THE VALUE OF BLOODMEAL AS A DIETARY SUBSTITUTE FOR FISHMEAL IN BROILER STARTER RATIIONS

By

I.I. DAFWANG

¹Agricultural Extension and Research Liaison Services

and

S.A. OFFIONG and J.M. OLOMU

²National Animal Production Research Institute,

Ahmadu Bello University, Zaria, Nigeria.

SUMMARY

Three experiments were conducted with Ross-type broiler chicks to determine the optimum level of inclusion of fish meal and the value of bloodmeal as a substitute for fishmeal in practical broiler starter rations. The optimum level of fish meal was found to be 7.5%. Higher levels tended to increase the cost of production and lower growth performances. The addition of bloodmeal to all vegetable protein rations resulted in better performances than all vegetable protein ration. It was found that blood meal could be used at levels of up to 8% with no detrimental effects. Although total substitution of bloodmeal for fishmeal lower performances, partial substitution up to 67% resulted in similar performance to the fishmeal ration. Value of bloodmeal in broiler starter rations.

INTRODUCTION

A major constraint in the development of the poultry industry in most tropical countries is the scarcity of some feed ingredients that are essential for the production of good quality poultry feeds at reasonable costs. Fishmeal has been recognised as a high quality animal protein supplement and is often used in poultry rations. Numerous studies have been reported on the nutritional value of fishmeal (Pike, 1975).

Although fishmeal is known to be of high nutritional value in poultry rations, it is not usually included at levels beyond 10%. Factors responsible for this

restricted usage of fishmeal include the development of fishy off-flavors (Card & Nesheim 1973), incidences of gizzard and intestinal erosion (Kubena *et al* 1976) and economic considerations. In most tropical countries it is an imported product, therefore it is very expensive and often scarce. Scarcity may arise as a result of difficulties with importation or occasional world-wide shortages in supply (Bhatti 1971, Bellido 1974, Tola and Hearne 1974). This often results in high feed costs and fluctuating feed supplies to the poultry industry. There is therefore an urgent need to determine optimum levels of utilisation and also to investigate alternative ingredients that are more easily available.

In contrast to fishmeal, bloodmeal is processed locally and cheaply in many countries (Hassan *et al* 1974, Galal *et al* 1977, Dafwang *et al* 1978). Bloodmeal has high protein content and is known to be rich in lysine. However, reports on the nutritional value of bloodmeal for poultry are comparatively few and inconsistent. It has been shown to be inferior to fishmeal (Bird and Groschke 1942, cited by Serfontein 1947); meatmeal (Hassan *et al* 1974) or synthetic amino acids (Galal *et al* 1977) as protein supplement in chick rations. Squibb and Braham (1955) found

bloodmeal to be a satisfactory source of lysine when used at levels of 2–4%. Rathore and Chaturvedi (1971) found bloodmeal to be a satisfactory animal protein supplement in diets for cockerels and recommended an optimum level of 6%.

The purpose of these studies was to determine the optimum level of inclusion of fishmeal and to investigate the value of bloodmeal as a dietary substitute for fishmeal in broiler starter rations.

MATERIALS AND METHODS

Unsexed Ross-type broiler chicks purchased from a local hatchery at day old were used in these studies. Each experiment covered the period, day old to five weeks of age. The chicks were randomly allocated to similar groups of fifty chicks per group. Two replicates (Experiment 1) and three replicates (Experiments 2 and 3) were assigned to each treatment. The birds were raised on floor pens (3.05 × 1.22 meter per pen) which were heated during the first four weeks of life of the birds. Continuous lighting was provided.

All the experimental rations were isonitrogenous and isocaloric. Diets were formulated to meet dietary protein and energy requirements in accordance with the recommendation of Olomu and Ofiong (1980). Feed and water were given *ad libitum*.

Ingredients were analysed for their proximate chemical composition using AOAC methods (1975). The amino acid composition of the ingredients were analysed using a technical Amino Acid Analyser. Commercial grade imported fishmeal (FM) was used in these studies. The bloodmeal (BLM) was obtained commercially from a local processor.

Weekly records of weight gain, feed consumption, efficiency of feed conversion and mortality were kept for each replicate.

At the end of each experiment, the data were subjected to the analysis of variance followed by Duncan's multiple range test at the 5% level of significance (Steel and Torrie 1960).

Experiment 1: This experiment was designed to study the optimum level of inclusion of fishmeal in broiler starter ration. The level of fishmeal studied and the composition of the rations are shown in Table 1.

Experiment 2: Experiment 2 was designed to study the effect of partial or total replacement of fishmeal with bloodmeal. The experimental treatments used and the composition of the rations are presented in Table 2. Each 2.5% level of fishmeal was replaced by 2% bloodmeal on the basis of equal protein contribution to the ration.

Experiment 3: In experiment 3, bloodmeal was included in the rations to replace 0, 33, 67 or 100% of the 7.5% optimum level of fishmeal determined in earlier studies, and these fed throughout the experimental period. Two other treatments in which the birds were fed the 7.5% fishmeal ration and then changed to the ration in which bloodmeal replaced 67% of the fishmeal at one or two weeks were also included. The composition of the rations are the same with those shown on Tables 1 and 2.

RESULTS

Chemical Composition:

The gross chemical and amino acid composition of the ingredients are presented in Table 3.

Experiment 1:

The results obtained in Experiment 1 (Table 4) show that the inclusion of fishmeal in the ration significantly im-

proved weight gain, feed consumption and efficiency of feed conversion. On the fishmeal containing rations the lowest performance was obtained on the rations containing 2.5% G.M. (Treatment 2). Beyond a fishmeal level of 5%, the differences in weight gain, feed consumption and efficiency of feed conversion were not significant between any two consecutive treatments. Differences in feed cost per kilogram liveweight gain were not significant between rations containing 2.5, 5 and 7.5% fishmeal. Levels of 12.5 and 15% significantly increased feed cost per kg liveweight gain.

Experiment 2:

The results of experiment 2 are as shown on Table 5.

The inclusion of bloomeal fishmeal in the rations resulted in significantly better weight gains and efficiency of feed conversion over those obtained on the all vegetable protein rations (Treatment 2—10) Vs Treatment 1). The results show that the optimum level of fishmeal to be included in broiler starter ration was 7.5 per cent. Weight gain and efficiency of feed conversion tended to improve non-significantly with increased levels of bloodmeal in the ration. The performance of birds on rations in which bloodmeal completely replaced fishmeal was significantly lower than that of birds fed rations containing 7.5 and 10% fishmeal but not significantly lower than the ration containing 5% fishmeal. When 4% bloodmeal was used to replace 5% fishmeal in the ration containing the optimum level of fishmeal (7.5%) feed consumption and feed efficiency were not significantly affected but weight gain was still less (Treatment 3 Vs 8). Mortality was not significantly affected by dietary treatment.

The results of Experiment 3 are summarised in Table 6. Weight gains, feed consumption and efficiency of feed con-

version obtained on the rations in which bloodmeal partially replaced fishmeal. (Treatments 3, 4, 6 and 7) were not significantly different from the control ration containing 7.5 per cent fishmeal. Weight gain was however slightly lower when bloodmeal replaced 67 per cent of the fishmeal from day old and improved slightly with delay in giving this ration to the birds. The substitution of all the fishmeal with bloodmeal resulted in significantly lower weight gain (Treatment 2 Vs 5). The weight gain on the all bloodmeal ration was however significantly higher than on the all vegetable protein ration (Treatment 5 Vs 1), confirming the results of Experiment 2 above. The all vegetable protein diet depressed feed consumption significantly.

Feed efficiencies were not significantly affected by dietary treatments. Cost per kg liveweight gain was significantly higher on the ration containing 7.5% fishmeal than on the rations in which fishmeal was partially substituted with bloodmeal (Treatment 2 Vs Treatments 3 and 4). Mortality was not significantly affected by dietary treatments.

DISCUSSION

The addition of fishmeal to broiler starter rations resulted in optimum growth performances. This is in agreement with the report Oluyemi and Oyenuga (1974), Pike (1975, 1976) and Olomu (1978). The recommended level of fishmeal (7.5 per cent) is however lower than that (10 per cent) recommended by Oluyemi and Oyenuga (1974).

The addition of bloodmeal to an all-vegetable protein ration improved performances. This may be due to its high content of lysine. Squibb and Braham (1955), among other workers, had earlier found bloodmeal to be a satisfactory source of lysine. The performances of the birds in this study was not depressed as the dietary

bloodmeal level was increased to 8%. This is contrary to the findings of Grau and Almquist (1944) and Hassan *et al* (1974) who reported growth depressions when dietary bloodmeal level exceeded 6%. On the basis of their findings, these workers recommended that bloodmeal should not be used beyond 4–6% in broiler rations. The present results indicate that up to 8% could be used without detrimental effects.

Performances of chicks on rations containing bloodmeal as the only supplementary animal protein were however lower than those on rations containing fishmeal. This growth depression may be due to amino acid deficiency, especially of isoleucine, and amino acid imbalance of bloodmeal (Fisher 1968). Calculated levels of essential amino acids of the ration used in these studies tend to confirm this proposition. The levels of the amino acids in the rations containing 7.5% fishmeal were closer to the NRC (1971) and Olomu (1978) recommendations than those of the rations containing bloodmeal as the only source of supplementary animal protein. Some of the levels of amino acids in the bloodmeal ration were either in excess (histidine, leucine and valine) or were deficient (methionine plus Cystine and isoleucine) as compared to the fishmeal containing rations or the recommendations of NRC (1971) and Olomu (1978). Such excesses or deficiencies may create amino acid imbalances that may result in departure from the "ideal" proportions of amino acids required for optimum performance. Lower feed consumption on the bloodmeal containing ration may also have contributed to the lower performances.

The results of these experiments also indicate that up to 67 per cent of the fishmeal in broiler-starter rations may be replaced by bloodmeal at lower feed cost per kg of gain and with no adverse effects, more so when the bloodmeal rations are

introduced after one week. Serfontein (1947) working with cockerels and pullets, recommended 25% substitution rate but indicated that performances were still satisfactory at 50% substitution rate. Not much information is available on the complementary effects of bloodmeal and fishmeal but it is possible that when both animal proteins are used they tend to complement each other with the result that any adverse effects of amino acid imbalances or problem of palatability are removed.

ACKNOWLEDGEMENTS

The authors wish to thank Dr. S. Simulikowska and Mr. S.A. Bello for their assistance in chemical analyses of the feed ingredients and Mr. S. Abed of the Institute of Agriculture for his advice and assistance with the statistical analyses.

REFERENCES

- A.O.A.C. 1975. Official Methods of Analysis of the Association of Official Analytical Chemists (12th Edition). Association of Official Analytical Chemists, Washington D.C.
- BELLIDO, A.D. 1974. World production and utilization of fishmeal and factors affecting quality and marketability. Proc. Conf. Animal feeds of Tropical and subtropical origin. Tropical Products Research Institute, London.
- BHATTI, M.Y. 1971. Poultry Nutrition in Pakistan. Proc. Conf. Development of feed resources and improvement of animal feeding methods in the CENTO region Countries. Tropical Products Research Institute, London.
- CARD, L.E. and NESHEIM, M.C. 1973. Poultry Prod. 11th edition. Lea and Febiger, Philadelphia.
- DAFWANG, I.I., OLOMU, J.M., and OFFIONG, S.A. 1978. Optimum utilization of fishmeal and replacement value of locally processed blood meal for fish meal in practical broiler rations. Proc. Annual Conference of Nig. Soc. Anim. Prod.

- FISHER, H. 1968. The amino acid deficiencies of bloodmeal for the chick. *Poultry Sci.* **47**; 1478—1481.
- GALAL, A.H., BAKER, D.H., NORTON, H. and BECKER, D.E. Improvement of Egyptian broiler diets by addition of either lysine and methionine or bloodmeal. *Poultry Sci.* **56**; 698—700.
- GRAU, C.R. and ALMQUIST, H.J. 1944. Beef blood protein in chick diets. *Poultry Sci.* **23**; 486—490.
- HASSAN, O.E.M., MUKHTAR, A.M.S. and NASR, M.E.A. 1974. The use of bloodmeal in tropical broiler diets. *Trop. Anim. Hlth. Prod.*, **6**; 179—182.
- KUBENA, R.F., C.R., SANDER, R.L., HAYNES, T.H., VARDAMA and J.W. DEATON. 1976. The effect of fish meal and poultry by-product meal on the intestine and gizzard of broilers. *Poultry Sci.* **55**; 30—33.
- N.R.C. 1971. Nutrient Requirements of Domestic Animals. I. Nutrient Requirement of Poultry. National Research Council, Washington, D.C.
- OLOMU, J.M., and S.A. OFFIONG. 1980. The effects of different protein and energy levels and time of change from starter to finisher ration on the performance of broiler chickens in the tropics. *Poultry Sci.* (In Press).
- OLOMU, J.M. 1978. Protein and energy nutrition of poultry in the tropics. In: "Breeds and Nutrition of poultry in Nigeria." Published by World's Poultry Science Association (Nigerian Branch). pp. 41—48.
- OLUYEMI, J.A. and OYENUGA, V.A. 1974. Performance of White Rock Local Nigerian Chickens on diets supplemented with fish meal. *E. Afr. Agric. For J.* **40**; 157—160.
- PIKE, I.H. 1975. The role of fish meal in diets for poultry. Technical Bulletin of the International Association of fish meal Manufacturers. No. 3.
- PIKE, I.H. 1976. Formulation of poultry diets for maximum profit requirements for protein. *Feedstuffs* **47**, 25 — 33.
- RATHORE, B.S. and CHATURREDI, D.K. 1971. Studies on cereal free rations based on rice polishings and groundnut cake for growing chicks. 3. Effect of cheap protein supplements. *Poultry Sci.* **50**; 370—374.
- SERFONTEIN, P.J. 1947. Blood meal in poultry rations. Union of South Africa. Department of Agriculture. Agricultural Education and Research series. No. 48.
- SQUIBB, R.L. and BRAHAM, J.E. 1955. Blood meal as lysine supplement to all vegetable protein for chicks. *Poultry Sci.* **34**; 1050—1053.
- STEEL, R.G. and TORRIE, J.H. 1960. Principles and Procedures of Statistics. McGraw-Hill Book Co., New York.
- TOLAN A. and HEARNE, J.A. 1974. The potential of single cell protein for animal feed. Pro. Conf. Animal feeds of Tropical Products Subtropical Origin. Tropical Products Research Institute, London.

TABLE 1

Percentage Composition of Starter Rations

Ingredients	1	2	3	4	5	6	7
Guinea corn	47.90	48.20	48.50	48.80	49.10	49.40	49.70
Groundnut cake	41.70	37.80	33.90	30.00	26.10	22.20	18.30
Fish meal	—	2.50	5.00	7.50	10.00	12.50	15.00
Wheat bran	2.90	4.25	5.60	6.95	8.30	9.65	11.00
Palm oil	2.95	2.95	2.95	2.95	2.95	2.95	2.95
Bone meal	2.75	2.50	2.25	2.00	1.75	1.50	1.25
Periwinkle shell	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Common salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Premix ¹	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Calculated Analysis:							
Crude protein (%)	23.0	23.0	23.0	23.1	23.1	23.1	23.1
M.E. Kcal/kg ration	3000	3000	3000	3000	3000	3000	3000
Ca (%)	1.24	1.24	1.24	1.24	1.24	1.24	1.24
P (%)—total	0.75	0.76	0.77	0.78	0.80	0.81	0.82
Lysine (%)	1.07	1.07	1.15	1.21	1.28	1.39	1.41
Methionine + Cystine (%)	0.64	0.68	0.71	0.74	0.78	0.81	0.85
Crude fibre (%)	6.52	6.23	5.95	5.66	5.38	5.10	4.80

¹Premix — supplied the following per kg of ration: Vit. A, 150.00 I.U.; Vit. D₃, 30.00 I.U.; Vit. E., 5mg; Vit. K, 3mg; Vit. B₁, 2mg; Vit. B₂, 5.5mg; Niacin, 25mg; D. Calcium pantothenate, 10mg; Vit. B₁₂, 10 ug; Choline Chloride, 120mg; Ethoxyquine, 10mg; Manganese oxide, 32.26mg; Potassium iodide, 0.07mg; Cobalt sulphate, 0.57mg; Zinc oxide 25mg; Copper oxide 2.56mg; Ferrocyanate, 40.65mg.

TABLE 2

Percentage Composition of Starter Rations Containing Bloodmeal

Ingredients	1	2	3	4	5	6	7
Guinea corn	49.50	50.30	51.10	49.80	50.10	50.60	49.30
Groundnut cake	33.90	30.00	26.10	30.00	26.10	26.60	30.00
Fish meal	—	—	—	2.50	5.00	2.50	5.00
Blood meal	4.00	6.00	8.00	4.00	4.00	6.00	2.00
Wheat bran	5.10	6.20	7.30	6.45	7.80	7.55	6.70
Palm oil	2.95	2.95	2.95	2.95	2.95	2.95	2.95
Bone meal	2.75	2.75	2.75	2.50	2.25	2.50	2.25
Periwinkle shell	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Common salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Premix ¹	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Calculated analysis:							
Crude protein (%)	23.1	23.2	23.2	23.2	23.2	23.2	23.1
M.E. Kcal/kg ration	3000	3000	3000	3000	3000	3000	3000
Calcium (%)	1.24	1.24	1.24	1.24	1.24	1.24	1.24
Total Phosphorus (%)	0.74	0.74	0.74	0.79	0.82	0.76	0.77
Lysine (%)	0.93	1.02	1.11	1.01	1.10	1.09	1.03
Methionine + Cystine (%)	0.64	0.64	0.64	0.67	0.70	0.67	0.71
Crude fibre (%)	5.91	5.60	5.29	5.76	5.33	5.31	5.64

¹Premix — a commercial product with composition as shown on Table 1.

TABLE 3

Proximate Chemical and Amino Acid Composition of the Major Ingredients used in Ration Formulation. (% Air dry Basis)

	Sorghum grain	Groundnut cake	Fishmeal	Bloodmeal	Wheat bran
Dry matter	92.08	91.96	91.40	89.52	92.00
Crude protein	9.60	44.91	63.11	77.35	15.61
Ether Extract	3.22	9.16	7.63	0.53	5.14
Crude fibre	1.32	3.81	1.31	1.46	3.88
Ash	1.51	5.51	17.00	2.08	1.05
Calcium	0.05	0.97	3.00	0.30	0.10
Phosphorus	0.31	0.11	2.00	0.20	1.20
Arginine	0.47	5.37	3.84	2.97	1.16
Cystine + Methionine	0.36	1.09	2.74	2.10	0.48
Glycine	0.43	2.98	3.96	3.18	1.07
Histidine	0.35	1.77	1.66	5.45	0.62
Isoleucine	0.41	1.56	2.76	1.01	0.53
Leucine	1.63	3.27	4.43	10.05	1.05
Lysine	0.27	2.07	5.47	8.13	0.80
Phenylalanine	0.61	2.35	2.39	5.83	0.67
Tyrosine	0.42	1.74	2.03	2.23	0.39
Valine	0.55	2.12	3.20	6.31	0.93

TABLE 4

Effect of different Levels of Fishmeal on the Performance of Broiler Chicks (0—5 weeks).

Treat ment No.	Level of FM (%)	Wt. gain (g)	Feed Consump- tion g/bird	EFC ² (g feed) (g gain)	Feed cost/ kg. gain (₹)	Mortality (%)
1	0.0	472 ^e	1091 ^d	2.32 ^c	0.57 ^c	9 ^{ab}
2	2.5	584 ^d	1242 ^c	2.13 ^b	0.55 ^{cd}	12 ^a
3	5.0	720 ^c	1395 ^b	1.94 ^a	0.53 ^d	7 ^{ab}
4	7.5	751 ^{bc}	1446 ^{ab}	1.93 ^a	0.56 ^{ab}	8 ^{ab}
5	10.0	788 ^{ab}	1492 ^{ab}	1.89 ^a	0.58 ^c	6 ^{ab}
6	12.5	804 ^a	1535 ^a	1.91 ^a	0.62 ^b	3 ^b
7	15.0	798 ^a	1542 ^a	1.94 ^a	0.65 ^b	11 ^a
	SEM ³	12	39	0.04	0.01	2.00

Means within each column with same superscript are not significantly different (P = 0.05).

EFC¹ = Efficiency of feed conversion.

SEM² = Standard error of the mean.