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NUTRITIVE AND REPLACEMENT VALUE OF HUNGRY RICE ''ACHA'' (*DIGITARIA EXILIS*) GRAIN FOR MAIZE GRAIN IN BROILER STARTER CHICKS

C. I. UKIM, G. S. OJEWOLA AND C. O. OBUN

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ABSTRACT

The hungry rice grains (HG) were determined for nutrients and anti nutrients and evaluated for growth performance. Five dietary diets were formulated with AG replacing maize at 0, 25, 50, 75 and 100 %. A total of 150 7days-old broiler chicks (Abor-Acre) were randomly allotted to five treatments of 30 birds each, replicated thrice (10 birds each) in a completely randomized design for 28 days. The results of the proximate composition of hungry rice grains showed 87.00% dry matter, 12.00 % crude protein, 6.49% ether extracts, 8.57% crude fibre, 5.70% ash, 67.24% nitrogen free extracts and gross energy of 3556.06 Kcal/kg. The anti- nutrient values of acha grains contained 0.18 mg/100g of tannin, 1.03 mg/100g of phytate, 0.90 mg/100g of oxalate and 0.05mg/100g of cyanide. The mineral element of acha grains showed the following trend (mg/100g) K (215.82)<P (131.00)<Mg(46.02)<S(32.40)<Ca (28.17)< Fe (22.82ppm)<Na (11.30). The HG is a rich source of amino acids {methionine (5.19 g/16gN), leucine (4.26 g/16gN), valine (4.11 g/16gN), phenylalanine (2.34 g/16gN), lysine (1.96 g/16gN), isoleucine (1.39 g/16gN), arginine (1.29 g/16gN), histidine (1.35 g/16gN), glutamic acid (5.63 g/16gN), alanine (4.16g/16N) and limiting in tryptophan (0.98g/16gN). The birds on 100% HG had better (P<0.05) growth rate compared with those on 75, 50, 25 and 0%. The feed intake of birds fed 100% HG (1999.33g) was higher (P<0.05) than those fed 50% (1852.31g) but similar (P>0.05) to those on 75% (1948.26g) and 0% (1972.90g). The feed: gain of birds on 25 % (1.97) HG was superior (P<0.05) compared with those of other diets.

KEY WORDS: Nutrients, Metabolites, Performance, Acha Grains, Broiler Chicks

INTRODUCTION

High costs of broiler feeds have been recognised as one of the major factors militating against rapid development of the poultry industry in the developing countries. Mutassim *et al*. (2008); Ojewola and Olugbemi (2011) reported that feed is the most expensive item in poultry production between 60-80% of the total cost of production.

The competition for maize use as food and feed limits the availability, hence increase in price. This has necessitated research into non-conventional energy ingredients that could replace maize without compromising broiler growth, carcass quality, efficiency and economic of production.

One important measure that can be taken to alleviate this situation is the use of alternative energy sources like sorghum, millet and acha which are produced extensively in the semi-arid areas. Issa *et al.* (2007) and Chukwu and Abdul-Kadir (2008) reported that cereal grains (sorghum, millet and acha) can play an important role in poultry feed in the sahelian countries. Other workers (Jideani, 1990; NRC, 1996b; Dowling *et al.*, 2002; Travis *et al.*, 2006 and Chukwu and Abdul-Kadir, 2008)) have shown that acha grains, a similar cereal like sorghum and millet could be a suitable feedstuff in the poultry industry.

Acha (*Digitaria exilis*) commonly referred to as *fonio, finni*, hungry rice (Rachie, 1974; Jideani and Akingbola, 1993; Kwon-Ndung and Dachi, 2007) is probably one of the oldest African cereals (NRC, 1996b) and it is classified as one of the lost crops of Africa. "Acha" crop is exceptionally tolerant to a wide variety of conditions, particularly drought and poor soil (NRC, 1996b). Acha grains have been reported to contain about 8.6-14.8% moisture, crude protein of 7-11.5 %, fat content of 2.2-2.8 %, crude fibre of 1.9-2.9 %, ash content of 1.5-3.6%, nitrogen free extracts of 67-75.35 % and energy values of 3454.50- 3886.23Kcal/kg (Temple and Bassa, 1991; NRC 1996b; Enwere, 1998; Chukwu and Abdul-Kadir, 2008; Anuonye *et al*., 2010). The low moisture content (14.8%) of acha grains suggests that it could be stored for longer (long shelf life) period. However, acha has been implicated with anti- nutritional factors such as oxalate, phytate, cyanide, trypsin inhibitor and tannins (Echendu *et al*.,

C. I. Ukim, Nigerian Institute of Animal Science, Salt Lake Street, Maitama, Abuja, Nigeria

G. S. Ojewola, Department of Animal Science, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

C. O. Obun, Department of Animal Production, Federal College of Wildlife Management, New Bussa, Niger State, Nigeria.

2009). This study was designed to determine the nutritive and anti nutritive components and growth performance of broilers fed acha grains.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Poultry Unit of the Teaching and Research Farm of the College of Animal Science and Production, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. Umudike is located at latitude 5^0 29'N and Longitude 7^0 32'E in the rain forest zone of Nigeria (NRCRI, 2003).

Source of hungry rice *(Digitaria exilis)* Grains

The Acha (*Digitaria exilis*) grains were purchased from Jos Central Market, Plateau State, Nigeria. The acha grains were manually cleaned by hand picking of the chaffs.

Experimental Diets

Five broiler starter diets were formulated with acha grains replacing maize at graded levels of 0, 25, 50, 75, and 100%, respectively (Table 1) and designated as T_1, T_2, T_3, T_4 and T_5 respectively.

Source of Experimental Birds and design

One hundred and fifty day-old Abor-Acre broiler chicks were purchased from Ibadan, Oyo State, Nigeria. After one week of brooding with commercial diets, birds were equally distributed into five experimental dietary treatments of 30 chicks each, replicated three times (10 birds each) in completely randomize design (CRD)

Management of Experimental Birds

The chicks were raised on deep litter floor using wood shavings as litter material. Brooding was by means of kerosene stove as source of heat placed under a hover. Temperature of the brooding room was controlled by either reducing or increasing the flame of the stove or outright removal after reading the thermometer. On arrival at the farm, glucose was added to the birds' drinking water as anti stress. Birds were intra-ocularly vaccinated against Newcastle disease on the third day. Lasota vaccine was administered on the 14^{th} and 28^{th} day while infectious bursal disease vaccine (Gumboro) was administered on the 12^{th} and 19^{th} day. Birds were protected against coccidiosis from the 15^{th} - 21^{st} days using Amprolium drug.

Feed Intake and Growth Parameters measurements

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 ration and Protein efficiency Ratio

Chemical Assay

The hungry rice (*Digitaria exilis*) grains and diets were analyzed for proximate composition according to AOAC (1990) methods. Acha grains were analyzed for mineral elements using atomic absorption spectrophotometer; amino acid composition was estimated by the procedure of Spackman *et al*. (1984) and cysteine by the procedure of Gaitonde (1987) while the anti-nutritional factors were determined as described by Deshpande and Salunkhe (1982). Gross energy of the acha grains was determined against thermocouple grade benzoic acid using a Gallenkamp ballistic bomb calorimeter (Model CBB-330-0104L).

Table 1: Dietary composition of starter broilers' diets

	Dietary Acha replacements levels				
Ingredients	**T1 (0%)**	**T2 (25%)**	**T3 (50%)**	**T4 (75%)**	**T5 (100%)**
Maize	51.80	38.85	25.90	12.95	0.00
Acha grains	0.00	12.95	25.90	38.85	51.80
Soybean meal	35.00	35.00	35.00	35.00	35.00
Palm kernel cake	8.00	8.00	8.00	8.00	8.00
Bone meal	4.00	4.00	4.00	4.00	4.00
Anti-mold^{+}	0.20	0.20	0.20	0.20	0.20
*Vit-Min Premix	0.25	0.25	0.25	0.25	0.25
Common Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
Calculated nutrients (% DM)					
Crude protein	22.20	22.45	22.75	22.85	23.00
Crude fibre	3.57	4.06	4.32	5.50	5.68
Ether extract	3.24	3.53	4.00	4.76	5.01
Ca (%)	1.20	1.26	1.28	1.30	1.33
P (%)	0.75	0.80	0.82	0.85	0.86
Lysine (%)	1.42	1.45	1.48	1.49	1.52
Methionine(%)	0.45	0.47	0.50	0.54	0.57
ME (Kcal/Kg)	2897.81	2905.65	2964.32	2987.33	3002.00.
Analyzed compostion (% DM basis)					
Crude protein	21.40	21.60	21.90	22.18	22.44
Crude fibre	4.28	4.30	5.46	5.53	5.60
Ether extract	3.78	4.10	4.43	4.75	5.07
Ash	4.21	4.69	5.18	5.26	5.32
NFE	53.36	53.31	51.26	50.94	49.11
ME(Kcal/kg)*	3036.18	3043.45	3044.76	3045.88	3047.77
Tannins (mg/100g)*	-	0.02	0.05	0.07	0.09
Phytate (mg/100g)*	-	0.13	0.27	0.40	0.53
Oxalate (mg/100g)*	-	0.12	0.23	0.35	0.47
Cyanide (mg/100g)*	-	0.01	0.01	0.02	0.03

*Premix supplied (kg^{-1} diet): Vitamin A (15,000 I.U); Vitamin D3 (3,000 I.U); Vitamin E (30 I. U): Vitamin K (2.5mg); Thiamin (2mg); Riboflavin (6mg); Pyridoxine (4mg); Niacin (40mg); Cobalamin (0.02mg); Pantothenic acid (910mg); Folic acid (0.06g); Iron (0.024g); Copper (0.006g); Iodine (0.0014g); Selenium (0.24mg); Cobalt (0.024mg); Antioxidant (0.125g); $^{+}$Anti-mold (Anti-mycotoxin).
Calculated* values

Data Analyses

All data collected were subjected to Analysis of variance (ANOVA) as outlined by Steel and Torrie (1980). Means were separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Nutrient, Energy and anti nutrient Composition of hungry rice (*Digitaria exilis*) grains

The result in Table 2 shows the proximate composition of acha grains. The grains values of 87.00% dry matter, 12.00 % crude protein (CP), 6.49% ether extracts (EE), 8.57% crude fibre (CF), 5.70% ash, 67.24% nitrogen free extracts and gross energy of 3556.06 Kcal/kg were obtained. The anti- nutritional values of 0.18 mg/100g for tannin, 1.03 mg/100g for phytate, 0.90 mg/100g for oxalate and 0.05 mg/100g for cyanide were obtained (Table 2).

Table 2: Chemical composition and anti nutritional factor of hungry rice grains (% on DM basis)

Parameters	Content
Dry matter (DM)	87.00
Crude protein (CP)	12.00
Crude fibre (CF)	8.57
Ether extract (EE)	6.49
Ash	5.70
Nitrogen free extracts	67.24
Gross energy	3556.06 Kcal/kg
Tannins (mg/100g)	0.18
Phytate (mg/100g)	1.03
Oxalate (mg/100g)	0.90
Cyanide (mg/100g)	0.05

Mineral Composition of hungry rice *(Digitaria exilis)* Grains

The mineral contents of acha grains are presented in Table 4. The results showed that K was the most concentrated mineral element with value of 215.82mg/100g, followed by P (131.00 mg/100g), while the least mineral was Fe (22.82ppm).

Table 4: Mineral composition of hungry rice *(Digitaria exilis)* grains (mg/100g)

Mineral elements	**(g/100g DM)**
Calcium	28.17
Potassium	215.82
Sodium	11.30
Phosphorus	131.00
Manganese (ppm)	21.73
Magnesium	46.02
Sulphur	32.40
Iron (ppm)	22.82

Amino acid profile of hungry rice *(digitaria exilis)* grains

The results of the amino acids (Table 5) showed that acha grain is a rich source of essential amino acids {methionine (5.19 g/16gN), leucine (4.26 g/16gN), valine (4.11 g/16gN), phenylalanine (2.34 g/16gN), lysine (1.96 g/16gN), isoleucine (1.39 g/16gN), arginine (1.29 g/16gN), histidine (1.35 g/16gN) and limiting in tryptophan (0.98g/16gN)}. The grains also contained non essential amino acids with glutamic acid (5.63 g/16gN) and alanine (4.16g/16N) having highest values.

Table 5: Amino acid profile of hungry rice *(Digitaria exilis)* grains (g/16gN)

Amino acid profile	Acha grains
Arginine*	1.29
Lysine*	1.96
Isoleucine*	1.39
Leucine*	4.26
Phenylalanine*	2.34
Histidine*	1.35
Valine*	4.11
Tryptophan*	0.98
Threonine*	1.91
Methionine*	5.19
Alanine	4.16
Glycine	1.96
Proline	3.18
Glutamic acid	5.63
Cystine	2.85
Tyrosine	0.87
Serine	2.14

*EAA= Essential amino acids

Performance of broiler starter chicks

The growth performance of experimental birds in Table 6 showed that diet T_5 had better (P<0.05) growth rate compared with those on diets T_4, T_3, T_2 and T_1. Similarly birds on diet T_2 grew significantly (P<0.05) better than those on diets T_4, T_3 and T_1. The average feed intake of birds fed T_5 (1999.33g) was higher (P<0.05) though similar (P>0.05) with those on diets T_4 (1948.26g) and T_1 (1972.90g) but significantly (P<0.05) different from those on diets T_3 (1852.31g). The feed: gain ratio of birds on T_2 (1.97) were superior (P<0.05) compared with those of other diets. The protein efficiency ratio of birds on T_2 (2.66) was better utilized compared with those on the control, 50 %, 75% and 100% hungry rice grains' diets.

Table 6: Effect of Diets on Growth Performance of Broiler Starter chicks

Parameters	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)	SEM
Initial body weight, g/bird	100.70	101.25	101.07	101.43	103.21	0.07
Final body weight, g/bird	1005.00^{c}	1049.64^{b}	1001.48^{c}	1024.81^{c}	1101.55^{a}	23.10
Total weight gain, g/bird	904.30^{c}	948.58^{b}	900.41^{c}	923.38^{c}	998.34^{a}	0.89
Av daily weight gain, g/bird	32.30	33.88	32.16	32.98	35.66	0.06
Total feed intake, g/bird	1972.90^{ab}	1864.67^{bc}	1852.31^{c}	1948.26^{ab}	1999.33^{a}	0.04
Av. daily feed intake, g/bird	70.46^{ab}	66.59^{bc}	66.15^{c}	69.58^{abc}	71.40^{a}	0.02
Feed: gain ratio	2.18^{a}	1.97^{b}	2.06^{ab}	2.11^{ab}	2.00^{b}	0.21
Protein efficiency ratio	2.18^{d}	2.66^{a}	2.50^{ab}	2.39^{c}	2.46^{b}	0.06

a,b,c,d Means on the same row with different superscripts are significantly (p<0.05) different.

DISCUSSION

The crude protein (CP) value of 12% obtained in this study differs from lower range values of 7-8.29% reported by Temple and Bassa (1991); Vietumeyer *et al.* (1996); Chukwu and Abdul-kadir (2008; Echendu *et al.* (2009) and Anuonye *et al.* (2010). Similarly, EE, CF and ash levels were slightly higher compared with reported values of 2.20-2.62% EE, 1.76-1.90% CF 2.10-3.60% ash by Chukwu and Abdul-kadir (2008), Echendu *et al*. (2009) and Anuonye *et al.* (2010) while the NFE of 67.24% obtained in this study was lower compared with range values of 75.20-75.35% reported by Echendu *et al*. (2009) and Anuonye *et al.* (2010). The gross energy values (3556.06 Kcal/kg) obtained in this study was higher compared with values of 3430 Kcal/Kg reported by Echendu *et al*. (2009) and Anuonye *et al.* (2010) but lower than values of 3886.23 Kcal/kg obtained by Temple and Bassa (1991). The observed differences in nutrient composition in this study compared to previous authors may be attributed to the agro-ecological and climatic influences, soil type, processing and analytical techniques used.

The phytate values of 1.03 mg/100g, 0.90 mg/100g for oxalate and 0.05 mg/100g for cyanide obtained in this trial were lower compared with those reported by Echendu *et al.* (2009) and Anuonye *et al*. (2010) while the tannin values of 0.18mg/100g obtained in this study is slightly higher compared with values of 0.13mg/100g reported by Echendu *et al.* (2009) but

lower than values of 3.00 % reported by Anuonye *et al*. (2010).

The mineral values (mg/100g) of 28.07 for Ca, 11.30 for Na, 21.73 for Mn and 131 for P were higher compared with reported literature values of 19.84, 1.29 and 1.21 mg/100g by Echendu *et al*. (2009). The overall mineral content obtained in this study did not corroborate with the findings of Anuonye *et al.* (2010) whose values were higher. The values of iron (22.82ppm), Ca (28.17mg/100g DM), K (215.82mg/100g DM) and Na (11.30mg/100g DM) in this study disagreed with previous reports by Echendu *et al.* (2009), Chukwu and Abdul-Kadir (2008) and Anuonye *et al.* (2010) who reported higher values. These findings agreed in part with reports of Temple and Bassa (1991) that acha grain is richer in Ca, Mg, Fe and Cu than maize but poorer in K, Na and Mn.

The high methionine (5.19g/6gN), leucine (4.26g/16gN) and valine (4.11g/16gN) values obtained in this study corroborated earlier reports by Benitor *et al*. (1993); Ruskin *et al*. (1996) and NAS (1996). The lysine value (1.96) is in agreement with findings of Chukwu and Abdul-Kadir (2008) but differed from the value of 9.8 % reported by Ruskin *et al*. (1996). All the other amino acid values in this study are closely at par with those reported by Chukwu and Abdul-Kadir (2008). The slight variations in the values from previous researchers could be due to the agro-ecological and climatic influences, soil type, processing and analytical techniques used.

The significant ($p<0.05$) high feed intake and growth improvement of birds on 100% acha grains replacement for maize grains is an indication that hungry rice grain could completely served as an energy source for broiler diets without compromising the diet acceptability and palatability. The high growth performance of birds on 100% hungry rice replacement for maize is in agreement with the reports of Jideani and Akingbala (1993) that the crude protein content and amino acid profile of hungry rice grains may have stimulated a better growth response proportionate to the concentration of nutrient in the diets.

The better FCR and protein efficiency ratio of birds with increasing maize replacement with hungry rice grain in the diets conformed with the reports by Ruskin *et al*. (1996) that acha grain is rich in methionine and cysteine the limiting amino acids of most cereals compared with maize grains

CONCLUSION

Acha (*Digitaria exilis)* grain is a rich source of crude protein, mineral elements and amino acid when compared with maize. It also contains traces of tannins, phytate, oxalate and cyanide which were tolerated by broiler chicks in this feeding trial.

Hungry rice grains can be used to replace maize up to 100% without any adverse effect on broiler performance.

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