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EVALUATION OF TWO ANIMAL PROTEIN SOURCES IN SINGLE PHASE FEEDING OF BROILER CHICKENS

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ABSTRACT

A study was carried out to compare the use of blood meal and fish meal as protein sources in single phase feeding of broiler chickens. Three isonitrogenious and isocaloric diets containing between 20.5 to 21.1 % CP and 3440 to 3454 kcal/kg ME were formulated. The control diet contained none of the animal protein sources while the other two diets contained blood meal and fish meal at 6%, respectively. After six weeks of straight feeding, data were collected on feed intake, weight gain and feed conversion ratio was calculated. Carcass characteristics and cost benefit were also calculated. The results indicated that birds fed fish meal based diet consumed more feed ($p< 0.05$) than those on control diet, while intake of those on blood meal based diet was an interphase between the control and fish meal based diet groups. The birds fed fish meal based diet also recorded higher ($p< 0.05$) daily weight gain than those on control and blood meal based diets. Feed conversion ratio was better in the group fed fish meal based diet than those fed the control diet, but similar ($p> 0.05$) to the group fed the blood meal based diet. The dressing percentage of the birds was similar ($p>0.05$) in the control and blood meal based diet groups, but they were higher ($p<0.05$) than the fish meal based diet group. The neck, back, drumstick and head were significantly ($p<0.05$) higher in the control group than in the groups containing animal protein. Cost benefit analysis showed that feed cost and cost per kg weight gain were higher ($p< 0.05$) in fish meal based diet group than in control and blood meal based diet groups. Revenue per bird and gross margin were higher ($p< 0.05$) in the blood meal based diet group than in the control diet and fish meal based diet groups. In conclusion, fast growing broiler chickens for eatery houses can be better reared with a single diet of 21 % CP and 3440 kcal/kg ME using blood meal as a protein source.

Keywords: Blood meal, broiler chicken, feeding, feed intake, fish meal, single phase, weight gain

INTRODUCTION

The growing quest for broiler chicken meat in Nigeria has led to a phenomenal influx of unwholesome poultry meat through Nigeria's porous borders. Also in recent times, there has been a rapid development of chicken based fast food eateries such as Mr. Biggs, KFC, Tantalizers and Chicken Republic. The fast food industries consume a considerable quantity of chicken meat and has thereby created a market for a brand of broiler chicken called 'Hotel Size Broiler

Chickens'. These are medium size broiler chickens that weigh about 2 kg live weight averaging 1.35 - 1.5 kg dressed weight. This size is easily dressed as whole chicken or cut into quarters and sold as chicken parts by hotels, restaurants and caterers.

It is expected for a broiler farmer to key into this market he must be able to grow his/her birds rapidly to about 2 kg live weight in 6 weeks or less; the shorter the period of production the better for the farmer. Also for profitability, he/she must be able to do so with cost efficient feeds to achieve a rapid growth capable of reaching the desired market size within 6 weeks.

At the early stage of broiler chicks, growth is normally more rapid and hence better feed conversion ratio than at the finisher stage. The better feed conversion ratio therefore results in cost effective production of broiler chickens. Classical (traditional) feeding programmes, and notably that of National Research Council (NRC), usually define the nutrient requirements of broiler chickens based on age within three feeding regimes (phases) namely starter, grower and finisher. These broad phases defined by the NRC (1994) have been used for decades although the production needs that was originally designed to achieve have been altered in some ways. According to Pope and Emmert (2002) the NRC feeding programmes does not correspond with the grow-out periods typically used in modern poultry production practices, and thus, are now difficult to apply in current commercial poultry nutrition programmes.

The main aim of the NRC feeding programmes was to produce table birds of about 3 to 4 kg live weight in 9 weeks. The trend of producing big sized broiler chickens has, however, changed as restaurants and operators of eatery houses now prefer medium sized birds of about 2 kg live weight, dressed weight of 1.3 to 1.5 kg reported to be more palatable and easy to package. This demand has created a specialized chicken meat market that demands specialized production protocols. The production of such medium sized birds calls for a paradigm shift in the production protocol. Instead of a two phase feeding procedure, a single (striaght feeding) is advocated. The challenge is that of formulating a single diet that combines the nutrient needs of both the starter and the finisher birds. In single phase feeding regime, the broiler chickens are fed the same diet from start to finish (Okah *et al.,* 2014). This is aimed at providing constant nutrient per weight of the diet throughout the rearing period. This feeding method is currently under investigation to produce medium sized (about 2 kg) market broiler chickens for the ever growing food chain operators, restaurants and hotels.

The nutrient composition of feed ingredients and availability of nutrients for utilization by birds are very important for optimal performance of broiler chickens. Fish meal is usually marketed at 56% crude protein but this can vary from 56 to 77% depending on the species of fish used (Maigulema and Garnet, 2003). Fish meal is considered to be one of the best ingredients for broilers because it enhances feed consumptions and efficiency. It contains all the essential amino acids especially lysine and methionine in adequate quantities required by poultry and also contains growth factors that enhance performance of young growing birds (Poultry Feeding Standard, 2005). Dobrzan'ski *et al.* (2003) reported that fish meal can be used up to 5% inclusion level in broiler chicken's

diets while Maigulema and Garnet (2003) reported that tilapia by-product (containing crude protein up to 50%) can be substituted for soybean meal without negatively affecting birds' performance and carcass characteristics. Fish meal has about 20 percent mineral content which is high in calcium (8%) and phosphorus (3.5%). The protein digestibility is about 93 to 95% (Banerjee, 2013).

The nutrients composition of blood meal has been reported by several workers. A study by Donkoh and Attoh, (2009) indicated that blood meal contains (gkg^{-1} DM) 852.3 crude protein, 14.90 fat, 35.10 crude fiber, 20.60 ash, 81.40 lysine and 12.80 methionine. These proximate values as reported by Donkoh and Attoh (2009) were similar to those reported by NRC (1994). Blood meal has a good essential amino acid profile relative to chicks' requirements. It contains a substantial amounts of essential amino acids including lysine, methionine, leucine and threonine, but very poor in isoleucine (Donkoh and Attoh, 2009), and arginine (NRC, 1994).

Blood meal is low in calcium and phosphorus thus differing from meat scrap or tankage. It is worthy of note that nutrients composition of blood meal depends substantially on methods of processing (Mourghan *et al*., 1999). Blood meal has high protein value (80%), however, it is lower in digestibility and quality than most other animal protein feeds (Banerjee, 2013).

This study was therefore carried out to compare the use of these two animal protein sources in single phase feeding regime of broiler chickens.

MAERIALS AND METHODS

Location of Experiment

The experiment was conducted at the poultry unit of the Teaching and Research farm of the Michael Okpara University of Agriculture, Umudike, Abia State. Umudike is located on latitude 5º 29' North and longitude 7º 32' East in the rain forest zone of Nigeria. The experiment was carried out between the months of October and November 2014. The climate of the region has a daily temperature of between 27º C and 35 ºC; the average rainfall is 2000 mm per annum (NRCRI, 2014).

Experimental Birds, Design and Management

One hundred and thirty five (135) day- old Agritech strain broiler chicks were divided into 3 groups of forty five (45) birds with 3 replicates groups of 15 birds each and randomly assigned to 3 dietary treatments in a Completely Randomized Design (CRD) experimental layout. The pens used for the experiment were cleaned disinfected using formalin. The pens were then rested for two weeks after disinfection. Polythene sheets were then used to cover the sides of the pens in order to conserve heat during the first 4 weeks of feeding. Wood shavings were used as litter material to avoid direct contact with floor or droppings. The feeding trial lasted 6 weeks from day old. Vaccinations against Gumboro and New castle diseases were administered routinely. Anti-coccidia prophylaxis was administered through drinking water using Amprollium and Diaveridine. Drinking water and feed were offered *ad libitum* throughout the study.

Experimental Diets

Three isocaloric and isonitrogenous diets containing an average of 21% CP and 3440 kcal/kg metabolizable energy as calculated

were formulated (Table 1). The diets were formulated with the inclusion of blood meal and fish meal at 6% in diets 2 and 3, respectively as animal protein sources in combination with soybean meal as plant protein source. The control diet contained only soybean meal and no animal protein source. Metabolizable energy (ME KcalKg^{-1}) was calculated according to the prediction equation of Morgan *et al*. (1975).

Table 1: Experimental diets containing 6% blood meal or fish meal

Ingredient (%)	Control (No animal protein)	Blood meal based diet	Fish meal based diet
Maize	53.00	60.00	57.00
Soya bean meal	42.50	29.50	32.50
Bone meal	4.00	4.00	4.00
Fish Meal	-	-	6.00
Blood Meal	-	6.00	-
Vit & Min. Premix	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**
Calculated Composition			
Crude protein	20.74	20.52	21.10
ME (Kcal/kg)	3446	3440	3454
Ca (%)	1.15	1.15	1.18
Av. Phosphorus (%)	0.87	0.80	0.99
Lysine (%)	1.32	1.29	1.32
Methionine (%)	0.35	0.34	0.32
Tryptophane (%)	0.32	0.31	0.30

The premix contain per kg of diet: Vit A 10000 – 15000 iu; Vit D3 2000 – 5000 icu; Vit E 5 – 20 iu; Vit K 2.2 – 3mg; Thiamine 1.5 – 2.0 mg; Riboflavin 5.5mg; Niacin 25mg; calcium pantothenate 10mg; pyridoxine 2mg; choline chloride 120 – 350mg; folic acid 1mg; Vit B12 0.01mg; manganese 56 – 80mg; zinc 50 mg; copper 10 – 20 mg, iron 20mg, iodine 0.4 – 1.0 mg; cobalt 0.6 – 1.25 mg

Data collection and statistical analysis

The blood meal, fish meal and the experimental diets were analyzed for proximate composition according to AOAC (2000). The birds were weighed at the beginning of the experiment, then weekly thereafter. The weight gain was obtained by subtracting the initial live weight of birds from their final live weight. Feed intake was obtained by subtracting quantity leftover from the quantity offered every day. The average feed intake was divided by the average weight gain to obtain the feed conversion ratio.

At the end of the feeding trial 2 broiler chickens per replicate were fasted for 18 hours, slaughtered and dressed to determine carcass and organ characteristics of the experimental birds. The data obtained from the study were subjected to analysis of variance (ANOVA) (Steel and Torrie, 1980), significant means were separated using Duncan Multiple Range Test (Gomez and Gomez, 1985).

RESULTS AND DISCUSSION

The anaylzed proximate composition of the blood meal and fish meal used in this experiment is shown in Table 2, while the proximate composition of the diets fed in this experiment is presented in Table 3. The crude protein content of the blood meal (69.2%) used in this study was lower than the 80% reported by Banerjee (2013), 83.2% (Donkoh and Attoh, 2009; Olomu, 2011), and the ether extract of 0.51% was also quite lower than the 3.5% reported by Donkoh and Attoh (2009). The crude protein content of the fish meal (66.3%) agreed with the value reported by Heuze *et al.* (2015) and was within the range of 56 to 77% reported by Maigulema and Garnet, 2003. The ether extract content the fish meal (6.9%) was lower than the range (8 – 11%) reported by Heuze *et al. (*2015). The analyzed crude protein contents of the three diets were 20.7, 20.5% and 21.1% for the control, the blood meal based and the fish meal based diets, respectively. The dry matter and crude fibre contents of the diets (Table 3) were very close, but the diet which contained fish meal was slightly higher in CP%, EE%, NFE% and energy ($Kcalkg^{-1}$) than in the control diet and the diet which contained blood meal.

Table 2: Proximate composition of the blood meal and fish meal used in this experiment

Parameter (%)	Blood Meal	Fish Meal
Dry matter	92.27	94.17
Crude protein	69.20	66.34
Ether extract	0.51	6.94
Crude fibre	0.98	0.00
Ash	1.27	6.32
Nitrogen Free Extract	20.67	14.57

Table 3: Analyzed composition of the diets containing 6% blood or fish meal

Parameters (%)	Control (No animal protein)	Blood meal based diet	Fish meal based diet
Dry matter	90.30	90.00	90.20
Crude protein	20.74	20.52	21.10
Ether extract	7.00	6.89	7.20
Crude fiber	5.02	5.00	5.00
Ash	1.25	1.00	1.20
Nitrogen Free Extract	56.29	58.90	59.90
ME (Kcal/kg)*	3446	3440	3454

*Calculated according to Morgan *et al*. (1975)

The production performance of broiler chickens fed straight diet for 6 weeks is shown in Table 4. The average daily feed intake of birds was significantly ($p<0.05$) higher in the group fed fish meal based diet than in the group fed control diet (contained no animal protein), but the group fed blood meal based diet had similar ($p>0.05$) feed intake with both the groups fed the control and fish meal based diets. Higher feed intake by birds fed the fish meal based diet seen to indicate that the fish meal based diet was more palatible than the blood meal and soybean based diets. Earlier report by Banerjee (2013) had shown that blood meal is unpalatilble. The average daily weight gain was similar ($p>0.05$) in the blood meal and fish meal based diets groups, but significantly ($p<0.05$) higher than the group fed the control diet. Feed conversion ratio was significantly ($p<0.05$) better in the fish meal based diet group than the group fed control diet, though similar ($p>0.05$) with the blood meal based diet group. The higher growth and better feed conversion ratio by birds fed fish meal based diet might be due to the fact that fish meal has enhanced nutritional value because of its content of growth factors collectively known as animal protein factor (APF). Poultry Feeding Standard (2005) earlier reported that fish meal contains growth factors that enhance performance of young growing birds. This result also agreed with the report of Ojewola *et al*. (2005) who measured the effect of inclusion of locally processed fish meal in broiler chickens' diet. They concluded that the inclusion of animal protein in broiler chickens' diets enhanced performance and improved the feed conversion ration.

Table 4: Growth performance of birds fed diets containing 6% blood or fish meal in a straight diet

Parameters	Control (No animal protein)	Blood meal based diet	Fish meal based diet	SEM
Initial weight (g)	42.00	42.00	42.00	0.00
Final weight (g)	1926.67^{c}	2093.33^{b}	2166.67^{a}	50.82
Average daily feed intake (g)	121.06^{b}	129.63^{ab}	133.44^{a}	6.81
Average daily weight gain (g)	44.87^{b}	48.84^{a}	50.59^{a}	3.63
Feed conversion ratio	2.70^{a}	2.66^{ab}	2.64^{b}	0.09
Mortality (%)	0.00	0.00	0.00	0,00

^{a,b} Means with different superscripts across the rows differ significantly at $p<0.05$; SEM= Standard error of the mean.

The levels of combination of soybean meal and blood meal in the blood meal based diet seem to have provided a good amino acid blend which led to comparable results with birds fed the fish meal based diet.

Some of the carcass characteristics parameters differed significantly ($p<0.05$), while some were similar ($p>0.05$). Dressing percentage was significantly ($p<0.05$) higher in birds fed control diet and the blood meal based diet, but lower ($p<0.05$) in the group fed the fish meal based diet. The similar value of dressing percentage of birds fed the control diet and the blood meal based diet, seem to suggest that blood meal encouraged carcass yield more than fish meal; although the converse was true in live weight of birds. Lysine, arginine, methionine, cystine and leucine being richest in blood (NRC, 1994) may have promoted carcass yield in the chickens fed blood meal based diet. However, the carcass yield in all the diets was within the range (65-70%) reported by Oluyemi and Roberts (2000). Among the cut parts, the thighs, wings and breast did not indicate significant ($p>0.05$) differences among the treatment means. The neck, back and drumstick were significantly ($p<0.05$) higher in the birds fed control diet than in the birds fed diets containing blood meal and fish meal. The relative weight of neck and drumstick were higher ($p<0.05$) in birds fed blood meal based diet than in birds fed fish meal based diet, but they had similar ($p>0.05$) values for the relative weight of back. The weight of head of birds were higher ($p<0.05$) in birds fed control diet followed by birds in blood meal based diet and least in birds fed fish meal based diet.

Table 5: Carcass characteristic of broiler chickens fed 6% blood or fish meal in straight diet

Parameters	Control (No animal protein)	Blood meal based diet	Fish meal based diet	SEM
Live weight (g)	1926.67[b]	2093.33[a]	2166.67[a]	50.82
Dressed weight (g)	1329.40	1465.33	1473.67	35.17
Dressing percent (%)	70.00 [a]	70.00 [a]	68.00[b]	0.89
Thigh (%)	9.86	9.55	9.23	0.41
Wing (%)	8.30	8.12	7.85	2.00
Neck (%)	5.19 [a]	4.78[b]	4.60[c]	0.00
Breast (%)	20.76	20.54	20.77	2.00
Back (%)	18.16[a]	17.68[b]	17.08[b]	0.13
Drumstick (%)	9.86[a]	9.55[b]	9.23[c]	0.06
Shank (%)	3.69	3.58	3.46	0.51
Head (%)	5.19[a]	4.78[b]	4.61[c]	0.00

[a,b,c] Means with different superscripts across the rows differ significantly ($p<0.05$) ; SEM= Standard error of mean.

The results of the cost benefits of broiler chickens fed 6% blood meal based and fish meal based straight diets for 6 weeks are presented in Table 6. The feed cost and cost per kg weight gain were generally lower in the blood meal diet group than the control diet and fish meal based diet groups. This was so because the prevailing market price at the time of this study was less for blood meal than either soybean or fish meal. Revenue per bird and gross margin was also higher from birds fed blood meal based diet than from the ones fed either soybean based diet (control) or fish meal based diet.

Table 6: Economics analysis of straight feeding of broiler chicken with 6% of blood or fish meal for 6 weeks

Parameters	Control (No animal protein)	Blood meal based diet	Fish meal based diet
Cost/kg feed (N/kg	93.95	86.00	109.85
Total feed cost/bird (N)	488.73	478.87	628.34
Feed cost/kg weight gain (N)	253.67	228.76	290.00
Revenue/bird (N)	864.11	979.67	957.88
Gross Margin/bird	375.38	500.83	329.54

The observed differences in the economic parameters were mainly due to the prices of the protein sources used in diets. The blood meal was purchased at the rate of ₦90/kg, fish meal at the rate of ₦390/kg and soybean meal at the rate of ₦110 per kg. Revenue per bird was determined based on the average farm gate price of dressed chicken at the time of this study.

CONCLUSION AND RECOMMENDATIONS

The results of this study indicated that medium sized broiler chickens of 1.33 to 1.50kg dressed weight can be achieved with diets containing 21% crude protein and 3440 Kcal metabolizable energy within six (6) weeks, using soybean meal, or its combination with either fish meal or blood meal as sources of protein. However, for higher carcass yeild of broiler chickens and lower cost of production obtained from the birds fed blood meal based diet implies that blood meal is a preferred protien source than fish meal for fast carcass yield in broiler chickens production.

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