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Article

Performance Characteristics of Broilers Fed Bread Waste Based Diets

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Abstract: This study was conducted to determine the effect of bread waste on performance and carcass characteristics of broilers at starter and finisher phases. A total of 240 broiler chicks were purchased and allotted randomly into four dietary treatments: T_0, T_1, T_2 and T_3 at an inclusion level of 0, 33, 67 and 100% respectively with three replicates of twenty birds per replicate. A total of 120 broilers were slaughtered at the end of the 8th week of the experiment and analyzed for carcass parameters. The results obtained at the starter phase of the experiment shows that T_2 having (67%) level of inclusion of bread waste showed similar performance to the control diet with feed conversion ratio of 2.08 and final weight of 0.54 kg. However, at the finisher phase, T_3 shows a similar performance to the control diet with feed conversion ratio of 2.30 and final weight of 1.82 kg. The bread waste could be used as a replacement for maize in the diets of broilers either partially or completely in order to reduce feed cost and subsequently the cost of production.

Keywords: bread waste; broiler; performance; carcass characteristics; maize; chicken.

1. Introduction

Poultry production is an aspect of livestock production that deals with rearing of birds of different breeds either for meat or egg production. One of the major problems facing poultry production in Africa is the high cost of feed ingredients particularly grains, proteins, concentrates, vitamins and mineral premix. The competition between humans and domestic fowl for some feedstuffs greatly hampers the production of quality meat and eggs. The broiler chicken industry has now occupied the second place in volume in the world just after pork (Yang and Jiang, 2005) that representing about 29% of the total meat production from farm animals and is rising every year (Mckay *et al*., 2000). Thus, the growth of poultry production has been based on strong consumer demand for products that are cheap, safe and healthy. The intensification and commercialization of poultry sector was accelerated by discoveries in the field of breeding, nutrition, housing management and disease control (Sasidhar, 2006). However, the projected growth of the industry depends to a great extent on the availability of feed ingredients to meet the requirements of the birds. Energy and protein source feeds contributes >90% of all required nutrients for poultry nutrition. This problem tends to reduce the rate of expansion of the poultry industry and has added to the low level of animal protein nutrition in a country.

A possible way of increasing the supply of poultry products at cheaper prices is by reducing the cost of production through the use of cheaper, locally available sources of energy source feeds. This competition affects the relative availability and affordability of basic feed ingredients used in poultry nutrition (Onifade, 1993). High cost of feed ingredients has drastically reduce production output in the poultry industry, therefore efforts have been made by animal nutritionists to increase the level of animal protein intake of the populace through the use of non-conventional feed ingredients. The major conventional energy source in the diets of poultry is maize. Maize is a staple food for man and confectionary industry; thus, there is a high competition for maize, which invariably leads to increase in the cost of this product. Bread waste is a by-product of the bakery industry that is made from flour, which is a product gotten from dehulled wheat (*Triticum aestusum*). Because bread waste is not consumed by man, it is always been disposed. Olomu (1995) stated that dried bakery products are highly digestible because of their pre-cooked nature and can easily be incorporated in the diets of poultry and swine. The author also stated that there is no anti-nutritional factor that is associated with wheat. Hence, there is a need to look inward for alternative feedstuffs that are non-conventional.

Hence this study was carried out to investigate the effect and inclusion of bread waste on the performance and carcass characteristics of broiler chickens.

2. Materials and Methods

The experiment was carried out at Bora Poultry of Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan, Oyo state. The experimental materials include bread waste, weighing scale, feeding trays feeding trough, drinkers (baby), broiler birds (240) and wood shavings etc.

2.1. Collection of Test Ingredient

The test ingredient (bread waste) was collected from butter field bakery and sun dried to prevent staling, the bread waste were incorporated into the experimental diet at 0%, 33%, 67% and 100% graded levels of inclusion as presented in gross composition of feed for starter and finisher diet in Tables 1 and 2. The proximate composition of the bread waste is shown in Table 3.

Table 1. Gross composition of the experimental diets for starter phase (%)

Ingredients	T_0	T_1	T_2	T_3
Maize (%)	56.00	37.50	18.50	0.00
Bread waste (%)	0.00	18.50	37.50	56.00
Groundnut cake (%)	18.00	18.00	18.00	18.00
Soyabean meal (%)	20.00	20.00	20.00	20.00
72% fish meal (%)	2.00	2.00	2.00	2.00
Lysine (%)	0.10	0.10	0.10	0.10
Methionine (%)	0.10	0.10	0.10	0.10
Limestone (%)	1.00	1.00	1.00	1.00
Bone meal (%)	2.30	2.30	2.30	2.30
Salt (%)	0.25	0.25	0.25	0.25
Broiler premix (%)	0.25	0.25	0.25	0.25
Total	100	100	100	100
Metabolisable energy (kcal/kg)	2843	2840	2845	2848
Crude protein (%)	22.10	23.50	22.60	22.15

Note: premix: Vit A 8000 iu, Vit D3 2000 iu, Vit E 5 iu, Vit K 2 mg, Riboflavin 4.20 mg, Vit B12 0.01 mg, Pantothenic acid 5 mg, Nicotinic acid 20 mg, Folic acid 5 mg, Choline 300 g, Mn 56 mg, Fe 20 mg, Cu 10 mg, Zn 50 mg, and 1.25 mg.

2.2. Management of Experimental Birds

A total of 240 unsexed day old Arboracre broiler chicks were purchased, the birds were collected from Chi farms Ajanla along Lagos Ibadan express road, Oyo State, Nigeria. The birds were completely randomised based on weight and allotted into 4 dietary treatments with each treatment having 3 replicates. The birds were housed in 12 different compartments and they were kept on deep litter system of management. Feed and water were provided each day.

All necessary vaccinations and medications were carried out as at when due. Immediately the birds arrived, they were given Gentamycin injectable (subcutaneously) in order to confer immunity on the birds. Vitalyte and glucose were also served in water. The first Gumboro vaccination was given on the 7th day and on the 10th day Newcastle disease vaccine Lasota was administered to prevent the chicks against Newcastle disease. The second IBDV was administered on the 18th day, second Lasota vaccine was also administered on the 28th day. All vaccines were administered orally according to manufacturers' instruction. Coccidiostat drug (prococ) was given to the birds for 5 days on the 3rd and 6th week respectively. The experiment lasted for a period of eight weeks. The first 4 weeks was for the starter phase, and last 4 weeks was for the finisher phase.

Table 2. Gross composition of experimental diets for finisher phase (%)

Ingredients	T_0	T_1	T_2	T_3
Maize	60.00	40.00	20.00	0.00
Bread waste	0.00	20.00	40.00	60.00
Wheat bran	2.00	2.00	2.00	2.00
Soyabean meal	30.00	30.00	30.00	30.00
60% fish meal	2.40	2.40	2.40	2.40
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Limestone	1.90	1.90	1.90	1.90
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Broiler premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
Metabolisable energy (kcal/kg)	2930	2933	2934	2925
Crude protein (%)	20.11	20.10	20.11	20.15

Note: premix: Vit A 8000 iu, Vit D3 2000 iu, Vit E 5 iu, Vit K 2 mg, Riboflavin 4.20 mg, Vit B12 0.01 mg, Pantothenic acid 5 mg, Nicotinic acid 20 mg, Folic acid 5 mg, Choline 300 g, Mn 56 mg, Fe 20 mg, Cu 10 mg, Zn 50 mg, and 1.25 mg.

Table 3. Proximate composition of the bread waste

Parameters (%)	Bread waste
Dry matter	89.18
Ash	0.64
Ether extract	2.14
Crude fibre	1.04
Crude protein	12.38
Gross energy (kcal/g)	2.67

2.3. Data Collection

2.3.1. Feed intake

A known quantity of feed was given to the chicks on daily basis while the leftover of feed was weighed to determine daily feed intake and consequently weekly feed intake. All birds were fed adlibitum each day to ensure adequate access to feed.

$$\text{Feed intake per bird} = \frac{\text{Feed supplied} - \text{Leftover of feed}}{\text{Number of birds}}$$

2.3.2. Weight gain

The live weight gains were recorded on weekly basis. The initial live weight was deducted from the final live weight and divided by the number of birds per treatment compartment. Birds are usually weighed before feeding in the morning.

$$\text{Weight gain} = \frac{\text{Final live weight} - \text{Initial live weight}}{\text{Number of birds/treatment/replicate}}$$

2.3.3. Feed conversion ratio

Feed conversion ratio of each group of birds was determined by calculating the ratio of feed intake to weight gain and thus calculated as:

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Feed intake}}{\text{Weight gain}}$$

2.4. Carcass Evaluation

At the end of the experiment, a total of 120 birds in which 10 birds per replicate were randomly selected and fasted overnight for feed but given water to prevent shrinkage. Each bird was weighed, slaughtered, bled, plucked and eviscerated. The live weight, plucked weight and dressed weight were taken. Also, cut-up parts (head, neck, wings, breast, thigh, drumstick, back and shank) and organs (gizzard, liver, spleen and heart) were weighed and taken as criteria for the measurement of carcass performance. All weights were taken using Mettler® top-loading sensitive scale and expressed as percentage of the live weight.

2.5. Statistical Analysis

The experimental design was a Completely Randomised Design (CRD) and data obtained were subjected to Analysis of Variance. Significant differences among treatment means were determined using Duncan Multiple Range Test (Duncan, 1955) as contained in SAS (2011) package. The experimental model that was used is shown below:

$$Y_{ij} = \mu + T_i + \varepsilon_{ij}$$

where Y_{ij} = Observed yield, μ = Overall mean value, Ti = Effect of bread waste, and ε_{ij} = Random residual error.

3. Results and Discussion

The gross composition and calculated analysis of the experimental diets at starter phase is shown in Table 1 on fed basis. All treatment diets were formulated according to broiler requirements for starter phase. Treatment 0 which is the control diet was formulated without replacing maize with bread waste while treatments 1, 2 and 3 were formulated by replacing maize with bread waste at various inclusion levels. All feed ingredients in percentages were similar across all treatment diets except for maize and bread waste that was varied.

The gross composition of the experimental diets at finisher phase is shown in Table 2 as fed basis. All treatment diets were formulated according to broiler requirements for finisher phase. Treatment 0 which is the control diet was formulated without replacing maize with bread waste while treatments 1, 2 and 3 were formulated by replacing maize with bread waste at various inclusion levels. All ingredients in percentages were similar across all treatment diets except for maize and bread waste that was varied. The calculated analysis shows that the metabolisable energy (kcal/kg) and the crude protein (%) were similar across the treatment diets.

The proximate composition of the bread waste has been shown in Table 3. Table 4 shows the proximate composition of starter diets with the highest dry matter of 90.29% for T_0, which is the control diet. T_3 had (90.07%) of dry matter and ether extract of 3.88% which was the highest while T_2 has 3.63%. T_0 had the highest ash content of 5.32% followed by T_2 (5.23%), crude fibre was 6.73% in T_3 compared to T_2 (5.58%) which had the lowest value. T_3 had the highest crude protein of 23.01% as compared to T_0 that recorded the least value 22.16%. The crude protein obtained for the starter phase in this study is in accordance with that in the literature by smith (1995) who reported that crude protein of 23% is required for the starter phase.

Table 4. Proximate composition of starter diet

Parameters (%)	T_0	T_1	T_2	T_3
Dry matter	90.29	89.56	89.82	90.01
Crude protein	22.16	25.59	22.94	23.01
Ether extract	3.50	3.53	3.63	3.88
Ash	5.32	4.59	5.23	5.08
Nitrogen free extract	54.19	50.22	52.44	51.37
Crude fibre	5.12	5.63	5.58	6.73

Table 5 shows the proximate composition of finisher diets. T_3 had the highest dry matter of 90.84% compared to T_2 that recorded the lowest value 90.76% for dry matter. T_3 had the highest ether extract of 4.07% compared to T_2 that recorded a lower value of 3.52%. The ash content for T_1 was 5.26% which was the highest compared to 5.13% recorded for T_3. Crude protein of 20.62% was recorded for T_3 compared to T_0 that recorded the lowest value of 19.34%. The crude protein obtained for the finisher phase in this study is in accordance with that in the literature by smith (1995) who reported that crude protein of 20% is required for the finisher phase.

Table 5. Proximate composition of finisher diet

Parameters (%)	T_0	T_1	T_2	T_3
Dry matter	90.67	91.23	90.76	90.84
Crude protein	19.34	19.75	20.11	20.62
Ether extract	3.51	3.48	3.52	4.07
Ash	5.21	5.26	4.07	5.13
Nitrogen free extract	57.53	56.82	56.89	54.46
Crude fibre	5.08	5.92	6.17	6.56

Table 6 shows the performance of broiler birds fed bread waste based diet at the starter phase. There were significant differences (P<0.05) on average feed intake/bird/kg with T_1 having the highest mean (1.34 kg) value compared to T_2 that recorded (0.98 kg) for its mean value. Significant differences were not obtained for average weight gain/bird/kg. Significant differences (P<0.05) were obtained on the feed conversion ratio across the dietary treatment with T_2 having the lowest mean value (2.08) compared to T_1 that recorded the highest mean value (2.56). There were no significant differences on the final live weight at the starter phase. However, control diet showed similar performance with T_2. The result obtained on the final weight at the starter phase disagrees with the findings of Al-Ruqaie *et al* (2011) who reported that BWP could replace 100% of the corn in broiler diets at the starter phase without any adverse effects on the performance when corn was used at levels of 53.7% in the finisher diets. However, Saleh *et al*. (1996) and Al-Tulaihan *et al*. (2004) suggested that the maximum dietary level of BWP in broiler diets were at 10, 15, 25 and 30%, respectively.

Table 6. Performance characteristics of broilers fed bread waste based diet at starter phase

Parameter	T_0	T_1	T_2	T_3	SEM
Initial weight (kg)	0.07	0.07	0.07	0.08	0.00
Average feed intake/bird/kg	1.22^a	1.34^a	0.98^b	1.21^a	0.04
Average weight gain/bird/kg	0.53	0.52	0.47	0.50	0.01
Feed conversion ratio	2.29^{ab}	2.56^a	2.08^b	2.42^a	0.06
Final live weight (kg)	0.61	0.60	0.54	0.58	0.01

Note: ^{ab} Means on the same row with different superscript are significantly different (P<0.05); SEM: Standard error of means.

Table 7 shows the performance of broiler birds fed bread waste at the finisher phase. There were no significant differences (P>0.05) on the initial weight, average feed intake/bird/kg, average weight gain/bird/kg, and the final live weight at the finisher phase. Highest initial live weight (0.61) for finisher phase was recorded in T_0 compared to T_3 that recorded the least value (0.58 kg). Average feed intake/bird/kg was similar throughout the finisher phase with T_2 recording (3.24 kg) compared to T_3 that recorded the least value (2.90 kg). Feed conversion ratio was significant (P<0.05) throughout the finisher phase with T_1 having the highest FCR (3.4) compared to T_3 that recorded the least value (2.33). According to Brown *et al.* (2001) who reported that comparison of feed conversion ratio among difference species may be of little significance unless the feeds involve are of similar quality and suitability. The result obtained in this study shows that birds on T_3 had more ability to turn feed to body mass due to their low feed conversion ratio value compared to birds on T_0. The final live weight was similar across the treatment group with T_3 having the highest weight (1.82 kg) compared to T_1 that recorded the least value (1.52 kg) and this result agrees with the findings of Al-Ruqaie *et al* (2011) who reported that BWP could replace 100% of the corn in broiler diets without any adverse effects on the performance when corn was used at levels of 62.78% in the finisher diets.

Table 7. Performance characteristics of broilers fed bread waste diet at finisher phase

Parameter	T_0	T_1	T_2	T_3	SEM
Initial weight (kg)	0.61	0.60	0.54	0.58	0.01
Average feed intake/bird/kg	3.03	3.21	3.24	2.90	0.08
Average weight gain/bird/kg	1.01	0.94	1.14	1.24	0.05
Feed conversion ratio	2.99^{ab}	3.40^{a}	2.92^{ab}	2.33^{b}	0.16
Final live weight (kg)	1.62	1.54	1.68	1.82	0.06

Note: ^{ab} Means on the same row with different superscript are significantly different ($P<0.05$); SEM: Standard error of means.

Table 8 shows the carcass characteristics of broilers fed bread waste based diet. There were no significant differences ($P>0.05$) on the live weight, carcass weight, drum stick, back, neck, wing, shank, head and liver. However, significant differences were obtained on eviscerated weight, thigh, breast, gizzard, spleen and the heart. The highest eviscerated weight (70.72) was recorded for T_3 compared to T_1 that recorded the least value (62.45). The enviscerated weight obtained in this study was lower than that recorded by Aduku and Olukosi (2000) who reported 78% for Nigerian dressed chickens. The thigh varies across the dietary treatment with T_3 having the highest mean value of 10.41 compared to 8.38 which was recorded for T_1. A significant difference was recorded for the breast meat with T_3 having the highest mean value (20.58) compared to T_1 that recorded the least value (14.49). The mean value for gizzard was higher (2.46) in T_0 which might be due to the inclusion of maize that allowed muscular functioning of the gizzard as compared to T_3 that recorded a lower mean value (1.43) which had bread waste in its diet. The result obtained for gizzard weight for birds on T_3 had lower weight as compared with others. The decreased gizzard weight obtained for birds in T_3 could be as a result of the particle size and higher inclusion level of bread waste in the diet which might have led to decreased muscular function (grinding) of the gizzard. Aderolu *et al.* (2007) reported that gizzard weight is expected to increase due to more work to blend the grains ingested. This result is in agreement with those from Longe (1987) and Adeyemo *et al*. (2013) who reported that gizzard weights were significantly lower for the diets containing biscuit waste at 25 – 100% replacement for maize. Higher mean values were recorded for spleen (0.17) and heart (0.47) in T_3 compared to T_1 and T_2 that recorded same mean (0.12) values for spleen.

Table 8. Carcass evaluation of broilers fed bread waste based diet as percentage of live weight

Parameters (% LW)	T_0	T_1	T_2	T_3	SEM
Live weight (g)	1513.30	1500.00	1741.70	1830.00	75.69
Carcass weight	92.13	93.04	92.61	92.78	0.51
Eviscerated weight	68.99^{ab}	62.45^{b}	66.50^{ab}	70.72^{a}	67.17
Thigh	10.62^{a}	8.38^{b}	10.06^{a}	10.41^{a}	0.33
Drumstick	9.47	8.99	10.31	9.65	0.31
Breast	15.53^{ab}	14.49^{b}	17.97^{ab}	20.58^{a}	0.86
Back	16.74	15.32	15.31	16.38	0.89
Neck	3.05	3.01	2.95	2.94	0.10
Wing	8.71	7.10	7.52	8.25	0.29
Shank	4.46	3.94	3.87	3.57	0.16
Head	3.47	2.74	3.38	3.10	0.17
Gizzard	2.46^{a}	2.01^{b}	1.75^{b}	1.43^{c}	0.12
Liver	2.24	2.31	2.53	2.39	0.07
Spleen	0.13^{ab}	0.12^{b}	0.12^{b}	0.17^{a}	0.01
Heart	0.39^{b}	0.35^{b}	0.40^{b}	0.47^{a}	0.01

Note: ^{ab} Means on the same row with different superscript are significantly different (P<0.05); SEM: Standard error of means.

4. Conclusions and Recommendation

From the results obtained in this study, it can be deduced that increasing levels of bread waste in replacement for maize in broiler diets can be practised because it showed similar performance to the control diet on carcass yield. It can be therefore recommended that 67% inclusion level of bread waste as a replacement for maize at the starter phase is ideal, while 100% inclusion level of bread waste as a replacement for maize at the finisher phase will give similar performance and carcass yield to the control diet.

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