*Original Research Article***Performance, Haematology and Serum Chemistry of Weaner Rabbits Fed Urea-Treated and Fermented Brewer's Dried Grains Groundnut Cake-Based Diets**

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*Department of Animal Science, Delta State University, Asaba Campus, Nigeria***Abstract**

The effects of replacing groundnut cake (GNC) with urea-treated and fermented brewer's dried grains in weaner rabbits diets on the performance, haematology and serum chemistry was investigated. Urea-treated and fermented brewer's dried grains were used to replace GNC at 0, 25, 50, 75 and 100% levels in weaner rabbits' diets. Diets were formulated to be isonitrogenous and isocaloric to provide 18% crude protein and 11.00 MJ/kg metabolizable energy. Weaner rabbits of mixed breeds and sexes, aged 8 weeks, were randomly allocated to five treatment groups on equal weight and sex basis. They consisted of two rabbits per replicate and six rabbits per treatment. They were fed *ad libitum* in hutches for ten weeks. Significant ($P < 0.05$) differences were observed in final body weight, daily body weight gain, feed intake, feed conversion ratio, white blood cell count (WBC), glucose and sodium content for all treatment groups. Results indicate that urea-treated and fermented brewers dried grains can be used to replace up to 75% GNC (18.00% of the diet) as an alternative plant protein source. Mortality level (3 – 7%) was normal and evenly spread across treatment groups.

Key words: Brewer's dried grains; fermented; haematology; serology; groundnut cake; urea-treated; weaner rabbits.

INTRODUCTION

One of the ways out of the present animal protein intake deficit in developing economies lies in the intensive utilization of animals with short generation interval (Iyeghe-Erakpotobor and Esievo, 2010). Rabbit is an example of a micro-livestock and short-cycle animal whose fine white grained and low fat meat is widely accepted (Obioha, 1976; Iyeghe-Erakpotobor and Esievo, 2010). At this time when there is a clarion call for poverty alleviation, there is need to boost animal agriculture. Feed cost is always the largest item of expenditure in livestock production and protein sources are the most expensive ingredients. Groundnut cake (GNC) is regularly used as a plant protein source in livestock feeds but its price has continued to rise due to human-animal competition for groundnut and groundnut products. To produce cheap and good quality animals and animal products for the populace, feed cost must be reduced. The need to turn to ingredients not directly consumed by humans, but cheap and readily available as substitutes becomes an imperative. Brewer's dried grain (BDG), a brewery by-product which has an amino acid profile that is similar to that of GNC is a possible alternative to GNC. However, its high fibre content places a limitation to its use in monogastrics. There is need for further processing of BDG in order to reduce its fibre content. Alkali treatment of various fibrous materials has been found to improve their nutritional qualities (Faniyi et al., 1997; Vipond et al., 2001; Isikwenu, 2008). Urea-treated and fermented BDG have been successfully used in broiler

starter diets as a replacement for GNC up to 16.70% of the diet without detrimental effects (Isikwenu et al., 2008). This study is therefore designed to investigate the effect of replacing GNC with urea-treated and fermented BDG on the performance and blood variables in weaner rabbits.

MATERIALS AND METHODS**Experimental Site**

This study was conducted at the rabbitry unit of the Department of Animal Science, Delta State University, Asaba Campus, with mean annual rainfall, temperature and relative humidity of 1137mm, 35.7 °C and 82%, respectively.

Preparation of Test Ingredients

The brewer's dried grains (BDG) used in this experiment was fermented for 7 days in 2% urea concentration. To obtain the 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). Fourteen kg of BDG was weighed into the 20 litre urea solution and thoroughly mixed to obtain uniform wetness and excess solution was allowed to drain off on a standard sieve. The materials were put into thick polythene bag, sealed and stored under shade to ferment for 7 days. At the end of the 7 days fermentation period, the

treated BDG was sun-dried to a safe moisture level of 7-15% and used for feed formulation. The proximate composition of groundnut cake, urea-treated and fermented BDG and untreated BDG are as determined by Aduku (1993) and Isikwenu et al. (2008), Table 2.

Experimental Diets

Urea-treated and fermented BDG was used to replace GNC at 0, 25, 50, 75 and 100% levels in weaner rabbits diets on protein equivalent basis. Five diets were formulated to be isonitrogenous and isocaloric to provide 18% crude protein and 11.00 MJ/kg metabolizable energy.

Experimental Rabbits and Management

Thirty, eight-weeks-old weaner rabbits of mixed breeds (California, Flemish Giant, New Zealand and Chinchilla) and sexes with initial weight of 808-810 g were used for the ten weeks feeding trial. The rabbits were randomly allocated into five treatment groups on equal weight and sex basis in a completely randomized design (CRD). Each treatment group consisted of six rabbits and three replicates of two rabbits each and kept in a single tier hutch of 75 cm × 75 cm × 60 cm dimensions. Feed, fresh green forage (*Panicum maximum*, *Talinum triangulare* and *Tridax procumbens*) and water were provided *ad libitum*. Data on weight performance, feed intake, feed/grain ratio and mortality were recorded weekly on replicate basis for the experimental period. At the end of the feeding trial, one rabbit was randomly selected from each replicate, weighed and slaughtered by severing the jugular vein and carotid arteries. Blood samples, approximately 10 ml per rabbit, were collected from replicates in each treatment groups into specimen bottles with or without ethylene diamine tetra-acetic acid (EDTA). Haematological and serological analyses were carried out using routinely available methods. The packed cell volume (PCV) was determined by Wintrobe's microhaematocrit method, red blood cell count (RBC) and white blood cell count (WBC) were by Neubauer haemocytometer and haemoglobin concentration (Hb) by cyanomethaemoglobin method. The mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) were computed as outlined by Seal and Erickson (1979). Total protein, albumin and globulin were determined by biuret and colorimetric methods, respectively. Cholesterol and glucose (using glucose oxidase) were obtained by enzymatic colorimetric method. Sodium (Na⁺) was estimated by flame photometry using atomic emission principles.

Statistical Analysis

Data collected were subjected to analysis of variance and treatment means were compared by Duncan's Multiple Range Test (Duncan, 1955) using SPSS (10.0) package.

RESULTS

The composition of the weaner rabbits diets are presented in Table 1. The proximate composition of urea-treated and fermented BDG, untreated BDG and groundnut cake are

Table 1. Composition of Experimental Weaned Rabbit Diets

Ingredient	Dietary Treatment				
	D ₁ (Control)	D ₂	D ₃	D ₄	D ₅
Maize (White)	54.00	53.10	51.90	51.00	49.90
Groundnut cake	20.00	15.00	10.00	5.00	-
Urea-Treated BDG	-	5.90	12.10	18.00	24.10
Wheat offals	20.75	20.75	20.75	20.75	20.75
Fish Meal	1.50	1.50	1.50	1.50	1.50
Bone Meal	2.35	2.35	2.35	2.35	2.35
Oyster Shell	1.10	1.10	1.10	1.10	1.10
Salt	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Crude Protein (%)	18.07	18.01	18.04	17.99	17.99
Crude Fibre (%)	4.32	4.36	4.42	4.48	4.54
M. Energy (MJ/Kg)	11.18	11.14	11.09	11.05	11.01

Table 2. Chemical Composition of Groundnut Cake, Untreated BDG and Treated and Fermented BDG (Test Ingredient)

Parameter %	GNC	Untreated BDG	Urea-treated BDG
Dry Matter	92.00	93.34	88.76
Crude Protein	45.00	24.21	38.52
Ether Extract	9.16	3.69	4.87
Ash	5.51	8.04	5.99
Nitrogen Free Extract	28.52	46.20	34.89
Organic Matter	86.49	85.30	82.77
Metabolizations Energy (MJ/Kg)	10.63	10.55	10.58

Source: Aduku (1993) and Isikwenu et al. (2008)

presented in Table 2. The performance of rabbits is presented in Table 3. There were significant ($P < 0.05$) differences in the final body weight, daily body weight gain, feed intake and feed conversion ratio of rabbits fed the different diets. The rabbits fed the control diet were significantly ($P < 0.05$) different from those fed diet with 100% urea-treated and fermented BDG inclusion in final body weight. Feed conversion ratio of rabbits fed the control diets (4.16 ± 0.01) were significantly ($P < 0.05$) better than those on diets with

Table 3. Performance Characteristics of Rabbits Fed Experimental Diets

Replacement Level (%)	00UTBDG 100GNC 1	25UTBDG 75GNC 2	50UTBDG 50GNC 3	75UTBDG 25GNC 4	100UTBDG 00GNC 5
Initial Body Wt (g)	809.0	808.0	810.0	808.0	808.0
Final Body Wt (g)	1993.30 ± 0.12 ^a	1780.00 ± 0.11 ^{ab}	1830.00 ± 0.10 ^{ab}	1686.70 ± 0.16 ^{ab}	1500.00 ± 0.05 ^b
Body Wt. gain (g/rabbit/day)	16.92 ± 0.17 ^a	13.89 ± 0.14 ^a	14.57 ± 0.07 ^a	12.60 ± 0.15 ^a	9.89 ± 0.06 ^b
Feed intake (g/rabbit/day)	70.34 ± 1.03 ^a	66.99 ± 0.65 ^b	63.22 ± 1.24 ^b	64.87 ± 1.22 ^b	66.42 ± 0.57 ^b
Feed conversion Ratio	4.16 ± 0.01 ^a	4.17 ± 0.01 ^a	4.20 ± 0.01 ^a	4.35 ± 0.01 ^a	6.72 ± 0.01 ^b
Mortality (%)	3	Nil	7	Nil	3

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

UTBDG: Treated and Fermented Brewer's dried grains

GNC: Groundnut Cake.

Table 4. Haematological Indices of Weaned Rabbits Fed Experimental Diets

Replacement Level (%)	00UTBDG 100GNC 1	25UTBDG 75GNC 2	50UTBDG 50GNC 3	75UTBDG 25GNC 4	100UTBDG 00GNC 5
PCV (%)	33.33 ± 0.04	32.00 ± 0.06	30.33 ± 0.09	33.00 ± 0.05	31.00 ± 0.05
Hb (g/dl)	8.12 ± 1.70	7.78 ± 2.11	7.37 ± 0.62	8.03 ± 0.52	7.53 ± 1.77
RBC (10 ⁶ /mm ³)	3.50 ± 0.38	3.35 ± 0.15	3.18 ± 0.23	3.46 ± 0.54	3.25 ± 0.35
WBC (10 ³ /mm ³)	2.47 ± 0.18 ^c	2.60 ± 0.15 ^c	2.77 ± 0.12 ^{bc}	3.47 ± 0.20 ^a	3.17 ± 0.19 ^a
MCV (fl)	95.23 ± 0.01	95.02 ± 0.02	95.38 ± 0.04	95.38 ± 0.06	95.38 ± 0.04
MCH (pg)	23.20 ± 0.52	23.22 ± 1.13	23.18 ± 0.30	23.21 ± 0.30	23.17 ± 0.60
MCHC (%)	24.36 ± 0.05	24.31 ± 0.05	24.30 ± 0.06	24.33 ± 0.05	24.30 ± 0.06

Mean with different superscripts a,b,c in the same row are significantly different ($P < 0.05$). UTBDG: Urea – treated and fermented brewer's dried grains. GNC: Groundnut Cake.

Table 5. Serological Indices of Weaned Rabbits Fed Experimental Diets

Indicators	00UTBDG 100GNC 1	25UTBDG 75GNC 2	50UTBDG 50GNC 3	75UTBDG 25GNC 4	100UTBDG 00GNC 5
Cholesterol (mmol/l)	1.98 ± 0.00	1.98 ± 0.01	1.97 ± 0.01	1.98 ± 0.06	1.98 ± 0.06
Glucose (mmol/l)	8.73 ± 0.01 ^b	8.86 ± 0.02 ^a	8.76 ± 0.03 ^b	8.73 ± 0.01 ^b	8.88 ± 0.01 ^a
Sodium (mmol/l)	62.85 ± 0.03 ^a	62.84 ± 0.03 ^a	62.78 ± 0.02 ^a	60.37 ± 0.09 ^b	58.45 ± 0.03 ^c
Total Protein (g/dl)	10.71 ± 0.01	10.66 ± 0.04	10.65 ± 0.03	10.67 ± 0.02	10.67 ± 0.05
Albumin (g/dl)	4.93 ± 0.01	4.91 ± 0.03	4.90 ± 0.03	4.91 ± 0.04	4.91 ± 0.04
Globulin (g/dl)	5.78 ± 0.01	5.76 ± 0.05	5.75 ± 0.01	5.77 ± 0.01	5.76 ± 0.02
Albumin:Globulin Ratio	0.85 ± 0.00	0.85 ± 0.01	0.85 ± 0.01	0.85 ± 0.00	0.85 ± 0.01

Means a, b, c with different superscripts in the same row are significantly ($P < 0.05$) different. UTBDG: urea-treated and fermented brewer's dried grains GNC: Groundnut Cake

100% urea treated BDG (6.72 ± 0.01) inclusion but similar ($P < 0.05$) to those fed 25%, 50% and 75% inclusion levels. Mortality level (3 – 7%) was normal and evenly spread across treatment groups. The results of the haematological indicators of weaned rabbits fed experimental diets are presented in Table 4. The only significant differences occurred in the white blood cell count (WBC) values. The white blood cell count (WBC) of rabbits fed the control and 25% diets were significantly ($P < 0.05$) lower than those fed diets of 75 and

100% urea-treated and fermented BDG inclusion levels but were similar ($P < 0.05$) to those fed 50% inclusion diets. White blood cell count (WBC) of rabbits fed diets with 75 and 100% inclusion levels were similar ($P < 0.05$). White blood cell count increased as the level of urea-treated and fermented BDG increased in the diets. The results of the serological indices of weaned rabbits fed experimental diets are presented in Table 5. There were no differences in cholesterol, total protein, albumin, globulin contents and albumin: globulin

ratio in any of the treatment groups. There were significant ($P < 0.05$) differences in the glucose and sodium contents of rabbit's sera. The glucose level of the sera of rabbits fed the control diet ($8.73 \pm 0.01 \text{ mmol/L}$) were similar ($P < 0.05$) to those fed 50 and 75% urea-treated and fermented BDG inclusion levels but ($P < 0.05$) lower than those of 25 and 100% levels. The sodium content of rabbit sera fed the control, 25 and 50% urea-treated and fermented BDG diets were significantly ($P < 0.05$) higher than those fed the 75 and 100% inclusion levels. Rabbits fed the 100% inclusion level had the least sodium content in their sera. Sodium content of rabbit sera was observed to decrease with increased level of urea-treated and fermented BDG inclusion.

DISCUSSION

The final body weight and daily body weight gain of rabbits were similar for the control and treatment groups with 25, 50 and 75% urea-treated and fermented BDG diets. This implies that these replacement levels were able to furnish adequate nutrients to obtain a growth rate comparable to the control diet. It also indicates that weaner rabbits can tolerate inclusions of urea-treated and fermented BDG up to 75%, which is about 18.00% of the diet. These replacement levels are therefore, within the optimum range that can be used for good body weight performance and these results are similar with those reported by Sobayo et al. (2008). The rabbits ate significantly more of the control diet than urea-treated BDG based diets, indicating that the control diet was more palatable and acceptable to the rabbits. The observed similarity of the feed conversion ratio of rabbits fed the control, 25, 50 and 75% inclusion levels followed the same trend as the growth performance.

The haematological indicators of packed cell volume (PCV), haemoglobin concentration (Hb), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean cell haemoglobin concentration (MCHC) and red blood cell count (RBC) in Table 5 for rabbits fed the different dietary treatments showed no significant differences. The values of these indicators obtained in this study fall within the physiological ranges reported by several workers (Poole, 1987; Anon, 1980; PGCVS, 1990). Hackbath et al. (1983) found that there is a strong influence of diet on haematological traits with PCV and Hb being very strong indicators of nutritional status of animals. The values obtained for all treatment groups in these indicators indicate nutritional adequacy of the diets since values did not indicate malnutrition or under-nutrition (Church et al., 1984). This means urea-treated BDG inclusion in the diets of weaner rabbits had no detrimental effect on blood nutrient composition and level. The similarity in values of these parameters is an index of good physiological, pathological

and nutritional status of rabbits fed both GNC and urea-treated BDG based diets (Isikwenu and Omeje, 2007). The WBC values which increased with higher inclusion levels of urea-treated BDG in the diet is an indication that the use of urea-treated BDG in rabbit diet is safe since WBC indicate animal health condition (Isikwenu and Omeje, 2007). The non-significant differences in serological indices such as total protein, albumin, globulin, cholesterol and albumin: globulin ratio in the different treatments is indicative of the adequacy of nutrients contained in the diets. The similarity of the serum total protein, albumin and globulin levels indicate good quality dietary protein and this agrees with the findings of Eggum (1986). Similarity of the serum albumin content of rabbits also indicates the presence of a healthy and functioning liver, since hypoalbuminaemia is associated with the presence of liver disease (Treacher, 1977; Cheesbrough, 1999). It also indicates a proper protein : energy balance in the diets and absence of parasitic infections (Treacher, 1977; Cheesbrough, 1999). The serum glucose values did not show any pattern even though differences were significant. Observed difference in glucose values may be due to the difference in the physiology of the individual animals. The lower values of serum sodium for treatment with 75 and 100% treated BDG inclusion may be due to slightly increased sodium excretion or poor assimilation as a result of higher fibre contents of these diets (Mitaru and Blair, 1984; Nworgu and Ologhobo, 2000; Isikwenu et al., 2008).

In conclusion, based on the result of weight performance and low mortality rate, the use of urea-treated and fermented BDG in weaner rabbit's diet in place of GNC is highly advocated. It was found that urea-treated and fermented BDG can replace up to 75% GNC (18.00% of the diet) as an alternative plant protein source in weaner rabbits diets. The generally similar result of the haematological and serological indices is indicative of the absence of pathological abnormalities such as liver and kidney failures and toxicity. It is, therefore safe to use urea-treated and fermented BDG at recommended concentration and levels to replace GNC in weaner rabbit's diets without any health implication for the consumers of the products.

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