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PERFORMANCE AND ECONOMIC ANALYSIS OF EGG PRODUCTION OF LAYING PULLETS FED UREA-TREATED AND FERMENTED BREWER'S DRIED GRAINS DIETS IN PLACE OF GROUNDNUT CAKE

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ABSTRACT

The effect of replacing groundnut cake (GNC) with urea-treated and fermented brewer's dried grains at 0, 25, 50, 75 and 100% graded levels in pullet layers diets was investigated. Five dietary treatments were formulated to be isonitrogenous and isocaloric to provide 17% crude protein and 2600kcal/kg metabolizable energy. One hundred and twenty pullet layers of Goldline hybreed were randomly allotted into five treatments of 24 birds each and replicated three times with 8 birds per replicate. They were fed *ad libitum* in deep litter for eight weeks. Daily feed intake, total eggs produced for the period, total eggs weight per bird and feed conversion ratio were not significantly (P>0.05) different, while significant (P<0.5) differences were observed in final body weight, body weight gain, total eggs produced per bird per week, average egg weight and hen day production. Hen day was similar for the control and up to 75% replacement level. It was more economical and profitable to use urea-treated and fermented brewer's dried grains in replacing GNC in pullet layer's diets.

KEYWORDS: Egg weight, Groundnut cake, Hen day production, pullet layers, Urea-treated and fermented BDG.

INTRODUCTION

The escalating cost of conventional feed sources has continued to cause inadequate concentrate feeding and low productivity in the Nigerian livestock and poultry industry. A critical appraisal of monogastric livestock feed situation in Nigeria will probably indicate more protein deficit than calorie inadequacies of livestock feeds. Adequate protein in poultry diets is critical to their optimum performance (Oluyemi and Roberts, 1979; Helena-Strazincka, 1990). Groundnut cake (GNC) has been used as a plant protein source but its price has continue to increase astronomically in the market. The need to turn to alternative non-conventional ingredients not consumed by man but are cheap and readily available as substitutes becomes imperative. Brewer's dried grain (BDG) a brewery by-product has an amino acid profile that is close to that of GNC, (Aduku, 1993). It, however has a very high fibre content. Alkali treatment of various fibrous materials have been found to improve their nutritional qualities (Lewis *et al.,* 1999; Faniyi and Ologhobo, 1999; Vipond *et al*., 2001). The use of urea treatment and fermentation was therefore expected to break-down the fibre components of BDG which could release locked-up nutrients and further improve its amino acids profile. This study was therefore conducted to investigate the effect of urea-treated and fermented BDG on pullet layers performance as a replacement for GNC in layer's diets. The response parameters considered were the performance and economics of egg production.

MATERIALS AND METHODS

Preparation of the Experimental Diets

Urea-treated and fermented brewer's dried grains (as a test ingredient) was used to replace groundnut cake (GNC) at 0, 25,50, 75 and 100% levels in layer diets on protein equivalent basis. The brewer's dried grains (BDG) used in this experiment was treated and fermented for 7 days using 2% urea concentration. To obtain a 2% urea solution, 400g of urea (46% N, fertilizer grade) was dissolved in 20 litres of clean water to produce a 2% urea solution containing 20g urea/litre of water (Adeleye, 1988). Five dietary treatments were formulated to be isonitrogenous and isocaloric to provide 17% crude protein and 2600 kcal/kg metabolizable energy, and adequately furnished with minerals and vitamins. The compositions of the layer diets are presented in Table 1.

Feeding Trials

One hundred and twenty laying pullets aged 25 weeks (8 weeks in lay) of Goldline hybreed were randomly placed into five equal dietary treatment groups of 24 layers each, replicated thrice with 8 birds per replicate and reared in deep litter for eight weeks. Feed and water were provided *ad libitum*. Data on weight, performance, feed intake, feed: gain ratio (feed: egg in kg), egg weight and mortality were recorded weekly on replicate basis. Egg production was recorded daily and used for the estimation of the hen-day production.

Economic Analysis

Economic analysis of egg production of the layers was based on the cost of the diets computed from the prevailing market prices of the ingredients at the time of purchase. This was used to compute the cost per kg of feed and cost of feed consumed per kg of egg produced, percentage gain per kg in naira, the cost differential and relative cost-benefit values of the diets in relation to the control diet. The chemical analysis of the proximate compositions of the test ingredients and experimental diets were carried out (AOAC, 1990). Data obtained were subjected to analysis of variance using SAS (2000) package. Duncan's multiple range test (1955) was used to access the significance of differences between treatment means.

RESULTS

The proximate composition of the urea treated and fermented BDG and the untreated BDG are presented in Table 2, while the proximate composition of experimental diets are presented in Table 3. The results of the performance characteristics of layer pullets fed the experimental diets are presented in Table 4. The daily feed intake, total feed consumed per bird, total eggs produced for the experimental period, total eggs weight per bird and feed conversion ratio in the different dietary treatments were not significantly (P>0.05) different in all treatment groups. The final body weight, body weight gain, total eggs produced per bird per week, average egg weight and hen day production of layers were significantly (P<0.05) different in the treatments. The final body weight of layers fed diet with 25% urea-treated BDG(1.60$\pm$0.02) were

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significantly (P<0.05) heavier than the others(1.50±0.03, 1.46±0.04, 1.48±0.02, 1.46±0.01 kg) which were similar (P>0.05). Body weight gain of layers fed the control diet(0.08±0.04 kg) were significantly (P<0.05) higher than those fed diets with urea-treated BDG (0.05±0.00, 0.02±0.00, 0.01±0.00, 0.01±0.01, kg)which were similar (P>0.05) with body weight gain decreasing as the levels of urea-treated BDG inclusion increased in the diets. The total eggs produced per bird per week of the layers fed the control diet (5.78±0.06) were significantly (P<0.05) higher than layers fed urea-treated BDG diets (5.26±0.13, 5.34±0.11, 5.38±0.11, 5.33±0.15). The total number of eggs produced per bird in the entire period were not significantly (P>0.05) different. However, the values of urea-treated BDG based diets were slightly lower than those of the control diet. Average egg weight of layers fed 25 and 50% urea-treated BDG based diets (52.21±0.41, 52.20±0.33g) were significantly (P<0.05) heavier than those on 75 and 100% urea-treated BDG diets(50.50±0.52, 50.81±0.39g) but were similar (P>0.05) to the control while the control is similar (P>0.05) to all treatments. The hen day production of the layers fed the control diet (82.51±0.84%) was significantly (P<0.05) higher than that of layers on 100% urea-treated BDG diets (76.03±2.09%) but similar (P>0.05) to those fed 25, 50 and 75% urea-treated BDG diets. There were no significant ((P>0.05) differences in feed conversion ratio (feed: egg in kg) in all treatment groups.

The results of the economic analysis of egg production are presented in Table 5. There were no significant ((P>0.05) differences in the amount of total feed consumed (kg/bird) among layers on the different dietary treatments. The cost of total feed consumed per bird for the control and 25% urea-treated BDG diets (₦181.34±2.0, ₦176.57±5.64) were similar ((P>0.05), but were significantly ((P<0.05) higher than the others; while diets with 75 and 100% urea-treated BDG inclusions (₦144.02±2.19, ₦145.42±0.18) were significantly (P<0.05) the cheapest in terms of cost. The feed cost per kilogramme egg for birds fed diets with 0, 25, and 50% urea-treated BDG were similar (P>0.05) but were significantly (P<0.05) higher than diets with 75 and 100% inclusion levels. The cost differential and relative cost-benefit per kg egg for layers fed diets with 75 and 100% were similar (P>0.05) but significantly (P<0.05) higher than for layers fed diets with 25 and 50% inclusion levels.

Table 1. Composition of Experimental Layer Diets

	Dietary treatments				
Ingredients	L_1 (Control)	L_2	L_3	L_4	L_5
Maize (yellow)	55.50	54.23	53.35	52.37	51.40
Groundnut cake	18.50	13.87	9.25	4.63	-
Urea-treated BDG	-	5.90	11.40	17.00	22.60
Wheat Offal	11.80	11.80	11.80	11.80	11.80
Fish meal	3.00	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Oyster shell	7.50	7.50	7.50	7.50	7.50
Salt	0.30	0.30	0.30	0.30	0.30
Premix (Layer)*	0.25	0.25	0.25	0.25	0.25
Methionine	0.15	0.15	0.15	0.15	0.15
TOTAL	100.00	100.00	100.00	100.00	100.00
Calculated:					
Crude protein (%)	17.11	17.04	17.00	16.99	16.98
Crude fibre (%)	3.42	3.77	4.11	4.45	4.79
Metabolizable Energy (ME) kcal/kg	2607.48	2595.02	2591.66	2583.71	2575.85

*Vitamin-mineral premix (Maxi-Mix) provided the following vitamins and minerals per kg of diet: A, 10,700 I.U, D_3, 2,900 I.U, E,15 I.U, K_3., 2.2mg; B_1 1.6mg; B_2, 4.0mg; Niacin, 15mg; pantothenic acid, 11.5mg; B_6, 2.0mg; B_{12}, 0.01mg; Folic acid 1.0mg; Biotin, 0.03mg; Choline chloride, 150mg; Mn 70mg; Fe, 25mg; Zn, 45mg; Cu 25mg; I, 2.0mg; Co, 0.2mg; Se, 0.2mg; Anti-oxidant, 125mg

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)

Table 3. Proximate Composition of Experimental Layer Diets (% Dry matter)

	Dietary Treatments				
Parameters	L_1	L_2	L_3	L_4	L_5
Dry matter	90.90	92.67	93.22	90.07	89.55
Crude protein	17.49	17.54	17.68	17.75	17.86
Crude fibre	7.57	7.84	8.05	9.17	9.88
Ether extract	1.34	1.89	2.16	2.39	2.47
Ash	12.46	13.10	13.45	13.38	14.52
Nitrogen Free extract	52.04	52.30	51.88	47.38	44.82

Table 4. Performance Characteristics of Layer Pullets Fed Experimental Diets

Replacement Levels (%)	00UTBDG 100GNC	25UTBDG 75GNC	50UTBDG 50GNC	75UTBDG 25GNC	100UTBDG 00GNC
	Dietary Treatments				
Parameters	1	2	3	4	5
Initial body Weight (kg)/Bird)	1.42 ± 0.04^{b}	1.55 ± 0.01^{a}	1.44 ± 0.04^{b}	1.47 ± 0.02^{ab}	1.45 ± 0.01^{b}
Final Body Weight (kg/bird)	1.50 ± 0.03^{b}	1.60 ± 0.02^{a}	1.46 ± 0.04^{b}	1.48 ± 0.02^{b}	1.46 ± 0.01^{b}
Body Weight Gain (kg/bird)	0.08 ± 0.04^{a}	0.05 ± 0.00^{b}	0.02 ± 0.00^{b}	0.01 ± 0.00^{b}	0.01 ± 0.01^{b}
Feed Intake (g/bird/day)	93.68 ± 2.08^{a}	95.97 ± 1.87^{a}	94.57 ± 1.78^{a}	93.21 ± 1.59^{a}	93.45 ± 1.37^{a}
Total Feed Consumed/bird (kg)	5.25 ± 0.01^{a}	5.37 ± 0.17^{a}	5.30 ± 0.11^{a}	5.22 ± 0.01^{a}	5.24 ± 0.01^{a}
Total Eggs produced (per bird/wk)	5.78 ± 0.06^{a}	5.26 ± 0.13^{b}	5.34 ± 0.11^{b}	5.38 ± 0.11^{b}	5.33 ± 0.15^{b}
Total Eggs produced per bird	46.23 ± 0.69^{a}	42.06 ± 3.27^{a}	43.27 ± 0.69^{a}	43.03 ± 1.66^{a}	42.61 ± 1.33^{a}
Average Egg Weight (g)	51.47 ± 0.44^{ab}	52.21 ± 0.41^{a}	52.20 ± 0.33^{a}	50.50 ± 0.52^{b}	50.81 ± 0.39^{b}
Total Eggs Weight/bird (kg)	2.38 ± 0.06^{a}	2.33 ± 0.20^{a}	2.22 ± 0.06^{a}	2.17 ± 0.04^{a}	2.16 ± 0.08^{a}
Hen Day production (%)	82.51 ± 0.84^{a}	80.60 ± 0.62^{ab}	78.38 ± 1.45^{ab}	76.79 ± 1.51^{ab}	76.03 ± 2.09^{b}
Feed Conversion ratio (feed: egg in kg)	2.21 ± 0.03^{a}	2.47 ± 0.16^{a}	2.44 ± 0.04^{a}	2.41 ± 0.03^{a}	2.43 ± 0.09^{a}
Mortality	Nil	Nil	1	Nil	Nil

a,b,c,d Mean values with different superscripts in the same row are significantly different (P<0.05).

UTBDG: Urea-treated and fermented brewer's dried grains

GNC: Groundnut cake

Table 5. Economic Analysis of Egg Production

Replacement Level (%)	00UTBDG 100GNC	25 UTBDG 75 GNC	50 UTBDG 50 GNC	75 UTBDG 25 GNC	100 UTBDG 00 GNC
Parameters	1	2	3	4	5
Total Feed Consumed (kg/bird)	5.25 ± 0.06^{a}	5.37 ± 0.17^{a}	5.30 ± 0.11^{a}	$5..22\pm 0.08^{a}$	5.24 ± 0.01^{a}
Cost of total Feed Consumed/bird (₦)	181.43 ± 2.00^{a}	176.57 ± 5.64^{a}	164.73 ± 3.45^{b}	144.02 ± 2.19^{c}	$145.42+0.18^{c}$
Feed Cost per Kg Egg(₦)	76.32 ± 1.21^{a}	75.74 ± 0.32^{a}	74.15 ± 0.67^{a}	66.08 ± 2.01^{b}	66.48 ± 1.88^{b}
Cost Differential per Kg Egg (₦)	-	1.24 ± 0.49^{b}	2.17 ± 0.53^{b}	10.23 ± 2.90^{a}	9.84 ± 1.18^{a}
Relative Cost Benefit per Kg Egg (%)	100.00^{b}	100.76 ± 1.21^{b}	102.91 ± 0.70^{b}	115.76 ± 4.76^{a}	114.90 ± 2.10^{a}

a.b.c. Means with different superscripts in the same row are significantly different (P<0.05).
* Cost of feed per Kg (₦): Diet 1, ₦34.58: Diet 2, ₦32.86: Diet 3, ₦31.10; Diet 4, ₦27.59: Diet 5, ₦27.77
UTBDG: Urea-treated and fermented brewer's dried grains
GNC: Groundnut cake

DISCUSSION

The results of performance parameters showed that daily feed intake and the total feed consumed per bird for all dietary treatments were similar. This implies that replacement of GNC with urea-treated BDG did not affect the amount of feed intake of layer birds. The similarity in the level of consumption of all diets indicate that birds had the same level of acceptability for both GNC and urea-treated BDG based diets. The similarity in total egg produced per bird for the period and feed conversion ratio (feed: egg in kg) for all treatment levels is a confirmation of the acceptability of the diets and a comparable nutrient content among the dietary treatments. However, the trend seemed to have slightly favoured the control treatment over others which may not be unconnected with increase in fibre as urea-treated BDG replaces GNC in the diets. The average egg weights from dietary treatments with 25 and 50% urea-treated BDG which compared favourably with the control indicated that these replacement levels lied within the optimum range of inclusion for positive synergistic effects on egg weights. Average egg weights obtained in this study were comparable to that of Sekoni *et al.* (2002) and Ayanwale *et al.* (2003) who fed cottonseed cake to pullet layers. The similarity of the hen day production of birds fed the control and the urea-treated and fermented BDG diets up to the 75% inclusion level is an indication that these levels of inclusion furnished adequate nutrients to the birds to support same production level. The decline in hen day production at 100% inclusion level is an indication of the effects of increase dietary fibre level on productivity, and supported by similar results of Babatunde and Oluyemi (2000) and Isikwenu *et al.* (2000). The body weight gain performance for the control diet was significantly better than all treatments containing urea-treated BDG and could be as a result of the slight advantage of nutrient density in the control over urea-treated BDG based diets. This result is in agreement with findings of Summers and Leeson (1986), Pond (1989), Babatunde and Oluyemi (2000) and Isikwenu *et al.* (2000) who obtained poor growth rate with high fibre diets.

The reduction in the calculated cost of a kg feed with incremental levels of urea-treated BDG followed from the reduced cost of production of urea-treated BDG relative to the cost price of GNC. The decrease in feed cost between the control diet of ₦34.56 per kg feed and that of diet with 75% replacement of GNC that cost ₦27.59 per kg feed represent a 20.17% reduction in the cost of making 1 kg of feed. A saving of this magnitude on feed formulation will be of great benefit to the farmer. This is because feed alone accounts for about 80% of the recurrent expenditure in poultry production. Therefore, it is no surprise that the cost of production of a kg of egg decreased from ₦76.32 for control to ₦66.08 for 75% replacement of GNC, representing a 13.42% reduction in the cost of producing 1 kg of eggs. This is an indication of a favourable cost analysis which could be interpreted to mean a positive response to urea-treated BDG as replacement for GNC in the diet of laying hens. The cost differential and relative cost-benefit results also showed a progressive gain per kg egg produced as urea-treated BDG replaced GNC in the layers diets. The use of urea-treated and fermented BDG is a possible alternative to GNC in the diets of egg laying birds.

CONCLUSION

Based on the similarity in hen day production, the experiment showed that the replacement of groundnut cake with urea-treated and fermented BDG up to 75% level is possible. The use of urea-treated and fermented BDG in replacing GNC in layer's diets was economical because the cost of producing 1kg of feed and feed cost per kg egg were markedly reduced by 20.17% and 13.42% respectively. The use of urea-treated and fermented BDG as an alternative to GNC in layers' diets is possible and is therefore recommended.

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Table 5. Economic Analysis of Egg Production

Replacement Level (%)	00UTBDG 100GNC	25 UTBDG 75 GNC	50 UTBDG 50 GNC	75 UTBDG 25 GNC	100 UTBDG 00 GNC
Parameters	**1**	**2**	**3**	**4**	**5**
Total Feed Consumed (kg/bird)	5.25± 0.06^{a}	5.37± 0.17^{a}	5.30± 0.11^{a}	5..22± 0.08^{a}	5.24± 0.01^{a}
Cost of total Feed Consumed/bird (₦)	181.43± 2.00^{a}	176.57± 5.64^{a}	164.73± 3.45^{b}	144.02± 2.19^{c}	145.42+0.18^{c}
Feed Cost per Kg Egg(₦)	76.32± 1.21^{a}	75.74± 0.32^{a}	74.15 ± 0.67^{a}	66.08± 2.01^{b}	66.48± 1.88^{b}
Cost Differential per Kg Egg (₦)	-	1.24± 0.49^{b}	2.17± 0.53^{b}	10.23± 2.90^{a}	9.84± 1.18^{a}
Relative Cost Benefit per Kg Egg (%)	100.00^{b}	100.76 ± 1.21^{b}	102.91± 0.70^{b}	115.76± 4.76^{a}	114.90± 2.10^{a}

a.b.c. Means with different superscripts in the same row are significantly different ($P<0.05$).

* Cost of feed per Kg (₦): Diet 1, ₦34.58: Diet 2, ₦32.86: Diet 3, ₦31.10; Diet 4, ₦27.59: Diet 5, ₦27.77

UTBDG: Urea-treated and fermented brewer's dried grains

GNC: Groundnut cake

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