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Growth performance and feed cost benefit of broiler chickens fed Acha grain-based diet supplemented with different plant protein sources

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Abstract

Conventional energy sources for poultry feed are scarce, expensive and highly competed for by man and industry in Nigeria which has resulted to subsequent high cost of feed and at times, poor quality of feed sold to farmers. Therefore, this study was carried out to evaluate the growth performance and feed cost benefit of broiler chickens fed various plant protein sources in acha grain based diet. A total of 120, one day-old Abor acre broiler chicks were procured and assigned in a Completely Randomized Design to four dietary treatments of three replicates and ten chicks per replicate. The four diets comprise soybean meal (full fat), soybean cake, groundnut cake and cashew nut meal at 28% inclusion level each in an acha based diet. Data on growth parameters (Daily feed intake, Final Weight Gain, Total Weight Gain, Feed-to-gain ratio and mortality) were collected daily and weekly. The results showed that the birds fed diet 3 having soyabean meal as the main plant protein source with 2700 Kcal/kg ME gave the best growth performance. It is also important to note that, the growth performance of birds fed diet 4 which had 28% cashew nut (full fat) had the poorest feed-to-gain ratio. The findings from this study further showed that using cashew nut (T4) as plant protein source in poultry (broiler chicken) ration is rather too expensive and production of cashew nut may have to increase so as to bring down the cost of production of broiler chicken. There was significant difference ($P<0.05$) in all the variables of feed cost benefit analysis. It is concluded that soyabean, whether used as meal/cake or full-fat confirmed its superiority over groundnut cake and cashew nut meal in this study. It is therefore recommended that farmers or poultry feed producers should use acha based diet with either soyabean meal or full-fat soyabean.

Keywords: Soya bean, Groundnut cake, Cashew nut meal, Acha grain, Growth performance, Feed cost benefit, Broiler chicken

La Performance de croissance et l'avantage en termes de coûts alimentaires des poulets de chair nourris avec un régime à base de céréales d'*Acha* complété par des sources différentes de protéines végétales

Résumé

Les sources d'énergie conventionnelles pour l'alimentation de la volaille sont rares, coûteuses et très concurrencées par l'homme et l'industrie au Nigéria, ce qui a résulté en un coût élevé des aliments et parfois, une mauvaise qualité des aliments vendus aux agriculteurs. Par conséquent, cette étude a été réalisée pour évaluer les performances de croissance et les avantages en termes de coûts d'alimentation des poulets de chair nourris

avec diverses sources de protéines végétales dans un régime à base de céréales acha. Un total de 120 poussins de chair Abor acre d'un jour ont été achetés et assignés dans une conception complètement aléatoire à quatre traitements diététiques de trois répétitions et dix poussins par répétition. Les quatre régimes comprennent la farine de soja (pleine matière grasse), le tourteau de soja, le tourteau d'arachide et la farine de noix de cajou à un taux d'inclusion de 28% chacun dans un régime alimentaire classique. Les données sur les paramètres de croissance (ingestion journalière, gain de poids final, gain de poids total, rapport alimentation / gain et mortalité) ont été collectées quotidiennement et hebdomadairement. Les résultats ont montré que les oiseaux nourris avec le régime 3 contenant de la farine de soja comme principale source de protéines végétales avec 2700 Kcal / kg ME ont donné les meilleures performances de croissance. Il est également important de noter que les performances de croissance des oiseaux nourris avec un régime alimentaire 4 contenant 28% de noix de cajou (gras) présentaient le rapport alimentation / gain le plus faible. Les résultats de cette étude ont en outre montré que l'utilisation de la noix de cajou (T4) comme source de protéines végétales dans la ration de volaille (poulet à griller) est plutôt trop coûteuse et que la production de noix de cajou peut devoir augmenter afin de réduire le coût de production du poulet à griller. . Il y avait une différence significative (P <0,05) dans toutes les variables de l'analyse coûts-avantages des aliments. Il est conclu que le soja, qu'il soit utilisé comme farine / tourteau ou gras entier, a confirmé sa supériorité sur le tourteau d'arachide et la farine de noix de cajou dans cette étude. Il est donc recommandé que les agriculteurs ou les producteurs d'aliments pour volaille utilisent un régime à base d'acha avec du tourteau de soja ou du soja entier.

Mots clés : Graine de soja, Tourteau d'arachide, Farine de noix de cajou, Graine Acha, Performance de croissance, Coût de l'alimentation, Poulet à griller

Introduction

Feed cost has been constantly reported to be a hindrance to the progress of poultry production worldwide. The cost of feed in poultry is considered to be important because it is between 60 - 80% of the total cost of production (Onunkwo, 2017). Maize is the major and well-known source of energy in poultry feed and it constitutes about 60% in the poultry diet (Onunkwo *et al.*, 2019). Unfortunately, the rapid growth of human population has intensified the competition between man and livestock for these cereal grains resulting in high cost of feeds and consequently high prices of poultry products leading to very low level of protein intake in most developing countries (Ekine and Onunkwo, 2020). Consequent upon the increase in poultry production cost, research attention is now geared toward lesser known cereal ingredients that will not compromise the feed quality, such cereal grains are Acha, Sorghum and Millet. "Acha" crop is exceptionally tolerant to a wide variety of conditions, particularly drought and poor soil (NRC, 1996). Acha has similar crude protein content with maize (10%) with high constituents of essential mineral elements (Anuonye *et al.,* 2010). Ruskin *et al.* (1996) and Chukwu and Abdul-kadir (2008) reported that acha is rich in methionine and cysteine, the limiting amino acids of most cereals. The plant compares favorably with rice, sorghum, maize and millet in terms of its content of protein, crude fat, carbohydrate and essential mineral (Jideani, 1990). It has the potential to contribute significantly to whole grain diets, wellness, economic status improvement and play an important role in medicine, animal feed and food security in a developing nation like Nigeria. Acha is a rich source of vitamins, minerals, fibre, carbohydrate, protein, amino acids

containing methionine and cysteine. It has health benefits, because it is rich in energy, iron, aids digestion and cardiovascular function.

Though positive results have been achieved with guided use of other alternative feedstuffs in monogastric nutrition, most research work on the use of acha is on human nutrition (Egwin and Oloyede, 2006) and in aquaculture (Nwanna *et al*., 2006). Considering the fact that most research work on the use of acha is on human nutrition and the determination of the chemical composition of Acha grain (Temple and Bassa, 1991; Chukwu and Abdul-Kadir, 2008), there is need to evaluate the growth performance and feed cost benefit of broiler chickens fed Acha grain-based diet and different plant protein sources.

Materials and methods

Location of the study

This study was conducted at the Poultry Unit of the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike Abia State. Umudike is located within the tropical rainforest zone and the environment is characterized by annual rainfall of 2177 mm. It also bears the co-ordinate of 5˚28' North and 7˚31' East which lies at an altitude of 122 mm above sea level (NRCRI, 2019).

Experimental diets

A total of four experimental diets were formulated with soybean meal (full fat), soybean cake, groundnut cake and cashew nut meal were used at 28% inclusion level each in acha-based diets (Table 1). The proximate composition of acha is as follows; 6.9% protein, 2.10% fat, 87.48% carbohydrate, 1.02% crude fibre and 2.44% mineral salts.

Experimental birds and management

A total of 120 Abor acre day old broiler chicks from a reputable and disease-free farm were used for this study. The birds were weighed individually and randomly allocated to the 4 treatment dietary groups with each group having 30 birds replicated thrice (10 birds/replicate) in a Completely Randomized Design (CRD). The study lasted 56 days and the birds were fed and offered drinking water *ad-libitum*.

Data collection

Data on body weight and feed intake were collected weekly. The birds were individually weighed weekly in each replicate. The quantity of feed fed to the birds was measured and recorded on daily basis in grammes by subtracting the left over from the quantity fed the previous day to determine the quantity consumed by each replicate. The feed intake and weight gain were used to calculate feed conversion ratio.

At the end of the experiment, net and gross margin analysis was carried out to determine and compared the profitability of Acha grains in broiler diets using the procedure of Ukachukwu and Anugwa (1995).

Statistical Analysis

The data collected were subjected to Analysis of variance (ANOVA) as outlined in Completely Randomized Design (CRD) by Steel and Torrie (1980) Significant means were separated using Duncan's New Multiple Range Test (Duncan 1955).

Table 1: Percent composition of the experimental diet

Ingredients	T1	T2	T3	T4
Acha	54.30	54.30	54.30	54.30
Brewers dried grain	11.00	11.00	11.00	11.00
Groundnut cake	28.00	-	-	-
Soyabean (full fat)	-	28.00	-	-
Soyabean meal	-	-	28.00	-
Cashew nut cake	-	-	-	28.00
Fish meal (Local)	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Vitamin Premix	0.25	0.25	0.25	0.25
D1 Methionine	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
Percent crude protein	22.51	21.61	21.61	22.51
ME. (kcal/kg)	2700.00	2806.80	2700.00	2836.80
Protein: Calories ratio	1:120	1:130	1:125	1:126

T1 (28% Groundnut cake), T2 (Full fat Soyabean meal) T3 (Soyabean meal) T4 (Cashew nut meal)

Results and discussion

The results of the growth performance of broiler chickens fed varying plant protein sources in acha grain-based diets is presented in Table 2. The mean initial weight of the birds ranged from 52.47g - 53.80g but showed no significant different ($P>0.05$). The mean final weight showed significant different ($P<0.05$), with birds fed T3 having 2350.18g weight while birds fed T4 had the least final weight (884.07g). Birds fed T2 significantly followed closely T3 in being the second best (2047.83g). The mean total weight gain was significantly ($p<0.05$) different among the treatments. It followed the same pattern as the mean final weight gain, with T3 (2296.38g) having the highest weight, followed by T2 (1994.70g) and T1 (1368.60g). They showed significant difference ($P<0.05$). There was significant ($p<0.05$) difference in total feed intake with birds fed T3 having the highest feed intake (5842.67g), followed by T2 (5710.00g) and diet 1 (4582.00g) respectively. Birds fed diet 4 gave the least feed intake (3495.33g). Feed-to-gain ratio (F:G) was significantly different ($P<0.05$), with birds fed diet 3 having the best F:G (2.54) while diets 1 and 2 had 3.35 and 2.86, respectively. Birds fed diet 4 had the poorest (4.20) feed-to-gain ratio. Values obtained from birds fed dietary 28% soyabean cake as the main plant protein source with 2700 kcal/kg ME and protein calorie ratio of 1:125 slightly agreed with the findings of Ojewola and Longe (1999) which recommended a lower ME for broilers raised in the warm humid tropics as a means of raising heavy broiler chickens provided other requisite nutrients are available in the right quantity. Birds fed low-energy, low protein in this trial consumed more feed. This result is in an agreement with the report of Keshavarz and Fuller (1980) who observed that birds fed low protein or low energy diets increased their -consumption presumably in an effort to overcome the protein and energy deficiencies. It is also noteworthy that, the performance of birds fed diet 4 which had 28% cashew nut (full-fat) could be due to the fact that, at high ambient temperature as obtained in the tropics, stress exerted due to the metabolism of excess fat and high dietary metabolizable energy, coupled with thermal stress might have reduced

efficiency of utilization; which in-turn contributed to the small weights of the birds, poor feed-to-gain ratio and mean total weight gain. So, poor performance obtained in diet 4 may not be unconnected with inability of the birds to consume substantial amount of feed because of the high fat content in cashew nut meal which depressed appetite, hence the birds could not consume enough mineral and vitamins required for body weight. Another reason for the poor performance could be attributed to the heat stress caused by the hot environmental condition which may have hindered adequate feed intake resulting in the poor daily gain of the birds fed diet 4.

The crude protein of 21.61% combined with 2700.00 Kcal/kg ME seemed to be adequate under the tropical condition, and above all 28% soyabean cake in diet 3 with 54.30% acha grain and other nutrients seemed to have provided the requisite protein and energy in adequate proportion, and this enhanced adequate consumption of feed components thus promoting efficient utilization of such components by the birds.

The results of feed cost benefit analysis of broiler chickens fed varying plant protein sources in acha grain-based diets is shown in Table 3. The variables of the feed cost benefit analysis considered showed significant difference ($P<0.05$). The cost per kg of feed, cost per kg of feed/bird (N), mean total weight (kg) and cost of production (N) showed that the cost of feed increased from diet 1 to diet 4. The result showed that using cashew nut as plant protein source in broiler diet is rather too expensive and production of cashew may have to increase so as to bring down the cost of production.

Table 2: Performance Response of the broiler chickens fed varying plant protein sources in acha grain-based diets

Parameter (g)	T1	T2	T3	T4	SEM
Mean Initial Weight	52.47	53.13	53.80	52.56	0.295
Mean Final Weight	1421.07^{c}	2047.83^{b}	2350.18^{a}	884.07^{d}	1.00
Mean Total Weight Gain	1368.60^{c}	1994.70^{b}	2296.38^{a}	831.51^{d}	1.00
Mean Feed Intake	4582.00^{b}	5710.00^{a}	5842.67^{a}	3495.3^{c}	0.499
Mean Daily Feed Intake	58.06^{ab}	75.36^{a}	79.23^{a}	52.86^{b}	0.052
Feed-to-Gain Ratio	3.35^{ab}	2.86^{b}	2.54^{b}	4.20^{a}	0.60
Mortality	0.67	1.00	1.67	0.33	

^{a,b,c} means with different superscripts on same row are significantly different ($P<0.05$).

Table 3: Feed cost benefit analysis of broiler chickens fed varying plant protein sources in acha grain-based diets

Parameter	T1	T2	T3	T4	SEM
Cost/kg diet	243.28	255.28	252.28	487.28	30.85
Mean total feed intake (kg)	4.58^{b}	$5.7\ l^{a}$	5.84^{a}	3.50^{c}	0.499
Cost per kg of feed/bird (N)	1114.71^{c}	1457.65^{b}	1473.99^{b}	1703.21^{a}	1.00
Mean total weight (kg)	1.31^{c}	1.93^{b}	2.24^{a}	0.77^{d}	1.00
Cost of Production (N)	1554.71^{c}	1897.65^{b}	1913.99^{b}	2143.21^{a}	

^{a,b,c} values with different superscripts on same row are significantly different ($P<0.05$).

Conclusion

Acha is a good energy sources in poultry diet and it can be compared favourably with all other energy sources like maize, millet, sorghum and so on. It is concluded that soyabean, whether used as meal/cake or full-fat confirmed its superiority over groundnut cake and cashew nut meal in this study. It is therefore recommended that farmers or poultry feed producers should use acha based diet with soaybean meal whether it is soyabean meal or soyabean full-fat.

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