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Nutritive and Economic Value of Danish Fish Meal, Crayfish Dust Meal and Shrimp Waste Meal Inclusion in Broiler Diets

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Abstract: Nutritional and economic evaluation of the dietary inclusion of Danish (imported) fish meal, crayfish dust meal and shrimp waste meal as animal protein sources in broiler ration was carried out using 144-day old broiler chicks in a completely randomized design experiment. This trial lasted seven weeks. The 144 – unsexed chicks of. Anak Strain were randomly allocated to 6 dietary treatments, with each having 2 replications of 12 chicks per replicate. The diets were designated as diets 1,2,3,4,5 and 6. Diets 1, 2 and 3 respectively had 6% Danish fish meal, crayfish dust meal and shrimp waste meal, while diets 4, 5 and 6 respectively contained 3% each of crayfish dust meal and shrimp waste meal. The birds were fed and watered *ad libitum*. Proximate analysis showed that the test ingredient (FM, CFDM and SWM) respectively had a crude protein content of 61.34%, 65.27% and 46.20%. The gross energy were 2614kcal/kg, 3625kcal/kg and 2982kcal/kg in that same order. The mean final body weight, daily weight gain, daily feed intake and feed - to -gain ratio showed no significant difference ($P>0.05$). Birds fed diet 4 gave the best (2.05) feed-to-gain ratio and weight gain. The nutrient and mineral utilization analysis showed significant variation ($P<0.05$) in the percent nitrogen and energy retention as well as calcium and phosphrous retention values among the diets. Birds fed diet 2 had their nitrogen retention improved (83.32%). The cost analysis indices showed significant ($P<0.05$) differences. Diet 4 was the cheapest (N39.07) per kilogramme while diet 1 gave the least marginal revenue (N451.34). From the foregoing, the Danish fishmeal, crayfish dust meal and shrimp waste meal are generally comparable and had no adverse effect on the performance and economic of broiler production through the combination of crayfish dust meal and shrimp waste meal proved to be the best diet. This is an indication that satisfactory animal protein can be prepared from these unconventional sources.

Key words: Nutritive, economic, danish fish meal, crayfish dust meal, shrimp waste meal, broiler diets

Introduction

Commercial broiler production has become a specialized and speedy poultry operation during the recent years all over the world. The total consumption of poultry meat and eggs has also increased dramatically during the past five decades and continues to increase ahead of human population growth (Hossain *at al*., 2003). The broiler industry, therefore, demands fast growing chicks and good quality feed with high level of energy, protein, vitamins and essential minerals to support maximum growth. According to Banerjee (1992), poultry feed cost about 60-65% of the total cost of poultry production while protein costs about 13% of the total feed cost. Animal feed situation has become one of great concern in Nigeria. Today, average price of a 25kg bag of broiler feed stands at a staggering figure of about N1,200.00/ N1,300.00 ($10) with an associated problem of dwindling quality. This situation, therefore, calls for solutions that can urgently check the steadily increasing prices of feeds so as to encourage more people to get back into animal farming and thus increases animal protein supply.

The quality and quantity of dietary protein are primary factor influencing growth and feed costs. Consequently, considerable research has been conducted to evaluate protein requirements (Guillaume, 1997) and the acceptability of various feedstuffs as protein source (Tacon and Akiyama, 1997). Feedstuffs containing at least 20% crude protein are often considered to be suitable protein not always available in every environment. And this wouldn't have constituted another problem. If poultry farmers will take advantage of available animal protein resources in their neighbourhood. For instance, huge swarms of grasshopper usually seen in the Northern part of Nigeria, especially at the onset of harvesting are being harvested and locally processed into meal which is being used in feeding some of their livestock and sparingly as food for human (Rosenfeld *et al*.,1997). Squilla, shrimp waste meal and crayfish dust meal are by – products of marine food processing industry. In the Niger – Delta region of Nigeria, it is often used in preparing local fish meal. According to Okoye (1998), being marine in origin, they are expected to be relatively rich in calcium and phosphorous, minor inorganic elements, fatty acids, methionine and lysine, vitamins

Table 1: Proximate composition of the test ingredients

Measurement + (%)	Danish Fish meal	Crayfish dust meal	Shrimp waste meal
Crude protein	61.34	65.27	46.20
Ether extract	6.94	5.00	6.21
Crude fibre	0.00	2.23	2.07
Ask	6.32	11.31	13.18
Nitrogen free extract	15.72	11.91	22.57
Dry matter	90.32	95.00	90.00
Gross energy(kcal/kg)	2614.00	3625.00	2982.00.

Table 2: Mineral composition of the test ingredients

Measurement + (%)	Danish Fish meal	Crayfish dust meal	Shrimp waste meal
K	N.D	1.80	1.21
Na	N.D	1.50	1.34
Ca	0.3	0.89	0.98
P	0.2	1.19	0.42
Mg	N.D	0.30	0.29

N.D - Not determined.

and unidentified growth factors. It is on the basis of this that this trial was conducted to comparatively evaluate the performance, nutrient utilization and economics of production of broiler chickens fed Danish (imported) fish meal, crayfish dust meal and shrimp waste meal in an attempt to increase the animal protein resource pool from which poultry farmers can source from.

Materials and Methods

Procurement and Processing of the test ingredients: Fresh samples of the species litpenaeus vannemci (shrimp) was purchased from the local beach market in Calabar, Cross River State, Nigeria. Their heads, appendages and exoskeleton were extracted from the tissues. It was boiled to reduce moisture content and then sundried under intense sun for 120 hours. The crayfish dust was purchased dried from the same local market. They were then ground separately using a commercial though, locally made blender. Danish fishmeal was purchased from Ibadan, Oyo State, Nigeria. Each of the test ingredients was then put into a labeled jute bag.

Experimental diets: A total of six diets having percent crude protein which ranged between 20.86% and 22.01% and caloric densities of 2989.6 and 3035.50kcal/kg were formulated as shown in Table 3. Maize was the major source of energy while Danish fish meal, Soybean meal, shrimp waste meal and crayfish dust meal were the major protein sources. The diets were fortified with synthetic amino acid, such as lysine and methionine. Diet 1, designated the control, contained no shrimp waste meal and or crayfish dust meal. Diets 2 (100% crayfish dust meal), 3 (100% shrimp waste meal) 4 (50% crayfish dust meal and 50% shrimp waste meal), 5 (50% Danish fish meal and 50% crayfish dust meal) and 6 (50 Danish fishmeal and 50% shrimp Waste meal).

Experimental birds, management and design: A total of one hundred and forty-four (144) day-old unsexed broilers of the Anak strain were procured from Obasanjo Farms limited, Ota, Ogun State. On arrival, the chicks were randomly allocated to each diet and replicated twice giving 12 chicks per replicate. The initial weights of the chicks were measured and antistress was administered. The chicks were brooded using lantern and kerosene store while electric bulbs were used in providing artificial light at night. Vaccination against Newcastle disease was administered to the birds' intraoccular at day-old while lasota vaccine was administered on the 16th day. Keproceryl was given to the birds to protect them against Chronic Respiratory Diseases (CRD). Coccidiostat (Pentacox) was administered between the 4th and 5th week.

Data collection: The experimental design was completely Randomized Design (CRD). Initial live weights of the birds were taken on group basis at the beginning of the experiment. Subsequent weighing of birds was done weekly and on individual basis. Weight gain was obtained by subtracting the initial live weight from the final live weight. Feed intake was determined by subtracting the weight of the left over from the feed offered to the birds the previous morning on daily basis. Feed conversion ratio was determined by dividing feed intake by weight gain.

Nutrient retention trial: At six weeks of age, digestibility trial was carried out. Two birds (one per replicate) closest to the mean weight of the birds per treatment were randomly selected and transferred to metabolic cages and in individual compartments, each bird was housed. They were fed test diets according to their experimental diet groups for 4 days acclimatization period followed by feeding of a measured quality of feed (200g) for 3 days. Droppings were collected for those 3 days by means of clean trays placed under the cages. Samples of the droppings were collected and oven dried at 90^{oC}, bulked, and representative samples of the droppings, feed and test ingredients were taken for proximate and mineral analysis according to A.O.A.C (1990). Estimation of the digestible nutrient was according to McDonald *et al.* (2000) as shown below:

$$\%\text{Digestibility} = \frac{\text{Nutrient intake} - \text{Nutrient in feaces}}{\text{Nutrient intake}} \times 100$$

Economic analysis: The cost of dietary ingredients (N/kg) were recorded and used to calculate the cost/kg of each diet. Feed intake per bird per treatment for the

Table 3: Composition of the experimental diets

Diets	Ingredients (%)					
	1	2	3	4	5	6
Yellow maize	60.00	60.00	60.00	60.00	60.00	60.00
Soyabean meal	28.80	28.80	28.80	28.80	28.80	28.80
Fish meal (Danish)	6.00	0.00	0.99	0.00	3.00	3.00
Crayfish dust meal	0.00	6.00	0.00	3.00	3.00	0.00
Shrimp waste meal	0.00	0.00	6.00	3.00	0.00	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Oyster shell	1.50	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Vit Min. Premix	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	O.10	0.10	0.10	0.10	0.10
Lysine	0.10	O.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis:						
Crude protein (%)	21.69	22.01	20.86	21.44	21.85	21.28
Metabolizable Energy (Kcal/kg)	2989.60	3035.50	2996.92	3016.21	3012.55	2993.26
Calrie: Protein ratio	138	138	144	141	138	141
Determined Proximate analysis:						
Crude protein (%)	22.92	23.62	23.01	23.36	23.01	22.66
Ether extract (%)	4.20	3.72	3.70	3.64	4.17	4.36
Crude fibre (%)	3.88	3.73	4.04	3.71	3.97	4.03
Ash (%)	7.74	7.77	8.22	8.51	8.60	8.76
NFE (%)	51.47	52.43	52.28	50.93	51.10	51.30
Cry matter (%)	90.20	91.30	91.24	90.15	10.84	91.10
Gross energy (Kcal/kg)	3989	4129	4131	4020	4181	4170
Determined Mineral analysis						
Potassium (%)	1.14	1.21	1.19	1.13	1.30	1.21
Sodium (%)	0.83	0.87	0.90	0.99	0.82	0.91
Manganese (%)	0.33	0.39	0.36	0.37	0.52	0.41
Calcium (%)	1.00	1.00	1.01	0.99	1.00	1.04
Phosphorous (%)	0.60	0.64	0.70	0.64	0.70	0.72

Vitamin Mineral premix provided (Per kg of diet): Vit A I1500IU, Vit. D_3, 1600IU; Riboffavin, 9.9mg; Biotin, 0.25; Pantothenic acid, 11.0mg; Vitamin K, 3.0mg; Vit B_2, 2.5MG; Vit. B6, 0.3mg; Vit. B12, 8.0mg; Nicotinic acid, 8.0mg; Iron, 5.0mg; Manganese, 10.0mg; Zinc, 4.5mg; Cobalt, 0.02mg; Selenium, 0.01mg.

experimental period was used to multiply the cost/kg feed to obtain the cost of feed was calculated using the procedure of Sonaiya *et al.* (1986) and Ukachukwu and Anugwa (1995), which involved taken the product of cost/kg feed and feed to-gain ratio of consuming such diets.

1 Cost of production = Cost/kg weight gain x mean weight gain
2 Revenue = Price (N/kg) Meat x Mean weight gain
3 Gross Margin = Revenue - Cost of production

Statistical analysis: Data were subjected to analysis of variance of a completely randomized design in this study. When analysis of variance indicated a significant treatment effect, Duncan's multiple range test was used to differentiate the means using procedures described by Steel and Torrie (1980).

Results and Discussion

The proximate and mineral composition of the test ingredients are shown in Table 1 and 2 respectively. The differences in the values obtained could be due to the sources of the test ingredients, processing techniques, storage and some other hiding factors.

The results of the body weight, body weight gain and feed conversion ratio of broilers as affected by the dietary treatments are summarized in Table 4. There was no significant difference (P>0.05) among the treatment means for all the parameters considered. Broilers fed combination of fish meal and crayfish dust meal (Diet 5) consumed the highest quantity of feed (82.23g) while those fed 6% Danish fish meal only (Diet 1) consumed the least (74.5g). Olomu (1995) reported that crayfish is very tasty; the combination of crayfish with Danish fish meal in equal proportion could have enhanced the palatability of this diet, which inturn improved the intake. In overall performance, birds fed combination of crayfish dust meal (3%) and shrimp waste means (3%) (diet 4) gave the best weight gain (1875.30g) and better feed conversion (2.05). Diet 1 had the least weight gain (1600.00g) and second best feed conversion (2.16). This suggests that at low levels, chitin has a growth promoting effect by producing glucosamine during its digestion through chitinase enzyme secreted by intestinal bacteria (Ramanchandran Nair *et al.*, 1987). Similar observation had been documented (Spreen *et al.*, 1984). They observed that chitinous material at lower

Table 4: Performance characteristics of the broiler birds fed danish fishmenl, shrimp waste meal and Crayfish dust meal (0-49 days).

Performance index (g/b/d)	Diets						
	1	2	3	4	5	6	SED
Mean initial body weight	49.69	49.50	50.00	49.70	49.68	49.75	0.00
Mean final body weigh	1650	1900.00	1725.00	1925.00	1800.00	1850.00	128.00
Mean body weight gain	1600	1850.50	1675.00	1875.30	1750.30	1800.00	128.00
Mean daily weight gain	32.66	37.77	34/18	38.27	35.72	36.74	261.00
Mean total feed intake	3651.6	4017.30	3697.50	3821.00	4029.30	3932.6	218.00
Mean daily feed intake	74.52	81.98	57.46	77.98	82.23	80.25	4.49
Feed-to-gain ratio	2.29	2.16	2.20	2.05	2.30	2.18	0.13

Table 5: Nutrient utilization of the different animal protein sources by the experimental birds

Parameter (%)	Diets						
	1	2	3	4	5	6	SED
Nitrogen retained	77.65^{b}	83.32^{a}	77.82^{b}	79.56^{b}	78.39^{b}	78.21^{b}	0.94
Crude fibre digestibility	7.80^{cd}	27.47^{a}	11.78^{bc}	1.50^{d}	18.51^{cd}	7.46^{cd}	4.05
Fat digestibility	86.93^{c}	89.74^{a}	8753^{bc}	86.79^{c}	88.65^{ab}	87.83^{bc}	0.56
Ash digestibility	34.47^{c}	51.87^{a}	42.88^{b}	52.64^{a}	$46/79^{ab}$	48.18^{ab}	2.68
Energy retained	91.14^{c}	93.65^{a}	91.96^{ab}	92.01^{b}	92.32^{b}	92.01^{b}	0.35

Abcd - means within a row with different superscripts are significantly different (P<0.05)

Table 6: Mineral utilization of the different animal protein sources by the experimental birds

Parameter (%)	Diets						
	1	2	3	4	5	6	SED
K	61.92	70.00	64.18	62.35	65.02	62.49	2.05
Na	6312^{d}	72.98^{ab}	65.97^{cd}	69.85^{bc}	75.51^{a}	6393^{d}	1.64
Mg	89.60^{b}	89.92^{b}	88.00^{c}	87.48^{c}	92.96^{a}	87.46^{c}	0.59
Ca	32.55^{c}	50.67^{a}	38.06^{bc}	37.90^{bc}	39.54^{b}	40.74^{b}	2.74
P	33.26^{c}	50.49^{ab}	54.47^{a}	47.39^{b}	48.68^{ab}	46.84^{b}	2.71

abcd - means within a row with different superscripts are significantly different (P<0.05)

Table 7: Economic analysis of broiler birds fed dietary danish fishmeal, shrimp waste meal and crayfish dust meal

Parameter (%)	Diets						
	1	2	3	4	5	6	SED
Cost kg/feed(N)	68.10^{a}	38.78^{d}	39.37^{d}	39.37^{d}	43.11^{c}	43.40^{b}	0.00
Total feed consumed/bird(g)	3651.6	4017.30	3697.5	3697.5	4029.30	3932.60	218.98
Cost of feed per bird (N)	248.67^{a}	155.75^{bc}	$145..53^{c}$	145.53^{c}	173.66^{b}	169.85^{bc}	8.98
Marginal Revenue(N)	451.34^{b}	544.26^{a}	552.54^{a}	550.72	526.34^{a}	530.16^{a}	8.86

abcd - means within a row with different superscripts are significantly different (P<0.05).

levels supports the growth of bifidobacterium, thus stimulating improved gains. The performance of birds fed diets 1 (6% fish meal) showed that, though, fish meal is known to be of good nutritive value in chicken rations, but according to Card and Nesheim (1972), it should not be included at higher level so as not to decrease growth performance. Among several factors, genetic background of chickens, energy content of diet, environmental temperature, sex, availability of nutrients from various feedstuffs, destruction or loss of nutrients in feeds or in gastro-intestinal tracts can alter the dietary amino acid requirement of broiler chicken which will inturn affect growth performance. 6% dietary inclusion of shrimp waste meal inclusion in diet 3 could have depressed growth (Spreen *et al.,* 1984).

Tables 5 and 6 show the nutrient and mineral utilization of the various animal protein sources. The nutrient and mineral utilization of the various dietary treatments showed significant differences (P<0.05). Diet 2 recorded the highest value of nitrogen (83.32%) and energy (93.65%) retained. This could have contributed to the high body weight gain observed in birds fed crayfish dust meal. The fat digestibility values recorded ranged between 86.79% and 89.94%. An indication that all the dietary treatments were comparable and had enough supply of the essential fatty acids which inturn could bring about improvement in the general physical properties of the food. It is also an indication that none of the unconventional protein sources is inferior to the imported fish meal. Rather, they may even be found to possess fish soluble properties and some identified growth factors. Birds fed diet 2 also recorded the highest percent potassium retained value (70.00).

Table 7 shows the economics of production analysis of

broiler chicken fed the varying dietary treatments. The cost per kilogramme feed consumed and cost per total feed consumed (N) during the period were significantly influenced ($P<0.05$). Diet 1 was highest in cost per kilogramme (N68.10) and cost per total feed consumed (N). This is attributable to the high cost of Danish fishmeal. Diet 2 had least cost/kg feed(N) and cost of feed per bird (N). The other test ingredients. (apart from diet 1) were economically comparable and advantageous. This further confirms the findings of Islam *et al.* (1994) and Akpodiete and Inoni (2000). Consequently, there was a significantly improved savings with the use of these non-conventional animal protein concentrates.

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