GROWTH INDICES AND COST IMPLICATION OF BROILERS FED SPENT GRAINAND ENZYME SUPPLEMENTED DIETS

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ABSTRACT
This study was aimed at investigating growth indices and cost of feed consumption of broilers fed enzyme fortified diet containing high fibre content. One hundred and forty-four broilers of 7 d old were randomly assigned into nine treatments (SN1 to SN9) with each treatment replicated twice with eight birds per replicate. The experimental design used was a 3 x 3 factorial arrangement involving three levels of enzyme supplementation of 0 g, 0.5 g and 0.8 g per kg diet and three levels of spent grain inclusion of 0%, 6% and 12% in starter's diet and 0%, 7% and 12% in finisher's diets. Results obtained proved that DFI, FW, WG, FCR and FC were affected ($p < 0.05$) in starter and finisher birds across treatments. Starter broilers fed SN3 diet had the best growth indices of the highest ($p < 0.05$) FW (1300.50 g) and WG (1149.58 g) value at the lowest ($p < 0.05$) DFI (73.03 g) and FCR (1.98) means. Finisher broilers fed SN3 diet expressed the highest ($p < 0.05$) FW (3221.54g), WG (1920.54 g) and DFI (177.23 g) means and the lowest ($p < 0.05$) FCR (2.71) value, while finisher broilers fed SN9 diet had lowest ($p < 0.05$) DFI value of 148.43 g. However, finisher broilers fed SN6 diet exhibited moderate growth indices at the lowest FC value of ₦362.50. In conclusion, SN3 starter diet and SN6 finisher diet are therefore recommended to farmers because the diets showed better growth indices at low cost of feed consumption.
Keywords: Broilers, Spent grains, Enzyme, Diet, Growth, Feed cost

INTRODUCTION

Poultry industry in Nigeria is fast growing and the production of broilers is a fast means of bridging the gap of animal protein intake in the country. However, the poultry industry has been unable to tackle its numerous challenges in which high cost of feed is the most paramount challenge the industry is currently facing (Gbenga, 2021). Madubuike (2012) reported that 70% to 75% of total cost of poultry production accounts for the cost of feed production. It was further reported that the high cost/shortages of maize have forced many farmers out from the poultry business. However, the replacement of maize with alternatives that are cheaper and readily available is a practicable technique to minimize the cost of feed production. Igwebuike *et al*. (2001) reported that spent grains may be supplemented with maize which are predominantly available in brewery industries as by-product. Spent grains are low energy-base ingredient with high fibre level and non-starch polysaccharides (NSPs).

The use of NSP enzymes in animal feed industries is basically to improve the efficiency of feed utilization and increase the rate of growth (Oyeagu *et al*., 2015). Despite, the benefits of spent grain and feed enzyme, the use of these ingredients is not widespread among farmers due to lack of relevant information required in our local environments. Therefore, this study was aimed at investigating the growth performance and cost implication of broiler birds fed diets containing different levels of spent grains and feed enzyme when reared in deep litter system.

MATERIALS AND METHODS

Location and duration of the study

This study was conducted in the Poultry Unit of the Teaching and Research Farm of the University of Nigeria Nsukka, Enugu State. Nsukka lies in the derived savannah region located on longitude 6° 25[1] N and latitude 07° 24[1] E, at an altitude of 430 m above sea level (Weather Spark, 2019). The climate is a tropical humid type with a relative humidity and annual rainfall ranging from 34 to 78% and 1,567.05 mm to 1,846.98 mm respectively. The average annual maximum and minimum temperatures are 29.7°C and 21.0°C respectively. The study lasted for 56 days which included 7days of pre-experimental period when the chicks were brooded.

Management of birds and treatments

A total of 144 unsexed Acre broiler chicks were randomly allocated into nine treatments of six birds each after one week of brooding. Each treatment was replicated twice with eight birds/replicate. The treatments were randomly assigned in a 3 x 3 factorial arrangement involving three levels of enzyme supplementation of 0g, 0.5g and 0.8g per kg diet in both starter and finisher diets; and three levels of spent grain inclusion of 0%, 6% and 12% in starter diet and 0%, 7% and 12% in finisher diet as shown in Table 1.

Table 1: Composition of experimental diets containing different levels of spent grain and enzyme

Treatment		SN1	SN2	SN3	SN4	SN5	SN6	SN7	SN8	SN9
		Ingredient (%)								
Starter	Maize	33.30	33.30	33.30	28.42	28.42	28.42	23.28	23.28	23.28
	Wheat offal	22.21	21,71	21.41	22.41	22.91	21.61	23.00	22.05	22.00
	Spent grain	**0.00**	**0.00**	**0.00**	**6.00**	**6.00**	**6.00**	**12.00**	**12.00**	**12.00**
	Soybean meal	15.79	15.79	15.79	15.27	15.27	15.27	14.72	14.72	14.72
	Groundnut cake	15.79	15.79	15.79	15.27	15.27	15.27	14.72	14.72	14.72
	Fish meal	7.89	7.89	7.89	7.63	7.63	7.63	7.36	7.36	7.36
	Bone meal	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
	Nutrizyme	**0.00**	**0.05**	**0.08**	**0.00**	**0.05**	**0.08**	**0.00**	**0.05**	**0.08**
		Calculated analysis								
	Crude protein (%)	24	24	24	24	24	24	24	24	24
	Crude fibre (%)	5	5	5	7	7	7	9	9	9
	ME (kcal/kg)	3200	3200	3200	3120	3120	3120	2950	2950	2950
		Proximate composition								
	Dm (g)	91.00	90.40	89.25	91.10	89.90	88.40	91.92	91.95	91.90
	Cp (%)	23.70	24.04	23.50	23.00	23.03	23.30	23.00	23.01	23.00
	Cf (%)	5.03	5.02	5.01	7.07	7.09	6.90	8.98	9.02	8.99
	Ee (%)	5.45	5.33	5.35	5.20	5.05	5.00	4.96	5.01	4.98
	Ash (%)	7.2	7.60	7.70	8.80	8.70	8.75	9.01	9.04	9.01
	Nfe	57.31	56.43	56.30	55.95	51.04	50,58	52.68	49.67	52.00
		Ingredient (%)								
Finisher	Maize	20.27	20.27	20.27	13.84	13.84	13.84	10.50	10.50	10.50
	Wheat offal	47.29	47.29	47.05	48.37	47.87	47.57	47.62	47.12	46.82
	Spent grain	**0.00**	**0.00**	**0.00**	**7.00**	**7.00**	**7.00**	**12.00**	**12.00**	**12.00**
	Soybean meal	19.21	19.21	17.47	18.05	18.05	18.05	17.47	17.47	17.47
	Groundnut cake	5.49	5.49	4.99	5.16	5.16	5.16	4.99	4.99	4.99
	Fishmeal	2.74	2.74	2.49	2.58	2.58	2.58	2.49	2.49	2.49
	Bone meal	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
	Nutrizyme	**0.00**	**0.05**	**0.08**	**0.00**	**0.05**	**0.08**	**0.00**	**0.05**	**0.08**
		Calculated analysis								
	Crude protein (%)	20	20	20	20	20	20	20	20	20
	Crude fibre (%)	7	7	7	9	9	9	11	11	11
	ME (kcal/kg)	2950	2950	2950	2850	2850	2850	2720	2720	2720
		Proximate composition								
	Dm (g)	91.00	90.40	89.25	91.10	89.90	88.40	91.92	91.95	91.90
	Cp (%)	23.70	24.04	23.50	23.00	23.03	23.30	23.00	23.01	23.00
	Cf (%)	5.03	5.02	5.01	7.07	7.09	6.90	8.98	9.02	8.99
	Ee (%)	5.45	5.33	5.35	5.20	5.05	5.00	4.96	5.01	4.98
	Ash (%)	7.2	7.60	7.70	8.80	8.70	8.75	9.01	9.04	9.01
	Nfe	57.31	56.43	56.30	55.95	51.04	50,58	52.68	49.67	52.00

Note: 0.25% of Salt, 0.25% of Methionine, 0.25% of Lysin and 0.25% of Vitamin and mineral premix were formulated in starter and finisher diets; ME = Metabolizable energy; Dm = Dry matter; Cp = Crude protein; Cf = Crude fibre; Ee = Esther extract; Nfe = Nitrogen free extract

These diets were formulated to meet the nutrient requirements of broilers recommended by NRC (1994). Starter and finisher diet were given *ad libitum* between 7 d - 28 d and 29 d - 56 d age of the birds respectively. Representative feed samples were assayed for their proximate composition using AOAC (2001) method. The procedures adopted in this study were in compliant with the provisions of UNN Research Policy (2013).

Measurement of growth indices and cost of feed intake

Weight gain (WG) (final body weight – initial body weight) in g; average daily feed intake (DFI) [(total feed consumed by birds ÷ the number of the birds) ÷ number of days of the diet was given] in g; feed conversion ratio (FCR) (quantity of feed consumed ÷ weight gain); and feed cost per weight gain (FC) (cost of total feed consumed ÷ total weight gain) in ₦ were calculated for starter and finisher broilers.

Experimental design

The experimental design used was a completely randomized design (CRD) with the following model:

$\mathbf{X_{ijk} = \mu + S_i + N_j + (SN)_{ij} + \epsilon_{ijk}}$, where: $\mathbf{X_{ijk}}$= overall observations of the birds fed diets containing (i^{th}) spent grain and (j^{th}) enzyme at different (k^{th}) levels; $\boldsymbol{\mu}$ = overall mean of the experiment; $\mathbf{S_i}$ = effect of the (i^{th}) spent grain on the individual bird; $\mathbf{N_j}$ = effect of the (j^{th}) enzyme on the individual bird; $\mathbf{(SN)_{ij}}$ = interaction effect of the (i^{th}) spent grain and the (j^{th}) enzyme on the individual bird; and $\boldsymbol{\epsilon_{ijk}}$= experimental error associated with the (i^{th}) spent grain and (j^{th}) enzyme at different (k^{th}) levels.

Statistical analysis

Data collected were subjected to analysis of variance for factorial experiments in a completely randomized design using a statistical software package (SPSS, 2007) model. Means were separated using Duncan's New Multiple Range Test and accepted at the level of $p < 0.05$.

RESULTS AND DISCUSSION

The results of the study are presented in Table 2. Body weight ((insert values)), weight gain ((insert values)), feed intake ((insert values)), feed conversion ratio ((insert values)) and feed cost ((insert values)) were significantly ($p < 0.05$) affected in the starter and finisher birds subjected across the dietary treatments.

Table 2: Interaction effects of different levels of spent grain and enzyme on growth indices and cost of feed intake of starter and Finisher broilers

Trts	SN1	SN2	SN3	SN4	SN5	SN6	SN7	SN8	SN9	
LS (%)	0	0	0	6	6	6	12	12	12	
LE (g/kg)	0	0.5	0.8	0	0.5	0.8	0	0.5	0.8	SEM
Starter boilers										
IW (g)	164.29	150.00	151.58	150.00	152.15	150.00	161.56	161.87	161.58	4.38
FW (g)	1123.44^{b}	1194.46^{b}	1300.50^{a}	1038.22^{c}	1125.43^{b}	1138.22^{b}	988.22^{cd}	1075.43^{c}	973.44^{d}	6.32
WG (g)	959.15^{c}	1044.46^{b}	1149.58^{a}	886.43^{d}	975.06^{c}	987.21^{c}	827.4^{d}	913.30^{d}	812.02^{e}	7.2
DFI(g)	74.01^{a}	74.07^{a}	73.03^{a}	77.01^{b}	75.4^{ab}	74.05^{a}	76.10^{b}	84.11^{c}	83.04^{c}	1.63
FCR	2.10^{d}	2.0.03^{d}	1.98^{e}	2.54^{c}	2.50^{cd}	2.43^{d}	3.22^{a}	2.65^{b}	2.62.12^{b}	0.33
FC (₦)	282.19^{f}	292.50^{e}	282.03^{f}	336.20^{b}	318.54^{d}	338.25^{b}	322.03^{cd}	397.30^{a}	326.84^{c}	1.62
Finisher boilers										
IW (g)	1123.44	1194.46	1300.50	1038.22	1125.43	1138.22	988.22	1075.43	973.44	5.51
FW (g)	3000.07^{a}	3065.66^{a}	3221.54^{a}	2500.10^{c}	2575.43^{b}	2645.89^{b}	2100.01^{d}	2150.09^{c}	2450.87^{c}	7.34
WG (g)	1878.44^{a}	1886.46^{a}	1920.54^{a}	1375.43^{c}	1507.33^{bc}	1537.01^{b}	1105.22^{c}	1125.43^{d}	1478.43^{c}	6.71
DFI (g)	164.49^{b}	173.58^{d}	177.23^{d}	169.64^{c}	163.14^{b}	158.14^{ab}	154.14^{a}	151.14^{a}	148.43^{a}	3.38
FCR	3.07^{c}	2.92^{d}	2.71^{e}	3.56^{b}	3.20^{bc}	3.12^{c}	3.84^{a}	3.69^{a}	3.53^{b}	0.96
FC (₦)	410.43^{c}	390.50^{c}	365.25^{b}	456..02^{d}	399.87^{c}	362.50^{c}	493.32^{e}	429.62^{c}	342..04^{a}	23.06

$^{a, b, c, d, e}$ = Means with different superscripts significantly different at $p < 0.05$; Trts = Treatments; SEM=Standard error of mean; LS=Level of spent grain; LE = Level of enzyme; IW = Initial weight; FW = Final weight; WG = weight gain, DFI = Daily feed intake; FCR = Feed conversion ratio; and FC = Feed cost per kg weight gain.

Growth performance and Cost of Feed Consumption

Starter birds that were fed diet SN3 had the lowest ($p < 0.05$) DFI of 73.03 g; and the highest ($p < 0.05$) WG of 1149.58 g and FW of 1300.50 g when compared to the broilers fed diets SN1 and SN2. This implies that starter broilers fed enzyme-fortified diets tends to increase in the rate of digestion and absorption of nutrients which in turn may improve weight gain at low feed intake (Oyeagu *et al*., 2015). FW and WG means were significantly ($p < 0.05$) improved among the birds fed enzyme-fortified diets containing 6% and 12% of spent grain (SN5, SN6 and SN8 diets) compared to birds fed enzyme-free diet containing 6% and12% spent grain (SN4 and SN7 diets), except for SN9 diet that had lowest ($p < 0.05$) FW (973.44 g) and WG (812.02 g) at starter phase. These results indicated that enzyme supplementation had beneficial impacts on the utilization of diets by improving the energy digestibility through the increase of degradation of high fibre (as shown in Table 1) and NSP content (Ani and Omeje, 2007). However, birds in treatment SN9 were relatively retarded ($p < 0.05$) in their growth indices. This may be because of the incapacity of the microflora and enzymes in digestive tract of young birds to breakdown the complex chemical composition of spent grain taken in large quantity by the birds (Pourreza *et al*., 2007). Thus,

starter broilers fed diet SN3 had the best ($p < 0.05$) growth indices of lowest DFI (73.03 g), highest FCR (1.98), highest FBW (1300.50 g) and WG (1149.58 g) at lowest FC (₦282.03).

Finisher broilers fed SN1, SN2 and SN3 diet had better ($p < 0.05$) FW means of 3000.07 g, 3065.66 g, 3220.54 g; and WG ($p < 0.05$) values of 1878.44 g, 1886.46 g and 1920.54 g respectively than broilers fed diets containing high levels of spent grain (i.e., diet SN4 to SN9). This may be attributed to the high metabolizable energy and low crude fibre content of diet SN1, SN2 and SN3, as shown in Table 1. Furthermore, looking at each level of spent grain inclusion (i.e. 0%; 7% and 12%), birds fed with 0.5 g or 0.8 g of enzyme per kg diets had improved growth indices than birds fed with enzyme-free diets. This indicates that enzyme supplementation promotes digestion and absorption of nutrients (Pourreza *et al*., 2007). The birds in SN7 treatment had the lowest ($p < 0.05$) WG of 1125.22 g and FW of 2100.01 g. This therefore showed high NSP concentration inhibits the growth performance of finisher broilers. Birds in treatment SN3 had highest ($p < 0.05$) mean of FW (3220.54 g), WG (1923.54 g) and DFI (177.23 g) as well as the best ($p < 0.05$) FCR (2.71), while birds fed SN9 diet had the lowest ($p < 0.05$) DFI (148.43 g) and the highest ($p < 0.05$) FCR (3.53) mean. These observations showed that enzyme supplementation improves feed utilization and spent grain inclusion reduces feed efficiency (Zhou, 2009). Broilers in treatment SN7 had the lowest ($p < 0.05$) BWof 2100.01 g but incurred the highest ($p < 0.05$) FC of ₦493.50, while birds in treatment SN9 obtained an improved ($p < 0.05$) FBW of 2450.87 g and WG of 1478.43g at cheapest FC of ₦342.04 due to the increased level of 0.08g/kg enzyme supplementation.

CONCLUSION

It is evident from the results obtained in this study that inclusion of exogenous enzyme to broilers' diet improves growth and consequently reduces cost of feed consumption of the birds. Inclusion of 0.8g enzyme per kg starter diet that was free from spent grain improves the growth of young broilers at favourable cost of feed consumption. Finisher birds fed enzyme-free diets that contained 7% (SN4) or 12% (SN7) spent grain retarded growth and incurred high cost of feed. The inclusion of 7% spent grain and 0.8g enzyme supplement in finisher diet (SN6) moderately improves growth at minimal cost of feed consumption. Therefore, SN3 (starter) and SN6 (finisher) diets are recommended to poultry farmers to increase profit and production of broilers.

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