Effect of enzyme supplementation on the utilization of shrimp-waste meal based diets by broiler chicken

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Abstract

The effects of enzyme supplementation of shrimp waste meal (SWM) based diets on the performance and nutrient utilization of starter and finisher broilers were studied. One hundred and twenty day old broilers (Anak strain) were randomly divided into four groups of 30 birds each. Each group was further divided into three replicates of 10 birds each. The birds were assigned the four dietary treatment in 2 X 2 factorial design. Diets 1 and 3 had fish meal as the sole animal protein source, diets 2 and 4 had shrimp waste as the animal protein source. Diets 1 and 2 were without enzymes while diets 3 and 4 were supplemented with enzyme. Records of performance, nutrient utilization, blood parameters and carcass characteristics were taken. The values of average final weight, daily weight gain, feed conversion ratio and protein efficiency ratio at starter and finisher phases were not significantly ($P > 0.05$) influenced by the dietary treatment. The daily feed intake of the starter broilers fed diet 3 (fish meal based diets with enzyme) was significantly ($P < 0.05$) higher than those of other treatment. Birds fed fish meal diet without enzyme had the highest serum uric acid and serum cholesterol at the starter phase. Finisher broiler fed fish meal based diet without enzyme had a significantly ($P < 0.05$) higher serum creatinine value. Carcass characteristics measured were not significantly influenced by the dietary treatments. It was concluded that SWM can be employed as an animal protein source in broiler diets. The exogenous enzyme (Roxazyme G) used did not effect any appreciable improvement on the utilization of SWM based diets.

Keywords: Enzyme supplementation, utilization, shrimp waste, broiler chicken.

Introduction

The sustainability of the poultry sector of the Nigerian livestock industry will depend on the efficient utilization of highly nutritious feed ingredients in the diets of the animals. The high cost of the conventional feedstuff most especially the protein supplement, necessitated the quest for locally available alternatives which is capable of being an economic substitutes to the conventional feedstuffs. This ideal is capable of reducing feeding cost and make poultry enterprise a more profitable one. In the last few years, the shrimp industry in Nigeria has grown significantly. The production of shrimp both in

offshore and Lagos amount to 637,000 metric tonnes in 1990 (Nigeria Agrovet News, 1994). There are significant amount of waste generated by the shrimps industry during various processing operations. Shrimp waste meal (SWM) is basically the dried milled waste of the shrimp industry, consisting of the heads, appendages and exoskeleton of the shrimp (Fanimo *et al.*, 1996; Rosenfeld *et al.*, 1997). This product has been identified as having potential of being an alternative protein source in broiler rations, partially or totally replacing conventional protein sources such as fish meal, soybean (Rosenfeld, 1997). Shrimp waste

meal is highly palatable and of a pleasant aroma. It is particularly rich in lysine which make it an ideal supplement to cereals.

Despite the fact that SWM has a high nutritive potential, its level of use as feed ingredient in livestock diet is low. This is not unconnected to the chitin which constitute about 14 – 27 % of the shrimp waste (Ferrer *et al.*, 1996). Chitin is a carbohydrate with a structure similar to cellulose. It is an N-acetyl glucosamine polymer with α -1,4 glycosidic bond between each monomeric unit. Gohl (1975) reported that about 10% of the crude protein in the whole shrimp meals originates from chitin while up to 50% of the nitrogen in the waste originates from chitin which he described as nearly digestible.

Several processing methods have been employed on shrimp meal with the aim of improving its utilization. Oduguwa *et al.*, (1998) used different processing methods like oven-drying, acid treatment and sun drying. Fanimo *et al.*, (1998) supplemented shrimp waste based diets with synthetic amino acid, the results of these treatments were far from being encouraging when compared to the control diets. The objective of this study was to evaluate the effect of enzyme (Roxazyme G) supplementation of shrimp waste meal on growth performance, nutrient digestibilities, blood parameters and carcass characteristics of broilers.

Materials and Methods

One hundred and twenty day-old Anak broiler chicks from Obasanjo farms, Ota were used. The birds received at day-old were brooded and raised to maturity on deep litter system of management. The birds were weighed and randomly assigned to four dietary treatments. Thirty birds were assigned to each treatment

with two replicates of 15 birds each in an open-sided naturally ventilated broiler house. Four treatments were allotted to the 8 pens in 2 x 2 factorial design. Experimental diets and water were provided *ad libitum*.

The dietary treatments consists of (1) fish meal without enzyme supplementation, (2) Shrimp waste meal diet without enzyme supplementation, (3) Fish meal diet with enzyme supplementation, (4) Shrimp waste meal diet with enzyme supplementation (Table 1). Body weights, feed consumption (intake) and feed conversion ratio were determined for each treatment at weekly intervals. At the 3rd and 7th week of the experiments, 2 birds per replicate were randomly selected and transferred into the metabolic cages. Weighed quantities of diets were supplied and excreta collected over a period of 3 days. A two-day acclimatization period was allowed prior to the collection of droppings. Excreta samples were oven-dried at 65°C, ground and analyzed for crude protein, crude fibre, ash and dry matter. Crude protein retention and digestibilities of dry matter, crude fibre, ether extract, NFE and ash were determined. At the 8th week of the experiment, 2 birds per treatment were randomly picked, kept-off feed overnight and slaughtered by severing the jugular vein. After scalding and defeathering, the carcass was eviscerated and cut into parts for carcass evaluation. Carcass weight and relative cut parts and organ weights were determined. The relative weight was calculated by expressing the weight of the cut parts as a percentage of the dressed weight. Blood samples were collected from the birds immediately after slaughtering and were analysed for haematological and serum metabolites. Data obtained were subjected to analysis of variance. Significant means were separated using Duncan's Multiple Range Tests (Duncan, 1955).

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Table 1: Percentage composition of experimental diets

Ingredient	Starting Phase				Finishing Phase			
	Without Enzyme		With Enzyme		Without Enzyme		With Enzyme	
	FM	SWM	FM	SWM	FM	SWM	FM	SWM
Maize	52.00	52.00	52.00	52.00	52.00	52.00	52.00	52.00
Soybean meal	20.00	20.00	20.00	20.00	22.00	22.00	22.00	22.00
Groundnut cake	10.00	10.00	10.00	10.00	12.00	12.00	12.00	12.00
Fish meal	7.00	-	7.00	-	5.00	-	5.00	-
Shrimp waste meal	-	13.00	-	13.00	-	9.29	-	9.29
Wheat offal	5.90	-	5.90	-	3.90	-	3.90	-
Bone meal	2.50	2.40	2.50	2.40	2.50	2.11	2.50	2.11
Oyster shell	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Methionine	0.30	0.30	0.30	0.30	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.25	0.25	0.25	0.25
Premix	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Enzyme	-	-	0.05	0.05	-	-	0.05	0.05
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Determined Analysis								
Crude Protein (%)	22.69	22.75	22.79	22.02	20.91	20.09	20.65	19.79
Energy (Estimate)								
*Kcal/kg	3169.63	3000.00	3133.84	3045.5	3019.16	3032.04	3080.89	3099.72
Crude Fibre (%)	3.77	4.11	5.40	3.62	3.20	3.00	2.98	2.16

*NE was estimated using the formula of Pauzenaga (1985) ME Kcal/kg = (37 x %CP + 81.8 x % Fat + 35.5 x % NFE)

Results and Discussion

Table 2 shows the proximate composition of shrimp waste meal and fish meal. The crude protein, crude fibre, ether extract values of the shrimp waste determined agreed with the

values recorded by Oduguwa *et al.*, (1998). However, the values of ash determined in this study is relatively lower than the one recorded by Oduguwa *et al.*, (1998).

Table 2: Proximate composition of the test ingredients (%)

Ingredients	CP	CF	EE	Ash	Ca	P
Shrimp waste	33.89	11.70	9.00	6.10	15.77	0.45
Fish meal	65.40	1.31	4.70	17.00	6.10	3.00

Table 3 presents the performance characteristics of experimental birds at the two physiological stages of growth. At the starting phase, birds placed on shrimp waste meal diets whether supplemented or unsupplemented with enzyme had relatively lower final weights. The result shows the relative superiority of fish meal over shrimp waste meal in terms of protein quality. The findings of Fanimo *et al.*, (1996) and Odugudwa *et al.*, (1998) earlier indicated this fact. Supplementation of fishmeal based diet with enzyme led to slight increase in final weight, though the level of increase was not significant ($P>0.05$). The same was observed for the shrimp waste meal based diets. Lack of significant effect of enzyme supplementation on shrimp waste diet points to the fact that the enzyme has not been able to take care of the factor causing impairment in the utilization of shrimp waste based diets. Birds fed fish meal based diets supplemented with enzyme had the highest feed consumption rate ($p<0.05$). No significant difference was observed for those fed other dietary treatments. It may be that combination of fish meal and enzyme in the diet induced birds to eat more which reflected in their final weights. The average weight gains followed the same trend as the average final weight.

were better utilized. Though the birds fed unsupplemented shrimp waste diets recorded the worst value, the feed conversion ratio values recorded for all the dietary treatment were not significantly different ($P>0.05$). There was no significant difference ($P>0.05$) among the various dietary treatments at the finishing phase, though a slight enhancement of feed consumption was noted with enzyme supplemented diets. Fishmeal based diets whether supplemented or not induced higher feed intake in the birds. This is probably due to the higher protein quality of the fishmeal over the shrimp waste meal based diets. This further confirms the earlier studies of Oduguwa *et al.*, (1998) and Fanimo *et al.*, (1996). The final weight values were not also significantly ($P>0.05$) different among the dietary treatments. However, birds fed fishmeal based diets had a slight edge over those fed shrimp waste meal based diets whether supplemented or not. The daily weight gains followed the same trend as described for final live weight. The protein efficiency ratio among the various dietary treatments were not significantly different from one another. The fishmeal diets were best converted to flesh by the birds while the unsupplemented shrimp waste based diets were least converted though the difference ($P>0.05$) among the treatment means were not significant.

The values of feed conversion ratio recorded for birds on fish meal diets showed that the diets

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Table 3: Performance characteristics of the chicken fed experimental diets

Parameters	Without Enzyme		With Enzyme		SEM
	FM	SWM	FM	SWM	
Starter phase					
Ave. initial wt (g)	39.50	40.30	40.00	38.60	0.32
Ave final wt (g)	327.88	258.91	342.00	259.05	19.16
Ave. daily wt. Gain	10.30	7.81	10.79	7.89	0.68
Ave. daily feed intake	29.91 ^b	29.91 ^b	32.47 ^a	28.11 ^b	0.78
Feed Conversion Ratio	2.90	3.89	3.01	3.78	0.22
Protein Efficiency ratio	1.52	1.15	1.46	1.26	0.075
Finisher phase					
Ave. Final wt (g)	1310.42	1118.49	1405.55	1061.46	32.5
Ave daily wt (g)	35.09	30.70	37.99	30.60	1.76
Ave. daily feed intake	118.72	107.12	125.06	120.15	3.80
Feed Conversion Ratio	3.39	3.50	3.33	3.92	0.12
Protein Efficiency ratio	1.42	1.43	1.47	1.24	0.05

a,b,c means without common superscript in each row are significantly different ($P < 0.05$)

Table 4 shows the mean values of nutrient utilization by the experimental birds. At starter phase, supplementation of fishmeal and shrimp waste meal diets slightly improved the crude protein retention, NFE and dry matter digestibilities but the effects were not significant ($P > 0.05$). Furthermore, enzymes supplementation of both fishmeal and shrimp waste meal slightly improved the digestibility of ether extract and

ash. Digestibility data presented in Table 4 indicated that as the birds matured, the nutrient digestibilities increased with the finisher broilers having higher values than the starters. Supplementation of the diets with enzyme recorded no significant effects in the nutrient digestibility of the birds placed on various dietary treatments.

Table 4: Mean values nutrient utilization by the experimental birds

Parameters	Without Enzyme		With Enzyme		SEM
	FM	SWM	FM	SWM	
Starter phase					
Crude protein retention	85.17	85.67	89.69	90.18	0.98
Crude fibre digestibility	40.93	40.65	64.33	44.09	4.91
Ether extract digestibility	44.19	50.11	73.10	63.28	5.64
Ash digestibility	14.84	16.07	24.40	36.94	4.41
NFE digestibility	74.33	83.77	76.90	84.80	2.22
Dry matter digestibility	58.36	53.17	61.22	65.45	2.23
Finisher phase					
Crude protein retention	92.76	90.89	93.05	91.20	0.47
Crude fibre digestibility	66.53	71.05	71.99	31.34	8.86
Ether extract digestibility	68.43	81.12	69.01	74.54	2.56
Ash digestibility	59.10	49.97	52.50	47.92	2.10
NFE digestibility	88.66	87.20	88.66	90.01	0.49
Dry matter digestibility	75.47	71.58	77.13	73.90	1.02

Table 5 shows the mean values of some haematological parameters of the experimental birds at the starting phase. Analysis showed no significant difference ($P>0.05$) among the dietary treatments for the haematocrits such as PVC, RBC and WBC. The serum metabolites values were also not statistically different with the exception of serum uric acid and cholesterol in which case the difference among the dietary means were significant ($P<0.05$). At finishing phase, the mean values of haematological parameters showed no significant effect among the dietary treatment. So also were the values for serum metabolites except serum creatinine values which was significant ($P<0.05$).

Eggum (1970) attributed high blood creatinine level to poor utilization of dietary protein. The relatively low value of serum creatinine recorded for birds on shrimp waste meal diets suggested that the shrimp waste diets were better utilized. This deviates from the reasoning above, because the same group of birds has the lowest weights which could be traced to a poor utilization of protein in shrimp waste meal. Oduguwa (1991) opined that, increase in blood creatinine could be as a result of the release of energy from the high energy compound phospho-creatinine present in the skeletal tissue. It may be that when the groups fed fishmeal diets were being apprehended for bleeding, there was so much physical exertion in their muscles that the phospho-creatinine had to be called upon for the production of extra energy which released creatinine into the blood.

There were no significant effects ($P>0.05$) of dietary treatment on all the carcass traits measured. This report supports the findings of Osei and Duodu (1988) that dietary treatment seldomly exert significant influence on carcass quality parameters such as dressed weight. Result on relative cut part weights showed that only relative mean weights of back were found to be significantly different ($P<0.05$). The enzyme supplemented diets increased the abdominal fat. No significant differences were observed for the relative weights of liver,

gizzards, heart and spleen ($P>0.05$). However, there were significant difference ($P<0.05$) among the dietary treatments for the relative weights of kidney and lungs.

The result of the study showed that shrimp waste meal can be employed as an animal protein source in formulating broiler diets although it did not produce results as good as when fishmeal was used. Furthermore, the exogenous (Roxazyme G) enzyme used in this study did not seem to effect any appreciable improvement on the utilization of shrimp waste based diets.

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