
EFFECT OF DIETARY FERMENTED COCOA BEAN SHELL ON NUTRIENT DIGESTIBILITY OF BROILER CHICKENS

[§]Ewuola, M. K., [§]Olowo, F. P., [@]Fatai R. B., and [§]Hamzat, R. A

[§]Department of Animal Science, Faculty of Agriculture, University of Abuja, FCT, Abuja.

[@]Animal breeding and Genetics Unit, Department of Animal Science, University of Ibadan, Nigeria.

[§]Corresponding author details: +2347068601651, ewuolamk@gmail.com

ABSTRACT

Cocoa bean shell (CBS) as an agro-industrial by-product is a potential feed ingredient that can be used in broiler chicken diets. However, due to the presence of anti-nutritional factors, digestibility and availability of nutrients is negatively affected. Hence, this study was conducted to investigate the effect of fermented (FCBS) on nutrient digestibility of broiler chickens. One day-old Ross 308 broiler chickens ($n=150$), were randomly allocated into five dietary treatments with three replicates per treatment in a completely randomized design. The CBS was fermented using bovine rumen filtrate and incorporated into the experimental diets at varying levels of 0, 5, 10, 15 and 20% respectively to formulate five dietary treatments. Phytochemical analysis revealed that FCBS contained phytate (0.20%), oxalate (1.20%), flavonoids (8.52%), tannins (7.97%), saponins (1.61%), terpenoids (2.1%), steroids (1.40%) and theobromine (10.83%). Data on nutrient digestibility parameters were subjected to one way ANOVA at $P<0.05$. Dietary FCBS had significant influence ($P<0.05$) on nutrient digestibility of broiler chicken. The crude protein (84.22-81.88%) varied significantly ($P<0.05$) across the dietary treatments in which birds on dietary 0 and 10% FCBS values which were significantly higher than in other dietary treatments. Birds fed 10% FCBS had higher ash (66.38%) and crude fibre (71.74%) content than in other dietary treatments. Thus, FCBS can be incorporated into broiler chicken's diet at up to 10% inclusion level to improve the nutrient digestibility.

Keywords: Broiler Chickens, Digestibility, Theobromine, Fermentation, Phytochemicals

INTRODUCTION

The production of broiler chickens is important in terms of global food security, providing a reliable and consistent source of protein (Belay *et al.*, 2020). However, the conventional feed ingredients used in broiler chicken nutrition, such as maize and soybean meal, have limitations in terms of availability, cost, and environmental impact (Cortez-Vega *et al.*, 2017). Agricultural by-products such as cocoa bean shells are potential feed ingredients for poultry, as they are rich in fiber, vitamins, and minerals Smith *et al.* (2018). The outer cover of the cocoa bean that remains after the cocoa beans have been extracted is known as the cocoa bean shell. Cocoa bean shells are potential alternative feed ingredients that are by-products of cocoa processing. They contain bioactive compounds and nutritional properties that can be beneficial to animal health and performance. For instance, cocoa bean shells are rich in polyphenols, which have antioxidant and inflammatory effects. These polyphenols are said to have the ability to reduce the risk of chronic diseases such as cancer, diabetes, and cardiovascular diseases (Ramlagan *et al.*, 2015). Owolabi *et al.* (2018) also reported improved growth performance and carcass characteristics in broiler chickens fed diets containing cocoa bean shells. Despite these promising findings, there is dearth of long-term studies on the effects of fermented cocoa bean shells on the nutrient digestibility and performance of broiler chickens. Additionally, the optimal inclusion of fermented cocoa bean shells in broiler chicken feed has not been determined. Finding alternative feed ingredients that are cost-effective and sustainable is crucial. Utilizing cocoa bean shells, a by-product that would otherwise go to waste, could address these challenges. The current study therefore was aimed at evaluating the effect of FCBS on the nutrient digestibility in broiler chickens.

MATERIALS AND METHODS

This study was carried out at Teaching and Research Farm of the Animal Science Department, Faculty of Agriculture, University of Abuja. Fresh CBS were collected from cocoa bean processors in Ondo State. Fresh bovine rumen content was collected from four randomly selected slaughtered cattle at the Gwagwalada abattoir in FCT and mixed with potable water at a ratio of 1:1, stirred, and sieved to

obtain rumen filtrate, which were added to the cocoa bean shell at a ratio of 5:5. It was mixed thoroughly manually, packed into polythene bags, tied at the open end, left under the shade of a tree to ferment for 24 hours, and thereafter sun-dried within 48 hours to less than 10%, as described Oluremi *et al.* (2018). The fermented cocoa bean shell, was used to formulate the experimental diet at an inclusion rate of 0% (T1), 5% (T2), 10% (T3), 15% (T4), and 20% (T5), as described by Olumide and Hamzat (2021).

Day-old chicks (n=150) weighing 45±10g were randomly divided into five treatments with three replicates in each treatment. Thirty birds were allotted to each treatment with ten birds per replicate in a completely randomized design (CRD) for the evaluation of nutrient digestibility. Feed and fresh water were provided *ad libitum*.

Proximate analysis of the diet was carried out (AOAC, 2016), and a nutrient digestibility trial was carried out at the end of the feeding trial using metabolic cages, as described by Dersjant-Li (2018). The birds were allowed to acclimatize for three days before the 3-day metabolic trial was carried out. Three birds were randomly selected from each replicate. The birds were fed the experimental diets accordingly. The weight of feed given to each bird was taken and recorded. Excreta was collected daily on labeled aluminum foil paper. The wet weight was taken and recorded, then dried in an oven at 65 °C to attain a constant weight. Samples were weighed at the end, and 10% of each was collected, homogenized, grinded, and analyzed for proximate analysis (AOAC, 2016).

Apparent Nutrient Digestibility = $\frac{\text{Nutrient intake (DM)} - \text{Nutrient fecal output (DM)}}{\text{Nutrient intake (DM)}} \times 100$

Data were analyzed using a one-way analysis of variance (ANOVA) and means were separated using Duncan's multiple range test at a significance level of $p < 0.05$ (SAS, 2005).

RESULTS AND DISCUSSION

Phytochemical composition of FCBS is shown in table 1. Results indicated that FCBS contained 0.20% phytate, 1.20% oxalate, 8.52% flavonoids, tannins 7.97%, 1.61% saponins, 2.1% terpenoids, 1.40% steroids and 10.83% theobromine. Effect of FCBS on nutrient digestibility of broiler chickens is shown in table 2. Results revealed that FCBS had a significant influence ($P < 0.05$) on the nutrient digestibility of broiler chickens. Birds fed dietary 0 (89.49%), 10 (89.58%), and 20% (89.59%) had similar ($P > 0.05$) dry matter values which were significantly higher ($P < 0.05$) in birds fed 15 and 5% FCBS, respectively. The crude protein (84.22–81.88%) values obtained in this study varied significantly ($P < 0.05$) across the dietary treatments, with birds on dietary 0% (T1) and 10% (T3) FCBS having similar values but significantly higher than in other dietary treatments. Birds fed 10% FCBS (T3) recorded the higher ash (66.38%) and crude fiber (71.74%) content than in other dietary treatments. The nitrogen-free extract values of the experimental birds observed in this study was the highest (79.17%) value in birds fed 20% FCBS (T5), while the lowest (72.59%) value was obtained in those fed 5% FCBS (T2). The tannin and theobromine content of the FCBS obtained were higher than (0.91 and 2.64%) reported by Adeyeye *et al.* (2017). This may be due to the age of the cocoa plant used and other environmental factors. Nutrient digestibility implies bioavailability. The digestibility of nutrients obtained in this study for dry matter (88.21–89.59%) and crude fiber (65.66–71.46%) were relatively higher than the range of 63.63–69.37% reported by Adedire *et al.* (2012) for digestible dry matter and crude fiber (55.61–62.88%), when crop-based residues fermented with *Rhizopus oligosporus* were fed to experimental rabbits. The high dry matter possessed by experimental diets is an indication that the diet was properly processed. There was a synergy between the high dry matter content of the feed and the crude protein content. The high dry matter, crude protein, ash, and crude fiber content observed in birds in treatment 3 (10% FCBS) could be attributed to the effect of secondary metabolites contained in cocoa bean shell on enhancing the degradability of the ingesta. The digestibility of crude protein declined marginally across dietary treatments without a definite pattern. The decline in crude protein digestibility observed across the dietary treatments may be associated with the theobromine content of the raw cocoa pod husk, which has been reported to limit

its utilization in animals (Marcel *et al.*, 2011). It may also be due to the increasing level of fiber in the cocoa pod husk meal. The decline in protein digestibility confirms the negative influence of fibrous substances on nutrient digestibility in farm animals (Ndindana *et al.*, 2002). The high digestibility coefficients obtained in birds fed dietary 10% FCBS in this study implied that the birds were able to utilize nutrients in the diets for their growth. The digestible crude fiber values in this study were quite high. Ingested feed was not absorbed totally by the animal but ingested as it is not used, passes through the digestive tract, and found excreted in feces (Deiltel *et al.*, 2012). The results in this study conform to observations of Adeyeye *et al.* (2017), which supported the feeding of processed cocoa pod husk meal for the normal growth of growing rabbits at a 15% inclusion level.

Table 1 Phytochemical Composition of Fermented Cocoa Beans Shell

Parameters	%
Phytate	0.20
Oxalate	1.20
Flavonoids	8.52
Tannins	7.97
Saponins	1.61
Terpenoids	2.1
Steroids	1.40
Theobromine	10.83

Table 2. Effect of fermented cocoa bean shell on the Nutrient Digestibility of broiler chickens

Parameters	Inclusion levels of FCBS (%)					SEM
	0	5	10	15	20	
Dry matter	89.49 ^a	88.21 ^c	89.58 ^a	88.56 ^b	89.59 ^a	0.16
Crude Protein	83.22 ^a	81.88 ^d	84.22 ^a	80.53 ^e	82.23 ^c	0.33
Ash	43.28 ^d	49.36 ^b	66.38 ^a	45.77 ^c	40.83 ^e	2.43
Crude fibre	68.29 ^c	65.66 ^e	71.46 ^a	66.35 ^d	65.66 ^e	0.61
NFE	75.14 ^c	72.59 ^e	77.74 ^b	74.43 ^d	79.17 ^a	0.63

^{abc} Means along the same row with different superscripts are significantly different (P<0.05)

NFE= Nitrogen Free Extracts, FCBS= Fermented cocoa bean shells

CONCLUSION

Thus, the broiler chickens in Treatment 3 (10% FCBS) had the best nutrient digestibility results.

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