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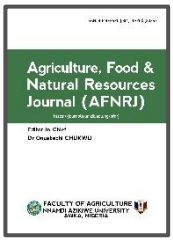

Original Article

Effects of biodegraded breadfruit husk on the growth performance, carcass and organ characteristics of broiler finisher

OPEN ACCESS

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A B S T R A C T

The study was conducted to evaluate the growth performance, carcass characteristics, and internal organs of broiler finishers fed with graded levels of biodegraded breadfruit husk. This study was conducted at the Poultry Unit of the Department of Animal Science, Faculty of Agriculture, Chukwuemeka Odumegwu Ojukwu University, Igbaraim campus. A total of one hundred and twenty broiler chickens were used for this experiment. The birds were allocated into four treatments with thirty birds per treatment, ten birds per replicate. The birds were fed graded levels of biodegraded breadfruit husk (BBFH) (0, 100, 75, 25 %). On the 42 days of the experiment, the 120 birds were starved for 12 hours; two (2) birds per treatment closest to the mean were selected from each of the replicates, tagged, slaughtered, and scalded at 55°C for one minute and dressed to evaluate the carcass characteristics and internal organs. Data were subjected to analysis of variance (ANOVA), and significant means were separated using least significant difference (LSD). The result showed that the feed intake, body weight gain, and feed conversion ratio of the birds showed no significant difference ($P>0.05$). The analysis also, for carcass characteristics and organ properties, showed that there was no significant difference ($P>0.05$) in most of the parameters except the live weight, shank, and abdominal fat, which were significantly different ($P<0.05$). The intestine weight was influenced ($P<0.05$) by the experimental diets. Thus, BBFH can be used in broiler diets without any deleterious effect on carcass quality and internal organs and can be included up to 16% in the diet of broiler chicken to enhance growth.

K E Y W O R D S : *Biodegradable, Breadfruit husk, Carcass, Growth parameter, Organ characteristics*

INTRODUCTION

Livestock production represents a major investment with important economic, nutritional and social implications for developing countries. The levels of animal protein consumption however, have been reported to be very low and generally influencing the health and well-being of ever-increasing population (Ahaotu *et al*, 2018). Broiler production is still highlighted as the central key to food security and development of any nation (Olarotimi *et al*, 2017). Ending poverty and hunger as well as improving health is the key mile stones of the United Nations Sustainable Development Goals (SDGs) (UN, 2014). To achieve the goals will definitely involve a good deal of animal production by the member of nations.

The growth of poultry industry in developing countries especially Nigeria, has been rapid during the past decades. Broiler chicken production is one of the easiest and fastest means of providing animal protein in developing countries like Nigeria due to its short generation interval, rapid weight gain, and efficient food utilization (Jiwuba *et al*, 2016). The intensification and development of animal production sector in

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Nigeria will play a vital role in provision of better protein source.

In developing countries, majority of the populace suffer from protein deficiency, therefore, there is need to look for easier and simple ways of getting the animal protein required for normal body growth and functioning (Olumide, 2017). Ezeoke (2023) stated that the demand for animal for animal protein has risen sharply in the recent years. It has been reported by (Ezeoke & Nwoye, 2022) that feed cost accounts for over 65-70% of the entire expenses in poultry production. The high price of feed has been attributed to competition between the man, industries and monogastric animals, the stiff competition existing between humans and animals over available conventional feed (mostly grains) has resulted in the near collapse of the poultry industry in Nigeria (Ayo-enwerem *et al*, 2017). Also, the high cost of feed in most tropical countries clearly indicates that the production of cereal grains for livestock business is grossly inadequate (Ahaotu *et al*., 2017) has been the prime stimulant for the search of alternative feed stuff for monogastric animals (Ezeoke & Nwoye, 2022). Therefore, there is urgent need to turn attention to other tropical sources to reduce the high production cost due to the rising costs of conventional ingredients.

The nutritive value of different crop residues has been reported by various researchers. Examples of such crop residues are cocoa husk, rice husk, breadfruit husk, and cowpea husk. Otaha (2013) reported the potential of cocoa husk as feed ingredients in poultry diets. Omede, (2018) reported the potential of cassava products as feed ingredients in poultry diets. African breadfruit (*Treculia africana*) seeds and shells have been neglected and under exploited. This is a plant known for its large fruit heads which is rich in energy, protein, minerals, and vitamins (Diarra, 2014). It is among the ecologically available forest-based feed resources with good biomass production which can be converted into feed for livestock which is found in the wild (Ezeoke *et al*, 2023). The breadfruit tree belongs to the genus *Artocarpus* with the specific name, *altilis* and the full scientific name, *Artocarpus artilis* (Turi, 2015). On the other hand, the African relative (both specie belonging to the same Mulberry family called *Moraceae*) is known as the African breadfruit tree, with the scientific name, *Treculia africana*. The *T.africana* species is a forest fruit tree widely grown in Southern Nigeria such as, "*afon*" (Yoruba), "*baratuta*" (Hausa), "*ize*" (Benin), "*eyo*" (Igala), "*edikang*" (Efik), and "*ukwa*" by the Igbo people (Eleazu, 2017).

The breadfruit tree stores carbohydrates, mainly, and produces fruit 2-3 times in a year. The number of seed produce by the fruit is very high. The fruit is aromatic, rich in latex and weighing up to 1-4kg (Turi, 2015). Apart from carbohydrates, the breadfruit is also an important source of nutrients such as vitamins, minerals, proteins as well as fats. It is an indigenous fruit and generally plays a role in the diet of man (Obiako *et al*., 2014). The fruits contain brown or black seeds covered with hulls. It is a grain legume, which has quite a good number of nutrients.

Eleazu (2017) reported that the potential industrial uses of the African breadfruit have not been sufficiently explored and investigated, other than attempts carried out at determining its chemical composition. African breadfruit offers high in livestock nutrients containing about 86.27% dry matter, 12.98% crude protein, 42.2% crude fiber, 3.95% ash, and metabolizable energy of 3870.30Kcal/kg for poultry (Eleazu, 2017). Turi, (2015) reported that African breadfruit can be processed into meal suitable for poultry. Husk as a membranous outer covering of various seed mostly considered as waste, breadfruit husk is brown in color and often change to black due to oxidation after fermentation period that varies between 6 to 12 days (Soccol, 2017). Botanically, the husk contains high cellulose, which is a fiber source and the inclusion of fiber source in low fiber diets of poultry results in beneficial effects in the development in different organs, digestibility, gut health and productive performance.

Several researches have been carried out on the breadfruit seed on livestock. Much has not been done on the utilization of breadfruit husk as a functional feed for broiler birds. Meanwhile a very possible way of increasing the feed in poultry is reducing the cost of production by the utilization of cheap available and less demanded protein resources (Turi, 2015). The aim of this study is to know the effects of biodegraded breadfruit husk on the growth performance, economic analysis, carcass and organ characteristics of broiler finisher.

MATERIALS AND METHOD

Experimental site

The experiment was carried out at the Poultry Unit of the Department of Animal Science, Faculty of Agriculture, Chukwuemeka Odumegwu Ojukwu University, Igbariam campus, Anambra State, Nigeria. The University covers an area of about 714 hectares and located between longitude 6.94869° to 6.98174° E and latitude 6.27321° to 6.31003° N with a maximum and minimum temperature of f 24 – 36°C and annual rainfall of 1520-2020 mm (Ukpeli *et al*., 2024).

Sourcing of test ingredients

Breadfruit (*ukwa*) husk was obtained from *Eke-Awka* market (*ogbo-ukwa*) in Awka, Anambra State. Where large quantities were found as deposited by the commercial dealers in breadfruit (*ukwa*) and its husk residue. The white rot fungi (*Pleurotus tuber regium*) were sourced from *Nkwo-Awkuzu* market, Anambra state.

Preparation and inoculation of breadfruit husk with fungi

The inoculation room was thoroughly swept, washed and disinfected; this is to reduce the effect of micro-organism in the environment. The procured Breadfruit husk was sun dried for about 2 – 3 days after which it was milled to reduce the particle size in order to increase the surface area for easy digestion. The tuber regium was chopped into pieces and soaked for two (2) hours. After which it was removed from the water and kept for

two days. The milled breadfruit husk was soaked in water and then placed in a sieve and was left for some hours for the water to drain out completely. The Breadfruit husk was subjected to pasteurization, which was done by placing the BFH in a boiling steam after which it was allowed to cool. The breadfruit husk was then mixed with the tuber regium at the ratio of 5:1 respectively. The mixture (BFH and fungi) was tied in a white nylon and placed in a dark room for 5 days, after which it was kept in an open space under normal temperature for 40 days. After these processes, the biodegraded Breadfruit husk was sun-dried and grinded into fine particle.

Experimental diet

The experimental ingredient was incorporated into four (4) experimental diets at 0%, 100%, 75%, and 25% levels respectively. The levels will form the 4 treatments that the birds will be subjected to. Each treatment will be replicated three (3) times.

Table 1: Experimental diet

Ingredients (kg)	T_1	T_2	T_3	T_4
Maize	60	60	60	60
Soya	17	17	17	17
BFH	16	0	12	4
BDBFH	0	16	4	12
Bonemeal	3.3	3.3	3.3	3.3
Lycine	0.1	0.1	0.1	0.1
Meothionine	0.1	0.1	0.1	0.1
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Fish Meal	3	3	3	3
Total	**100**	**100**	**100**	**100**

Where; BFH = Breadfruit husk, BBFH = Biodegraded breadfruit husk, the experimental diet will be constituted as follows, T1=Diet containing the feed with non-biodegraded breadfruit husk, which serves as control, T2= Diet containing 100% biodegraded breadfruit husk in the diet, T3=Diet containing 75% biodegraded breadfruit husk in the diet and T4= Diet containing 25% biodegraded breadfruit husk in the diet.

Experimental Animals and Management

The experimental animals that were used for this study is broiler chicken. A total sum of 150 birds was procured from a reputable farm. The experimental birds were introduced into the poultry unit where the chicks were brooded under normal brooding condition for about 2 weeks with the necessary vaccination against diseases. After the brooding period, the birds were distributed into 4 treatment groups of 30 birds, replicated into three (3), that is 10 birds per replicate. The birds were managed on a deep litter system and were provided with the experimental diet and water *ad libitum*. Good sanitation practices, bio-security, and routine vaccination were carried out.

Data collection

Birds were weighed at the beginning of the experiments and thereafter weighing was done weekly. Data was collected on body weight, feed intake; feed conversion and mortality were recorded as it occurred. Body weight gain: The birds were weighed at the beginning of the experiment and the initial weight was obtained. The final weight was taken at the end of the experiment by subtracting the initial weight from the final weight. Body weight gain = Final weight – initial weight. Feed intake: Daily feed intake was determined by subtracting the quantity of the feed left over from the quantity of feed supplied/ given to the birds.

Total feed intake (kg) = Total feed given – left over feed. (1)

Feed conversion ratio: This was determined by dividing the average feed intake of a bird by the average weight gained by the bird.

At the end of the experiment, two (2) birds from each replicate comprising of six (6) birds from each treatment were selected randomly for carcass analysis. These birds were fasted of feed for 12 hours (in order to empty the gut and prevent carcass contamination). The birds were slaughtered by severing the jungular vein and allowed to bleed. Following through bleeding, the birds were de-feathered by scalding in hot water. The de-feathered birds were weighed, labeled, and eviscerated. Each carcass cut into their parts and parameters such as the thigh, breast, neck, head, drumstick, shank, wings, back, abdominal fat were analyzed. Also, the various internal organs such as the heart, kidney, liver, intestines, gizzard, spleen, proventricus, were also weighed/analyzed.

Statistical analysis

Data collected from the experiment was subjected to one-way analysis of variance (ANOVA) as described by SAS (2008); significant means was separated using least significant difference (LSD).

RESULTS AND DISCUSSION

Growth Performance of the Broiler Chickens

The average daily feed intake of the finisher broilers was 1328.85g, 1290.75g, 1318.78g and 1312.22g respectively for the T_1 (16% BFH and 0% BDBFH), T_2 (0% BFH and 16% BDBFH), T_3 (12% BFH and 4% BDBFH) T_4 (4% BFH and 12% BDBFH) as showed in Table 2. The feed intake of the finisher broiler on diet 3 and 4 were similar and compared favorably with those on the control diet and significantly different ($P< 0.05$) from those on diet 2. The finisher broiler group on diet 2 recorded the lowest feed intake of 1290.75g. This could be due to the addition of biodegradable test material (*OSU*). The body weight gain of the finisher broilers was 988.33g, 866.67g, 866.67g and 836.67g respectively for T_1, T_2, T_3 and T_4 respectively. There was no significant difference ($P>0.05$) among the treatment groups. The body weight gain of the

treatment groups compared favorably among one another. The feed conversion ratio of the finisher broiler fed biodegradable breadfruit husk and non-biodegraded breadfruit husk had no significant differences among the treatment diets (P>0.05).

The feed intake of the finisher broilers on T1, T3 and T4 were similar and compared favorably with those in the T1 diet. The finisher group on diet 2 and 4 recorded lower and lowest feed intake respectively possibly because of the addition of biodegradable material (*OSU*) and the anti-nutrient factor may be an added reason. The body weight gain of the finisher broilers on diet 1 (16% BFH and 0% BDBFH) favorably with other treatment groups. It appeared that finisher broilers tolerate the levels of inclusion of the BFH and BDBFH. This shows that the method of processing and its technique is good. Information on non-biodegradable breadfruit husk and biodegradable breadfruit husk were scarce in literature. The superiority in final body weight and average daily weight gain of the animals on 16% non-biodegradable breadfruit husk and 0% biodegraded breadfruit husk-based diet may be due to it's being more efficiently utilized for growth by growing birds than other test ingredients in this study. Also, the differences in values obtained for all the growth parameters monitored in this study may be due to the variations in crude fibre and crude protein contents of the test ingredients. The average daily feed intake ranged from 1290.95g to 1328.85g with highest value occurring in diet 1 (1328.85g). The differences in feed intake may be due to variations in the crude fibre content of the diet because broilers may eat more to compensate partially for lower digestible energy level *(Zoiopoules, 1989).* The feed conversion ratio (FCR) ranged from 3.81 to 4.40. Diet 4 had the highest value of (4.40) while diet 1 had the least value of (3.81). The differences in the FCR may be due to the variations in the feed intake and weight gain of the experimental animals.

Table 2: Growth performance of broiler finisher fed biodegraded breadfruit husk and non – biodegraded breadfruit husk.

Parameters	T_1	T_2	T_3	T_4	SEM
IBWT(g)	920.00^{a}	876.67^{ab}	821.67^{b}	845.00^{ab}	15.96
FBWT(g)	1911.67^{a}	1770.00^{ab}	1688.33^{b}	1681.67^{b}	39.43
BWTG(g)	988.33	886.67	866.67	836.67	32.92
DBWTG(g)	35.29	31.66	30.95	29.88	1.17
TFI (g)	37208.00^{a}	36141.00^{b}	36926.00^{a}	36742.33^{a}	133.47
ADFI(g)	1328.85^{a}	1290.75^{b}	1318.78^{a}	1312.22^{a}	4.76
FCR	3.81	4.07	4.30	4.40	0.15

^{ab} *means along the same row with different superscripts are significant difference (P<0.05)*

SEM means Standard Error of Mean, IBWT means Initial body weight, FBWT means Final body weight, DBWTG means Daily body weight gain, TFI means Total feed intake, ADFI means Average daily feed intake, FCR means Feed Conversion Ratio, BWTG means Body weight gain. T1=Diet containing the feed with non-biodegraded breadfruit husk, which serves as control, T2= Diet containing 100% biodegraded breadfruit husk in the diet, T3=Diet containing 75% biodegraded breadfruit husk in the diet and T4= Diet containing 25% biodegraded breadfruit husk in the diet.

Carcass characteristics

Table 3 showed the carcass characteristics of broilers fed with biodegraded breadfruit husk-based diet. The live weight gain of birds on T_2, T_3 and T_4 were 2058.33g, 2025.00g and 1958.33g respectively. This is in line with Umeh (2023) There were no significant difference (P<0.05) in most of the parameters; carcass weight, dressed weight, thigh, drumstick, neck, wing, head and back cut while the value obtained from the live weight, shank, abdominal fat were significantly different (P<0.05). The control diet (T_1) recorded the highest value of 2.05% (P<0.05) while the experimental treated diets 2, 3 and 4 recorded the lowest values when compared to control diet (1.30, 1.41 and 1.38%) respectively, but the treated diets were similarly affected (P>0.05).

The dressing percentage value range from 74.84 to 79.80%. The highest dressed percentage was obtained from the birds on the experimental diet 2 (79.80%). The value was within the range 77.33 – 83.00 obtained by Onurah, (2021) but was higher than the range 60.30 – 74.65 recommended for broiler chickens (Olumide,). Apparent difference in the values of thigh and drumstick percentage were not significant (Olumide *et al*., 2017). Ezeoke *et al*., (2023), however, observed that high dietary fiber level could be linked with the lower abdominal fat and decreased live weight.

Internal organ properties

The main effects of dietary biodegraded breadfruit husk and inclusion levels on internal offals of broiler chickens as presented in Table 4. The gizzard, liver, spleen, proventriculus, gall bladder and heart weight as expressed in the percentages were not significantly affected (P>0.05) by the inclusion levels.

The intestine weight which was influenced (P<0.05) by the dietary biodegraded breadfruit husk had chicks on T_2 recording higher intestine yield and least were observed for those in T_3. The gizzard was not influenced (P>0.05) by the test material inclusion levels and higher at control diet (T_1) with value of 3.11% and lowest at T_2 with 2.53% value.

The main effect of dietary biodegraded breadfruit husk and inclusion level on heart and liver weights were not significantly different (P>0.05). This indicated that breadfruit husk and its kevels of inclusion did not pose any toxic threat on the health of the fed chickens. Liver and heart have not been noted to play important roles on the vitro detoxification processes (Diarra, 2014), similarities in liver yield are an indication that the biodegradable breadfruit husk inclusions levels do not pose challenge on the birds. The result of the findings was in line with Oladimeji *et al.,* (2020) on the study of carcass characteristics and organ weights of broiler chickens fed varying inclusion levels of cassava peel products-based diets.

Spleen condition is an index of immunity and adequacy in supply of oxygen to the tissue (Smith, 2019). The values obtained (0.16 to 0.19%) for spleen weight in this study conforms to the range of (0.07 – 0.11%) weight reported by Oladimeji *et al.,* (2020). The increase in the size of gizzard as observed in control diet could be explained by the increase in dietary fiber as higher the crude fiber, the lower the digestibility of a diet (Ezeoke *et al*., 2023). Increase in the fiber intake could increase gut and gizzard size with fiber intake as reported elsewhere (Obiakor, 2014). This implies that the test material does not have higher fiber content than maize, since the gizzard of the treated diets were lesser in weight when compared to the control diet.

Earlier, authors (Udedidia *et al*., 2021) however, observed no significant differences (P>0.05) when broiler chickens were fed diets containing 5, 10, and 15% cassava products. This observation maybe due to lower inclusion levels of cassava peel in the diet. The values obtained in this study were similar to the study. The variations observed were not consistent with the breadfruit husk products or inclusion levels used; this could be due to iso-caloric and iso-nitrogenous diets employed in this study.

Table 3: Carcass characteristics of finisher broiler chicken fed biodegradable breadfruit husk.

Parameters	T1	T2	T3	T4	SEM
Live weight(g)	2466.67^{a}	2058.33^{b}	2025.00^{b}	1958.33^{b}	77.51
Carcass weight (%)	86.44	92.73	90.95	88.57	1.87
Dressed weight (%)	76.60	79.80	74.84	77.83	1.83
Breast weight (%)	25.02	23.87	25.02	24.62	0.44
Thigh (%)	13.47	13.39	14.16	13.37	0.19
Drumstick (%)	12.98	12.69	13.60	12.50	0.21
Shank (%)	5.55^{ab}	5.28^{ab}	6.36^{a}	4.60^{b}	0.26
Neck (%)	6.79	6.32	6.51	6.58	0.17
Wing (%)	9.00	9.69	9.92	9.54	0.12
Head (%)	3.23	3.25	3.87	3.86	0.12
Back (%)	15.51	15.00	15.59	15.65	0.19
Abdominal fat (%)	2.05^{a}	1.30^{b}	1.41^{b}	1.38^{b}	0.11

$^{a\ b}$ Means along the same row with different super scripts are significant (P<0.05)
SEM means standard Error of Mean

Table 4: Effect of biodegraded breadfruit husk on the organs of finisher broiler chicken

Parameters (%)	T1	T2	T3	T4	SEM
Gizzard	3.11	2.53	2.74	2.55	0.16
Liver	3.23	3.47	3.06	3.03	0.12
Spleen	0.19	0.16	0.16	0.17	0.01
Intestine	8.79^{b}	12.39^{a}	8.09^{b}	8.86^{b}	0.67
Proventriculus	0.99	1.00	0.81	0.95	0.03
Gall bladder	0.20	0.20	0.22	0.20	0.01
Heart	0.66	0.67	0.65	0.69	0.02

a b Means along the same row with different super scripts are significant (P<0.05)
SEM means standard Error of Mean

CONCLUSION AND RECOMMENDATION

It was concluded from the results obtained in this study that biodegradable breadfruit husk and biodegraded breadfruit husk could be used in the diet of finisher broilers up to 16% without affecting body weight gain, feed intake, and feed conversion ratio as indicated in this study.

The result obtained from the study cleared that the breast meat yield of the chickens on maize-based diets had similar breast weight (yield) compared to those on biodegraded breadfruit husk which had lower but similar weights (yield). Biodegraded breadfruit husk can be used up to 100%, 75% and 25% in broiler diets without negative effect on carcass primal cuts and internal offal's yield of broiler finisher chicken. It is therefore recommended that large scale production of breadfruit for poultry feeding be encouraged so as to reduce the pressure of demand for conventional feedstuff. This may in the other hand help to reduce the cost of poultry production and hence the costs of poultry products like egg and poultry meat. Further studies should be conducted to know the highest levels of inclusion of biodegraded breadfruit husk in broiler finisher diets.

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Authors' Contributions

FCE initiated the project title and reported the findings of the experiment into journals article, ELO monitored and conducted the experiment.

Ethical Statement

This research was done in line with the ethical standards as prescribed by Department of Animal Science, Faculty of Agriculture, Chukwuemeka Odumegwu Ojukwu University, Igbariam campus, Anambra State, Nigeria.

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