EFFECT OF REPLACING GROUNDNUT CAKE WITH UREA FERMENTED BREWER'S DRIED GRAINS IN BROILER CHICKS DIETS

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ABSTRACT

The effect of replacing groundnut cake with urea fermented brewer's dried grains at 0, 25, 50, 75 and 100 % graded levels in broiler chick starter diets was investigated. Five dietary treatments were formulated to be isonitrogenous and isocaloric to provide 23 % crude protein and 2900 kcal/kg metabolizable energy. One hundred and ninety – five day-old broiler chicks (Anak breed) were randomly allotted to five treatments replicated thrice with 13 chicks per replicate, fed and watered ad libitum in battery cages for 35 days. Means of body weight, weight gain, feed intake and feed: weight gain ratio of broiler chicks fed the control diet, 25 and 50 % urea fermented brewer's dried grains diets were significantly (P < 0.05) better than those fed 75 and 100 % inclusion levels. Nitrogen and lipid retention, crude fibre and dry matter digestibilities of broiler chicks followed the same trend with the weight performance. Mortality was zero. Economically, it was more profitable to use urea fermented brewer's dried grains in replacing groundnut cake in broiler chicks diets.

Keywords: Broiler chicks, Groundnut cake, Urea, Fermented, Brewer's dried grains

INTRODUCTION

The broiler chicken production is among one of the fastest means of producing animal protein because of their short generation interval (Babatunde, 1980). However, the cost of production of broiler meat has remained high due to high cost of feed. Groundnut cake (GNC) has been used as a protein supplement in broiler diets but its price has continued to increase in our markets. This has engineered the need for an alternative feed ingredient for groundnut cake as a protein supplement. Such an ingredient of choice in the diet of monogastrics must have the ability to supply required protein, amino acid profile, provides balanced energy: protein ratio and in addition possess the merit of easy storage, availability and low cost. Brewer's dried grain (BDG) is a possible alternative to groundnut cake (GNC) because of its nutritional qualities that are comparable to GNC. BDG is cheap and readily available and contributes to the protein, amino acids and energy content of formulated feeds. It also furnishes trace minerals, B-vitamins, Vitamin E, linolenic and significant percentage of essential fatty acids (McDonald *et al.,* 1995). Although its nutritional qualities have been evaluated in the diets of broilers and growing chickens with some success (Oluyemi and Harms, 1978; Barber and Lonsdale, 1980; Aduku, 1993; Uchegbu and Udedibie, 1998) it's maximum utilization as a plant protein source have been limited by its high fibre content. The need to further process BDG in order to reduce its fibre content by use of urea is imperative. Alkali treatment of various fibrous materials have been found to improve their nutritional qualities (McDonald *et al.*, 1995; O'Donovan *et al.*, 1997; Chenost and Kayouli, 1997; Faniyi *et al.*, 1997; Liu *et al.,* 1998; Lewis *et al.,* 1999; Faniyi and Ologhobo,1999; khuc *et al.,* 2001;Vipond *et al.,* 2001). Therefore, this study was conducted to determine the effect of replacing GNC with urea fermented BDG in broiler chick diets.

MATERIALS AND METHODS

Urea fermented BDG (as the test ingredient) was used to replace groundnut cake (GNC) at 0, 25, 50, 75 and 100 % levels in broiler chick starter diets on protein equivalent basis. The BDG used in this experiment was fermented for 7 days in 2 % urea concentration. To obtain 2 % urea solution, 400 g of urea (46 % N, fertilizer grade) was dissolved in 20 litres of clean water to produce 2 % urea solution containing 20 g urea per litre of water (Adeleye, 1988). Table 1 shows the chemical composition of groundnut cake and brewer's dried grains. The proximate compositions of the urea fermented BDG and the untreated BDG are presented in Table 2. Five dietary treatments were formulated to be isonitrogenous and isocaloric to supply 23 % crude protein and 2900 kcal/kg metabolizable energy. Diets were adequately fortified with vitamins and minerals. The compositions of the broiler chick starter diets are presented in Table 3.

Experimental Birds: One hundred and ninety-five (195) day-old broiler chicks (Anak breed) were randomly allotted to five equal groups and brooded in battery cages after a four day initial stabilization period on deep litter system. Each treatment was replicated thrice with 13 chicks per replicate giving 39 chicks per treatment. Food and water were provided *ad libitum* while necessary prophylaxis and

Table 1: Chemical Composition of Groundnut Cake and Brewer's Dried Grain

Chemical Component	GNC	BDG (Untreated)
Crude protein	45.00	27.90
Ether extract	9.16	7.40
Crude fibre	3.81	11.70
Ash	5.51	4.80
Calcium	0.20	0.30
Phosphorus	0.60	0.88
TDN	76.00	78.00
ME kcal/kg (Swine)	3185.00	2240.00
ME kcal/kg (Poultry)	2530.00	2513.00
Lysine	1.73	0.90
Methionine	0.44	0.60
Cystein	0.72	0.40
Arginine	5.00	1.30
Tryptophan	0.49	0.40

Source: *Aduku, (1993)*

Table 2: Proximate Analysis of Test Ingredient (Urea-Treated and Fermented BDG)

Parameters %	Treated BDG	Untreated BDG
Dry matter	88.76	93.34
Crude Protein	38.52	24.21
Crude fibre	4.49	11.20
Ether extract	4.87	3.69
Ash	5.99	8.04
Nitrogen free Extract	34.89	46.20
Organic Matter	82.77	85.30
Gross Energy kcal/g (calculated)	5.17	5.14

(Urea concentration used was 2%, 20g urea per litre of water)

vaccinations for broiler were administered. Data on weight performance, feed intake, feed: gain ratio and mortality were recorded on replicate basis weekly to 35 days of age. At the end of the 4th week, 9 broiler birds per treatment, 3 birds per replicate, were randomly selected from the five treatments for metabolic study. After an adjustment period of three days, dropping trays covered with aluminium foil paper were used for digestibility study. Feed intake over the three days of metabolic trials was also recorded. The faecal droppings from each replicate were oven dried at low temperature ranging from 60 – 80^{o} C to minimize loss of nitrogen. The total collection were pooled, weighed and ground, and representative samples together with experimental diets were taken for chemical analysis of their proximate composition (AOAC, 1990). Economic analysis of broiler chicks' production was based on the cost of the diets compounded from the prevailing market price of the ingredients at the time of purchase. This information was used to compute the cost of feed consumed/kilogramme weight gain for each diet, the cost differential and relative cost-benefit values of the diets in relation to the control diet. Data collected from the field and laboratory was subjected to analysis of variance using SAS (2000) package. Duncan's Multiple Range Test was used to assess significance of differences between treatment means (Duncan, 1955).

RESULTS

The results of the performance of broiler chicks (0 - 35d) are presented in Table 4. Mean body weight, weight gain, feed intake and feed: gain ratio of broiler chicks fed the control diet and up to 50 % replacement levels of urea-treated and fermented BDG diets were significantly ($P < 0.05$) better than those fed 75 and 100 % replacement level of urea-treated and fermented BDG diets. The results of the metabolism trial of broiler birds at 35 days of age fed the experimental starter diets are presented in Table 5. The nitrogen and lipid retention, crude fibre and dry matter digestibilities for broiler birds at 35 days of age showed a significant ($P < 0.05$) decrease as the levels of urea-treated and fermented BDG increased in the diets. The nitrogen retention rate of broiler chicks fed the control diet was similar ($P > 0.05$) to broilers fed 25 and 50 % level of urea-treated BDG diets but was significantly ($P < 0.05$) higher than those fed 75 and 100 % levels of urea-treated BDG diets. Lipid retention and dry matter digestibility of broilers fed the control diet at 35 days were significantly ($P < 0.05$) different from those fed diets with 50, 75 and 100 % inclusion levels while that of 25 % urea-treated BDG inclusion level was similar ($P < 0.05$) to the control diet. Broiler chicks fed the control diet were significantly ($P < 0.05$) better than all other treatment groups in crude fibre digestibility. The results of the cost-benefit analysis of the production of broiler chicks fed the experimental diets are presented in Table 6. There was significant ($P < 0.05$) reduction in the amount of total feed consumed per bird with increased levels of urea-treated and fermented BDG in the diets of broiler chicks. Cost of total feed consumed / bird was also significantly ($P < 0.05$) reduced with increased levels of BDG in all treatment groups. The cost of producing one kilogramme of live weight of each broiler during this stage was significantly ($P < 0.05$) reduced as the level of urea-treated and fermented BDG increased in the diets, except for the 100 % inclusion level that was most ($P < 0.05$) expensive. The cost differential and relative cost-benefit / kilogramme gain generally ($P < 0.05$) increased with increasing levels of urea-treated BDG in the diets in all treatments, except for the 100 % inclusion diet.

DISCUSSION

The average body weight, daily weight gain, feed intake and feed: gain ratio in Table 3 of broilers at 35 days of age showed that diets with 0, 25 and 50 % inclusions were similar, indicating that starter chicks can tolerate inclusions of urea-treated and fermented BDG up to 50 %, which is about 16.70 % of the diets. Broiler chicks fed BDG at 0, 25 and 50 % inclusion levels had significantly higher feed intake than those on 75 and 100 % inclusion levels, which means that 0, 25 and 50 % inclusion levels were equally acceptable to broiler chicks as they ate approximately the same quantity. However, the decrease in feed intake at the 75 and 100 % urea-treated BDG inclusion levels may be attributed to

Table 3: Composition of Experimental Broiler Starter Diets

Ingredients	Dietary Treatments				
	D_1(control)	D_2	D_3	D_4	D_5
Maize (Yellow)	56.20	55.00	53.75	52.37	50.90
Groundnut cake	28.50	21.38	14.25	7.13	-
Urea Treated BDG	-	8.32	16.70	25.00	33.50
Fish meal	2.50	2.50	2.50	2.50	2.50
Blood meal	5.00	5.00	5.00	5.00	5.00
Oyster shell	1.50	1.50	1.50	1.50	1.50
Bone meal	3.50	3.50	3.50	3.50	3.50
Palm oil	1.50	1.50	1.50	1.70	1.80
Premix (starter)*	0.50	0.50	0.50	0.50	0.50
Methionine	0.30	0.30	0.30	0.30	0.30
Salt	0.50	0.50	0.50	0.50	0.50
Calculated:					
Crude protein (%)	23.38	23.28	23.18	23.05	22.99
Metabolizable Energy (ME) kcal/kg	2986.89	2974.66	2961.96	2959.41	2954.36
Determined:					
Dry matter	90.12	89.88	91.08	90.55	91.55
Crude protein	23.13	23.44	23.48	23.62	23.85
Crude fibre	4.24	4.47	5.40	5.69	6.30
Ether extract	2.45	2.85	3.02	2.93	3.17
Ash	3.26	7.07	8.16	8.33	8.62
Nitrogen free Extract	56.86	52.03	51.02	49.93	49.61

Vitamin-mineral premix provided the following vitamins and minerals per kg of diet: A, 15,000 I.U; D3, 3000 I.U; E,30 I.U; K, 2.5mg, B_1, 2.0mg; B_2, 6.0mg; B_6 4.0mg; Niacin, 40mg; B_{12}, 0.02mg; Pantothenic, 10mg; Folic, 1.0mg; Biotin, 0.08mg; choline Cl 500mg; Antioxidant, 125mg; Mn, 6mg; Zn, 60mg; Fe, 24mg; Cu, 6mg; I, 1.4mg; Se 0.24mg; co, 0.4mg. Product of Agricultural Technologies Nigeria Ltd. Marketed by S&D Farms Abeokuta.

Table 4: Performance Characteristics of Broilers Fed Experimental Starter Diets

Replacement levels (%)	00UTBDG 100GNC	25UTBDG 75GNC	50UTBDG 50GNC	75UTBDG 25GNC	100UTBDG 00GNC
Initial weight	137.18	142.31	138.97	138.46	137.18
Average Body weight (g)					
35th day	1175.25 ± 14.79^a	1158.97 ± 8.41^a	1141.54 ± 10.25^a	992.67 ± 1.34^b	820.52 ± 8.25^c
Weight gain/bird/day (g)					
35th day	46.15 ± 0.84^a	42.13 ± 0.66^a	41.56 ± 0.06^a	37.01 ± 2.99^b	29.82 ± 0.70^c
Feed Intake g/bird/day					
35th day	84.35 ± 0.83^a	84.57 ± 0.00^a	85.37 ± 0.00^a	74.58 ± 0.37^b	75.82 ± 0.00^b
Feed: Gain ratio					
0-35 days	1.84 ± 0.07^a	1.94 ± 0.07^{ab}	2.05 ± 0.08^{ab}	2.14 ± 0.09^b	2.66 ± 0.14^c
Mortality (birds/treatment)					
0-35 days	Nil	Nil	Nil	Nil	Nil

a,b,c Means with different superscripts letters in the same row are significantly different (P<0.05); UTBDG: Urea fermented brewer's dried grains

bulkiness and probably a problem of acceptability of the feed associated with high BDG levels as compared to GNC. The observed body weights and daily weight gains are related to the feed intake pattern of broiler chicks, which means the inclusion levels of 25 and 50 % urea-treated and fermented BDG were able to furnish adequate nutrients for tissue synthesis to record an enhanced growth rate comparable to the control diet that do not have any BDG. The 50 % replacement level which has 16.70 % of the diet as BDG exceeded the 10 % level of dietary inclusion achieved by Ademosun (1973) and Lopez and Carmona (1981) with untreated BDG in chicks diets. Thus the higher inclusion level achieved in this experiment is attributable to the urea fermentation of BDG, which resulted in fibre breakdown and reduction in fibre content, and the release of locked up nutrients which encouraged a good performance of broiler chicks even when fed a diet with higher inclusion level of 16.70 %. The performance may also be as a result of a better complementary role of nutrients (1:1 and 1:3 ratios) at this level of urea fermented BDG: groundnut cake mix. This might have encouraged better nutrient release and availability for enhanced tissue synthesis, leading to improved growth rate, a kind of synergistic effect in chicks. The lower weight gain obtained by broiler chicks fed the 75 and 100 % levels of urea fermented BDG diets at 35 days may have resulted from nutrient intake restriction precipitated by lower feed intake or nutrient dilution effect of crude fibre and bulkiness of feeds. This result is supported by previous reports on the implication of restricted feed intake (Oluyemi and Harms 1978; Leeson and

Table 5: Nutrient Digestibility and Retention of Broiler Birds at 35 Days of Age Fed Experimental Starter Diets

Parameters	00UTBDG 100GNC	25UTBDG 75GNC	50UTBDG 50GNC	75UTBDG 25GNC	100UTBDG 00GNC
Nitrogen retention (%) at 35th day	81.50±0.05[a]	80.50±0.38[ab]	79.78±2.59[ab]	74.87±1.06[b]	63.74±0.61[c]
Ether extract/Fat Retention (%) at 35th day	95.39±0.16[a]	94.64±0.30[ab]	94.10±0.46[b]	90.21±0.33[d]	92.97±0.06[c]
Crude fibre digestibility (%) at 35th day	20.05±0.72[a]	17.79±0.42[b]	17.79±0.09[b]	13.18±0.59[c]	13.27±0.62[c]
Dry matter digestibility (%) at 35th day	81.73±0.09[a]	80.6±0.34[ab]	77.74±2.47[b]	60.19±1.02[d]	65.09±0.57[c]

a,b,c,d Means with different superscript in the same row are significantly different (P<0.05) UTBDG: Urea fermented brewer's dried grains

Table 6: Economic Analysis of Broiler Birds Fed Experimental Diets from 0-35 days of Age

Replacement level (%)	00UTBDG 100GNC	25UTBDG 75GNC	50UTBDG 50GNC	75UTBDG 25GNC	100UTBDG 00GNC
Total feed consumed (kg/bird) 0-35 days	1.94±0.01[a]	1.91±0.01[b]	1.90±0.01[b]	1.74±0.00[c]	1.74±0.00[c]
Cost of Total feed consumed/bird(₦) 0-35 days	82.61±0.38[a]	77.62±0.23[b]	73.66±0.22[c]	64.66±0.12[d]	61.27±0.12[e]
Cost per Kg weight (₦) 0-35 days	113.43±1.30[b]	112.07±1.00[bc]	113.85±0.70[b]	109.02±1.02[c]	122.42±1.34[a]
Cost Differential per Kg gain (₦) 0-35 days	-	1.34±0.84[b]	-0.42±0.84[b]	4.41±2.07[a]	-8.99±1.63[c]
Relative Cost Benefit/Kg gain (%) 0-35 days	100.00[b]	101.20±0.78[ab]	99.63±0.81[b]	104.08±1.95[a]	92.68±1.27[c]

a,b,c,d,e Means with different superscripts in the same row are significantly different (P<0.05). Cost per Kg feed (₦): Starter-Diet 1 ₦42.51; Diet 2, ₦40.64; Diet 3, ₦38.77; Diet 4, ₦37.09; Diet 5, ₦35.28.

Summers, 1980; Fattori *et al.,* 1991; Ubosi, 1998; Mench, 2002; Erakpotobor and Umeh, 2005) on growth rate and body weight performance. The feed: gain ratio of broiler chicks followed the same pattern with the feed intake and daily weight performance and showed that the replacement of up to 50 % GNC with urea fermented BDG had no detrimental effects on performance of broiler chicks up to 35 days of age. The incorporation of urea fermented BDG into diets of broiler chicks significantly influenced the retention of nutrients since it has higher fibre content than GNC. Nitrogen retention (NR) for broiler chicks at 35 days of age fed the dietary treatments showed significantly decreasing nitrogen retention as the levels of urea fermented BDG increases in the diets. The downward trend in NR observed in this study is associated with the increase fibre loading of the diets with increase BDG inclusion levels. Fibre has been reported to absorb amino acids and peptides as well as preventing their absorption from the gastro intestinal tract (GIT). The extent of decrease in NR due to fibre is further linked to the degree of lignification of the fibre. Therefore, the downward trend observed in this study has been confirmed in previous reports (Mitaru and Blair, 1985; Sauer *et al.,* 1991; Nworgu *et al.,* 2000). The NR of broilers at 35 days followed the same trend with the daily weight gain performance of the period which implies that the weight gain was a true reflection of efficiency of nutrient retention and utilization. The similarity between 0, 25 and 50 % diets implies that broiler birds at 35 days of age will effectively utilize urea fermented BDG in place of GNC up to the 50 % (16.70 % of the diet) replacement levels without loss in efficiency. The improved level of replacement of GNC or incorporation of urea fermented BDG in broiler starter diets at 16.70 % of the diet instead of the 10 % recommended by Ademosun (1973), means that urea fermentation of BDG did improve its nutritive value, and therefore, higher levels of inclusion into broiler chicks diet. The lipid retention at 35 days of age followed the same trend as that of nitrogen and this indicate that broiler chicks lipid retention and utilization is not adversely affected by inclusion of up to 50 % urea fermented BDG in place of GNC in broiler chick diets. The poor lipid retention at 75 and 100 % inclusion levels is not unconnected with the increase in crude fibre content as the urea fermented BDG inclusion increases in the diets. Cherry and Jones (1982) and Janssen and Carre (1985) had earlier reported that high fibre level in diets causes increased faecal excretion of lipids in birds and encourages increased rate of food passage through the digestive tract and consequently low digestibility and retention. The crude fibre digestibility of broilers at 35 days of age was generally low and is an indication that broiler chicks at this age are ill-equipped to handle fibrous feeds and, therefore, cannot utilize much of the available crude fibre. Dry matter digestibility at 35 days of age was observed to decrease with increasing level of urea-treated BDG in the diets, indicating that increased use of urea-treated BDG will increase crude fibre content and, therefore, decrease in the ability of broilers to retain nutrients for utilization with its attendant decline in feed efficiency. Several authors have reported inverse relationship between dietary fibre digestibility coefficients and, or bio availability of nutrients (Mitaru and Blair, 1985; Longe, 1985; Sauer *et al.*, 1991; Nworgu *et al.,* 2000). The zero percent morality recorded in the experiment is an indication that the product is not toxic to the chicks when incorporated into their diets. Thus, the use of urea for treatment of BDG at the level used is considered safe for the chicks.

There was gain in financial margin in production cost with the inclusion of urea fermented BDG as part replacement for GNC in broiler chicks diets, except at the 100 % inclusion level which was least. The computed cost differential per kilogramme gain for diet with 75 % inclusion was the highest. It was found to be more profitable to produce broilers at the starter phase with 75 % urea-treated BDG than GNC, even when lower weight gain was observed as urea-treated BDG levels increased in the diets. This is because the cost of producing urea-treated BDG was much lower than the cost of purchasing GNC. Furthermore, the use of the urea fermented BDG in this experiment did not adversely affect the performance of the broiler chicks. It is thus expected that cost of production would be reduced. The highest significant savings (₦4.41)/ kilogramme weight gain of cost differential was obtained from dietary treatment with 75 % urea fermented BDG inclusion during the experimental period.

Urea fermented BDG can replace up to 50 % GNC (16.70 % of the diet) as a plant protein source in broiler starter diets. The zero percent mortality of broiler chicks fed the urea fermented BDG based diets is a proof that the product is safe as a feed ingredient. Based on the cost of production / kilogramme weight gain, the used of urea fermented BDG is more profitable than GNC in broiler starter diets, with inclusion not exceeding the 75 % level.

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