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EFFECT OF WHEAT OFFAL LEVELS AND ENZYME SUPPLEMENTATION ON DRY MATTER INTAKE AND NUTRIENT DIGESTIBILITY OF BROILER CHICKENS

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ABSTRACT

This study was conducted to evaluate the effect of graded levels of wheat offal diets supplemented with or without hemi-cell enzyme on dry matter intake and digestibility coefficient of broiler chickens. Two hundred and eighty eight (288) day old broiler chicks were allocated to eight dietary treatments (n=36/treatment) in a in a 4 x 2 factorial arrangement in a completely randomized design. The experiment involved the replacement of maize with wheat offal at four levels of inclusion 0, 10, 15, and 20, with or without hemi-cell enzyme supplementation. The result showed that dry matter intake and digestibility was higher on the wheat offal levels than the control. Broilers on 20% wheat offal and control diet had significantly ($P<0.001$) higher crude protein digestibility than 10 and 15% wheat offal levels. Crude fibre and ether extract digestibility were significantly higher on 20% wheat offal level than the other levels while NFE digestibility was higher on 10% wheat offal level. Hemi-cell® enzyme supplementation of wheat offal diets improved dry matter intake, crude protein digestibility, crude fibre digestibility and NFE digestibility. The enzyme supplemented wheat offal levels of 15 and 20% diets were better utilized leading to higher improvement in broiler performance in the experimental groups. The results of this study showed that hemi-cell® enzyme could improve performance, increase ileal nutrient digestibility with reduction in feed intake and higher profit, hence a reduction in feed cost.

Keywords: Wheat offal, Enzyme supplementation, Digestibility, Broiler Chicken, Hemi-cell®.

INTRODUCTION

The highest challenge in broiler production in Nigeria today has been the high cost of broiler feeds (Faniyi, 2002). High feed cost in poultry production has reduced the rate of expansion of the poultry industry and has caused serious animal protein deficiency among Nigerians, especially among low income earners leading to malnutrition (Adebajo *et al*., 2008, Abu and Suetan, 2009). Research into the use of cheaper industrial by-products and wastes at various levels of dietary inclusion for poultry has been intensified in the last few years to determine how they can be effectively utilized by birds (Adeniyi and Balogun 2002). However, agro-by-products are noted for their high fibre content which is a major problem against their efficient use in monogastric animal nutrition. Monogastric animals such as broilers have low capability of handling cellulose, hemi-celulose and lignin which form the major components of the agro-industrial products. Adesehinwa (2007) reported that these cheap and less expensive sources of livestock feeds play an important role in the maintenance of normal structure and function of intestinal mucosa of animals due to their high fibrous content. Chesson (1993) however stressed that crude fibre has been implicated as a factor depressing nutrient digestibility, absorption, availability and utilization in monogastric animals. However, crude fibre has been found to promote viscosity in the intestine thereby reducing

the overall efficiency in digestion and absorptive sites in the intestinal mucosa of the animals (Webel *et al*., 2003). Therefore, in order to make the active ingredients of agro-industrial by-products available for the monogastric animal nutrition, its structural carbohydrate and crude protein must be hydrolyzed into simpler digestible units that can be absorbed and assimilated by the animals. Supplemental enzymes have become common additives to monogastric diets to improve nutrient utilization (Adesehinwa, 2007). The use of enzymes to improve the nutritional value of feed has received increased attention. Researchers have observed beneficial effects from enzyme supplementation in poultry feeds, particularly feeds that contain grains with high fibre components (Petterson and Aman, 1989, Santos *et al*., 2004). The advent and use of commercial feed enzymes has therefore opened a new horizon for the use of agro-industrial by-products considered as waste in livestock feeds and feeding. Atteh (2001) reported that experimental results had shown that with the use of a bacterial zylanase enzyme, it was possible to replace 50% of maize with wheat offal without detrimental effect on broiler performance. Again, he reported 56% and 26% increase in apparent metabolizable energy (AME) of wheat offal and brewer dried grains (BDG) respectively, when the diets were supplemented with zylanase enzyme. Based on the necessity for research in the area of enzyme technology and its effect in monogastric nutrition, this study was designed to determine the effect of enzyme (hemi-cell®) supplementation on the utilization of wheat offal in broiler diets.

MATERIALS AND METHODS

Location of Study

This study was carried out in a commercial Poultry Farm in Kaduna, Nigeria, located on latitude 10°20'N and longitude 7°45'E in the northern Guinea Savannah. The area is characterised by a dry and rainy season. The rainy season starts from June, peaks in August and recedes in September.

Experimental Birds

Two hundred and eighty eight day old Cobs broiler chicks were used for the study. The birds were weighed at day old, brooded in a deep litter house and fed a commercial starter diet produced by Grand Cereals and Oil Mill Limited during a one week adjustment period. The chicks were weighed and randomly allocated to the treatments one week into brooding.

Experimental Procedure

The study involved the replacement of maize with wheat offal at four levels of inclusion (0, 10, 15, and 20%) and enzyme hemi-cell® supplementation at two levels (with and without) in a 4 x 2 factorial arrangement in a completely randomized design. Wheat offal used was obtained from Dangote flour mills, Lagos, Nigeria. The birds were randomly allocated to the treatment groups in three replicates (n= 12 birds per replicate). The experimental diets, in which maize was replaced with wheat offal at 10, 15 and 20%, were formulated to contain 23% crude protein and 2800 kcal ME/kg for the starter phase (Tables 1 and 2) and 21% crude protein and 3021 kcal ME/kg diet for the finisher phase (Tables 3 and 4). For the enzyme supplemented treatments and the control, hemi-cell® enzyme was included at the rate of 100 g per metric ton of feed, thoroughly mixed with the feed mechanically. Feed and water were supplied to the birds*ad-libitum*. Weekly records of live weight, weight gain, average daily gain and feed intake were taken. The study lasted for nine weeks.

DATA ANALYSIS

Data collected were subjected to analysis of variance test using the General Linear Model Procedure while Pair-wise Difference Method was used to separate significant means (SAS, 2004).

Table 1: Composition of Broiler Starter Diets for Replacement of Maize with Wheat Offal (%) and Enzyme Supplementation

Wheat Offal level	**0**	**0**	**10**	**10**	**15**	**15**	**20**	**20**
Enzyme supplementation	**-**	**+**	**-**	**+**	**-**	**+**	**-**	**+**
Maize	48	48	38	38	33	33	28	28
Wheat Offal	0	0	10	10	15	15	20	20
Soya Meal	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5
Groundnut cake	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Fish Meal	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49
Bone	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Limestone	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Salt	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Premix**	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Methionine	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Enzyme (Hemi-cell^{R})	-	0.1	-	0.1	-	0.1	-	0.1
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Cost/kg diet (₦)	66.60	67.60	65.40	65.80	64.80	65.20	64.20	64.60
Calculated analysis								
Metabolizable energy (Kcal/kg)	2875	2875	2758	2758	2635	2635	2575	2575
Crude protein (%)	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5
Crude Fibre (%)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Ether extract (%)	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Lysine (%)	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
Methionine (%)	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Calcium (%)	1.550	1.550	1.550	1.550	1.550	1.550	1.550	1.550
Available phosphorus (%)	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70

** Bio-Mix premix supplied per kg of diet vitamin A 12500 I.U Vit-D_3 2500 I.U Vit E-50mgL- Vit K_3 2.5mg; Vit B_1, -3.0mg: Vit B_2 6.0mg; Vit B_6 6.0mg: Niacin 40.0mg; calcium pantothenate 10.0mg; Biotin 0.80mg; Vit B_{12} 0.25mg; Folic acid 1.0mg; Chloline chloride 300mg; manganese 100mg: Iron 50mg; Zinc 45; copper 2.0mg; cobalt 0.25mg; iodine 1.55, selenium 0.1mg.

Table 2: Proximate Composition of Broiler Starter Diets

Wheat Offal level	**0**	**0**	**10**	**10**	**15**	**15**	**20**	**20**
Enzyme supplementation	-	+	-	+	-	+	-	+
Crude Protein (%)	23.54	23.04	23.58	23.62	23.03	23.07	23.86	23.25
Metabolize Energy (kcal/kg)	2813.77	2800.35	2504.38	2596.17	24871.37	2501.32	2378.57	2356.52
Ether Extract (%)	4.18	4.01	4.30	4.23	4.35	4.23	4.41	4.32
Crude fibre (%)	3.38	3.25	4.10	4.22	4.58	4.38	4.98	4.57
Calcium (%)	2.09	2.00	2.11	2.05	2.16	2.08	2.14	2.05
Available phosphorus (%)	0.50	0.47	0.65	0.6	0.71	0.69	0.73	0.71

Table 3: Composition of Broiler Finisher Ration for Replacement of Maize with Wheat Offal (%) and Enzyme Supplementation

Wheat Offal level	**0**	**0**	**10**	**10**	**15**	**15**	**20**	**20**
Enzyme supplementation	-	+	-	+	-	+	-	+
Maize	57.1	57.1	47.5	47.5	42.5	42.5	37.5	37.5
Wheat Offal	-	-	10	10	15	15	20	20
Soya Meal	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
Groundnut cake	22	22	22	22	22	22	22	22
Fish Meal	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Bone	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Limestone	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Salt	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Premix**	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Methionine	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Enzyme (Hemi-cell^{R})	-	0.1	-	0.1	-	0.1	-	0.1
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Cost/kg diet (₦)	60.2	60.6	59.0	59.4	58.4	58.8	57.8	58.2
Calculated analysis	63.4	63.8	62.2	62.6	61.6	61.8	61.0	61.4
Metabolizable energy (Kcal/kg)	3001	3001	2850	2850	2758	2758	2635	2635
Crude protein (%)	21	21	21	21	21	21	21	21

Crude Fibre (%)	3.00	3.00	4.00	4.00	5.00	5.00	6.00	6.00
Ether extract	4.70	4.70	4.90	4.90	5.10	5.10	5.30	5.30
Lysine (%)	1.10	1.10	1.14	1.14	1.00	1.00	1.00	1.00
Methionine (%)	0.39	0.39	0.42	0.42	0.40	0.40	4.45	4.45
Calcium (%)	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Available phosphorus (%)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60

** Bio-Mix premix supplied per kg of diet vitamin A 12500 I.U Vit-D_3 2500 I.U Vit E-50mgL- Vit K_3 2.5mg; Vit B_1, -3.0mg: Vit B_2 6.0mg; Vit B_6 6.0mg: Niacin 40.0mg; calcium pantothenate 10.0mg; Biotin 0.80mg; Vit B_{12} 0.25mg; Folic acid 1.0mg; Chloline chloride 300mg; manganese 100mg: Iron 50mg; Zinc 45; copper 2.0mg; cobalt 0.25mg; iodine 1.55, selenium 0.1mg.

Table 4: Proximate Composition of Broiler Finisher Diets

Wheat Offal level	**0**	**0**	**10**	**10**	**15**	**15**	**20**	**20**
Enzyme supplementation	**-**	**+**	**-**	**+**	**-**	**+**	**-**	**+**
Crude protein (%)	23.62	23.15	23.28	23.03	23.61	23.5	23.94	23.40
Metabolize Energy (kcal/kg)	2919.57	2891.77	2701.97	2750.57	2599.30	2630.20	2484.37	2480.02
Ether Extract (%)	4.23	4.21	4.35	4.28	4.41	4.43	4.46	4.38
Crude fibre (%)	3.01	2.98	3.81	3.90	4.21	4.09	4.61	4.53
Calcium (%)	1.91	1.95	1.92	1.91	1.93	1.94	1.93	1.85
Available phosphorus (%)	0.40	0.41	0.51	0.50	0.57	0.55	0.62	0.58

RESULT AND DISCUSSION

Table 5 shows that wheat offal inclusion levels up to 20% did not affect dry matter intake, dry matter digestibility, crude fibre digestibility and NFE digestibility. Dry matter intake and digestibility was higher on the wheat offal levels than the control. However, the broilers on 20% wheat offal and control diet had significantly ($P<0.001$) higher crude protein digestibility than 10 and 15% wheat offal levels. Crude fibre and ether extract digestibility were significantly higher on 20% wheat offal level than the other levels while NFE digestibility was higher on 10% wheat offal level. The higher dry matter intake of wheat offal based diets by the birds in the experimental group is likely due to the lower energy content of the diets, hence the higher dry matter intake so as to meet up their energy requirement. This observation is similar to the report of Christopher *et al*. (2007) who observed no difference in body weight, body weight gain, feed intake and efficiency of feed utilization with increasing level of wheat offal up to 25% in broiler diets.

Table 5: Effect of Wheat Offal Levels on Dry matter Intake and Nutrient Digestibility Coefficient of Broiler Chickens

	Wheat Offal Level (%)					
Parameter	0	10	15	20	SEM	P value
Dry matter intake	127.06[b]	132.78[a]	133.17[a]	134.16[a]	0.79	<0.001
Dry matter digested	0.63[c]	0.66[a]	0.65[b]	0.66[a]	0.003	<0.001
Crude protein digested	0.80[b]	0.77[c]	0.79[b]	0.81[a]	0.005	<0.001
Crude fibre digested	0.45[ab]	0.40[c]	0.43[b]	0.55[a]	0.011	<0.001
Ether extract digested	0.85[b]	0.85[b]	0.80[c]	0.86[a]	0.006	<0.001
NFE digested	0.65[c]	0.69[a]	0.67[b]	0.66[b]	0.004	<0.001

[abc]Means with different superscript along rows are significantly different (P<0.001), SEM=Standard Error of mean

Table 6 shows the effect of enzyme supplementation on dry matter intake and nutrient digestibility coefficients of broiler chickens. Enzyme supplementation of wheat offal diets resulted in improved dry matter intake, crude protein digestibility, crude fibre digestibility and NFE digestibility. This observation is in line with the findings of Torki and Chegeni, (2007) who reported improvement in feed intake, body weight gain and feed conversion ratio of broiler birds fed with hemi-cell enzyme supplementation of Canula and soybean meal based diets.

Table 6: Effect of Enzyme Supplementation on Dry Matter Intake and Nutrient Digestibility Coefficient of Broiler Chickens

	Enzyme supplementation			
Parameter	**Without (-)**	**With (+)**	**SEM**	**P value**
Dry matter intake (g)	133.43[a]	130.16[b]	0.556	<0.001
Dry matter digested	0.55[b]	0.65[a]	0.002	<0.001
Crude protein digested	0.79[b]	0.80[a]	0.003	<0.001
Crude fibre digested	0.44[b]	0.46[a]	0.008	<0.001
Ether extract digested	0.85[a]	0.83[b]	0.004	<0.001
NFE digested	0.57[b]	0.66[a]	0.003	<0.001

[ab]Means with different superscript along rows are significantly different (P<0.001) SEM = Standard Error of the mean

Table 7 shows the interaction of wheat offal levels and enzyme supplementation on dry matter intake and nutrient digestibility of broiler birds. The dry matter intake of the enzyme supplemented wheat offal diets was significantly lower than the control. The digestibility coefficient of the dry matter at 10 and 20% levels of inclusion were significantly higher than that of 15% and the control. The crude protein digestion of broilers on 0, 15 and 20% inclusion levels were similar and significantly higher than 10%. This result agrees with the report of Alabi and Atteh (2012), who reported that supplementing wheat offal diet with fungal enzyme caused a significant increase (P<0.001) in protein and fibre digestibilities. This result also agrees with the report of Saki *et al*. (2005) who reported that birds fed soybean meal supplemented with mannanse enzyme had better ileal protein digestibility than the control.

Table 7: Interaction of Wheat Offal Levels and Enzyme Supplementation on Dry matter intake and Nutrient Digestibility coefficients of Broiler Birds

Wheat offal level	0		10		15		20		SEM	P Value
Enzyme supplementation	-	+	-	+	-	+	-	+		
Dry matter intake (g)	129.50^{c}	124.63^{a}	133.64^{c}	131.92^{b}	134.83^{c}	131.51^{b}	135.74^{c}	132.59^{b}	1.11	<0.001
Dry matter digested	0.63^{c}	0.63^{c}	0.66^{a}	0.66^{a}	0.65^{ab}	0.64^{b}	0.65^{ab}	0.66^{a}	0.004	<0.001
Crude protein digested	0.78^{c}	0.81^{b}	0.76^{c}	0.78^{c}	0.81^{b}	0.87^{a}	0.81^{b}	0.82^{b}	0.007	<0.001
Crude fibre digested	0.41^{c}	0.48^{a}	0.40^{bc}	0.39^{b}	0.42^{c}	0.43^{c}	0.43^{c}	0.46^{b}	0.159	<0.001
Ether extract digested	0.80^{c}	0.84^{b}	0.81^{c}	0.82^{c}	0.80^{c}	0.80^{c}	0.88^{a}	0.84^{b}	0.009	<0.001
NFE digested	0.66^{a}	0.64^{a}	0.70^{a}	0.69^{ab}	0.67^{b}	0.66^{c}	0.66^{c}	0.68^{b}	0.005	<0.001

^{abc}Means with different superscript along rows are significantly different (P<0.001), SEM=Standard Error

The ether extract digestion of broilers was significantly (P<0.001) higher on the enzyme supplemented wheat offal levels than the un-supplemented levels. Alabi and Atteh (2012) reported that supplementing wheat offal diet with enzyme has better effect on crude fat digestibility. NFE digestibility of 15% and 20% were significantly similar but lower than 10% wheat offal level and higher than 0% wheat offal inclusion level. This observation agrees with the results of Cowieson and Acamovic (2003) when peanut was supplemented with enzymes. Results of this study showed that hemi-cell enzyme was efficient in fibre digestion which is in agreement with the work of Akinfemi and Mukar (2012) who reported improved digestibility of lignin with fungal treatment. The increased digestibility of fibre could be apparently related to enzyme ability to unlock polysaccharide molecules in the diet breaking down the long chains into smaller units (Jozefiat *et al.*, 2004). The dry matter intake decreased as the enzyme supplemented wheat offal diets increased. This is because animals eat to meet their body requirements which was achieved easily with enzyme supplemented

diets due to better feed utilization, digestion and absorption of nutrients, hence the lower dry matter intake in the experimental groups than the control. The result also indicated higher digestion coefficients of these nutrients (protein, NFE, crude fibre and ether extract) as the enzyme supplemented diet increased. This can be attributed to the catalytic nature of the enzyme (Hemi-cell®) in the intestine of the birds which aided better nutrient digestion, availability and absorption, hence, higher performance in the experimental groups. Enzymes help to decrease viscosity of digestive content resulting in improvement in nutrient digestibility. Mod *et al*. (1983) opined that the release of nutrients from fibrous feedstuff with addition of exogenous enzyme is possible *in vitro*. In this study, increase in the level of wheat offal in the absence of supplementary enzyme caused a decrease in nutrient digestibility while the addition of supplementary enzyme improved nutrient digestibility. The results of this study shows that inclusion of wheat offal at graded levels to replace maize with hemi-cell® enzyme supplementation lowered feed intake and increased nutrient digestibility leading to improved weight gain which should result in lower feed cost per kilogram gain of broiler chickens.

CONCLUSION

The study has shown that inclusion of wheat offal at graded levels to replace maize with enzyme supplementation lowered feed intake and increased nutrient digestibility of broiler chickens. The dry matter intake decreased with hemi-cell® enzyme supplementation which could lead to better feed economy. It is therefore, recommended that wheat offal should be used to replace maize in poultry diets at 15% inclusion level with supplementation of hemi-cell® enzyme for optimum performance.

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