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Effects of graded levels of biscuit dough waste meal as replacement for maize in broiler starter diet on performance and blood indices

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Target Audience: Nutritionists, Poultry Farmers, Researchers, Students

Abstract

An experiment was conducted for 4 weeks to evaluate the effect of dietary substitution of biscuit dough waste meal (BDW) for maize on performance, haematological and biochemical indices of broiler chicks. A total of 150 day old Marshal broiler chicks were used for the study. The experiment was conducted by using a completely randomized design with 5 treatments, 3 replicates, and 10 chicks in each replicate. Five experimental diets were formulated as follows: A (100%M: 0%BDW), B (75%M: 25%BDW), C (50%M: 50%BDW), D (25%M: 75%BDW), and E (0%M: 100%BDW). Growth, serum and haematological parameters of the experimental birds were measured. Variations obtained in the average final body weight (AFBW), average daily weight gain (ADWG), cost per kg feed (CPKF) and cost of feed per kg weight gain (CFPKWG) differed significantly (P < 0.05). The AFBW (g/b) were 638.10 (0% BDW) 587.30 (25% BDW), 565.47 (50% BDW), 544.44 (75% BDW), and 516.99 (100% BDW) respectively. The ADWG followed the same trend with respective values of 21.28, 19.48, 18.68, 17.93 and 16.97g/b/d in the same order. Lowest CFPKWG (₦246.15) obtained at 25% BDW was similar to ₦247.03 (0% BDW) and ₦248.71 (75% BDW) which were all significantly (P < 0.05) lower than ₦253.92 (50% BDW) and ₦268.46 (100% BDW). The erythrocyte sedimentation rate (ESR), packed cell volume (PCV), red blood cell (RBC), haemoglobin (Hb), basophils and eosophils varied significantly (P < 0.05) among the dietary treatments. The study showed that biscuit dough waste meal inclusion up to 100% level of substitution for maize poses no health threat to the experimental birds, CFPKWG at 0%, 25% and 75% BDW were similar; 25% level of substitution being the cheapest, most economical and therefore recommended for broiler farmers.

Keywords: Performance, Biscuit dough waste, Health status, Broilers

Description of Problem

The rising demand for poultry meat and egg for quality animal protein has led to tremendous increase in the number of poultry farms in Nigeria. However, escalating cost of feeds is currently undermining the progress made so far in the poultry sector in Nigeria and many other African countries. According to Apata and Ojo (1), the high cost of compound feeds for poultry is derived largely from the exorbitant prices of feed ingredients, increasing competitive demand for these ingredients by man and animals, and scarcity of the conventional ingredients. Therefore, to reduce the feed cost, which accounts for 60 to 70% of total cost (2), research efforts are being

geared towards evaluating alternative feed ingredients for poultry (3).Atteh and Ologbenla (4) stated that such alternatives should have comparative nutritive value and cheaper than the conventional sources. Biscuit dough waste is a source of energy with values relatively close to that of maize. Its cost is relatively low compared to that of maize and it is considered as a waste product (5). Biscuit waste meal, an agro-industrial waste product found in substantial quantities in biscuit producing industries is palatable, high energy feed produced from wheat flour, skimmed milk powder, vegetable fat, sugar, salt and flavour. Biscuit waste has no anti-nutritional factors and could make a good replacement for maize and other cereal grains in feeding broilers (6). This study examined the proximate composition of biscuit waste meal, and determined the effect of feeding broiler chicks with graded levels of the ingredient as substitute for maize on performance, haematology and serum metabolites of the experimental birds.

Materials and Methods

Site of the experiment

The experiment was carried out at the experimental section of the Poultry Unit of the Teaching and Research Farm, Joseph Ayo Babalola University, Ikeji-Arakeji, Osun State, Nigeria. Ikeji-Arakeji is situated on 350.52m above sea level at latitude 7^0 25'N and at longitude 5^0 19'E. The vegetation of the area is that of the rainforest characterized by hot and humid climate. The mean annual rainfall is 1500mm and the rain period is bimodal with a short break in August with mean annual relative humidity of 75% and mean temperature of 26-28^{0}C (7).

Table 1: Gross composition of experimental starter diets

Ingredients	Diets				
	D1 (0% BDW)	D2 (25% BDW)	D3 (50%BDW)	D4 (75% BDW)	D5 (100% BDW)
Maize	44.00	33.00	22.00	11.00	0.00
Biscuit dough	0.00	11.00	22.00	33.00	44.00
Wheat offal	15.00	15.00	15.00	15.00	15.00
Soybean meal	18.00	18.00	18.00	18.00	18.00
Groundnut cake	20.00	20.00	20.00	20.00	20.00
Bone meal	2.20	2.20	2.20	2.20	2.20
*Premix	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
Salt	0.20	0.20	0.20	0.20	0.20
Total	100.0	100.0	100.0	100.0	100.0
Calculated analysis					
Crude protein (%)	22.91	23.06	23.20	23.35	23.50
Ether extract (%)	4.12	5.20	6.28	7.37	8.45
Crude fibre (%)	4.33	4.17	4.01	3.86	3.70
ME (kcal/kg)	2805.46	2856.63	2907.80	2958.96	3010.13

ME = Metabolizable energy (kcal/kg); BD = biscuit dough *Premix contains the following; Vit. A, 10,000,000 lU; D3, 3,000,000 lU; Vit. K, 2.3g; Thiamine-Bi, 1.7g; Riboflavin-B2, 5.0g; Pyridoxine-B,3.1g; Vit. B12,16mg; Biotin, 60mg; Niacin, 31.0g; Pantothenic acid, 8g; Folic acid, 0.8g; Manganese, 85g; Zinc, 50.0g; Iron, 25.0g; Copper, 6.0g; Iodine, l.lg; Selenium, 120.0mg; Cobalt, 220.0mg; B.H.T., 60.0g; Ethoxyquin, 65.0g; Choline chloride, 200.0g.

Management of the experimental birds

One hundred and fifty (150) day old broiler chicks purchased from a reputable Hatchery in Ibadan, Oyo State were used for this experiment. The birds were randomly assigned to five dietary treatments, replicated three times in a completely randomized design with each replicate having 10 birds. The birds were raised on deep litter in an open-sided poultry house. Experimental diets and drinking water were provided *ad-libitum*; and the study lasted for four weeks. The water troughs were washed daily before fresh and clean water was served. Routine vaccination and necessary medications (anti-stress, antibiotics and coccidiostat) were administered to keep the birds healthy.

Experimental diets

Five experimental diets were formulated. Maize was used as the energy source in the control diet (0% BDW). Diets 2 (25% BDW), 3 (50% BDW), 4 (75% BDW) and 5 (100% BDW) were substitutes for maize to make up for the nutritional requirement of broiler chicks. The gross composition of the broiler starter diets is presented in Table 1.

Test ingredient

Biscuit dough waste (BDW) was obtained from Sumal Foods Limited®,, Oluyole Industrial Layout, Ibadan, Oyo State, Nigeria. The BDW represents the wastes along biscuit production chain before undergoing oven heating. The BDW was analysed for its nutritional composition using the AOAC (8) method. The proximate composition of the BDW is shown in Table 2.

Table 2: Proximate composition of biscuit dough waste meal

Nutrients	Composition
Dry matter (%)	92.94
Crude protein (%)	11.33
Crude fibre (%)	0.59
Ether extract (%)	13.86
Ash (%)	1.07
Nitrogen free extract (%)	66.09
Metabolizable energy (kcal/kg)	3899.16

Table 3: Performance characteristics of experimental broiler starters fed graded levels of biscuit dough waste meal as replacement for maize

Performance	Diets					SEM
	D1 (0% BDW)	D2 (25% BDW)	D3 (50% BDW)	D4 (75% BDW)	D5 (100% BDW)	
AIBW (g/b)	42.38	41.91	42.38	42.38	41.91	0.24
AFBW (g/b)	638.10^{a}	587.30^{ab}	565.47^{ab}	544.44^{ab}	516.99^{b}	16.07
ADFI (g/b/d)	58.74	57.95	59.63	57.96	62.95	1.81
ADWG (g/b/d)	21.28^{a}	19.48^{ab}	18.68^{ab}	17.93^{ab}	16.97^{b}	0.58
FCR	2.78	2.98	3.19	3.23	3.71	0.35
CPKF (₦)	88.86^{a}	82.60^{a}	79.60^{bc}	77.00^{bc}	72.36^{c}	14.55
CFPKWG (₦)	247.03^{c}	246.15^{c}	253.92^{b}	248.71^{c}	268.46^{a}	34.20

^{abc}Means with different superscript in the same row are significantly ($P < 0.05$) different from each other. BD = biscuit dough, AIBW = average initial body weight, AFBW = average final body weight, ADFI = average daily feed intake, ADWG = average daily weight gain, FCR = feed conversion ratio, CPKF = cost per kg feed, CFPKWG = cost of feed per kg weight gain

Data collection

Data collected during the four weeks duration of the experiment include; body weight (initial and final), weight gain, feed intake, and feed conversion ratio. A weighed amount of feed was served to each treatment on replicate basis each week and the left over at the end of the week was weighed to determine the average weekly feed intake. The weights of the birds per treatment were taken at the start of the experiment and at weekly interval by use of weighing scale. The differences observed in weight represent weight gain due to the treatment. Average daily feed intake and weight gain were subsequently calculated from the weekly values. The feed conversion ratio was calculated on the basis of feed intake (g) per unit body weight gain (g) of bird produced.

Blood sample collection and analysis

Blood samples were collected at the end of the study. The samples were collected from six birds per treatment (2 birds per replicate) picked at random. The blood were collected through the wing vein, the area was disinfected with cotton wool dampened with methyl alcohol swabs and by vein puncture; 5 ml of blood was drawn and emptied into Heparin and ethylene diamine tetra acetic acid EDTA bottles for serum biochemistry and haematological parameters determinations, respectively. All EDTA- and Heparin-containing bottles were labeled appropriately before collection. Blood samples in the EDTA bottles were subjected to haematological analysis to determine the following parameters: Erythrocyte sedimentation rate (ESR), Packed Cell Volume (PCV), Red Blood Cell (RBC), Haemoglobin (Hb), Lymphocytes (LYM), Neutrophils (NEU), Monocytes (MONO), Basophils (BAS) and Eosophils (EOS). The biochemical components of the serum determined from blood samples in the Heparin-containing bottles include Glucose (GLU), Total Protein (TP), Albumin (ALB) and Globulin (GLB).

Chemical analysis

Proximate analysis and energy value of the test ingredient (biscuit dough waste meal) and experimental diets were determined by the method of Association of Official Analytical Chemist (8).

Data analysis

Data obtained in the study were subjected to analysis of variance (ANOVA) using SAS Statistical Package (9). Duncan multiple range of the same statistical software was used to test significant difference between means.

Results

The gross composition, calculated nutrients and metabolizable energy of the experimental starter diets are presented in Table 1. The crude protein, ether extract, crude fibre and metabolizable energy values of the diets ranges were 22.91 – 23.50%, 4.12 – 8.45%, 3.70 – 4.33%, and 2805.46 – 3010.13 kcal/kg respectively. The CP, EE and ME increased while the CF decreased with increasing BDW inclusion levels in the diets.

The proximate composition and energy value of the test ingredient are presented in Table 2. The values were 92.94% DM, 11.33% crude protein, 0.59% crude fibre, 13.86% ether extract, 1.07% Ash, 66.09% NFE and 3899.16 kcal/kg ME.

Presented in Table 3 are the performance indices of the experimental birds. Variations obtained in the average final body weight (AFBW), average daily weight gain (ADWG), cost per kg feed (CPKF) and cost of feed per kg weight gain (CFPKWG) differed significantly ($P < 0.05$). The AFBW (g/b) were 638.10 (0% BDW), 587.30 (25% BDW), 565.47 (50% BDW), 544.44 (75% BDW), and 516.99 (100% BDW) respectively. Average daily weight gain followed the same trend with

respective values of 21.28, 19.48, 18.68, 17.93 and 16.97g/b/d in the same order. The highest cost (₦88.86) per kg feed (CPKF) obtained in birds fed with the control diet (0% BDW) significantly (*P < 0.05*) reduced to ₦82.60(25% BDW), ₦79.60 (50% BDW), ₦77.00 (75% BDW) and ₦72.36 (100% BDW) respectively. Lowest cost (₦246.15) of feed per kg weight gain (CFPKWG) obtained at 25% BDW was similar to ₦247.03 (0% BDW) and ₦248.71 (75% BDW) which were all significantly (P < 0.05) lower than ₦253.92 (50% BDW) and ₦268.46 (100% BDW). Average daily feed intake was similar (*P > 0.05*) across the treatments. Feed conversion ratio increased seamingly with increased BDW inclusion levels but the variations were not significant (*P > 0.05*).

Table 4: Haematological and biochemical indices of experimental broiler starters fed graded levels of biscuit dough waste meal as replacement for maize

Parameters	Diets					SEM
	D1 (0% BDW)	D2 (25% BDW)	D3 (50% BDW)	D4 (75% BDW)	D5 (100% BDW)	
Esr (mm/hr)	12.33^{b}	8.67^{c}	10.00^{b}	21.00^{a}	10.67^{b}	3.90
PCV (%)	18.67^{a}	22.00^{a}	19.33^{a}	17.33^{ab}	16.67^{b}	2.93
RBC (x10^{6}mm^{-3})	1.07^{a}	1.34^{a}	1.33^{a}	0.23^{b}	0.86^{b}	0.03
Hb (g/100ml)	6.23^{a}	7.33^{a}	6.43^{a}	2.43^{b}	5.53^{ab}	1.14
Lymphocytes (%)	62.00	60.67	60.67	60.67	61.00	0.93
Neutrophils (%)	20.67	21.33	24.67	22.00	23.33	1.44
Monocytes (%)	13.33	14.00	10.67	13.33	11.67	1.95
Basophils (%)	2.67^{ab}	2.00^{b}	2.33^{ab}	3.33^{a}	2.33^{ab}	0.30
Eosophils (%)	1.33^{ab}	2.00^{a}	1.67^{ab}	0.67^{b}	1.67^{ab}	0.30
Glucose (%)	3.73	3.68	2.25	2.60	3.63	0.99
Total protein (g/dl)	27.63	24.78	25.13	23.66	26.73	4.01
Albumin (g/dl)	12.62	12.56	15.93	12.99	15.14	2.11
Globulin (g/dl)	15.01	13.47	8.63	10.68	11.59	1.99

^{a,b,ab}Means with different superscript in the same row are significantly (P < 0.05) different from each other.
ESR- Eosophils**;** PCV—packed cell volume; RBC—red blood cell; Hb--- haemoglobin

Table 4 presents the haematological and biochemical parameters of the experimental broiler starters fed graded levels of biscuit dough waste meal as replacement for maize in the diets. The erythrocyte sedimentation rate (ESR), packed cell volume (PCV), red blood cell (RBC), haemoglobin (Hb), basophils and eosophils varied significantly (*P < 0.05*) among the dietary treatments. The ESR (mm/hr) were 12.33 (0% BDW), 8.67 (25% BDW), 10.00 (50%BDW), 21.00 (75% BDW) and 10.67 (100% BDW) respectively. The PCV in the same order were 18.67, 22.00, 19.33, 17.33 and 16.67%. The RBC (x10^{6}mm^{-3}) values 1.07 (0% BDW), 1.34 (25% BDW), and 1.33 (50% BDW) were similar, but significantly (*P < 0.05*) higher than 0.23 (75% BDW) and 0.86 (100% BDW). Birds fed with diet 2 (25% BDW) had the highest (7.33g/100ml) Hb which was similar to 6.23g/100ml (0% BDW) and 6.43g/100ml (50% BDW), all significantly (*P < 0.05*) higher than 2.43g/100ml (75% BDW) and 5.53g/100ml (100% BDW) in that order. The basophil values (%) were 2.67, 2.00, 2.33, 3.33, and 2.33; while the eosophils (%) were 1.33, 2.00, 1.67, 0.67 and 1.67 respectively for birds fed 0, 25, 50, 75 and 100% BDW-based

diets. The Lymphocytes, Neutrophils and Monocytes were not significantly ($P < 0.05$) affected by dietary treatments. All serum metabolites (glucose, total protein, albumin and globulin) investigated were not significantly ($P > 0.05$) affected by the dietary treatments.

Discussion

The experimental broiler starter diets were formulated to meet the recommended nutritional requirements of these birds under the tropical environment where the study was carried out (10). The increasing crude protein, ether extract and metabolisable energy; and decreasing crude fibre with increasing contents of the test ingredient in the diets were reflections of the differences in amount of the constituents in maize and the substitute. The crude protein of the biscuit dough waste meal obtained in this study was higher than 9.56% and 10.80% respectively obtained by (5, 11) for biscuit waste. The energy value is, however, slightly lower than 4.90 and 3.99 MJ/kg reported by (11, 12). The reason for the variations may be as a result of processing since biscuit dough waste in the present study was not oven dried as compared to biscuit wastes in other studies which had undergone oven processing. The decreasing final body weight, average daily weight gain and the numerical increase in feed conversion ratio with increasing levels of substitution could point to the fact that nutrients in the control diet were adequately converted to weight by these birds than those on experimental diets. Residual anti-nutritional factors in the ingredients used in making biscuit dough which has not been subjected to heat treatment could have been responsible for this. More so, the average feed intake (58.74, 57.95, 59.63, 57.96 and 62.95g/b/d) of these birds were similar across the dietary treatments. This result agrees with the reports of (6, 11) that birds fed on purely maize-based diets recorded the highest weight gain. Ajasin*et al.*, (5) reported a numerically higher feed intake by snails fed varying inclusion levels of biscuit waste. The FCR (2.47 – 2.94%), average daily feed intake (81.81 – 95.44g/b/d), average daily weight gain (27.82 – 35.66g/b/d), cost per kg feed (₦72.98 – ₦95.78), and cost of feed per kg live weight gain (₦190.48 – ₦250.94) were reported for broiler starters (14). Although the cost per kg feed reduced with increasing biscuit dough in the diets with the control diet being the most expensive, the lowest cost of feed per kg weight gain was obtained in birds fed 25% BDW. This was statistically similar to the control and that of 75% BDW; all lower than those of 50% and 100% BDW. Economically, 25% BDW was the best level of substitution being cheaper than the control.

With regard to the blood physical properties, it is believed that the frictional resistance of the surrounding plasma which holds the cells in suspension and the gravitational pull on the erythrocytes mostly determines the ESR (14, 15). However, the present findings with respect to ESR values of broiler starters on all dietary treatments did not give rise to acute infection as high values of sedimentation rates could be an indication of acute general infection and malignant tumours (14). The RBC, PCV, and Hb values are lower than 1.58-4.10 (x $10^6 mm^{-3)}$, 24.90-45.20% and 7.40-13.10 (g/100ml) respectively recommended for normal chickens (16). The PCV (25 – 45%) reported by (17, 18) are also higher than the values in this study. The RBC count of the control and those fed the test diets also falls below the range of 2.0 – 4.0 x $10^6 mm^{-3}$ reported for broiler chickens (14, 17, 18). The eosophils, however, falls within 0.67-2.48% recommended by the authors. The Lymphocytes, Neutrophils and Monocytes were similar across the treatments. The serum metabolites (glucose, total protein, albumin and globulin) investigated were also similar across the dietary treatments. Makale (19)

recorded an increasing value of glucose with increased rate of biscuit wafer inclusion in broiler diets.

Conclusions and Applications

The result indicated that:

1. Biscuit dough waste inclusion up to 100% level of substitution for maize in broiler starter diets poses no health threat to the experimental birds as depicted by blood indices investigated.
2. Cost of feed per kg weight gain of the birds fed with the control diet was similar to those fed with 25 and 75% BDW; but 25% level of substitution was the cheapest and most economical and therefore recommended for broiler farmers.

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