EFFECT OF SUBSTITUTING MAIZE WITH BISCUIT WASTE MEAL ON THE GROWTH PERFORMANCE, CARCASS TRAITS, RELATIVE ORGAN WEIGHT AND COST BENEFIT OF BROILER CHICKENS

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ABSTRACT

A feeding trial was conducted for a duration of eight weeks to assess the effect of substituting maize with biscuit waste meal (BWM) on the performance of 144 day old Anak 2000 broiler chickens. Four experimental broiler starter and finisher diets were formulated with diet 1 as the control. Diets 1, 2, 3 and 4 were formulated to contain BWM at 0, 25, 50 and 75 % replacement for maize. Chicks were randomly assigned to the four treatment diets (1, 2, 3 and 4) in a completely randomized design (CRD) and each treatment group contained three replicates with twelve chickens per replicate. Results on the growth performance revealed that average live weight, daily feed intake, daily weight, protein efficiency ratio and feed conversion ratio were significantly (p<0.05) better in birds fed 50 % BWM than those fed other dietary treatments. Carcass traits such as back and breast muscles as well as the relative weights of gizzard and kidney weight were significantly (p<0.05) influenced by the dietary treatments. Cost of feed/kg weight gain and net profit were highest among birds fed 50 % BWM and least in 75 % BWM based diet. The results suggest that BWM can replace maize up to 50% inclusion level in broiler diet for optimum performance and good economic returns.

Keywords: Biscuit waste meal, Broilers, Performance, Cost benefit

INTRODUCTION

In most developing countries such as Nigeria, animal protein intake has fallen below the 35 g/head/day recommended by FAO/WHO/UNU (1985). The obvious reason for this anomaly is the soaring increase in the prices of meat and other animal products such as milk and eggs which have gone beyond the reach of the common man. This has culminated in various nutritional deficiency ailments such as kwashiorkor, beriberi, marasmus among many others in infants and children, not only in rural areas but also in major cities (Onyimonyi and Ene, 2003). To this end, there is an urgent need to encourage the production of small, highly prolific livestock such as rabbits, chickens, quails and grass cutters with rapid turnover rate and very low cost of production. But the high cost of energy and protein feed sources such as maize and soya bean meal and the stiff competition for these feed stuffs between man and livestock has become an issue to ponder on. Consequently, the substitution of maize with agro by-products in poultry ration will significantly reduce cost of production (Adejumo *et al.,* 2005). This has motivated research effort in the utilization of alternative and cheaper feed resources particularly the agro-industrial by-products and wastes to replace maize in livestock feeding (Omoikhoje, 2004; Ajaja, 2005; Onimisi *et al.,* 2008; Fasuyi and Olumuyiwa, 2012; Babatunde, 2013). Onuh (2005) reported that agro-industrial by-products could be included at 10 % level in the diet of finishing broilers without any adverse effect on performance with a reduction in the feed cost per weight gain of birds. Besides, cassava root meals have been successfully used in the diet of pullet chicks at 42 % replacement level for maize without any deleterious effect on performance (Agugu and Okeke, 2005). Several authors have reported their success story on the use of biscuit waste meal as unconventional energy source to replace maize that is expensive and not readily available (Ajasin *et al.,* 2010; Apata *et al.,* 2010; Eniolorunda *et al.,* 2011; Adeyemo *et al.,* 2013). The focus of this study therefore is on biscuit waste meal (BWM) which is a by-product of wheat flour processing industry into biscuits, wafers, crackers etc. Large quantities of these wastes are produced in biscuit industry but there is dearth of information on their utilization in poultry feed formulation. This investigation was therefore carried out to assess the replacement value of BWM for maize on the performance, carcass traits, cost and returns of broiler chickens.

MATERIALS AND METHODS

Experimental Farm: The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Ambrose Alli University, Ekpoma, Edo State of Nigeria. The farm lies between latitude 6.44^0N and longitude 6.80^0E in Esan West Local Government Area, Ekpoma, Edo State of Nigeria. Ekpoma is within the south-south geo-political zone of Nigeria and has a prevailing tropical climate with a rainfall of about 1556 mm. The ambient temperature ranges from 26°C in December to 34°C in February, relative humidity ranges from 61 % in January to 92 % in August with yearly average of about 82 ± 15.0 %. The vegetation represents an interface between the tropical rainforest and the derived savanna.

Dietary Ingredients: The Biscuit Waste Meal (BWM) used for the research was obtained from NIKI Manufacturing Company, Kilometre 1, Ogba Road, beside NPDC, Benin City, Edo Nigeria. All other ingredients used for the formulation of the experimental diets were purchased from a commercial feed mill in Benin City and Ekpoma.

Design and Management of Experimental Birds: A total of 144 day-old Anak 2000 broiler chicks were used for the study. Thirty six birds each were selected based on their average initial weights and each group of birds was allotted to each of the four treatment diets (1, 2, 3 and 4) in a completely randomized design (CRD). Each treatment group contained 3 replicates of 12 chicks each. All chicks were brooded for four weeks in a deep litter compartment. The house, feeders and drinkers were properly washed and disinfected. The birds were fed with Top feed (super starter) having 22 % crude protein for one week acclimatization period. The birds had access to experimental feeds and clean water *ad-libitum.* Routine medication, vaccination and other management practices were carried out throughout the duration of the experiment.

Experimental Diets: The biscuit waste meal and maize used as basal ingredients were analysed for proximate compositions (Table 1) and four treatment diets (1, 2, 3 and 4) of both broiler starter and finisher phases were formulated as shown in (Table 2).

Table 1: Proximate composition of maize and biscuit waste meal

Component (%)	Maize	Biscuit waste meal
Dry matter	88.00	92.40
Crude protein	9.00	7.87
Crude fat	4.20	10.16
Crude Ash	1.90	1.62
Carbohydrate	72.00	49.46

Diet 1 was formulated to contain 55.50% maize (control diet), while diets 2, 3 and 4 were formulated by replacing the percentage of maize in diet 1 with 25, 50 and 75 % levels of BWM respectively. Both starter and finisher diets were iso-nitrogenous (23 and 21 %) and iso-caloric (2800 and 3000 ME Kcal/Kg).

Performance Study: During the feeding trial, daily feed intake, daily weight gain, feed conversion ratio and protein efficiency ratio were assessed. The average weekly feed intake was divided by the number of birds and further divided by seven for average feed intake per bird per day.

Table 2: Percentage compositions of broilers starter and finisher diets

Ingredients	Inclusion levels of BWM (%)							
	Starter Diets				Finisher Diets			
	0	25	50	75	0	25	50	75
	1	2	3	4	1	2	3	4
Maize	55.50	41.13	27.25	13.37	55.50	41.50	27.50	13.50
BWM	0.00	13.87	27.25	41.63	0.00	14.00	28.00	24.00
Soya bean meal	34.00	34.00	34.00	34.00	30.00	30.00	30.00	30.00
Fish meal	3.00	3.00	3.00	3.00	1.50	1.50	1.50	1.50
Wheat offal	2.00	2.00	2.00	2.00	4.50	4.50	4.50	4.50
PKC	2.00	2.00	2.00	2.00	4.50	4.50	4.50	4.50
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Lime stone	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Determined analyses								
Crude protein	23.00	22.37	22.51	22.64	21.00	21.16	21.30	21.44
Crude fibre	3.50	5.82	4.15	4.51	3.38	3.74	4.09	4.40
Ether extract	3.30	3.49	3.67	3.84	3.36	3.35	3.73	3.90
Starch	39.80	32.36	28.90	27.61	41.00	33.54	25.88	28.22
Calcium	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ME (Kcal/Kg)	2800	2749	2685	2634	2989	2955	2992	2928

The weekly weight gain was determined by the difference in the weight at the beginning of the week and the weight at the end of the week. Feed conversion ratio was calculated as the ratio of feed intake in grams to weight gain, also in grams. This was estimated weekly and at the end of the experiment. While, protein efficiency ratio was calculated as the ratio of weight gain to that of protein consumed. The formulae for calculating feed conversion and protein efficiency ratios are expressed thus: Feed Conversion Ratio = Feed Intake (g) / Weight Gain (g), and Protein Efficiency Ratio = Weight Gain of bird (g)/ Protein Consumed (g).

Carcass study: On the last day of the feeding trial, three (3) birds were selected based on their average live weight from each treatment group making a total of 12 broilers from the entire experiment. The broilers were starved of feed for 12 hours, but drinking water was provided. Each bird was tagged and weighed before and after slaughtering to determine the live and bled weights. The slaughtered broilers were dipped in hot warm water for about one minute and the feathers were plucked and the weights taken as plucked weight. The plucked chickens were eviscerated and also weighed as eviscerated weights. The eviscerated weight refers to the weight of the bird being partially butchered with all the intestinal organs removed. The carcass was thereafter cut into parts, such as back, breast muscle, drumsticks, head, neck, shanks, thighs, and wings. The organs such as gizzard, heart, kidney, liver and lungs were excised, blotted free of blood and weighed using a sensitive scale. The weights of the organs and cut parts were recorded and measured relative to the eviscerated weights as expressed: Relative organ weight = weight of organ / eviscerated weight x 100 and Relative cut part = weight of cut part / eviscerated weight x 100.

Cost Benefit Analysis: The prices of the feed ingredients at the time of the experiment were used to estimate the economic cost-benefit of raising broilers up to 8 weeks of age with biscuit waste meal (BWM) which was calculated as production cost = seed cost + feed cost + management cost for the respective dietary types.

Statistical Analysis: All data collected were subjected to a one-way analysis of variance (ANOVA) and differences between treatment means were compared using Duncan's Multiple Range Test (Duncan, 1955). All statistical procedures were carried out with the aid of SAS (1999) package.

RESULTS AND DISCUSSION

Tables 3 and 4 showed the performance of broiler chickens as influenced by the dietary treatments at the starter and finisher phases. Live weight was significantly influenced ($p<0.05$) by the dietary treatments with highest value (825 g/bird) recorded among birds placed on 50 % BWM, followed by a similar value (819 g/bird) in diet 2. The value in diet 2 was also similar to that in diet 4 and lowest (744 g/bird) value recorded in birds fed the control diet. The increase in weight gain and subsequent higher live weight may be due to nutrient density and availability in BWM which complemented that of maize and this perhaps accounted for the improvement in growth rate. This was in agreement with the findings of Świątkiewicz and Koreleski, (2006) who reported that distiller dried grain with soluble (DDGS), by-product of the ethanol industry produced by dry-mill ethanol plant can be included up to 5 – 8 % in the diet of starter broiler, and 10 – 15 % level in broiler finisher as partial replacement for soya bean meal, corn and other cereals. The findings of this study was also in agreement with the findings of Eniolorunda *et al.* (2008) who reported significant improvement in the growth rate of layer hens maintained on graded levels of indomie waste meal. Daily feed intake was statistically similar ($p>0.05$) with highest value of 32.62 g/bird recorded in bird fed 50 % BWM and lowest in birds fed 25 % BWM at the starter phase, while a significant ($p<0.05$) variation was observed at the finisher phase with highest value (101.90 g/bird) in birds placed on 50% BWM and least value of 94.16 g/bird in birds fed diet 4. The significant variation recorded in birds that ate 50% BWM could be adduced to the adequacy of dietary energy which enhanced the palatability of the diet and subsequently led to increase in the amount of feed consumed by the birds (Oduguwa *et al.,* 2004). Daily weight gain was significantly influenced ($p<0.05$) at both phases with highest values (29.17 and 42.38 g/bird) recorded in birds placed on 50 % BWM, while the least numerical values (26.37 and 37.73 g/bird) were recorded in birds fed the control diet. Protein efficiency and feed conversion ratios at the starter phase were statistically similar ($p>0.05$) among birds fed the varied treatment diets with values ranging from 1.18 % in diet 4 to 1.24 % in diet 3 and 1.10 % in diet 4 to 1.19 % in diet 2 respectively.

At the finisher phase the replacement of maize with BWM significantly ($p<0.05$) influenced the live weight with highest value of 2.17 kg/bird recorded among birds fed 50 % BWM and lowest value of 1.78 kg/bird recorded in birds placed on 75 % BWM which was comparable to the values recorded in diets 2(1.88 kg) and 1(1.82 kg). The increase in weight gain and subsequent higher live weight may be due to nutrient density and availability in BWM which complemented that of maize which perhaps accounted for the improvement in growth rate. The findings of this study was in agreement with the findings of Eniolorunda *et al.* (2008) who observed a significant improvement in the growth rate of layer hens maintained on graded levels of indomie waste meal. Weekly feed intake was significantly higher ($p<0.05$) (101.90 g/bird) in birds fed 50 % BWM, followed by comparable values of 97.62 and 96.81 g/bird in birds fed diets 1 and 2 respectively and lowest (94.16 g/bird) in diet 4. Weekly weight gain was also significantly higher ($p<0.05$) (42.38 g/bird) in birds fed 50 % BWM, followed by comparable values of 37.37 and 36.09 g/bird recorded in birds that ate the control diet and diet 4 respectively and lowest (39.15 g/bird) in birds fed diet 2. Protein efficiency ratio was significantly better ($p<0.05$) (2.01 %) in birds placed on 50 % BWM followed by comparable values of 1.86 and 1.72 % recorded in birds placed on diets 2 and 4 respectively, and lowest (1.80 %) in birds fed the control diet. Feed conversion ratio of birds was significantly better ($p<0.05$) in diet 3 (2.61), followed by similar values (2.59 and 2.47) recorded in birds that ate diets 1 and 2 and poorest (2.40) in birds fed diet 4. Feed utilization was better in birds fed 25 and 50 % BWM compared to those that were fed with other treatment diets.

Table 3: Performance characteristics of broilers starter fed treatment diets

Parameters	Inclusion levels of BWM (%) (Diets)			
	0	25	50	100
	1	2	3	4
Ave. initial body weight (Kg/birds)	45.00 ± 0.01	44.90 ± 0.03	45.00 ± 0.04	44.90 ± 0.03
Ave. live weight (g/birds)	774.00 ± 2.17^{c}	819.00 ± 2.19^{ab}	825.00 ± 2.21^{a}	813.00 ± 2.19^{b}
Ave. Daily feed intake (g/bird)	32.54 ± 0.77^{a}	32.27 ± 0.79^{a}	32.62 ± 0.82^{a}	31.38 ± 0.81^{a}
Ave. Daily weight gain (g/bird)	26.37 ± 0.28^{b}	27.23 ± 0.31^{b}	29.17 ± 0.37^{a}	28.24 ± 0.34^{b}
Protein efficiency ratio	1.23 ± 0.01^{a}	1.19 ± 0.03^{a}	1.24 ± 0.04^{a}	1.18 ± 0.02^{a}
Feed efficiency ratio	1.14 ± 0.03^{a}	1.19 ± 0.09^{a}	1.12 ± 0.05^{a}	1.10 ± 0.02^{a}

abc: means in the same row with varying superscript differ significantly (p<0.05), Ave. = average

Table 4: Performance characteristics of broilers finishers fed treatment diets

Parameters	Inclusion levels of BWM (%) (Diets)			
	0	25	50	100
	1	2	3	4
Ave. Live weight (Kg/birds)	1.82 ± 0.05^{b}	1.88 ± 0.07^{b}	2.17 ± 0.02^{a}	1.78 ± 0.04^{b}
Ave. Daily feed intake (g/birds)	97.62 ± 1.82^{b}	96.81 ± 1.96^{b}	101.90 ± 1.98^{a}	94.16 ± 2.02^{b}
Ave. Daily weight gain (g/bird)	37.37 ± 0.29^{c}	39.15 ± 0.34^{b}	42.38 ± 0.52^{a}	36.08 ± 0.42^{c}
Protein efficiency ratio	1.80 ± 0.01^{b}	1.86 ± 0.03^{b}	2.01 ± 0.04^{a}	1.72 ± 0.03^{c}
Feed conversion ratio	2.59 ± 0.04^{b}	2.47 ± 0.12^{b}	2.40 ± 0.08^{c}	2.61 ± 0.10^{a}

abc: means in the same row with varying superscript differ significantly (p<0.05), Ave. = average

This indicated that birds fed 25 and 50 % BWM optimally utilized their diets than those fed control and 75 % BWM. Protein utilization which is a measure of the value of digestible protein in feed was also better in 50 % BWM compared to other test diets. This may be due to the quality of nutrient in BWM which complemented that of maize. This observation agreed with earlier report of Onuh (2005) and Ayanwale and Aya (2006).

The data on the carcass characteristics of broilers fed varied percentages of BMW revealed that the average live weight, plucked and eviscerated weights as well as dressing percentage were not significantly influenced (p>0.05) by the treatment diets (Table 5). The average live weight of broiler chickens ranged from 1.78 kg/bird in diet 4 to 2.07 kg/bird in diet 3. Plucked and eviscerated weight values were 1.67 and 1.45 kg/bird, 1.71 and 1.42 kg/bird, 1.88 and 1.60 kg/bird, 1.68 and 1.35 kg/bird in birds fed diets 1, 2, 3 and 4 respectively. The similarities in the values of all the carcass traits examined in the study may be traced to the fact that broilers utilized the test diet effectively due to the high quality of the test diets. Dressing percentages were also similar (p>0.05) among birds fed the treatment diets which ranged from 75.41 % in birds fed 25 % BWM to 74.16 % in birds fed diet 3.

The non-significant variation in the dressing percentages of broilers fed the test diets suggested that broilers can perform well on diets formulated with various levels of BWM for salable poultry meat. Besides, the values for dressing percentage obtained in birds fed the treatment diets fell beyond the recommended range of 65.5 – 70.0 % reported as optimum weight for table birds (Nwokoro and Tewe, 1998; Adeniji, 2004). Relative weight of back was significantly higher (p<0.05) (6.82 %) in birds fed diet 2, but similar to 6.53 % recorded in birds fed 50 % BWM and least in birds fed diets 1(5.64 %) and 4(5.53 %). This could be due to the fact that the bird fed diet 2 built less bones at the back compared to birds fed other treatment diets. Relative weight of breast followed a similar pattern with that of back relative weight with highest value (18.88 %) recorded in birds fed diet 3, but similar to the value (18.66 %) recorded in diet 2. While, the values obtained in birds fed diets 1 and 4 (16.62 and 16.54 %) were statistically similar. It is obvious from the result that birds fed the control diet built more muscle at the breast than birds fed the test diets. Relative weights of drum stick, head, neck, shanks, thighs and wings showed no significant variation (p>0.05) among birds fed the treatment diets.

Table 5: Carcass traits of broiler chickens fed treatment diets

Parameters	Inclusion levels of BWM (%) (Diets)			
	0	25	50	75
	1	2	3	4
Average live weight (kg/bird)	1.83 ± 0.08[a]	1.87 ± 0.26[a]	2.07 ± 0.27[a]	1.78 ± 0.28[a]
Plucked weight (kg/bird)	1.67 ± 0.06[a]	1.71 ± 0.19[a]	1.88 ± 0.20[a]	1.63 ± 0.21[a]
Eviscerated weight (kg/bird)	1.45 ± 0.06[a]	1.42 ± 0.19[a]	1.60 ± 0.21[a]	1.35 ± 0.22[a]
Dressing percentage (%)	75.00 ± 0.81[a]	75.41 ± 2.64[a]	74.16 ± 2.62[a]	74.86 ± 2.81[a]
Cut Parts (%)				
Back	5.64 ± 0.43[b]	6.82 ± 1.40[a]	6.53 ± 1.41[a]	5.53 ± 1.36[b]
Breast muscle	16.62 ± 0.86[b]	18.66 ± 0.93[a]	18.88 ± 0.97[a]	16.54 ± 0.85[b]
Drumsticks	15.44 ± 1.56[a]	15.66 ± 1.52[a]	15.54 ± 1.55[a]	15.59 ± 1.51[a]
Head	2.46 ± 0.15[a]	2.42 ± 0.17[a]	2.66 ± 0.19[a]	2.51 ± 0.16[a]
Neck	4.18 ± 0.12[a]	4.42 ± 0.13[a]	4.22 ± 0.11[a]	4.81 ± 0.15[a]
Shanks	3.54 ± 0.28[a]	3.65 ± 0.31[a]	3.62 ± 0.32[a]	4.23 ± 0.34[a]
Thigh muscles	18.62 ± 0.80[a]	19.95 ± 0.82[a]	20.35 ± 0.80[a]	18.62 ± 0.78[a]
Wings	12.59 ± 0.56[a]	12.84 ± 0.52[a]	12.84 ± 0.52[a]	12.54 ± 0.47[a]

abc: Means in the same row with varying superscript differ significantly (p<0.05)

Results of the relative organ weights of broiler fed the treatment diets showed that only the relative weights of gizzard and kidney varied significantly ($p<0.05$) among the dietary treatments. However, relative weights of heart, liver and lungs were statistically similar ($p>0.05$) among birds fed the treatment diets (Table 6). Relative weight of gizzard was highest (5.08 %) in birds placed on 25 % BWM and lowest (3.75 %) in diet 4. Relative weight of kidney was significantly higher ($p<0.05$) (0.26 %) in birds fed 25 % BWM, but similar (0.24 %) to those fed diet 4. Comparable values of 0.19 and 0.19 % were recorded in birds fed diet 3 and 1 respectively. The comparable weight of gizzard and kidney amongst the treatment group showed that the observed variation may not necessarily be due to the test diets because no particular pattern was followed. The non-significant variation in the relative weight of liver further suggested that there was a balance of nutrients in the test diets. This was in agreement with the reports of Okosun and Eguaoje (2017).

The analysis of cost and returns of broilers as affected by the treatment diets (Table 7) revealed that cost of feed consumed at the starter phase reduced as the inclusion of BWM increased with least cost (₦36.45) recorded in diet 4 and highest cost (₦43.30) in the control diet. Cost of feed per kilogram weight gain was least (₦33.88) in birds that consumed diet 3, followed by (₦34.50) in diet 4 and highest (₦35.09) in birds fed the control diet. At the finisher phase, cost of feed consumed followed the same trend as that of the starter phase with least cost (₦96.29) in diet 4 followed by (₦104.17) in diet 3 and highest (₦118.66) in birds that ate the control diet. Cost of feed per kilogram weight gain was also least (₦39.61) in diet 4, followed by (₦43.32) in diet 3 and highest (₦45.86) in birds placed on the control diet. Total cost of production reduced with increasing inclusion of BWM with least cost of production (₦352.74) recorded in birds fed diet 4, followed by ₦363.77 in diet 3 and highest (₦381.96) in control diet. Income was highest (₦1, 302.00) in birds fed 50 % BWM, followed by ₦1128.00 in diet 2 and least income (₦1, 088.00) was realized in birds fed diet 4. But, the least (₦ 710.00) net profit (₦/bird) was obtained from birds fed the control diet (0 % BWM), followed by 75 % BWM (₦715.26), 25 % BWM (₦754.95) and the highest (₦938.23) in broilers on 50 % BWM. It is obvious from the result that at both phases the cost of feed consumed, cost of feed per kilogram weight gain, cost of production and income decreased progressively as the inclusion of BWM increases from 0 – 75 %. The finding of this study was in agreement with that of McNab and Shannon (1994) and Zahari and Alimon (2006) who stressed the need for dietary formulation that can be used as alternative, non-competitive, readily available and cheap ingredient that can partly replace the conventional energy and protein feed stuffs in poultry diets.

Table 6: Relative organ weight of broiler fed dietary treatments

Organs	Inclusion levels of BWM (%) (Diets)			
	0	25	50	75
	1	2	3	4
Gizzard	4.88 ± 0.26[a]	5.08 ± 0.25[a]	4.44 ± 0.21[b]	3.75 ± 0.23[c]
Heart	0.89 ± 0.08[a]	0.93 ± 0.07[a]	0.76 ± 0.06[a]	0.93 ± 0.06[a]
Kidney	0.19 ± 0.01[b]	0.26 ± 0.04[a]	0.19 ± 0.02[b]	0.24 ± 0.01[a]
Liver	2.80 ± 0.13[a]	3.07 ± 0.11[a]	2.86 ± 0.08[a]	2.90 ± 0.10[a]
Lungs	0.81 ± 0.04[a]	0.95 ± 0.02[a]	0.59 ± 0.04[a]	0.81 ± 0.01[a]

abc: means in the same row with varying script differ significantly (p<0.05)

Table 7: Cost benefit analysis of broiler chickens fed treatment diets

Parameters	Inclusion levels of BWM (%) (Diets)			
	0	25	50	75
	1	2	3	4
Starter Phase				
Cost of feed consumed (₦/bird)	43.30	41.07	39.60	36.45
Cost of feed/kg weight gain (₦)	35.09	34.65	33.88	34.50
Finisher Phase				
Cost of feed consumed (₦/bird)	118.66	111.98	104.17	96.29
Cost of feed/kg weight gain (₦)	45.86	45.28	43.32	39.61
Total cost of production (₦/bird)	381.96	373.05	363.77	352.74
Income (₦/bird)	1092.00	1128.00	1302.00	1088.00
Net profit (₦)	714.04	745.95	938.23	715.20

Conclusion: From the overall results it was obvious that the inclusion of BWM in the diet of broiler chickens up to 50 % improved performance of broiler chickens and gave better economic returns.

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