prior to bleeding, a cotton swab soaked in 70 per cent ethanol was used to dilate the vein and to prevent infection. About 2.0 ml blood was collected into labeled sterile universal bottles containing ethylene diamine tetra acetate (EDTA) as anticoagulant. The haematological parameters of the blood were determined by 'The Sysmex KX-2IN Autoanalyzer' and the biochemical factors with 'Flexor Jnr. Autoanalyser'. Parameters considered include haematological parameters (red blood cell, white blood cell, haemoglobin, PCV, MCH, MCHC and MCV) and biochemical parameters (Albumen, Globulin, Cholesterol, HDL, LDL, Total protein and TGS).

Chemical and statistical analysis

Proximate composition of the experimental diets and the treated neem products were determined by standard method of Association of Official Analytical Chemist (AOAC)

Table 1

The Percentage Inclusion Levels of Feed Ingredients and Proximate Chemical Composition of the Starter Diets fed to Broilers

Ingredients (%)	*Dietary treatments*				
	0%NKC	*5%WNKC*	*10%WNKC*	*5%WUNKC*	*10%WUNKC*
Maize	61.00	60.00	61.00	60.00	61.00
Wheat bran	10.00	8.95	5.95	10.95	8.95
WNKC	_	5.00	10.00	_	_
WUNKC	_	_	_	5.00	10.00
Soya bean meal	16.95	14.00	11.00	12.00	8.00
Fish meal	9.00	9.00	9.00	9.00	9.00
Oyster shell	0.50	0.50	0.50	0.50	0.50
Dicalcium phosphate	2.00	2.00	2.00	2.00	2.00
Vit/tm premix	0.30	0.30	0.30	0.30	0.30
Common salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Dry matter (DM)	89.00	88.50	89.00	88.50	88.50
Crude protein (CP)	18.3	18.4	18.6	18.4	18.7
Crude fibre (CF)	3.57	3.59	3.68	3.11	3.13
Ether extract (EE)	2.00	5.00	6.00	4.50	4.50
Ash	5.50	5.50	5.00	5.50	4.50
ME (kcal/kg)	2783.69	2917.75	3092.05	2892.91	3051.97

(1990) at the Animal Science Department of KNUST. The performance and carcass data obtained were subjected to (two-way) analysis of variance in a completely randomised design using SPSS (1999). Significant differences were separated using Duncan's Multiple Range Test (1995).

Carcass analysis

Nine birds were randomly selected per treatment (3 birds per replicate) for carcass and organ examination at the end of the experiment. Water and feed were withdrawn for 6 h before birds were slaughtered. Each bird was tagged and weighed before and after slaughtering to determine the live and bled weight. Other parameters taken included de-feathered weight, eviscerated weight, weight of neck, shank, intestine, head, liver and gizzard. These weights were expressed as the percentage of the final live weight of the birds. Prior to this, parameters on performance such as average daily feed intake (ADFI), average body weight gain (ABWG), average daily water intake (ADWI), feed conversion ratio (FCR) and feed cost kg^{-1} live weight gain were recorded.

Results and discussion

Proximate composition of the differently processed neem kernel cake (NKC)

The result on the proximate composition of the NKC is shown in Table 3. The crude protein levels of the processed neem seed

TABLE 2

Percentage Inclusion Levels and Proximate Chemical Composition of the Finisher Diets (as fed basis)

Ingredients (%)	*Dietary treatments*				
	0%NKC	*5%WNKC*	*10%WNKC*	*5%WUNKC*	*10%WUNKC*
Maize	65.00	64.00	65.00	64.00	65.00
Wheat bran	11.10	10.05	7.05	12.05	10.05
WNKC	_	5.00	10.00	_	_
WUNKC	_	_	_	5.00	10.00
Soya bean meal	14.45	11.50	8.50	9.50	5.50
Fish meal	7.00	7.00	7.00	7.00	7.00
Oyster shell	0.45	0.45	0.45	0.45	0.45
Dicalcium phosphate	1.50	1.50	1.50	1.50	1.50
Vit/tm premix1	0.25	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Dry matter (DM)	88.50	88.00	88.50	88.50	89.00
Crude protein (CP)	19.50	22.90	20.70	19.00	18.40
Crude fibre (CF)	3.46	4.02	4.67	5.10	3.59
Ether extract (EE)	1.00	0.50	0.50	0.50	0.50
Ash	4.50	5.00	4.50	4.00	4.50
ME* (kcal kg^{-1})	2824.64	2958.70	3133.30	2933.86	3082.92

*ME calculated (King, 2001). Vit/tm premix1 provided the following kg^{-1} of the diet: Iron- 100 mg, Manganese-110 mg, Copper-20 mg, Zinc-100 mg, Iodine-2 mg, Selenium-0.2 Cholecarciferol-25 mg, Cobalt-0.6mg, Sanoquine-0.6 mg, Retinal-2000 mg, Alpha-tocopherol-23000 mg, Menadione-1.33 mg, cobalamin-0.03 mg, Thiamin-0.83 mg, Riboflavin-2 mg, Folic acid-0.33 mg, Biotin-0.03 mg, Pantothenic acid-3.75 mg, Niacin 23.3 mg, Pyridoxine-1.33 mg.

TABLE 3

Proximate Composition of NKC from Different Processing Methods

Parameter	*RNSM (%)*	*WNKC (%)*	*WUNKC (%)*
Dry matter	88.50	89.5	87.5
Crude protein	26.50	32.7	41.4
Crude fibre	3.92	12.88	13.6
Ether extract	40.00	40.5	38
Ash	5.00	2	2
NFE	24.58	11.92	5.00

RNSM - Raw neem seed meal. WNKC-Water-treated neem kernel cake. WUNKC-Water and urea-treated neem kernel cake.

cakes were higher than the RNSM with the WUNKC having the highest crude protein content (Table 3). The crude protein figures obtained in the study were higher than the 17.48 and14.2 per cent, respectively, recorded by Bawa *et al*. (2007) and Odunsi *et al.* (2009). The differences observed here could be attributed to the differences in the genetic constitution of the neem plant and the various processing methods used. This finding corroborates with that of Gowda & Sastry (2000), who reported that the chemical composition of neem cake varies considerably depending on types of processing such as solvents or expeller extraction of undecorticated or decorticated seed.

NRC (1992) also reported that the problem of putting the seed cake to use still remains. This is because neem tree scattered around the world are genetically distinct and its nutritional potentials are affected by climatic condition, method of processing and, to a lesser extent, the genetic makeup of the animals. The crude protein content of the WUNKC being higher than the RNSM and the WNKC could be due to the addition of the urea for the detoxification process. According to Kornegoy *et al.* (1970) and Okumura (1976), urea contains about 42 per cent to 45 per cent nitrogen, and since the protein content of feeds is determined on the basis of the nitrogen content (AOAC, 2000), the crude protein content of the urea-containing feed, will in anyway, be higher than the feed without the urea.

The results on the haematological and biochemical components of the experimental birds fed NKC diets are presented in Tables 4 and 5, respectively. There were no significant (P = 0.05) differences in the values recorded on Haemoglobin, PCV, MCH, MCHC MCV and WBC between the birds

TABLE 4

Effect of Diet on Haematological Variables in Broilers

Parameter	*Treatments*				
	0%NKC	*5%WNKC*	*10%WNKC*	*5%WUNKC*	*10%WUNKC*
Haemoglobin (g/dl)	9.3	9.62	9.73	9.85	9.17
PCV (%)	29.5	30.95	31.30	31.67	30.38
MCH(Pg)	38.17	35.58	33.54	39.60	39.19
MCHC (g/dl)	30.77	30.57	31.52	30.65	30.48
MCV (fl)	129.17	131.67	131.50	132.00	132.17
RBC (x1012/l)	2.30b	2.54b	2.42b	2.45b	2.85a
WBC (x109/l)	2.481	2.540	2.572	2.582	2.550

a, b – Means bearing different superscript in the same row differ significantly (P = 0.05)

TABLE 5

Effect of Diet on Blood Biochemical Parameters in Broilers

Parameter	*Treatments*				
	0%NKC	*5%WNKC*	*10%WNKC*	*5%WUNKC*	*10%WUNKC*
Albumin (g l^{-1})	16.67	15.17	17.17	15.67	17.17
Cholesterol (mmol l^{-1})	3.35	3.45	3.59	3.62	3.49
Globulin (g l^{-1})	16.32b	16.00b	20.83a	21.67a	21.17a
HDL (mmol l^{-1})	1.55	1.55	1.63	1.65	1.39
LDL (mmol l^{-1})	1.42	1.54	1.58	1.60	1.70
Total protein (g l^{-1})	32.99a	31.17b	38.00a	37.34a	38.34a
TGS (mmol l^{-1})	0.80	0.83	0.83	0.83	0.80

a, b. – Means bearing different superscript in the same row differ significantly (P = 0.05)

on the reference diet and those on the test diets.

The biochemical composition of the blood of the birds indicated that there was no significant (P = 0.05) difference in the cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL), triglyceride (TGS) and albumin counts between the birds on the control diet and those on the NKC diets. However, significantly (P = 0.05) different values were recorded on the globulin and total protein composition of the experimental birds.

The values recorded on RBC for the experimental birds ranged from 2.30 to 2.85 × 1012 l^{-1}. Birds on the 10 per cent WUNKC recorded the highest value (2.85 × 1012 l^{-1}) which was significantly (P = 0.05) different from the lowest value (2.30 × 1012 l^{-1}) recorded by the birds on the control diet. All the values were, however, within the reference range (2.5-3.5 × 1012 l^{-1}) of chicken reported by Aeangwanich *et al*. (2004). This finding agreed with that of Ogbuewu *et al*. (2010) but differed from what was reported by Esonu *et al.* (2006).

The globulin values of the birds on the 10 per cent WNKC (20.83 g l^{-1}), 5%WUNKC (21.67 g l^{-1}), 10 per cent (21.17 g l^{-1}) diets were significantly (P = 0.05) higher than the birds on the control diet with the exception of the birds on 5 per cent WNKC (16.00 g l^{-1}) diet, which had similar (P = 0.05) value as those on the control diet (16.32 g l^{-1}). The rise in the globulin levels with subsequent significant rise in the total protein levels observed showed that the birds on the NKC diets had better resistance and immune response to disease infection than the birds on the control diet. Griminger (1986) stated that high globulin levels and low A/G ratio signify better disease resistance and immune response.

Lumeij (1997) also noted that in acute or chronic conditions, a rise in total protein caused by elevated globulin fraction may occur. Often, albumin concentrations are decreased in these situations. The combined effect of these changes is a decrease in the albumin/globulin ratio. Often, the total protein concentration is within the reference range, while the albumin/globulin ratio is decreased, therefore, the albumin/globulin ratio is often of greater clinical significance than the total protein from globulin.

The total protein composition of the blood of the experimental birds was 32.99, 31.17, 38.00, 37.34 and 38.34 g l^{-1} for the birds on the control, 5 per cent WNKC, 10 per cent WNKC, 5 per cent WUNKC and 10 per cent WUNKC, respectively. The value recorded by the birds on the 5 per cent WNKC diet was significantly ($P = 0.05$) lower than those on the control and the other NKC diets. The total protein value obtained could be an indication of the negative effect of the bitter principles of neem on the animals as was also observed by Bawa *et al.* (2007), after feeding broilers with raw neem seed meal diet (RNSMD).

Carcass characteristics of broiler birds fed NKC diets

Significant ($P = 0.05$) differences in live weight gain were observed at the end of the study (Table 6). The significant ($P = 0.05$) difference in live weight observed between broilers on the control diet in the study is a reflection of the feed ingestion which was higher for the birds fed the control diet. Tabler (2008) noted that flocks with the highest feed intake will almost always have the highest average daily gain and weigh most at processing. This finding is similar to that of Uko & Komalu. (2006), Oloyede, Minari & Mohammed (2010) and Bawa *et al.* (2007).

The live weight of the birds decreased as the inclusion levels of the NKC in the diets increased. The effect could be as a result of the increasing intensity of the bitterness of the neem triterpenoids, which led to the reduced feed intake and the subsequent effect on live weight of the birds. The observation contradicts the findings of Uko *et al*. (2008) but corroborates with the observation made earlier by Uko *et al*. (2006), when cockerels were fed autoclaved neem kernel cake at 75g kg^{-1} and 150g kg^{-1} inclusion levels. The differences observed could be attributed to the differences in the detoxification methods

Table 6

Performance and Carcass Parameters (as % live weight) of Broilers fed Different Levels of NKC Diets.

Parameter	*0% NKC*	*5% WNKC*	*10% WNKC*	*5% WUNKC*	*10% WUNKC*
Live weight (kg)	2.63a	2.16b	1.58c	2.11b	1.52c
Average daily feed intake (g/bird/day)	95.78a	76.52b	66.07b	77.79b	65.96b
Average daily weight gain (g/bird/day)	37.78a	28.09b	20.95cd	27.44bc	19.14d
Feed conversion ratio	2.50a	2.91ab	3.13ab	2.93ab	3.72ab
Feed cost/kg live weight(GH¢)	2.87a	3.73b	4.41b	3.85b	5.09b
Bled weight (%)	96.57	97.31	96.43	96.54	96.91
Defeathered weight (%)	89.72	90.66	86.97	88.04	90.21
Dressed weight (%)	83.50a	79.04b	77.44b	78.96b	76.43b
Heart (%)	1.82b	2.26a	2.07a	2.31a	2.36a
Shank (%)	11.89b	13.83a	12.89a	13.48a	15.43a
Liver (%)	6.32b	7.91b	8.23a	7.68b	7.35b
Full intestine (%)	17.17b	23.33a	23.91a	23.61a	23.48a
Empty gizzard (%)	7.39b	7.96b	8.83a	9.49a	9.68a

a, b c. – Means bearing different superscript in the same row differ significantly ($P = 0.05$)

used in the study. The toasting and the autoclaved methods used by Uko *et al*. (2008) might have reduced the level of toxicity in the neem to a more tolerable level, which led to an increased feed intake and a subsequent live weight gain than that of the water and urea soaking adopted in the experiment. Akinmutimi (2004) noted that most processing methods employed in improving feed value of non conventional or alternative feedstuff do not completely eliminate anti-nutritional substances, but only reduce their concentration to tolerable levels in feedstuffs.

The dressed weight of the birds on the control diet was significantly (*P* = 0.05) higher than those on the NKC diets. Birds on the 10 per cent WUNKC recorded the least dressing percentage (76.43%). The results showed that the weights of the heart, intestine, liver, and gizzard for the birds on the NKC diets were significantly higher than those on the control diets. These might have reduced their dressing percentage obtained since these organs are not usually added to the dressed weight. The observation is different from what was observed by Uko *et al.* (2006), who had the organ weights mentioned for cockerels on the test diets similar (*P* = 0.05) to those on the control diets and, therefore, did not have effect on the dressed weights.

The weight of the heart expressed as percentage of the live weight ranged from 2.36 per cent to 1.82 per cent. The birds on the control diet had the least heart weight (1.82%). The NKC significantly (*P* = 0.05) increased the heart weight of the birds. Values obtained (Table 6) were, however, comparable across all the test diets though the values recorded did not follow any particular trend with respect to the inclusion levels. The significantly (*P* = 0.05) higher values observed with heart weight could probably be due to higher physiological activities triggered by the presence of anti-nutritional factors in the neem and their concomitant effects reported by Uchegbu, Okoli & Etuk (2004).

The NKC diets influenced the shank weight of the birds. Values recorded for all the birds on the NKC diets (13.83, 12.89, 13.48, and 15.43), were significantly (*P* = 0.05) higher than that of the control diet (11.89). The weight, of liver for the broilers were; 6.32, 7.91, 8.23, 7.68 and 7.35 per cent for the control, 5 per cent WNKC, 10 per cent WNKC, 5 per cent WUNKC and 10 per cent WUNKC, respectively (Table 6). Increased shank weight has been characterised with poor growth performance often elicited by feeding non conventional feedstuff to animals. A similar observation was made by Uchegbu, Okoli & Etuk (2004) Odunsi *et al*. (2009), however, reported no significant difference in the shank weight of cockerels fed neem seed cake at 10 per cent and 20 per cent inclusion levels.

The results indicated that the average liver weight of the birds on the NKC diets was numerically higher than the birds on the control diets, but the differences were not significant (*P* = 0.05) with the exception of the birds on 10 per cent WNKC, which was significantly (*P* = 0.05) higher than the rest of the birds on all the treatment diets. The higher weights of liver observed between the birds on the control and NKC diets indicated that there was an increase in the metabolic rate of the liver of birds fed the neem diets in an attempt to reduce the effect of the toxic triterpenoids in the neem. Bone (1979) submitted that if there are toxic elements in the feed, abnormalities of liver and kidney would be observed. The abnormalities will arise because of increased metabolic rate of the organs in an attempt to reduce these toxic elements, or anti-nutritional factors to non toxic metabolites. The finding agrees with that of Uko & Kamalu (2005, 2008). Again, Babatunde & Pond (1987) stated that visceral organ hypertrophy is common when monogastrics are fed insufficiently processed plant protein. This is usually associated with increased enzyme secretions by the organ in response to presence of enzyme inhibitors from plants.

The results on the weight of the intestine (Table 6), showed that the NKC significantly (*P* = 0.05) increased the intestinal weights of the birds. The value obtained for the control diets (17.17%) was significantly (*P* = 0.05) lower than the values for 5 per cent WNKC (23.33%), 10 per cent WNKC (23.61%), 5 per cent WUNKC (23.61%) and 10 per cent WUNKC (23.48%). The weights of all the birds on the test diets were, however, similar. The increase in weight of intestine observed among the birds fed the treatment diets could be attributed to the inflammatory response to the neem toxins (Uko & Kamalu, 2008), and also due to additional bulk and greater volume of digester staying in the gastrointestinal tract during enzymatic digestion. Bawa *et al*. (2007) reported of a significantly (*P* = 0.05) higher intestinal weight after feeding rabbits with raw neem seed meal diet for 63 days. Uchegbu, Okoli & Etuk (2004) also reported increased weights of the proventriculus and intestine of all the broilers fed on *Napoleona imperialis* seed meal.

The weight of the empty gizzard for the birds on the control (0% NKC) diet, expressed as percentage live weight, was not significantly (*P* = 0.05) different from the weights of the birds on 5 per cent WNKC diet, but was significantly (*P* = 0.05) lower than the rest of the birds on the other NKC diets (Table 6). The gizzard weight of the birds on 10 per cent WUNKC was the highest (9.68%) but did not differ (*P* = 0.05) significantly from those on 10 per cent WNKC (8.83%) and 5 per cent WUNKC (9.49%). The higher percentage weight of gizzard observed on birds fed the neem diet might be as a result of the development of the muscularised gizzard in order to handle some fibrous component of the diet. This observation agrees with the findings of Oloyede, Minari & Muhammad (2010), who fed broilers with raw and processed bambara groundnut seed as a component of poultry feed to evaluate their growth and haematological characteristics. The gizzard weights observed in the study were, however, lower than what was reported by Odunsi *et al*. (2009), who reported no significant (*P* = 0.05) difference in the gizzard weight of cockerels fed water-treated neem seed cake and those on the control diet. The difference could be due to that in the breed of animals used for these various studies

Conclusion

It is concluded that feeding water treated and urea treated neem kernel cake to broilers can be a better replacement to soya bean meal for improvement in biochemical and haematological components of the blood.

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