

EFFECT OF ACTIVATED COCONUT SHELL CHARCOAL MEAL ON GROWTH PERFORMANCE AND NUTRIENT DIGESTIBILITY OF BROILER CHICKENS

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ABSTRACT

Aim: A 56 days feeding trial was conducted with 225 Marshal Broiler chicks to evaluate the effect of activated coconut charcoal on their growth performance and nutrient digestibility.

Study design: The design of the experiment was completely randomized design (CRD).

Place and duration of study: Poultry unit of the Teaching and Research Farm of the Department of Animal Production, School of Agriculture and Agricultural Technology, Federal University of Technology Minna, Niger State, between September- October 2011.

Methodology: The birds were randomly allocated into five dietary treatments designated as T1, T2, T3, T4 and T5 containing 0, 0.5, 1, 1.5 and 2 % of activated coconut shell charcoal meal respectively. Each treatment had three replicates with 15 birds in each replicate. The birds were fed *ad libitum*. Data were collected on body weight, feed intake, body weight gain; feed conversion ratio, protein efficiency ratio and nutrient digestibility were calculated. The starter phase covered week 0-4 and the finisher phase from week 5-8.

Results: The result showed that feed intake and feed conversion ratio values were ($P < 0.05$) different at the starter phase. The result of the finisher phase revealed ($P < 0.05$) differences in the values of mean final body weight, body weight gain, feed conversion ratio and protein efficiency ratio. Also high percentage mortality was observed in birds fed 2 % activated coconut charcoal meal. The result of the nutrient digestibility showed no ($P > 0.05$) difference in dry matter, crude protein, ether extract and nitrogen free extract. However, ($P < 0.05$) differences were observed in the digestibility of crude fibre and ash values.

Conclusion: It was concluded that activated coconut shell charcoal supplementation at 2 % inclusion at the starter phase increased feed intake and final body weight. However, at the finisher phase activated coconut shell charcoal can be included up to 0.05 % inclusion level for better performance.

Keywords: Broilers, Activated coconut shell charcoal, Supplementation Performance

INTRODUCTION

More emphasis than ever is placed on global food security, both in terms of availability in the right nutrient proportions and affordability to the masses at a reasonable cost (Onibi *et al.*, 2009). Poultry meats offer considerable potential in bridging the gap between supply and demand for animal protein especially in developing countries like Nigeria. In this continent and other less developed nations, the low level of supply of animal protein is due to poor performance of livestock industry, (Onibi *et al.*, 2009) which has been attributed to factors such as inadequate nutrition, high price and poor quality of feed industries. (Tewe, 1997). However attempts have been made to reduce the risk of mycotoxin in poultry feed which are secondary metabolites of fungi, especially by species of *Aspergillus*, *Penicillium*, and *Alternaria*. Mycotoxins in feed can cause huge problem for humans and animals. Consumption of a mycotoxin-

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contaminated diet may induce acute and long term chronic effects resulting in carcinogenic, estrogenic or immune suppressive effects. Direct consequences of consumption of mycotoxin contaminated animal feeds, include reduced feed intake, feed refusal, poor feed conversion, diminished body weight gain, increase in diseases incidence (due to immune suppression) and reduced reproductive capacity (Matt Pearce *et al.*, 2010) which will lead to economic losses. The most common mycotoxins are aflatoxins. The addition of mycotoxins binders to contaminated diets has been considered the most promising dietary approach to reduce effects of mycotoxins (Afzal and Zahid, 2004)). The theory is that the binder decontaminates mycotoxins in the feed by binding them strongly enough to prevent toxic interaction with the consuming animals and prevent mycotoxin adsorption across the digestive tract. It is impossible to completely remove such mycotoxins from the animal and human food chain given that feed and its precursor (raw materials) can be stored and transported through a range of time interval, atmosphere humidity and temperature, here lies the opportunity for mycotoxins to do their detrimental damage during the cultivation and harvest stages of grains.

Practical methods to detoxify mycotoxin from contaminated grain in a larger scale and in a cost effective manner are not currently available (Edrington *et al.*, 1997). Varieties of physical, chemical and biological techniques have been employed, however they have met with only limited success. A recent approach has been the addition of non-nutritive adsorptive material to the diet in order to reduce the absorption of mycotoxins from the gastro intestinal tract. Activated charcoal is a form of carbon with increased surface area for absorption. The term charcoal generally refers to carbonaceous residue of wood (Kutlu *et al.*, 2000). The very tiny, odorless, tasteless black powder is absorbent for many toxins, gases, drugs, and fat soluble substance without any specific action (Kutlu *et al.*, 2000). The adsorptive effect could be increased by treating with various substances at temperature ranging from 500-900° C, a treatment known as activation (Kutlu *et al.*, 2000). The final product is called activated charcoal (Osol, 1975) as cited by (Ayanwale *et al.*, 2006). Charcoal acts as an insoluble carrier that non- specifically absorbed molecule, thereby preventing their absorption. Several researchers have tested the efficacy of activated charcoal in binding mycotoxins. Ayanwale *et al.* (2006) conducted an experiment to investigate the growth performance, nutrient utilization, egg quality characteristics and cost-benefit values of feeding different levels of activated sheabutter tree charcoal to laying pullets. Five experimental diets supplemented with activated sheabutter charcoal were formulated to contain 0.0 (control), 10.0, 20.0, 30.0 and 40.0% levels of the charcoal using a total of 150 day-old pullets. The results showed no beneficial effect of feeding activated sheabutter charcoal to pullets up to 15 weeks of age as there were no significant ($p>0.05$) differences in the performance parameters measured up to this stage. At the laying stage, activated sheabutter charcoal significantly ($p<0.05$) improved egg weight from (48 ± 3.01) in the control to (54.86 ± 3.01) in 40.0% charcoal level. Percent cracked eggs also reduced significantly ($p<0.05$) from 15.33% (control) to 0.20% in 40.0% activated sheabutter charcoal level. No significant ($p>0.05$) effect of activated sheabutter charcoal was observed on the internal egg quality parameters measured. The pullets fed activated charcoal had higher economic returns than the control. The results were attributed to increased mineral intake and utilization enhanced by charcoal supplementation and also improved absorption capacity of charcoal for dietary fat. Choi *et al.* (2009) in an experiment investigated the feeding value of wood vinegar in weanling pigs. ($n = 224$; Landrace×Yorkshire×Duroc, 21 ± 3 d-old, initial BW 6.12 ± 0.10 kg). The pigs were assigned to four dietary treatments. Different levels of wood vinegar were added to the diets as dietary treatments (0, 0.1, 0.2 and 0.3%). Each treatment comprised 4 replicates with 14 piglets in each. Experimental feeding was conducted for 28 d in two phases (phase I, d 0 to 14 and phase II, d 15 to 28). Thus the findings of their study suggest that wood vinegar added to the diets of pigs could improve the performance, apparent nutrient digestibility and selectively inhibit the harmful coliforms. However, even though the feeding of antibiotics resulted in better performances in pigs, the performance of pigs fed wood vinegar was better than pigs fed organic acids. There were many advantages of adding charcoal to animal diets as it controls lactic acid concentration in the gastrointestinal tract of ruminant, maintaining of pH level and micro flora in the rumen of steers (Ghosh *et al.*, 1991 and Jean, 2010) moreover, and pathogenic bacteria was controlled by charcoal (Nikolacia *et al.*, 1994). In Nigeria and indeed many other countries, various feeds and additives are incorporated into poultry diets to ensure maximum productivity. Therefore the aim of this research was to evaluate the effect of activated coconut shell charcoal meal on growth performance and nutrient digestibility of broiler chickens

MATERIALS AND METHODS

A total of two hundred and twenty five (225) day old Marshal Chicks were used for the experiment. The birds were randomly allocated into five treatment (Table 1) groups of 45 birds and each group assigned to one of the dietary treatment of T₁ (0%), T₂ (0.5%), T₃ (1%), T₄ (1.5%) and T₅ (2%) activated coconut shell charcoal in a completely randomized design. Each treatment group was further subdivided into three replicates of 15 birds each. Feed and water were provided *ad-libitum*, uniform light were provided 24 hours and proper vaccinations and medications was taken while body weight was recorded weekly. Feed conversion ratio and body weight gain were used as measures for birds growth performance. The experiment lasted for 8weeks. The birds were managed under a deep liter system. The birds were managed purely on concrete floor with wood shavings on it, demarcated with wire mesh. The pen was thoroughly cleaned and disinfected before the commencement of the experiment. Heat was provided for the chicks during the brooding period with the use of charcoal pot and electric bulbs which were lit every evening and left all night. Vaccination and medication programme were strictly adhered to. Other Routine management procedures included, weighing of birds on arrival before the commencement of the experiment and subsequently at weekly intervals. Feed and clean water were supplied *ad-libitum*. Records of mortality, weight changes and feed intake were kept. The daily operation performed includes removal of left over feeds, cleaning of the drinkers and replacing the feeder and drinker with new feed and water. The following data were collected:

Table 1 Composition of the basal diets.

Ingredients	Starter phase (%)	Finisher phase (%)
Maize	51.63	59.67
Soybean meal	18.82	14.27
Ground nut cake	17.21	13.10
Fish	4.00	3.00
Wheat bran	2.62	5.00
Bone meal	2.00	2.00
Oyster shell	1.00	1.00
Premix	0.30	0.30
Methionine	0.20	0.20
Lysine	0.20	0.20
Salt	0.30	0.30
Palm oil	2.00	1.00
Total	100	100
Calculated values		
Crude protein	24.0 1%,	20.60%
Metabolizable energy	3150 (kcal/kg ME)	3250 (Kcal/Kg ME)

Premix:

Each 2.5kg contain vita. A – 10,000,000iu.; vita. D-2,000,000iv, vita. E- 20,000iv, vita. k- 2,250mg; thiamine – 170mg; 12iboflavin – 5,000mg; Pyridoxine – 2,750mg; Niacin- 27,500mg; vit B12 -15mg; Pantothenic acid – 7,500mg; folic Acid – 7,500mg; Biotin – 50mg; manganese – 80g; zine – 50g; copper – 5g; iodine 1.5g; selenium – 200mg and cobalt – 200mg;

Activated coconut shell charcoal supplementation (starter and finisher phase) at

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0 %, 0.5 %, 1 %, 1.5 %, and 2 % per 100kg of diet.

Data collection:

Data collected for ascertaining the performance of the birds include: *initial body weight* which was collected by taking the weight of the day old birds at arrival in the farm using a weighing scale; *final body weight* was collected at the last day of the experiment using the same weighing scale; body weight gain was calculated by subtracting the initial body weight from the final body weight; feed intake was also calculated by subtracting the amount of feed refused from the amount of feed offered the birds and feed conversion was calculated by dividing the feed intake by the body weight gain.

Digestibility trial

The digestibility trial was conducted by selecting two birds from each replicate of the treatments which were weighed and transferred into the metabolism cages. The birds continued to receive their diets for five days of the trial, the faecal droppings from each replicate **was** separately collected daily and were weighed and oven dried at 104°C until a constant weight was obtained. After drying, the droppings from each treatment were grouped together and sub-samples **were taken** for proximate analysis (AOAC, 1990).

Statistical analysis: Data obtained from the experiment were subjected to the analysis of variance (ANOVA) in a completely randomized design using the procedure of SAS (2000).

RESULT AND DISCUSSION

The experimental birds fed on 2 % activated coconut shell charcoal supplementation (**Table 2**) had the superior growth performance when compared to those fed on other diets at the starter phase. However at the finisher phase, the superior growth was observed in birds fed 0.5% activated coconut shell charcoal supplementation. This variation in growth performance observed was consistent with the observation made by (Kutlu *et al.*, 2000) that activated charcoal supplementation at 2 % significantly increased body weight up to 28 days of age, but at 49 days of age, activated charcoal inclusion at 2% did not significantly affect body weight.

Table 2 Growth Performance of broilers fed diets supplemented with Activated coconut shell charcoal. (Starter phase)

Parameters	T ₁	T ₂	T ₃	T ₄	T ₅
Initial body wt(g)	33.33±0.00	33.30±0.00	33.30±0.00	33.23±0.00	33.33±0.00
Final body wt(g)	889.88±32.82	880.78±27.73	834.35±28.97	880.37±12.91	903.97±85.12
Mean wt gain(g)	218.61±23.89	211.95±28.17	200.29±29.91	199.60±10.83	209.43±84.46
Mean feed int(g)	387.66 ^b ±22.61	401.28 ^b 3.77	381.62 ^b ±13.64	382.68 ^b ±13.94	445.82 ^a ±11.22
FCR	1.76 ^b ±0.06	1.82 ^{ab} ±0.05	1.82 ^{ab} ±0.02	1.84 ^{ab} ±0.04	1.92 ^a ±0.13
PER	7.34±0.91	8.02±0.48	7.99±0.06	8.17±0.19	8.34±0.37

Means on the same row with different superscript are significantly different (P<0.05)

T₁ -0% activated charcoal supplementation. T₂-0.5% activated charcoal supplementation.

T₃ -1% activated charcoal supplementation. T₄-1.5% activated charcoal supplementation.

T₅ .2% activated charcoal supplementation.

Int = intake, wt = weight, FCR = Feed conversion ratio, PER = Protein efficiency ratio.

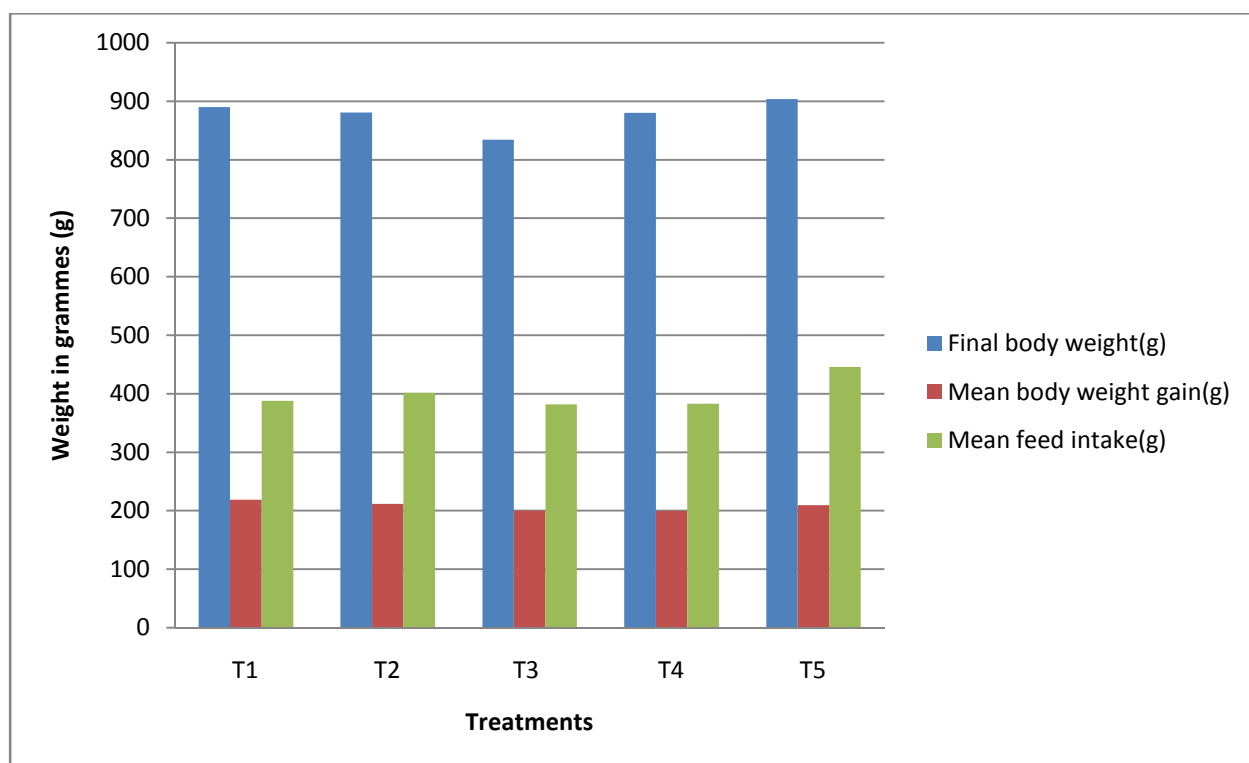


Figure 1. Growth Performance of broilers fed diets supplemented with Activated coconut shell charcoal. (Starter phase)

Table 3 Growth Performance of broilers fed diets supplemented with Activated coconut shell charcoal. (Finisher phase)

Parameters	T ₁	T ₂	T ₃	T ₄	T ₅
Initial body wt(g)	889.88±32.82	880.78±27.73	834.35±28.97	880.37±12.91	903.97±85.12
Final body wt(g)	2324.70 ^a ±120.15	2378.50 ^a ±50.67	2284.90 ^a ±93.67	2131.40 ^a ±65.42	2034.60 ^b ±44.56
Mean wt gain(g)	358.59 ^{ab} ±97.26	382.74 ^a ±130.57	362.59 ^{ab} ±87.99	325.29 ^{ab} ±77.63	282.60 ^b ±40.57
Mean feed int(g)	964.04±32.67	967.39±11.13	868.91±113.66	899.65±14.48	915.52±32.62
FCR.	2.92 ^b ±0.19	2.32 ^c ±0.28	2.74 ^{ab} ±0.14	2.96 ^b ±0.16	3.75 ^a ±0.19
PER.	7.53 ^{ab} ±0.29	8.11 ^a ±0.80	7.45 ^{ab} ±0.25	7.01 ^{ab} ±0.47	6.57 ^b ±0.13

Means on the same row with different superscript are significantly different (P<0.05)

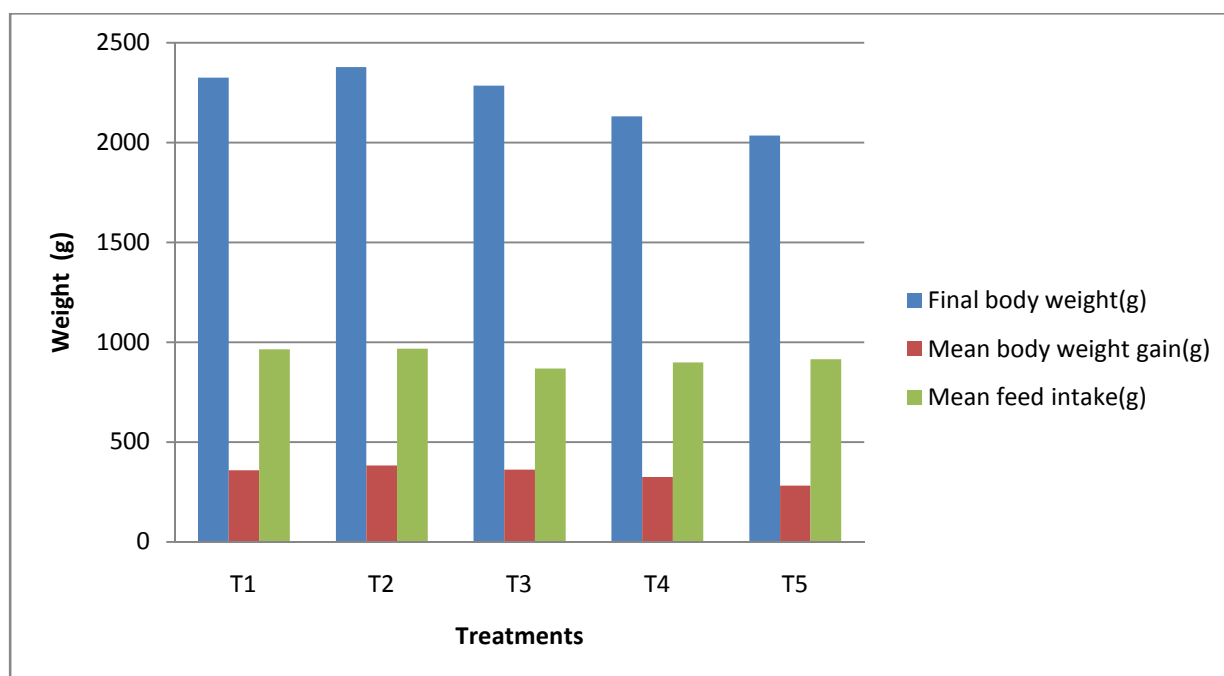


Figure 2: Growth Performance of broilers fed diets supplemented with Activated coconut shell charcoal. (Finisher phase)

The experimental birds showed no significant ($P>0.05$) difference in body weight gain at the starter phase, however at the finisher phase (Table 3) the significant ($P<0.05$) difference observed agrees with the report of (Wang *et al.*, 2006), Whose report suggested that activated charcoal supplementation at 2% affected average weight gain not through feed intake, but possibly dilution of nutrient concentration or possible nutrient binding (Wang *et al.*, 2006). The author reported that force feeding data with matured broiler roosters suggested less energy and protein availability when 2% activated charcoal was used in diet with less moldy corn.

The mean feed intake was ($P<0.05$) different at the starter phase. However at the finisher phase feed intake was not ($P>0.05$) different. This result is consistent with those reported by Eddin (2007), who reported considerable improvement in feed intake up to 29 days of age with Kutlu, *et al.*(2000) who also reported that oak charcoal showed similar result up to 28 days of age. This increase in feed intake might be the reason behind the increase in body weight at the starter phase.

There were ($P<0.05$) differences observed at the starter and finisher phases for feed conversion ratio. The starter phase revealed higher ($P<0.05$) efficiency of feed with the birds fed control diets (0% charcoal supplementation), it could be that increased supplementation reduced utilization of feed by the broilers. The observed results might be as a result of the source of activated charcoal used as reported by Wang *et al.* (2006). The authors suggested that activated charcoal made from willow tree affected average body weight gain. The authors corroborated that feeding activated charcoal at 2% supplementation might reduce energy and protein availability. The report of this study also agrees with the reports of Anyanwale *et al.* (2006), who used activated charcoal to feed laying hens. The authors reported that the effectiveness of activated charcoal is dose dependent. At the finisher phase the birds had higher ($P<0.05$) efficiency with birds fed 0.5% activated charcoal supplementation. This also might be as a result of feed utilization.

There was no ($P>0.05$) difference observed in protein efficiency ratio at the starter phase, however at the finisher phase ($P<0.05$) differences were observed. The proteins were effectively utilized by birds fed 0.5% activated coconut shell charcoal meal diet followed by 0% inclusion of the activated coconut shell

charcoal meal diet. This might be as result of possible nutrient binding or dilution of nutrient concentration. This result is consistent with the report of Wang *et al.* (2006) who stated that force feeding data with mature broiler rooster suggest less energy and protein availability when 2% activated charcoal was used in diet with less moldy corn. Leg problems were observed in birds fed 1.5% and 2% activated coconut shell charcoal meal diet. These developments were also reported by Wang *et al.* (2006) who's report suggested that activated charcoal at 2% dosage could be harmful for the birds even in normal diets.

The ($P<0.05$) difference observed in **Table 4 showed that faecal nutrient** digestibility of crude fibre and ash contents amongst birds fed activated coconut shell charcoal supplementation might related to the crude fibre and ash content of the charcoal used in the diets which aids digestion in monogastric animals. Doll *et al.* (2004) documented that fibre has an influence on the development of the physical structure of the digestive system. Kutlu *et al.* (2000) also reported that activated charcoal supplementation in broiler increases carcass ash content.

Table 4 **Faecal** Nutrient digestibility of broilers fed diets supplemented with Activated coconut shell charcoal

Parameters (%)	T ₁	T ₂	T ₃	T ₄	T ₅
Dry matter	81.46±2.83	83.07±2.83	81.87±2.83	79.78±2.83	78.84±2.83
Crude protein	92.21±2.83	93.50±2.83	91.25±2.83	89.96±2.83	88.62±2.83
Crude fibre	77.2 ^{ab} ±2.83	72.86 ^b ±2.83	85.91 ^a ±2.83	89.96 ^a ±2.83	88.62 ^a ±2.83
Ether extract	90.37±2.83	90.02±2.83	91.35±2.83	92.42±2.83	91.11±2.83
Ash	77.32 ^{ab} ±2.83	71.88 ^b ±4.24	78.92 ^{ab} ±2.83	80.23 ^{ab} ±2.83	81.23 ^a ±2.83
NFE	70.40±2.83	76.03±2.83	75.19±2.83	72.05±2.83	71.90±2.83

Means on the same row with different superscript are significantly different ($P<0.05$)

CONCLUSION:

It is therefore concluded that broilers fed 2% activated coconut shell charcoal supplementation at the starter phase had beneficial effects on the body weight, feed intake, body weight gain and protein efficiency ratio, while at the finisher phase, although the birds all attained market weight of 2 kg weight and above, birds fed 0.5 % activated coconut shell charcoal supplementation had better performance amongst the parameters measured.

ACKNOWLEDGEMENT:

The authors wish to express their profound gratitude to the Head of Department Animal Production. Federal University of Technology, Minna Niger state, Nigeria for permission to publish the study. The authors are also grateful to Ruojun Wang, College of Food Science and Nutritional Engineering, China Agricultural University, China, Dr. S. M. Lutful Kabir, Department of microbiology and Hygiene, Bangladesh Agricultural University, Mymensingh, Bangladesh and one other Anonymous reviewer for adding quality to this work.

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