Trop. J. Anim. Sci. 5 (1): 189- 196 (2002)
ISSN: 1119 - 4308

RESPONSES OF BROILER FINISHERS TO DIETARY METHIONINE AND OR LYSINE SUPPLEMENTATION

OJEWOLA, G. S., AMAEFULE, K. U., ABASIEKONG, S. F., AKINMUTIMI, A. H., LAWAL, A. S. AND ANYANWU, K.

College of Animal Science and Animal Health, Michael Okpara University of Agriculture, Umudike, PMB 7267, Umuahia, Abia State, Nigeria.

Target Audience: Animal nutritionists, feed millers, meat processors, broiler farmers and consumers.

ABSTRACT

This experiment was undertaken to evaluate the effect of dietary methionine and or lysine supplementation on the growth rate, feed efficiency, carcass characteristics and economics of production of broiler chicken. 600 Anak broiler chicks were brooded and fed broiler starter feed (23% CP & 12.10MJ/Kg ME) ad libitum for the first 4 weeks of life. Thereafter, 280 chicks were randomly selected and allocated into the treatment diets in duplicate lots of 20 chicks each. They were also fed and given water ad libitum. The experiment lasted for 6 weeks. Feed intake and feed conversion ratio (FCR) were significantly ($P<0.05$) influenced. Diets supplemented with 0.1% methionine (D4) and 0.1% lysine (D5) supported BW, BWG and improved FCR more than other diets. Diet 4 also gave the best cost benefit ratio, thus making it the best among the 7 treatment diets. Carcass quality characteristics showed no definite pattern though, the dressed weight and % drumstick were significantly ($P<0.05$) influenced. Data from this study indicated that supplementing broiler finisher diet with 0.1% methionine would bring about efficient productivity at the least cost to the producer.

Key words: Broiler chickens, Methionine, Lysine, Supplementation, Carcass characteristics and economics of production.

DESCRIPTION OF PROBLEM

Cereals are universally acknowledged to be deficient in several of the essential amino acids, particularly lysine and methionine, with certain individual cereals showing further deficiencies (1). The poor quality of some of these plant proteins could not be offset by increasing the concentrations of these feedstuffs in animal diets (2). The widespread inconsistent reports on the adequacy of low protein diets (3,4) are another major problem. Furthermore, as fish stocks decline and with increasing consumer apprehension over the use of meat and bone meal in animal feeds, there is the need to source for alternatives. Using feed additives of proven beneficial impacts in poultry production is a common practice (5). However, there is growing concern about some of these additives in animal

production, though the scientific bases still remain to be confirmed (6,7). Synthetic amino acids will inevitably have a role to play in this context (1). The recommended lysine level for starter (0-6weeks) and finisher (7-10weeks) phases are 1.25 and 1.10% respectively (8), while that of methionine was 0.86 and 0.73% respectively. Alternatively, (9) recommended 1.20 and 0.95% lysine and 0.55 and 0.40% methionine respectively for starter and finisher phases.

Methionine improves the efficiency of feed utilization, reduces mortality and cannibalism (8). Lysine on the other hand, is used in the synthesis of carnithine required for the transport of fatty acids within the cells (9) and it is also important for the growth of chicks (8). Its deficiency is associated with depigmentation of feathers. It was further observed that supplementation of groundnut meal diets with methionine and lysine elicited progressive and more efficient live weight gains at all levels of crude protein up to 270gkg^{-1} diet (2). In another experiment, it was observed that diets based on maize-soybean meal were inferior to similar diets supplemented with methionine, even though the un-supplemented diets at the higher CP levels satisfied the assumed requirement for the sulpur-amino acids (2). By supplementing a 14.40% CP diet fed to female broilers from 36 to 63 days with additional methionine and lysine, (10) observed growth and feed efficiency equal to that obtained with an 18.10% CP diet. The results of an additional experiment in the same report indicated that adding the same two EAA to a 15.50% CP diet resulted in males gaining weight and converting feed as efficiently as those that received a 20.20% CP diet during the 35 to 62 day period. (11) observed that adding methionine and lysine to a 16% CP diet supported growth from 21 to 65 days comparable to the growth of birds fed a 19% CP diet, although achieving equal feed efficiency necessitated adding threonine to the low CP diet. (12) fed diet based on maize and groundnut meal without methionine and lysine supplementation and observed depressed weight at market age.

The effectiveness of various protein sources to correct the amino acid deficiencies of cereals is a subject with long history (13). Therefore, supplements like methionine, lysine and tryptophan may be more efficiently utilized when provided in pure form rather than as components of intact protein, particularly at the higher dietary CP concentrations. The experiment reported herein was designed to explore further the effects of methionine and/ or lysine supplementation on broiler performance from 28 to 70 days of age.

MATERIALS AND METHODS

Composition of Diets

Broiler starter mash (23% CP; 12.10MJ/kg ME) was formulated and fed to 600 broilers at the starter phase (0-4wks). At the finisher phase (4-10wks), seven isocaloric and isonitrogenous diets, varying in methionine and/ or lysine

concentrations were formulated. Maize was the major energy source, while soybean meal and local fishmeal were the major protein sources. The composition of the finisher diets is as shown in Table 1.

Table 1: Percentage composition of the experimental diets.

	DIETS						
Feedstuffs	1	2	3	4	5	6	7
Yellow maize	45.00	45.00	45.00	45.00	45.00	45.00	45.00
Maize offal	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Local fishmeal	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Full fat soybean meal	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Wheat offal	5.50	5.50	5.50	5.50	5.50	5.50	5.50
Brewer's dry grain	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Vit./Mineral Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25
DL-Methionine	-	0.10	0.20	0.10	-	0.20	-
L-Lysine	-	0.10	0.20	-	0.10	-	0.20
Total (%)	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated composition:							
CP (%)	18.96	18.92	18.89	18.94	18.94	18.92	18.92
ME (MJ/kg)	12.10	12.08	12.07	12.09	12.09	12.09	12.09
Lysine	0.96	1.06	1.16	1.96	1.06	0.96	1.16
Methionine (%)	0.34	0.44	0.53	0.44	0.34	0.54	0.33
Protein: Energy ratio	152.56	152.69	152.73	152.62	152.62	152.69	152.69
Analyzed composition:							
Dry matter (%)	95.20	95.60	95.34	95.98	94.11	95.05	94.89
Crude Protein (%)	21.88	20.88	20.38	19.45	19.25	18.69	18.06
Crude Fibre (%)	16.79	14.98	10.20	9.52	8.40	8.00	7.84
Ash (%)	11.90	10.90	9.74	9.72	8.98	8.54	7.74
Ether extract (%)	1.94	1.17	1.14	0.77	0.39	0.28	0.12

* Composition per 2.50kg (Bio-mix) premix: Vit.A, 4000000IU; Vit.D3, 800000IU; Vit.E, 10000mg; Vit.K, 1200mg; Vit.B1, 1000mg; Vit.B2, 1500mg; Vit.B6, 1500mg; Niacin, 10000mg; Panthothenic acid, 10000mg; Choline chloride, 120000mg; Manganese, 60000mg; Iron, 15000mg; Zinc, 15000mg; Copper, 800mg; Iodine, 400mg; Cobalt, 80mg; Selenium, 400mg; Antioxidant, 40000mg.

Experimental Design

A total of 600 broiler chicks were reared at the starter phase, out of which 280, 4-week old chicks were randomly allocated into the treatment diets in duplicate lots of 20 chicks each and were immediately weighed. Birds were fed the 7 treatment diets ad libitum in a completely randomized design (CRD) experiment. Mean weekly live weight and mean weekly feed intake were recorded, while the mean daily weight gain and feed conversion ratio (FCR) were calculated from the data obtained.

Carcass evaluation

At 10 weeks of age, 2 broilers having live weights closest to the mean from each replicate were randomly selected, starved for 24 hours, weighed and killed by exsanguination. Carcass characteristics of the broilers were determined according to the procedure described by (14).

Economic analysis

The cost of dietary ingredients (N/kg) was noted. Feed intake per bird for the period was used to multiple the cost /kg of feed to obtain the cost of feeding a broiler for the period. The cost/kg weight gain was calculated by dividing the cost of feeding by the weight gain (kg). The cost differential and relative cost-benefit of the diets in relation to the control diet (without methionine and lysine supplementation) were derived as follows:

$$\text{Relative cost-benefit (\%)} = \frac{\text{Cost Differential}}{\text{Cost/kg weight gain of control diet}} \times \frac{100}{1}$$

Where relative cost benefit describes the % gain realized by feeding either methionine and/ or lysine at varying concentrations.

Statistical analysis

All data were subjected to analysis of variance (ANOVA) according to procedures described by (15). Duncan's new multiple range test (16) was employed to compare treatment means found to be statistically significant.

RESULTS AND DISCUSSION

The results of the body weight (BW), body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR) as affected by dietary treatments are summarized in Table 2. Both diets respectively supplemented with 0.1% methionine (D4)

Table 2: Performance of broiler chickens fed varying levels of methionine and or lysine supplemented diets during the finisher phase.

	DIETS							
Parameters	1	2	3	4	5	6	7	SEM
Initial body weight (g/b)	445.50	426.50	450.50	462.50	425.50	454.00	455.00	20.04
Final body weight (g/b)	2275.00	2250.00	2250.00	2450.00	2250.00	2400.00	2050.00	107.32
Body weight gain (g/b)	1829.50	1823.50	1799.50	1987.50	1824.50	1946.00	1595.00	107.67
Daily weight gain (g/b)	43.56	43.42	42.85	47.32	43.44	46.33	37.98	2.70
Total feed intake (g/b)	7101.50^{b}	6420.00^{c}	6186.50^{cd}	6489.00^{bc}	6052.50^{d}	6792.50^{ab}	6433.00^{c}	107.36
Daily feed intake (g/b)	169.08^{a}	152.86^{c}	147.30^{cd}	154.50^{bc}	144.11^{d}	161.73^{ab}	153.17^{c}	2.33
Feed: Gain ratio (FCR)	3.88^{a}	3.52^{b}	3.44^{b}	3.27^{b}	3.32^{b}	3.49^{b}	4.03^{a}	0.26

Means in a row with different superscripts a, b, c, d are significantly different ($P<0.05$).

SEM= standard error of mean.

and 0.1% lysine (D5) supported BW, BWG and improved FCR compared to the other diets (D1, 2, 3,6 and 7). Broilers fed Diets 4 and 5 also consumed less feed than others. In overall performance, broilers fed diet supplemented with 0.1% methionine gave the highest improvement for BW, BWG and FCR, while those fed diet supplemented with 0.2% lysine (D7) elicited a poor performance in terms of BW, BWG and FCR. Those birds fed diets supplemented with either

methionine or lysine at 0.1% level closely followed this. Generally to a farmer, the reasons for amino acid supplementation are production of heavy broiler within the shortest possible time, at least cost and at highest feed efficiency. This was mainly observed only with broilers fed 0.1% methionine (D4). These findings are consistent with observations by (17) who observed that methionine in a correct proportion in birds' diets enhances protein synthesis. (18) also observed a N-sparing action of amino acid such as methionine or methionine+arginine which was brought about by an enhanced protein synthesis when diets were supplemented with EAA. These could have been responsible for the good performance observed with birds fed D4. The performance of broilers fed diets 4 and 5 also suggests that it is better to supplement broiler finisher diets with 0.1% of either methionine or lysine, but not the two together as was the case with D2. This is in agreement with the findings of (19). Diet 1 was not supplemented with either methionine or lysine; this could be responsible for the inefficient conversion of feed, although birds fed this diet had the highest mean daily feed intake. This is in agreement with (2) and (12) who observed that diets based on maize and soybean meal or groundnut meal were inferior to similar diets supplemented with methionine and lysine even though the supplemented diets at higher CP levels satisfied the requirements for the sulphur-amino acids. The poor performance exhibited by broilers fed Diets 3 and 6 are not unconnected with the high level of methionine in the diets which was 0.53 and 0.54% for D3 and D6 respectively. This is slightly higher than 0.40% recommended by (9) for finisher phases. The is congruous with that of (20). He observed that high methionine diets brought about reduced BWG and efficiency of feed utilization at the finisher period. This was attributed to amino acid toxicity. (8) recommended 1.10% lysine for broiler finishers (7-10weeks). The calculated percent lysine in Diets 2, 3 and 7 ranged between 1.06 to 1.16% suggesting that an excess lysine was available to the birds. And according to (21), excess of lysine depressed growth by stimulating renal arginase activity, which in turn causes arginine breakdown. This also increases the arginine requirement of the birds as lysine increases. This in turn affects the efficiency of protein utilization between the dietary protein level and amino acid components. All these result in growth depression.

Both Diets 4 and 6 significantly ($P<0.05$) enhanced the carcass yields (dressed weight) above others suggesting that methionine supplementation in broiler finisher ration was more relevant than that of lysine. Broilers fed Diet 3 had the least percent abdominal fat which suggests that the supplementation of this diet with 0.20% methionine and lysine could have brought about a reduction in the rate of hepatic lipogenesis (22, 23). Furthermore, the need for nitrogen excretion by the birds fed a high protein diet may also account for the significant energy expenditure. Consequently, less fat was deposited in the carcass (24).

Table 3: Carcass quality characteristics of 10-week old broilers fed methionine and or lysine supplemented diets during the finisher phase.

	DIETS							
Parameters	1	2	3	4	5	6	7	SEM
Liveweight (g/b)	2275.00	2250.00	2250.00	2450.00	2250.00	2400.00	2050.00	107.32
Dressed weight (DW) (g)	1778.69^{c}	1863.94^{bc}	1680.29^{c}	1914.99^{ab}	1630.28^{cd}	1933.04^{a}	1594.04^{d}	69.05
Dressed weight as % of Liveweight	78.16	82.84	74.62	78.17	73.21	80.73	77.78	3.27
Meat as % of DW	72.92	78.56	79.75	80.00	75.92	79.51	77.87	2.03
Bone as % of DW	19.39	18.48	18.02	18.11	19.59	17.84	17.50	1.21
% Abdominal Fat	2.90	3.37	2.39	2.60	3.50	2.68	4.64	0.60
Flesh: Bone ratio	3.79	4.27	4.39	4.44	3.71	4.46	4.46	0.28
Cut Parts as % of DW:								
Breast (%)	24.44	25.43	29.08	26.15	23.42	26.14	25.11	2.44
Thigh (%)	15.28	16.24	15.45	16.12	16.24	15.34	15.08	0.66
Drumstick (%)	15.73^{a}	15.10^{ab}	13.70^{bc}	13.81^{bc}	12.41^{bc}	13.53^{bc}	13.89^{bc}	0.44
Wing (%)	12.84	6.65	11.00	11.71	7.13	10.69	11.20	3.00
Back (%)	21.67	20.59	21.73	22.51	25.13	24.48	23.11	1.51

Means in a row with different superscripts a, b, c, d are significantly different ($P<0.05$). SEM= standard error of mean.

The result of the economics of supplementing broiler finisher diets with methionine and/or lysine is presented in Table 4. Numerically, Diet 3 had the highest feed cost, closely followed by Diets 2, 6 and 7. Diet 7 had the highest

Table 4: Economics of supplementing broiler finisher ration with methionine and or lysine.

	DIETS							
Parameters	1	2	3	4	5	6	7	SEM
Final liveweight (g/b)	2275.00	2250.00	2250.00	2450.00	2250.00	2400.00	2050.00	107.32
Cost/kg feed (N)	21.57	22.76	23.98	22.17	22.16	22.76	22.76	-
Total weight gain (g/b)	1829.50	1823.50	1799.50	1987.50	1824.50	1946.00	1595.00	107.67
Total feed cost (N)	153.18	146.12	148.35	143.86	134.12	154.60	146.42	16.19
Relative cost-benefit (%)	-	4.32	1.56	13.58	12.23	5.13	-9.61	-
Cost/kg weight gain (%)	83.75^{ab}	80.13^{b}	82.44^{ab}	72.38^{c}	73.51^{c}	78.45^{bc}	91.80^{a}	21.87
Cost difference/kg gain (N)	-	3.62^{b}	1.31^{c}	11.37^{a}	10.24^{a}	4.30^{b}	-8.05^{d}	9.29

Means in a row with different superscripts a, b, c, d are significantly different ($P<0.05$). SEM= standard error of mean.

feed cost per kg weight gain, while diets 4 and 5 had the least of N72.38 and N73.51, respectively. Cost of total feed consumed per broiler was not significantly ($P>0.05$) different among the treatments. Numerically, Diet 6 had the highest value, while Diet 5 had the least and closely followed by Diet 4. Diet 4 also had the highest cost-benefit ratio of 13.58% followed by Diets 5 (12.23%) and 6

(5.13%). The contemporary challenges in broiler production center on enhancing productivity at the least cost (5). Furthermore, the goal of every business is to make profit and in poultry, input minimization and maximization of output results in "profit" (25). In the present study, Diet 4 proved to be more economically advantageous for the farmer than the other 6 dietary treatments. Addition of 0.2% methionine and lysine (D7) could therefore be regarded as an economic suicide for the farmer. Diet 1 (control) did not fare better when cost per kg weight gain was considered. This economic observation agrees with (24) who stated that from practical standpoint, both the essential (mainly lysine and other sulphur amino acids) and non-essential amino acid contents affect the economic costs of poultry rations.

CONCLUSIONS AND APPLICATIONS

Supplementing broiler finisher diets with 0.1% methionine enhanced carcass yield and productivity at the least cost. Broiler farmers and feed millers should therefore be informed that 0.1% methionine supplementation is adequate for broiler finisher; provided the dietary protein and energy is not below the minimum requirements.

REFERENCES

1. **D'Mello, J. P. F. (1993):** Amino acid supplementation of cereal-based diets for non-ruminants. Anim. Feed Sci. and Technol., 45: 1-18.
2. **Wethli, E., Morris, T. R. and Shresta, T. P. (1975):** The effect of feeding high levels of low-quality proteins to growing chickens. Brit. J. Nutr. 34: 363-373.
3. **Uzu, G. (1982):** Limit of reduction of the protein level in broiler feeds. Poult. Sci. 61: 1557-1558.
4. **Cheng, T. K., Hambre, M. L. and Coon, C. N. (1997):** Responses of broilers to dietary protein levels and amino acid supplementation to low protein diets at various environmental temperatures. J. Appl. Poult. Res. 6: 18-33.
5. **Onifade, A. A., Odunsi, A. A., Babatunde, G. M., Olorode, B. R. and Muma, E. (1999).** Comparison of the supplemental effect of Saccharomyces cerevisiae and antibiotics in low-protein and high fibre diets fed to broiler chickens. Arch. Anim. Nutr. Vil. 52: 29-39.
6. **National Research council (1994):** Nutrient requirements of poultry, 9th edn., National Academy Press, Washington D. C.
7. **Gadd, J. (1997):** Life without antibiotic digestive enhancers In: Plyons, T. and Jacques, K. A. (eds). Biotechnology in Feed Industry. Proceedings of the 13th Annual symposium. Alltech. International Publications, Nicholasville, KY, USA: 277-291.
8. **Oluyemi, J. A. (1979):** Selection of the Nigerian indigenous fowl for 12-week body weight.
9. **Olomu, J. M. (1995):** Monogastric Animal Nutrition: Principles and practice. Jachem Pub. Nigeria: 71-79.

10. **Lipstein, B. and Borstein, S. (1975):** The replacement of some of the soybean meal by the first limiting amino acids in practical broiler diets. Brit. Poult. Sci. 16: 189-200.
11. **Nakajima, T., Kishi, K., Kusubae, T., Wakamatsu, H. and Kusutani, Y. (1985):** Effect of L-threonine and DL-tryptophan supplementation to the low protein practical broiler finisher diet. J. Poult. Sci. 22: 10-11.
12. **Olomu, J. M. and Offiong, S. A. (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. Poult. Sci. 59: 828-835.
13. **Allison, J. B. (1964):** The nutritive value of dietary proteins. In: Munro, H. N. and Allison, J. B. (eds). Mammalian protein metabolism. Vol. II, Academic Press, N. Y. 41-86.
14. **Scott, M. L., Hill, N. F., Parsons, E. H. (Jr) and Bruchker, J. H. (1959):** Studies on duck nutrition 7: Effect of dietary energy : protein relationships upon growth, feed utilization and carcass composition in market ducklings. Poult. Sci. 38: 497-507.
15. **Steel, R. G. D. and Torrie, J. H. (1980):** Principles and procedures of statistics. McGraw Hill Books, New York.
16. **Duncan, D. B. (1955):** Multiple Range and Multiple F tests. Biometrics 11: 1-11.
17. **Yokogoshi, H. and Yoshida (1979):** Effect of supplementation of methionine and threonine on hepatic polyribosome profile in rats meal fed á protein-free diet. J. Nutr. 109: 148-154.
18. **Muramatsu, T., Toko, M., Tasaki, O. J. (1986):** Enhanced whole-body protein synthesis by methionine and arginine supplementation in protein-starved chicks. Brit. J. Nutr. 55: 635-641.
19. **Allen, R. E., Raines, P. L. and Regens, D. M. (1978):** Biochem. Biophys. Acts. 190: 323-340.
20. **Harper, A. E. (1964):** Amino acid toxicities and imbalances In: Munro, H. N. and Allison, J. B. (eds). Mammalian protein metabolism. Vol. II, Academic Press, N. Y. 87-134.
21. **Morris, T. R., Al-Azzawi, K., Gous, R. M. and Simpson, G. L. (1987):** Effects of protein concentration on reponces to dietary lysine by chicks. Brit. Poult. Sci. 28: 185-195.
22. **Pickard, M. and Brette, A. (1980):** Broiler nutrition and body composition, some questions, few answers. Proceedings of the 1980 Arkansas Nutrition Conference.
23. **Jones, R. L. (1986):** Nutritional influences on carcass composition in the broiler chicken. Proceedings of the Nutrition Society 45: 27-32.
24. **Mdeod, J. A. (1982):** Nutritional factors influencing carcass fat in broilers-A review World's Poult. Sci. J. 45 (3): 194-200.
25. **Ukachukwu, S. N. and Anugwa, F. O. (1995):** Bio-economics of feeding raw or heat-treated soybeans to broilers. Nig. J. Anim. Prod. 22 (2): 137-140.