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EC VETERINARY SCIENCE
Research Article

Effect of Substitution of Polished Whole Black Acha for Maize on Apparent Nutrient Digestibility and Growth Performance of Broiler Chickens

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Received: October 21, 2020; **Published:** November 25, 2020

DOI: 10.31080/ecve.2020.05.00343

Abstract

An experiment was carried out on a completely randomized design (CRD) to evaluate the effect of dietary substitution of polished whole black acha (PWBA) for maize on growth performance and apparent nutrient digestibility of broiler chickens. Two hundred and forty (240) day old Abor-acre chicks were used. They were grouped into eight dietary treatments (T). Each treatment had 30 birds, replicated three times with each replicate having 10 birds. Treatment one (T1) which was the control was a diet containing no PWBA and T2 - T8 had 15, 30, 45, 60, 75, 90 and 100% PWBA respectively as replacement for maize. Both starter and finisher diets contained the same levels of PWBA. The birds were fed and water was given ad libitum for 56 days the experiment lasted. Starter and finisher phases lasted 4 weeks each. At both the starter and finisher phases, 100% substitution gave higher live weight and lower feed intake compared to control. Also 100% substitution gave better crude protein, crude fibre and starch digestibility compared to control. Above 15%, combination of PWBA and maize gave better live weight and higher feed intake compared to 100% substitution. In conclusion, PWBA grains could be used to replace maize grains at 100% in broiler diets.

Keywords: *Apparent Nutrient Digestibility; Black Acha; Dietary Substitution; Broiler Chickens; Maize*

Introduction

The high cost of the conventional energy feedstuff such as maize, sorghum and cassava tuber meal used in feed formulation contributes immensely to the high cost of the finished feed. This is a major obstacle to the expansion of the poultry industry in Nigeria and by extension in most developing countries in the world [1-3]. Cereal grains always account for up to 50 percent and above in poultry feed formulation [4]. In Nigeria, the most popularly incorporated cereal grain in feed formulation is maize which supplies more than half of the metabolizable energy requirement of poultry. The interest in search for alternative feed resources is of paramount importance, mainly because of the global demand for maize which has exceeded production [5].

The high cost of maize as an energy source in feed formulation has generated a lot of controversy as to its economic justification. Moreover, competition for its use as human food and industrial biofuel production limits its use for animal feeds [6]. In order to meet the food

security goal of providing adequate and affordable food for the people at all times, recent research focus is geared towards the exploitation of locally available, nutritional viable, under-utilized and easy to cultivate feedstuffs which have the highly needed dietary resources that can replace or complement conventional feed ingredients in broiler feeds [6]. This has necessitated research into non-conventional energy supplying ingredients that would replace maize without compromising broiler growth and economics of production. One of such lesser known feed resources is acha. Research indicates that feeding different types of acha grains can improve starch digestibility [7] and is not detrimental to feed utilization by chicken when fed at low levels [7,8].

Black Acha (*Digitaria iburua*) is cultivated in Northern part of Nigeria, under-utilized and cheaper than maize [9]. It resembles the wild *Digitaria longiflora* [10] and grows under varying conditions from poor dry upland soils to hydromorphic valleys suitable for rice production [11]. Acha is an annual cereal cultivated for its straw and edible grains. Acha is a grain which contains low level of anti-nutritional factors such as phytate, tannins, oxalate and trypsin inhibitor [12,13].

Objective of the Study

The objective of the research was to evaluate the dietary effect of graded levels of polished whole black acha as substitute for maize on growth and apparent nutrient digestibility of broiler chickens.

Materials and Methods

Site of experiment

The study was carried out at the Poultry Unit of the Teaching and Research Farm, University of Calabar, Calabar, Cross River State, Nigeria. Calabar is located at latitude $4^0$57′N and longitude $8^0$20′E with an elevation of 38m above sea level. It has an annual rainfall of 3000 - 3,500 mm and relative humidity of 70 - 80 percent with average daily temperature of 25^0C - 35^0C [14].

Source of polished black acha

The polished black acha grains were purchased from central market in Jos city, Nigeria. Clean water was used to wash the grains and the grains were dried under the sun.

Experimental design and diets

One-day old Abor-acre chicks (n = 240) were used for this experiment. The birds were randomly grouped into eight treatments T1 - T8). Each treatment had 30 birds, replicated three times with 10 birds per replicate. The experiment was arranged on completely randomized design (CRD). Different graded levels of polished black acha grains replaced maize in the diets and were fed to the birds. Treatment one (T1) diet which was the control contained 0% polished whole black acha and 100% maize, while T2 - T8 had 15, 30, 45, 60, 75, 90 and 100% polished whole black acha respectively as shown below:

- T1 (control) = Diet containing 0% PWBA + 100% maize.
- T2 = Diet containing 15% PWBA + 85% maize
- T3 = Diet containing 30% PWBA + 70% maize

- T4 = Diet containing 45% PWBA + 55% maize
- T5 = Diet containing 60% PWBA + 40% maize
- T6 = Diet containing 75% PWBA + 25% maize
- T7 = Diet containing 90% PWBA + 10% maize
- T8 = Diet containing 100% PWBA + 0% maize.

The diets were formulated with conventionally available feed ingredients in line with the nutrient requirements of broiler chickens in the tropics [15] as shown in table 1-4.

Ingredients	T1 (0%)	T2 (15%)	T3 (30%)	T4 (45%)	T5 (60%)	T6 (75%)	T7 (90%)	T8 (100%)
Maize	54.00	45.90	37.80	29.70	21.60	13.50	5.40	0.00
PWBA	0.00	8.10	16.20	24.30	32.40	40.50	48.60	54.00
Soya bean meal	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
Fish meal	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Wheat offal	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Premix*	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 1: *Ingredients composition of starter broiler diets.*

**Vitamin-mineral premix provided: vitamin A, 1,500,000 IU; vitamin D_3, 300,000 IU; vitamin E, 400 mg; vitamin K_3, 100 mg; vitamin B_{12}, 2000 mcg; nicotinamide, 2,000 mg; calcium D-pantothenate 800 mg; choline chloride, 40,000 mg; ferrous sulphate, 2,000 mg; manganese sulphate, 5,000 mg; copper sulphate, 80 mg; zinc oxide, 3,000 mg; cobalt sulphate, 10 mg.; potassium iodide, 120 mg; magnesium sulphate, 1,000 mg; DL-methionine, 10,000 mg; antioxidant, 18,000 mg. PWBA: Polished While Acha, KcalME/kg: Kilocalories Metabolizable Energy Per Kilogramme.*

Crude protein (%)	22.73	22.88	23.02	23.17	23.31	23.46	23.60	23.70
Ether extract	4.32	4.13	4.05	4.03	4.08	4.10	4.17	4.26
Crude fibre	4.55	4.51	4.15	4.08	4.01	3.91	3.88	3.76
Calcium	1.11	1.11	1.13	1.15	1.17	1.19	1.21	1.22
Phosphorus	0.95	0.95	0.96	0.96	0.99	1.01	1.03	1.03
Lysine	1.10	1.10	1.11	1.11	1.13	1.14	1.15	1.16
Methionine	0.28	0.28	0.29	0.30	0.30	0.31	0.31	0.32
Energy (KcalME/kg)	3098	3074	3050	3025	3001	2974	2952	2936

Table 2: *Nutrient composition of starter broiler diets.*

Ingredients	T1 (0%)	T2 (15%)	T3 (30%)	T4 (45%)	T5 (60%)	T6 (75%)	T7 (90%)	T8 (100%)
Maize	58.00	49.30	40.60	31.90	23.20	14.50	5.80	0.00
PWBA	0.00	8.70	17.40	26.10	34.80	43.50	52.20	58.00
Soya bean meal	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
Fish meal	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Wheat offal	9.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Salt123-	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Premix*	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 3: *Ingredients composition of finisher broiler diets.*

**Vitamin-mineral premix contained: vitamin A, 1,500,000 IU; vitamin D_3, 300,000 IU; vitamin E, 400 mg; vitamin K_3, 100 mg; vitamin B_{12}, 2000 mcg; nicotinamide, 2,000 mg; calcium D-pantothenate 800 mg; choline chloride, 40,000 mg; ferrous sulphate, 2,000 mg; manganese sulphate, 5,000 mg; copper sulphate, 80 mg; zinc oxide, 3,000 mg; cobalt sulphate, 10 mg; potassium iodide, 120 mg; magnesium sulphate, 1,000 mg; DL-methionine, 10,000 mg; antioxidant, 18,000 mg. PWBA: Polished While Acha, ME: Metabolizable Energy. KcalME/kg: Kilocalories Metabolizable Energy Per Kilogramme.*

Nutrient composition	T1 (0%)	T2 (15%)	T3 (30%)	T4 (45%)	T5 (60%)	T6 (75%)	T7 (90%)	T8 (100%)
Crude Protein (%)	20.29	20.45	20.60	20.76	20.92	21.07	21.23	21.33
Ether extract	4.82	4.83	4.75	4.73	4.68	4.60	4.57	4.56
Crude fibre	4.62	4.62	4.61	4.61	4.59	3.59	3.57	3.56
Calcium	1.0	1.0	1.01	1.03	1.05	1.07	1.08	1.10
Phosphorus	0.85	0.85	0.86	0.86	0.89	1.00	1.00	1.02
Lysine	1.00	1.00	1.01	1.01	1.03	1.04	1.05	1.06
Methionine	0.23	0.23	0.25	0.25	0.26	0.26	0.27	0.27
ME (KcalME/kg)	3284	3235	3155	3123	3111	3087	3066	3194

Table 4: *Nutrient composition of finisher broiler diets.*

Management of experimental birds

On arrival to the farm glucose was added to the drinking water of the birds. They were weighed at the inception of the trial and then on weekly basis subsequently. Warmth was provided using kerosene stoves for three weeks. Feed and water were provided *ad libitum* throughout the experiment which lasted for 56 days. Other routine management practices including vaccination and drug administration were adhered to.

Data collection

Performance parameters

Feed intake was recorded weekly by subtracting the left over from the total feed served. Weight gain was calculated on a weekly basis by deducting the weight of the previous week from the weight of that week. Feed conversion ratio was obtained by dividing feed intake with weight gain. Mortality was recorded daily against the replicates throughout the experimental period.

Digestibility trial

At the end of the experiment digestibility trial using twenty-four birds of similar weight across the treatment groups (one per replicate) was conducted. This involved adoption of total collection method. Metabolism cages used were thoroughly washed and disinfected. The birds were acclimatized for four days in the metabolism cages. They were fed their individual experimental diets. At the end of the acclimatization period, a known quantity of the feed was fed to each treatment and feed intake was recorded. Faecal samples were collected for three days which were immediately taken to the laboratory where they were oven dried at 60°C to constant weight. Thereafter, dry faecal samples of each treatment were pooled and thoroughly mixed together. Dry faecal samples were ground to pass 1 mm sieve. A sample was taken from each treatment and stored in a refrigerator from which proximate analysis was carried out according to AOAC [16].

Statistical analysis

All data obtained were subjected to analysis of variance (ANOVA) procedures [17]. Where differences were declared significant, the means were separated using the Duncan's Multiple Range Test (DMRT). The Genstat computer software package was used for all statistical analysis.

Results and Discussion

Growth performance of broiler chickens

The effect of graded levels of polished whole black acha as substituted for maize on growth performance of starter broiler chicks is shown in table 5. Polished whole black acha significantly ($P < 0.05$) influenced growth indices of the starter chicks. Inclusion of the acha at 60% produced the best final live weight. This was followed by 75, 90 and 100%. However, the final live weight produced by 60% was similar to 45%. It was further observed that the least live weight was generated by 0, 15 and 30%. Daily weight gain was significantly ($P < 0.05$) higher in group that consumed 60% acha compared to control and other levels except 45%. Total feed intake and daily feed intake followed similar trend. The feed intake of control, 30, 45, 60, 75 and 90% were similar but higher compared to 15 and 100%. Thus, the lowest feed intake was noticed in 15 and 100%.

Parameters	T1 (0%)	T2 (15%)	T3 (30%)	T4 (45%)	T5 (60%)	T6 (75%)	T7 (90%)	T8 (100%)	SEM
Initial live weight (g)	49.20	48.87	48.97	49.23	48.93	48.80	48.90	49.20	0.83
Final live weight (g)	1015^{c}	1022^{c}	1078^{c}	1170^{ab}	1218^{a}	1135^{b}	1073^{b}	1095^{b}	58.80
Daily weight gain (g)	34.49^{d}	34.74^{d}	36.76^{c}	40.03^{ab}	41.76^{a}	38.79^{bc}	36.58^{c}	37.35^{c}	2.10
Total feed intake (g)	1556^{a}	1477^{b}	1523^{ab}	1565^{a}	1575^{a}	1567^{a}	1554^{a}	1405^{b}	66.50
Daily feed intake (g)	55.58^{a}	52.75^{b}	54.40^{ab}	55.89^{a}	56.26^{a}	55.95^{a}	55.51^{a}	50.11^{b}	2.37
Feed: gain ratio	1.62^{a}	1.52^{b}	1.48^{c}	1.40^{c}	1.35^{d}	1.44^{c}	1.34^{d}	1.34^{d}	0.06
Mortality (%)	3.33	3.33	3.33	3.33	3.33	3.33	3.37	3.33	0.00

Table 5: *Effect of substitution of polished whole black acha for maize on growth performance of starter broiler chicks.*

^{abcd}*: Means along the same row with different superscripts are significantly different (P<0.05). SEM: Standard Error of the Means.*

Feed: gain ratio was the poorest in control, but best in 60, 90 and 100% followed by 30, 45 and 75%. The higher final live weight and daily weight gain of chicks observed above 45% of inclusion could be as a result of crude protein and amino acid profile in acha grains which could have stimulated a better growth response [18]. Also [18] opined that the better feed: gain ratio recorded by all the levels of black acha could be due to the high digestibility of the protein in acha and thus making more of the essential amino-acids available for better performance. Lower total and daily feed intakes recorded by 100% could be as a result of lower energy content of the diet [15].

The performance of broiler chickens at finisher phase fed graded levels of polished whole black acha based diets is presented in table 6. Inclusion of polished black acha showed significant effects on total live weight, daily weight gain, total feed intake and daily feed intake, but had no effect ($P > 0.05$) on feed; gain ratio and mortality. Polished black acha significantly improved final live weight and daily weight gain. For final live weight this improvement was better in groups that fed diets containing 45, 60, 75 and 90% polished whole black acha. However, improvement by 15% substitution was the least. Considering daily weight gain the improvement was similar in all the substitution levels. Above 15% substitution feed consumption was increased significantly ($P < 0.05$). Though total feed intake was increased above 15%, birds on 30, 45 and 100% polished black acha consumed more. It was also noted that substitution above 15% brought about increase in daily feed intake. Unlike the total feed intake, above 15% daily feed intake of acha groups were similar ($P > 0.05$). Both the total and daily feed intakes of control and 15% were similar ($P > 0.05$).

Parameters	T1 (0%)	T2 (15%)	T3 (30%)	T4 (45%)	T5 (60%)	T6 (75%)	T7 (90%)	T8 (100%)	SEM
Initial live weight (g)	1015^{d}	1022^{d}	1078^{d}	1170^{ab}	1218^{a}	1135^{b}	1012^{d}	1095^{b}	58.80
Final live weight (g)	2413^{d}	2577^{c}	2627^{b}	2797^{a}	2737^{a}	2740^{a}	2757^{a}	2633^{b}	112
Daily weight gain	49.94^{c}	55.54^{b}	55.30^{b}	58.10^{a}	54.23^{b}	57.32^{b}	55.18^{b}	54.94^{b}	3.73
Total feed intake (g)	4098^{c}	3981^{c}	4391^{ab}	4456^{a}	4334^{b}	4358^{b}	4363^{b}	4423^{a}	195
Daily feed intake	146.40^{b}	142.20^{b}	157.0^{a}	159.20^{a}	154.79^{a}	155.60^{a}	156.0^{a}	158.00^{a}	6.97
Feed: gain ratio	2.93	2.55	2.85	2.74	2.85	2.78	2.84	2.89	0.45
Mortality (%)	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	0.00

Table 6: *Effect of substitution of polished whole black acha for maize on growth performance finisher broiler chicks.*

^{abc}*: Means along the same row with different superscripts are significantly different ($P < 0.05$). SEM: Standard Error of the Means.*

This result is in conformity with [19] who reported that improvement of birds on 100% acha grains in substitution for maize grains is an indication that acha grain could be a potential source of energy for broiler diets without compromising productivity. Also [20] recommended acha grains for broiler diets because it is rich in methionine and cysteine which are the limiting amino acids in comparison with maize and other grains.

Apparent nutrient digestibility of broiler chickens

Table 7 shows the result of the apparent nutrient digestibility of broiler chickens fed graded levels of polished whole black acha diets. Significant ($P < 0.05$) differences were observed in the digestibility of crude protein, crude fibre, ether extract, starch and ash. The values obtained for dry matter were not significantly ($P > 0.05$) different. Digestibility of crude protein was better in 90 and 100% substitu-

tion compared to control. The values obtained in control, 15, 30, 45, 60 and 75% were the same (P > 0.05). Within acha dietary groups, crude protein digestibility was similar. Digestibility of crude fibre was improved with increasing level of acha. Compared to control, 90 and 100% produced better crude fibre digestibility. The values for control, 25 and 30% were similar. Ash was poorly digested at 100% compared to control, 15, 30, 45 and 60%. There was no difference between control and other levels except 100%. Ether extract also was poorly digested at 100% level, but there was no difference between control and other levels of polished whole black acha. Above 15% ether extract digestibility was the same within acha groups. Beyond 30% starch digestibility was better compared to control, 15 and 30%.

Parameters (%)	T1 (0%)	T2 (15%)	T3(30%)	T4 (45%)	T5 (60%)	T6 (75%)	T7 (90%)	T8 (100%)	SEM
Dry matter	90.54	90.86	90 .12	91.79	91.97	92.20	92.52	92.69	4.10
Crude protein	78.20^{b}	78.81^{ab}	79.30^{ab}	79.63^{ab}	80.26^{ab}	80.74^{ab}	81.48^{a}	81.84^{a}	3.16
Crude fibre	43.66^{d}	44.53^{d}	45.32^{d}	46.04^{c}	46.88^{bc}	47.73^{ab}	48.27^{a}	48.71^{a}	1.18
Ash	68.77^{a}	68.39^{a}	67.72^{a}	67.45^{ab}	67.26^{a}	66.34^{abc}	66.34^{abc}	65.94^{c}	2.20
Ether extract	80.56^{a}	79.88^{a}	79.53^{ab}	79.47^{ab}	78.74^{ab}	78.49^{ab}	77.61^{ab}	76.56^{b}	3.10
Starch	76.41^{c}	76.90^{c}	77.34^{c}	77.85^{b}	78.49^{b}	79.67^{ab}	80.45^{ab}	81.56^{a}	3.10

Table 7: *Effect of substitution of polished whole black acha for maize on apparent nutrient digestibility of broiler chickens.*
^{abcd}: Means along the same row with different superscripts are significantly different (P < 0.05). SEM: Standard Error of the Means.

The better digestibility values of crude protein, crude fibre and starch especially at 90 and 100% showed that the polished whole black acha was well utilized which reflected on the growth performance. This is in line with [21] and [6].

Conclusion

Polished whole black acha as observed from the results, showed that 100% substitution gave better digestibility and live weight performance compared to maize which was achieved with lower feed consumption. Therefore, polished whole black acha showed a great potential as a complete replacement for maize in broiler diets.

Bibliography

1. Obun CO and Ayanwale BA. "The possibility of using Afzelia Africana seed meal in the diets of starter chicks". *Tropical Journal of Animal Science* 9.1 (2006): 55-61.

2. Afolayan SB., *et al*. "Response of broiler chickens fed on maize-based diets substituted with graded levels of sweet potato meal". *Asian Journal of Poultry Science* 6 (2012): 15-22.

3. Ojewola GS. and Olugbemi F. "Millet meal: A possible alternative dietary energy source for broiler chickens". Proceedings of the 36th Annual Conference of Nigeria Society for Animal Production, Abuja, Nigeria (2011).

4. Kwari ID., *et al*. "Growth, heamatology and serology of broiler chickens fed different cultivars of sorghum as replacement for maize in the semi-arid zone of Nigeria". *International Journal of Poultry Science* 10.8 (2014): 608-612.

5. McCalla AF. "World Food Prices: causes and consequences". *Canadian Journal of Agricultural Economics* 57(2009): 23-34.

6. Ukim CI., *et al*. "Nutritional Evaluation of *Digitaria iburua* (Black Acha) grains as feed resource in the diet of Broiler Chickens". *Nigerian Journal of Animal Science* 20.4 (2018): 619-630.

7. Jones GPD and Taylor RD. "The incorporation of whole grain into pelleted broiler chicken diets: production and physiological responses". *British Poultry Science* 42 (2001): 477-483.

8. Hetland H., *et al.* "Role of insoluble fiber on gizzard activity in layers". *Journal of Applied Poultry Research* 14 (2005): 38-46.

9. Jideani VA and Podgorski SC. "*In vitro* starch digestibility and glycemic property of acha (*Digitaria exilis*) porridge". *Cereal Foods World Supply* 54 (2009): 48.

10. Pursglove JW "Tropical crops (Monocotyledons)". Longman, Singapore (1988): 143.

11. NRC. National Research Council. "Nutrient requirements of poultry". 10th edition. National Academy Press. Washington, D.C (2012).

12. Echendu CA., *et al*. "Changes in chemical composition of treated and untreated hungry rice Acha" (Digitaria exilis)". *Pakistan Journal of Nutrition* 8.11 (2009): 1779-1785.

13. Anuonye JC., *et al*. "Nutrient and Antinutrient composition of extruded acha/soyabean blends". *Journal of Food Processing and Preservation* 34 (2010): 680-691.

14. Akpan ER., *et al.* "Baseline ecological studies of the great Qua River, Nigeria: Physico-chemical studies" Ecoserve (2006).

15. Oluyemi JA and Roberts FA. "Poultry Production in Warm Wet Climates". Ibadan, Macmillan Press Ltd, 2000.

16. AOAC "Association of Official and Analytical Chemist. Official methods of Analysis," Washington, D.C. U.S.A (2000).

17. GenStat. Reference Manual International, Hemel Hempstead (2012).

18. Jideani AI and Akingbala JO. "Some physicochemical properties of acha (*Digitaria exilis stapf* and *DigItaria iburua stapf*) grains". *Journal of Science Food and Agriculture* 63(1993): 369-374.

19. Ukim CI., *et al.* "Nutritive and replacement value of hungry rice 'acha'' (*Digitaria exilis*) grain for maize grain in broiler starter chicks". *Global Journal of Agricultural Sciences* 12 (2013): 55-61.

20. Ruskin FR., *et al*. "Grains". Boards of Science for International Development, USA (1996).

21. Oke OS., *et al*. "Performance and Nutrient Digestibility of Acha Grains (*Digitaria iburua* as Replacement for Maize in the Diet of Female Grower Rabbits". *Journal of Natural Sciences Research* 6.9 (2016): 58-60.

Volume 5 Issue 12 December 2020