PERFORMANCE AND CARCASS EVALUATION OF BROILER CHICKS FED SHRIMP WASTE MEAL SUPPLEMENTED WITH SYNTHETIC AMINO ACIDS

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ABSTRACT

A feeding trial was conducted using 104 one week-old anak broiler chicks to evaluate the replacement value of shrimp waste meal (SWM) for fish meal (FM) in broiler diets. Fish meal contribution to the dietary crude protein of the broiler diets was replaced with SWM at 0, 33, 66 and 100% of graded levels. Weight gain and feed conversion ratio were significantly ($P < 0.05$) reduced with SWM replacing FM at 100% at both the starter and finisher phases. No significant differences ($P > 0.05$) were observed for feed consumption. Mortality increased with an increased level of SWM in the diet at the starter phase. Liver weight increased ($P < 0.05$) with increased level of SWM in the diets. The 33% replacement level of SWM significantly ($P < 0.05$) increased the abdominal fat. Results of this present study show that the SWM could partially replace 66% of the crude protein of FM in broiler diets without negatively affecting performance or carcass quality.

Key words: broiler, shrimp waste meal, amino acids, performance.

INTRODUCTION

The shrimp industry in Nigeria has grown significantly in the last few years. The production of shrimp both in off-shore and Lagos Lagoon amount to 637,000 metric tonnes in 1990 (Nigeria Agro Vet News, 1994). The increase in shrimp farming and production has led to the concomitant production of shrimp waste. There is a significant amount of waste produced by the industry because of the large percentage of the animal heads, exoskeleton and appendages lost during the various processing operations.

Shrimp heads comprise approximately 44% of the whole raw shrimp (Meyers and Rutledge, 1971).

Shrimp waste meal is basically the dried milled waste of the shrimp industry, consisting of the heads, appendages and exoskeleton of the shrimp. The chemical composition of SWM is a factor of the constituents, method of processing and storage. It is a protein-rich concentrate that has been used as a protein supplement for poultry (Fanimo *et al.*, 1996, Rosenfeld *et al.*, 1997).

In their study, Fanimo *et al.*, (1996) recommended 33% as the best level of substitution of SWM for FM in broiler diets while Rosenfeld *et al.*, (1997) showed that the particular SWM used in his study could partially or totally replace SBM in broiler diets. Fanimo *et al.*, (1996) suggested that supplementation of the SWM diets with synthetic methionine and lysine may likely improve the utilization of the SWM protein.

Of a major concern with SWM is the chemical nature of the exoskeleton of the shrimp which is mainly composed of chitin, an N-acetylated glucosamine polysaccharide that forms part of the protein complex and is considered to have low digestibility when fed to animals (Austin *et al.*, 1981).

The objective of this study is therefore, to evaluate the effect of supplementation of SWM-based diet with synthetic methionine and lysine on the utilization of dietary protein by broilers.

MATERIALS AND METHODS

One hundred and four 1(one) week-old anak broiler chicks from a commercial hatchery were used. The birds were weighed individually and randomly assigned to four treatments with 2 replicates of 13 birds each in

TABLE 1: GROSS COMPOSITION OF EXPERIMENTAL DIETS (g/kg)

Ingredients	Starting diets				Finishing diets			
	Replacement level of SWM (%)				Replacement level of SWM (%)			
	0	33	66	100	0	33	66	100
Maize	515.0	500.0	495.0	485.0	515.0	500.0	495.0	485.0
SBM	220.0	220.0	220.0	220.0	150.0	150.0	150.0	150.0
Maize offal	125.0	121.0	100.0	97.0	234.0	238.0	150.0	232.0
Fish meal	90.0	60.0	30.0	-	50.0	33.0	233.0	-
SWM	-	49.0	99.0	148.0	-	27.0	17.0	81.7
Bone meal	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Oyster shell	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Salt	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Premix*	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Methionine	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Lysine	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Determined								
DM	909.0	912.0	922.0	911.0	910.0	914.0	915.0	917.0
CP	216.7	218.1	220.0	220.3	183.0	182.5	183.6	185.2
CF	38.7	43.5	45.9	50.0	48.7	50.4	53.5	55.3
Fat	39.7	39.6	37.9	38.4	38.0	38.2	37.5	37.6
ME (MJ/kg)	12.35	12.33	12.15	12.52	12.14	12.03	12.01	12.10

*Supplying the following per kg of diet: 800 I.U. Vit. A; 1200 I.U. Vit D₃; 13mg Vit. E; 2mg Vit. K₃; Riboflavin; 0.06mg Cobalamin; 1.5mg Folic acid; 0.25mg Biotin; 125mg Santoquin; 25mg Fe; 80mg Mn; 50mg Zn; 2mg Cu; 0.2mg Co and 0.1mg Se

ME, metabolizable energy; SBM, soyabean meal; SWM, shrimp waste meal; DM, dry matter; CP, crude protein; CF, crude fibre.

TABLE 2: PROXIMATE COMPOSITION OF THE TEST INGREDIENTS (g/kg)

Ingredients	Shrimp waste meal	Fish meal
Dry matter	997.9	961.0
Crude protein	437.1	645.0
Crude fibre	36.0	8.0
Fat	86.4	70.0
Ash	170.4	200.0
Chitin	98.2	-
Calcium	10.21	3.0
Phosphorus	0.48	2.0
Metabolizable energy (MJ/kg)	10.58	ND

ND - Not determined

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TABLE 3: PERFORMANCE CHARACTERISTICS OF EXPERIMENTAL BIRDS

		Replacement level of SWM (%)			SEM
	0	33	66	100	
Starting phase					
Weight gain (g/bird)	459.0 ^a	436.0 ^a	367.0 ^b	285.0 ^c	39.16
Feed consumption (g/bird)	912.0	1096.0	1019.0	939.0	41.59
Feed conversion ratio	1.99 ^c	2.57 ^b	2.77 ^b	3.29 ^a	0.27
Mortality (%)	3.8	7.6	11.54	30.77	5.99
Finishing phase					
Weight gain (g/bird)	1187.0 ^a	1197.0 ^a	1033.0 ^b	703.0 ^c	115.28
Feed consumption (g/bird)	3265.0	3054.0	3054.0	3316.0	68.22
Feed conversion ratio	2.75 ^b	2.56 ^b	2.96 ^b	4.72 ^a	0.50
Mortality (%)	0.0	0.0	0.0	0.0	0.0

Mean without common letter in the same row differ significantly ($P < 0.05$)

an open-sided naturally ventilated broiler house. Four treatments were allocated to the 8 pens in a randomized complete block design. Experimental diets and water were provided *ad libitum*. The treatments consisted of substituting 0, 33, 66 and 100% of the crude protein contributed by the FM in broiler diets with crude protein from SWM (Table 1 and 2). Body weight, feed consumption and feed conversion (feed:gain) were determined for each treatment at weekly intervals. Deaths were recorded daily. At 56 day of age, 2 birds per replicate were randomly picked, kept off feed overnight and slaughtered by severing the jugular vein. After scalding in warm water for almost a minute and manually plucking the feathers, each bird was cut into parts for carcass evaluation. Carcass weight and relative cut part and organ weights were determined prechill. The relative weight was calculated by expressing the weight of the cut parts as a percentage of the dressed weight.

Analytical techniques

Chemical

Test ingredients and diets were analysed for their proximate constituents using the methods of the A.O.A.C (1990). Mineral analysis was as outlined by Grueling (1966).

Statistical

The data obtained were subjected to

analysis of variance while least significant difference was used to estimate difference between treatment means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Table 3 shows the performance of birds fed the experimental diets. Weight gain and feed conversion ratio significant ($P < 0.05$) at both the starter and finisher phases. Birds on the 100% SWM substitution for FM had the least ($P < 0.05$) weight gain and feed efficiency while birds on the 33% SWM substitution for FM had the least ($P < 0.05$) value for these parameter especially at the finisher phase. The reduction in weight gain of birds on the 100% substitution was not due to feed consumption, as the differences in this measurement were not significant. However, birds fed this diet might not have been able to completely satisfy their amino acid requirements. Since synthetic methionine and lysine were supplemented, the amino acids in the SWM (Austin *et al.*, 1981). Babatunde and Fetuga (1976) found that when there is an imbalance in the amino acid profile, the optimal performance of the broiler is not attained. The results of this present study agree with the earlier findings of Fanimu *et al.*, (1996) that the best level of substitution of FM with SWM was at 33%, despite the

TABLE 4: CARCASS CHARACTERISTICS OF EXPERIMENTAL BIRDS

Parameters	Replacement level of SWM (%)				SEM
	0	33	66	100	
Live weight (kg/bird)	1.75a	1.50 ^b	1.18 ^c	1.10 ^c	0.15
Plucked weight (kg/bird)	1.55a	1.33 ^b	1.10 ^{bc}	0.99 ^c	0.13
Plucked weight (%)	88.57	88.67	93.62	90.00	1.18
Dressing weight (kg/bird)	1.27a	1.13 ^a	0.89 ^b	0.76 ^b	0.11
Dressing (%)	77.40	74.20	75.42	68.91	1.42
Carcass relative composition (%)					
Drumsticks	14.80	15.63	16.29	15.66	0.31
Wings	10.39	10.42	11.69	11.58	0.36
Breast	21.89	21.74	20.45	19.34	0.60
Back	17.40	16.35	16.29	16.97	0.26
Neck	7.17	7.10	5.96	6.45	0.29
Thigh	12.91	12.40	11.12	13.30	0.47
Gizzard	2.83	2.88	3.82	3.55	0.25
Liver	2.28c	2.61 ^b	2.81 ^b	3.16 ^a	0.18
Heart	0.55 ^c	0.72 ^b	0.67 ^{bc}	0.92 ^a	0.08
Abdominal fat	1.65 ^b	2.07 ^a	0.90 ^c	0.92 ^a	0.28
Intestine	7.57	8.08	10.11	7.89	0.54

Mean without common letter in the same row differ significantly ($P < 0.05$)

supplementation with methionine and lysine.

Mortality increased with level of SWM in the diet at the starter phase. This may be due to the inability of the chicks at this early age to cope with the chitin level in SWM. Cases of leg problems were observed during the early stage of the birds but they later overcame it. This is similar to the observation of Rosenfeld *et al.*, (1997). These observed leg problems may be due to the high ash or mineral content (especially Ca :P ratio) of the SWM which may lead to mineral imbalance. Calcium carbonate is responsible for the sclerotization of the exoskeleton and represents most of the mineral matter. Because of its high mineral level, SWM is usually used in combination with other protein supplements (Meyer and Rutledge, 1971).

Data on carcass evaluation is shown in Table 4. The differences in the live weight largely explain the variation observed in plucked and dressed weights. There were no significant ($P > 0.05$) differences in the cut

parts weight. Shrimp waste meal in the diet increased ($P < 0.05$) the liver weight. This may not be unconnected with the role of the liver in nutrient metabolism, especially the chitin in SWM. The 33% substitution level of SWM for FM increased ($P < 0.05$) the abdominal fat.

The amino acid supplementation of SWM diets did not improve the utilization of the dietary protein as suggested by Fanimo *et al.*, (1996), since substitution of FM protein by SWM protein in the diets above 66% led to negative performance of the broiler. The major problem, therefore, leading to the low utilization of dietary protein may be related to the presence of chitin in SWM. Chitin is an N-acetylated glucosamine polysaccharide that forms part of the protein complex. About 10% of the crude protein in whole shrimp meal originates from chitin while up to 50% of the nitrogen in scale meal originates from chitin (Gohl, 1975). Chitin has low digestibility when fed to animals. Therefore the use of exogenous enzymes that can break

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 down chitin may enhance the utilization of SWM protein by animals. The results of this study suggest that shrimp waste meal can replace up to 66% of fish meal (protein for protein basis) in diets for broiler chicks without significantly affecting their performance.

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