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Performance of broiler chickens fed graded levels of poultry meat meal

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***Target Audience:** Poultry farmers, Animal nutritionist*

Abstract

A 49 days experiment was carried out on the performance of broiler chickens fed poultry meat meal. 150 day old Arbor acre broiler chickens were divided into 5 dietary treatments of 3 replicates with 10 birds per replicate in a completely randomized design. Diet 1 had 100% fishmeal as the control (T_1) while the poultry meat meal was added to diets T_2, T_3, T_4, T_5 at 25%, 50%, 75%, 100% replacing fishmeal respectively. The result obtained showed that the weight gained and average daily weight gained of broiler chickens fed Diet T_5 (100) % had the highest mean (1624.33g/bird and 33.22g/bird). The breast, drumstick, thigh and the back cut showed that birds fed diet T_5 had higher values than birds on other diets. There were significant differences ($P<0.05$) in the values of spleen, heart and lungs across the diets. There was progressive decrease in cost/kg of feed with increase in inclusion of poultry meat meal: T_2 (₦182.20), T_3(₦179.20), T_4(₦176:20), T_5(₦173:20). The cost of feed consumed and cost of production showed that it was costlier to produce birds on T_1 than birds on other diets with T_5 having the least cost and highest revenue (₦1756.67) and gross margin (₦906.86). It was concluded that the inclusion of poultry meat meal in broiler diet improved growth, higher carcass yield and enhanced economic values. Therefore, T_5 (100%) total replacement of fishmeal with poultry meat meal is recommended.

Key words: poultry meat meal, broiler, fish meal

Description of problem

Poultry industry in Nigeria occupies a prominent position as a major source of animal protein supply to the citizens. United States Department of Agriculture (1) reported that commercial poultry production in Nigeria was estimated at about USD 800 million (₦288,400,000,000). Poultry sector contributed about 25% of the agricultural domestic products of the Nigerian economy (2). USDA (1) currently rated Nigeria as the leading country in Africa with respect to eggs production, but fourth in broiler production, this report indicated that Nigeria should improve on their production with respect to broiler birds. Poultry production is gaining popularity in the developing countries due to its role in bridging the protein malnutrition in their diets, economic empowerment of the resource poor segment of the society. Poultry

production is practiced in all levels ranging from subsistence to large scale commercial operations. Poultry meat and eggs are the most consumed animal protein; unrestricted by any religion or culture in Nigeria (2).

Nigeria presently produces above 550,000tons of poultry meat per annum and 700,000tons of eggs according to (2). Despite this, Nigeria is far from meeting her domestic demand when compared with developed countries that involved in poultry production. According to FAO, (2) It was reported that poultry expansion was 3.2percent against global increase of 2.2 percent; Nigeria supply had increase beyond her domestic borders while countries like Cameroon, Togo, Benin, Benin Republic, Niger and many of her neighbouring Countries are been supplied, but despite that Nigeria supply with respect to broiler production has not been consistent compared to layers production. The poultry industry has a large capacity in Nigeria to create employment. The potential in Nigeria is great and only the farmers that are financially buoyant can fill the gap and harness these opportunities.

Poultry offers the greatest scope for increasing the quantity and quality of animal protein. The challenge therefore, is how to produce poultry products at sustainable levels in order to bridge the protein supply gap in the nearest future.

Fish meal is an excellent source of protein and is also rich in essential amino acids, vitamins and minerals. It is a natural balanced feedstuff that is high in protein, energy, minerals (calcium and phosphorus), as a natural source of vitamins (including choline, biotin, vitamin A, B_{12} and E) and the micronutrients such as selenium and iodine. It has long been recognized that the antigenicity of fish protein is low, and coupled with the anti-inflammatory properties of fishmeal, its inclusion in chick diets has been shown to greatly improve disease resistance in poultry. Fish meal is produced from sustainable source and is a renewable feed source, produced almost excessively from types of fish for which there is no demand for human food use. Fishmeal is safe and traceable. It is a rich source of the essential fatty acids, anti-oxidant and minerals. (3)

With all these good properties of the fishmeal, the price is becoming unbearable by poultry farmers possibly because of the high foreign exchange rate and it is no more easily accessible to local farmers. There are two major types of fishmeal; the foreign which has 72% crude protein and the local having 65% crude protein content. Most often these types of fishmeal are adulterated simply because of the high cost and expected result is not gotten from the broilers that are fed feeds containing these adulterated products. These results to great lose on the part of the poultry farmers. An alternative has been found in poultry meat meal.

Poultry meat meal is a novel source of crude protein that could be used as a replacement for expensive, imported and local fish meal. It is made by combining the by-products coming from poultry slaughterhouses or poultry processing plants. Thus, poultry meat meal had been defined as the ground, rendered, clean parts of the carcass of slaughtered poultry such as necks, heads, feet, undeveloped eggs, gizzards and whole chickens prepared for human consumption, exclusive of feathers. The nutrient content of poultry meat meal can be quite variable and depends on the substrate that is being processed (4, 5). It is generally a palatable and high-quality feed ingredient due to its content in essential amino acids, fatty acids, vitamins and minerals. In addition to its use in livestock, it is in high demand for the pet food and aquaculture industries (6). Therefore, this study was to evaluate the performance of broiler chicken fed poultry meat meal.

Materials and Methods

Experimental location

The experiment was carried out at the Poultry Unit of the Research and Teaching farm of Michael Okpara University of Agriculture, Umudike. Umudike lies on latitude $05^0 29^{'}$ N and longitude $07^0 33^{'}$ E with an elevation of 122m above sea level and is located in the tropical rainforest zone of Nigeria. This zone is characterized by annual rainfall of about 2177 mm, monthly ambient temperature range of 22°C - 36°C and relative humidity of 50-95 % (7)

It is therefore, in a humid tropical environment, where the temperature and relative humidity are significant in agricultural production.

Procurement of experimental materials

The poultry meat meal was purchased from PROTANEX GOLD NIGERIA LIMITED, LAGOS. While the day-old broilers were bought from Chi farms, Ibadan.

Experimental animals and management

A total of one hundred and fifty (150) day old birds were used for the experiment. The birds were brooded for one week and reared till eight weeks. The birds were fed *ad libitum* with commercial starter diet from day old to one week of age before introducing the test diets. Clean water was provided to the birds *ad libitum*. Proper sanitation and routine medication were maintained to forestall any disease outbreak.

Experimental diets

The poultry meat meal was used to formulate five diets at 0%, 25%, 50%, 75%, and 100% levels designated T_1, T_2, T_3, T_4 and T_5 respectively to replace fishmeal. Table 1 shows the percentage composition of starter broiler fed Poultry meat meal while Table 2 shows the percentage composition of finisher broiler fed Poultry meat meal.

Table 1: Percentage composition of starter broiler fed Poultry meat meal.

Ingredients	T_1	T_2	T_3	T_4	T_5
Maize	49.00	49.00	49.00	49.00	49.00
SBM	30.00	30.00	30.00	30.00	30.00
Fish Meal	3.00	2.25	1.50	0.75	-
PMM	-	0.75	1.50	2.25	3.00
Wheat offal	5.15	5.15	5.15	5.15	5.15
GNC	8.00	8.00	8.00	8.00	8.00
Palm oil	0.85	0.85	0.85	0.85	0.85
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated composition					
ME kcal/kg	2898.04	2901.98	2905.93	2909.87	2913.82
CP (%)	23.11	23.09	23.08	23.07	23.05

SBM: Soya Bean Meal.PMM: Poultry Meat Meal. GNC: Groundnut Cake,

Table 2.0: Percentage composition of finisher broiler fed Poultry meat meal

Ingredients	T_1	T_2	T_3	T_4	T_5
Maize	59.20	59.20	59.20	59.20	59.20
Fish Meal	3.00	2.25	1.50	0.75	-
PMM	-	0.75	1.50	2.25	3.00
Wheat offal	3.00	3.00	3.00	3.00	3.00
SBM	20.00	20.00	20.00	20.00	20.00
GNC	10.00	10.00	10.00	10.00	10.00
Palm Oil	1.00	1.00	1.00	1.00	1.00
Bone Meal	3.00	3.00	3.00	3.00	3.00
Salt	0.20	0.20	0.20	0.20	0.20
Premix	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00	100.00
Calculated composition					
ME kcal/kg	3017.80	3021.75	3025.69	3029.64	3033.58
CP (%)	20.15	20.13	20.12	20.10	20.09

PMM: Poultry Meat Meal; SBM:SoyBean Meal; GNC: Groundnut Cake.

Data Collection

Determination of Growth parameters

Data was collected for a period of seven weeks. The following parameters were measured;

Initial body weight: The weight of the birds at the beginning of the experiment. This was done using single pan electronic balance (Setra® BL-310S).

Final body weight: The weight of the birds at the end of the experiment. This was done using triple beam balance (Camry® Dial Spring Scale).

Feed intake/bird/day (g):

$$\frac{\text{Quantity of feed given – leftover}}{\text{Number of birds x 56 days}}$$

Daily weight gain/bird (g):

$$\frac{\text{Final live weight - initial weight}}{\text{Number of birds x 56 days}}$$

Feed conversion ratio:

$$\frac{\text{Quantity of feed consumed}}{\text{Weight gained}}$$

Percentage (%) mortality:

$$\frac{\text{Number of dead birds}}{\text{Initial stock}} \times 100$$

Carcass characteristics and organ proportions

At the end of the experiment (49 days), 15 chickens of similar body weight to the group average were selected from the treatment group (1 chicken per replicate), weighed and slaughtered by severing the

jugular vein, they were then thoroughly bled and scalded by dipping in hot water with temperature of 70-75^{0}C before defeathering. The internal organs were removed. After evisceration, warm carcasses were weighed immediately to determine the carcass yield as prescribed by (8). The weights of the carcass cut parts; breast, thigh, drumstick, backcut and wings were recorded individually. The weights of these selected parts were expressed as a percentage of dressed weight of the broilers, while the weight of selected organs; gizzard, liver, spleen, heart, kidney, small intestine and large intestine were recorded and expressed as a percentage of live weight.

Economics of production

Economic parameters that were determined include; Mean weight gain, Total feed consumed (kg/bird), Cost/kg weight gain, Cost of total feed consumed (₦),
Cost of production (₦) = Cost/kg weight gain x Mean weight gain
Price/kg meat (₦) = Price of selling one kg of meat
Revenue (₦) = Price/kg meat x Mean weight gain
Gross margin (gain) = Revenue – Cost of production

Experimental Design and Analysis

The experiment was laid out in a Completely Randomized Design. All Data analysis were done using IBM® SPSS version 20.0. The data were subjected to analysis of variance (ANOVA). Where treatment means were significant, separation of means was done using the Duncan's Multiple Range Test (9) at 5% level of significance.
Completely randomized design model: $Y_{ij} = \mu + T_i + e_{ij}$
Where:
Y_{ij}= individual observation
μ = Overall mean
T_i= Treatment Effect
e_{ij}= Random error

Results and Discussion

The result of the growth performance of broiler chickens fed graded levels of poultry meat meal is showed in Table 3. The initial weight, final weight, weight gained, average daily weight and mortality showed that there were no significant differences (P>0.05) across the treatment groups but broiler chickens fed diet T_5 had the highest mean values except for mortality.

Table 3: Growth Performance of Broiler Chickens fed graded levels of Poultry Meat Meal

	DIETS					
Parameters	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)	SEM
Initial weight (g/bird)	131.67	131.67	131.33	131.00	132.33	0.32
Final weight (g/bird)	1741.67	1573.67	1626.00	1712.33	1756.67	30.72
Weight gained (g/bird)	1610.00	1442.00	1494.67	1581.33	1624.33	30.61
ADWG (g/bird)	32.92	29.57	30.73	32.32	33.22	0.64
TFI (g/bird)	4738.33^{ab}	4535.33^{b}	4711.67^{ab}	4605.00^{b}	4906.67^{a}	42.17
ADFI (g/bird)	96.69^{ab}	92.55^{b}	96.15^{ab}	93.98^{b}	100.12^{a}	0.86
FCR	2.94^{a}	3.14^{a}	3.13^{a}	2.45^{b}	3.01^{a}	0.09
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00

^{a,b,c} Means across rows with different superscripts differ significantly at P<0.05; S.E.M: Standard Error of the Mean; ADWG: Average Daily Weight Gained; TFI: Total feed intake; ADFI: Average Daily Feed Intake; FCR: Feed conversion ratio.

The total feed intake and the average daily feed intake showed the same trend of significances where broiler chickens fed diet T_5 (100%) were significantly higher ($P<0.05$) than those fed diet T_2 (25%) and diet T_4 (75%) while the remaining treatment groups were not significantly different ($P>0.05$) from each other. Also, the feed conversion ratio showed that broiler chickens fed diets T_1 (0%), T_2 (25%), T_3 (50%) and T_5 (100%) were not significantly different ($P>0.05$) from each other but they were significantly higher ($P<0.05$) than those fed diet T_4 (75%).Poultry meat meal is a by-product of poultry slaughter house with crude protein of about 70% had showed its potential in the general performance of broiler chickens. The result obtained showed that the weight gained and average daily weight gained of broiler chickens fed diet T_5 (100%) had the highest mean (1624.33g/bird and 33.22g/bird) which implies that total inclusion of poultry meat meal at 100% improves the performance of broiler chickens, also the result implies that inclusion of poultry meat meal enhanced performance better than fishmeal which could be due to improved digestibility. This is consistent with the studies reported by (10; 11; 12); that the higher the quality of protein the feed contains, the higher weight gain. According to (13), what determined the level of the biological values in proteins are the number of the materials used, the types and balance of amino acids. It was also stated that the balanced level of amino acids is highly influenced by the amino acids which the feed contains, the digestibility level of protein and availability of amino acids.

The result showed that significant increase in feed intake is due to the high levels of protein in the feed as this is consistent with the studies reported by (14;15; 16;12). The feed intake of the broiler chickens is affected by the feed composition, the ambient temperature, the age, the balance of energy and the protein level in the feed. Also, the feed conversion ratio revealed that broiler chickens fed T_4 were significantly lower ($P<0.05$) to the remaining treatment groups which were not significantly different ($P>0.05$) from each other. The result indicates that the feed constituents used affect feed intake, feed conversion and weight gain of the poultry. According (17), feed conversion is influenced by the balance of the nutrients in the feed, body size and ambient temperature, the ability to digest nutrients the feed contains, and decreases in the feed nutrients during the metabolism process.

The result of the carcass yield of broiler chickens fed graded levels of poultry meat meal is showed in Table 4. The live weight, dressed weight, breast cut and drum stick showed that there were no significant differences ($P>0.05$) across the treatment groups. The result of de-feathered weight showed that broiler chickens fed diet T_1 (0%) and diet T_5 (100%) were not significantly different ($P>0.05$) from each other but they were significantly higher ($P<0.05$) than those fed diet T_3 (50%), while the result of the dressing percentage showed that broiler chickens fed diet T_4 (75%) were significantly higher ($P<0.05$) than those fed diet T_5 (100%) but those fed diets T_1 (0%), T_2 (25%) and T_3 (50%) were not significantly different ($P>0.05$) from each other.

Table 4: Carcass Characteristics of Broiler Chicken fed graded levels of Poultry Meat Meal

	DIETS					
Parameters	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)	S.E.M
Live weight g/bird	1766.67	1633.33	1650.00	1650.00	1750.00	26.82
Def. weight g/bird	1633.33^{a}	1441.67^{b}	1500.00^{ab}	1516.67^{ab}	1616.67^{a}	25.78
Dressed weight g/bird	1141.67	1083.33	1066.67	1125.00	1100.00	19.95
Dressing %	64.57^{ab}	66.13^{ab}	64.67^{ab}	62.13^{b}	68.83^{a}	0.75
Cut Parts (%)						
Breast	33.71	30.20	30.39	30.64	32.09	0.63
Drumstick	16.48	15.43	15.67	15.94	17.29	0.30
Thigh	17.57^{ab}	16.89^{b}	16.76^{b}	17.17^{ab}	18.86^{a}	0.29
Wings	14.08^{a}	12.92^{ab}	12.99^{ab}	12.49^{b}	13.10^{ab}	0.21
Back cut	18.98^{abc}	18.77^{bc}	20.52^{ab}	18.09^{c}	20.94^{a}	0.38

^{a,b,c} Means across rows with different superscripts differ significantly at P<0.05; S.E.M: Standard Error of the Mean; Def.: Defeathered

The result of the thigh showed that broiler chickens fed diet T_2 (25%) and diet T_3 (50%) were not significantly different (P>0.05) from each other but they were significantly lower (P<0.05) to those fed diet T_5 (100%), while the wings showed that broiler chickens fed diet T_1 (0%) were significantly higher (P<0.05) than those fed diet T_4 (75%). The back cut showed that broiler chickens fed diet T_5 (100%) were significantly higher (P<0.05) than those fed diet T_3 (50%) and diet T_4 (75%) respectively, while those fed diet T_4 (75%) were also significantly higher (P<0.05) than those fed diet T_2 (25%).

These findings are consistent with those of (18) and (19), who did not obtain significant carcass yield differences when poultry meat meal was included in the diets of broiler chickens. The result obtained in this study showed that inclusion of poultry meat meal do not have deleterious effect on carcass yield. The increase in carcass were influenced by sex, age, temperature, breed/strain, quantity and quality of feed consumed. (20 and 21).

The organs weight of broiler chickens fed graded levels of poultry meat meal is showed in Table 5. The liver, gizzard, kidney, small intestine and large intestine showed that there were no significant differences (P>0.05) across the treatment groups.

Table 5: Organs weight of Broiler Chicken fed graded levels of Poultry Meat Meal

	Diets					
Parameters %	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)	SEM
Spleen	0.13^{ab}	0.19^{a}	0.14^{ab}	0.11^{b}	0.12^{b}	0.01
Heart	0.47^{ab}	0.51^{ab}	0.42^{b}	0.55^{a}	0.50^{ab}	0.02
Liver	2.92	2.33	2.65	2.28	2.16	0.15
Gizzard	2.11	2.27	2.16	2.05	2.18	0.04
Kidney	0.41	0.47	0.43	0.48	0.43	0.01
Lungs	0.46^{b}	0.68^{a}	0.61^{ab}	0.64^{ab}	0.54^{ab}	0.03
Small intestine	3.98	3.83	4.74	5.02	4.63	0.19
Large intestine	1.18	1.40	1.39	1.57	1.34	0.07

^{a,b,c} Means across rows with different superscripts differ significantly at P<0.05; S.E.M: Standard Error of the Mean.

While the spleen showed that broiler chickens fed diet T_2 (25%) were significantly higher (P<0.05) than those fed diet T_4 (75%) and diet T_5 (100%) respectively.

The heart showed that broiler chickens fed diet T_4 (75%) were significantly higher (P<0.05) than those fed diet T_3 (50%) whereas those fed diet T_1 (0%), diet T_2 (50%) and diet T_5 (100%) were not significantly different (P>0.05) from each other. The lungs showed that broiler chickens fed T_2 (25%) were significantly higher than (P<0.05) than those fed diet T_1 (0%), but those fed diet T_3 (50%), diet T_4 (75%) and diet T_5 (100%) were not significantly different (P>0.05) from each other.

The result obtained showed that some of the evaluated organs such as spleen, heart, gizzard, kidney, lungs, small intestine and large intestine of broiler chickens fed diet containing poultry meat meal at varying proportions were increased, the result is in agreement with previous findings (22; 23) where the relative weight of these organs are normal and this showed that the poultry meat meal does not have deleterious effect on the organ proportion.

Economics of Production

Table 6: Economics of production of broiler chicken fed graded levels of poultry meat meal

	Diets					
Parameters	T_1 (0%)	T_2(25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)	SEM
Cost/kg of feed (₦)	185.20^{a}	182.20^{ab}	179.20^{bc}	176.20^{cd}	173.20^{e}	1.31
Cost of feed consumed(₦)	877.52^{a}	858.44^{b}	812.71^{b}	811.38^{b}	849.81^{ab}	8.28
Cost/kg wt. gain (₦)	545.05	575.86	566.15	518.93	523.47	11.43
Cost of production (₦)	877.52^{a}	858.44^{b}	812.71^{b}	811.38^{b}	849.81^{ab}	8.28
Revenue (₦)	1741.67	1626.00	1573.67	1712.33	1756.67	30.72
Gross Margin (₦)	864.15	767.56	760.96	900.96	906.86	30.31

^{a,b,c} *Means across rows with different superscripts differ significantly at P<0.05; S.E.M: Standard Error of the Mean.*

The economics of production of broiler chickens fed graded levels of poultry meat meal is showed in Table 6. The cost/kg weight gain, revenue and gross margin showed that there were significant differences (P<0.05) across the treatment groups. The cost of feed showed that diet T_1 (0%) was significantly higher (P<0.05) diet T_3 (50%), diet T_4 (75%) and diet T_5 (100%) respectively, while the cost of feed consumed and cost of production had the same trend of significances where T_1 (0%) was significantly higher (P<0.05) than T_2 (25%), T_3 (50%) and T_4 (75%) respectively. Although there were no significant differences (P>0.05) in the revenue and gross margin, the broilers on diet T_5 gave the best values. This made the poultry meat meal to have an advantage over the conventional and costly fish meal

The result showed that the cost of poultry meat meal which is lower to fish meal reduced the overall cost of the diet and thus making it economically viable to use poultry meat meal as a possible replacement for fish meal.

Conclusion And Applications

1. This study showed that the inclusion of poultry meat meal to diet of broiler chickens was beneficial in improving

growth, higher carcass yield and better feed efficiency.

2. Poultry meat meal can totally replace expensive fishmeal in broiler production with a reduced cost of production

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