RESPONSE TO METHIONINE SUPPLEMENTATION OF BROILER CHICKS FED PRACTICAL CORN-GROUNDNUT MEAL DIETS IN THE TROPICS

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SUMMARY

Two floor feeding trials, involving 1000 broiler chicks fed two different practical-type diets, were conducted in order to determine the methionine and total sulphur amino acid (TSAA) requirements of broiler chicks (0—6 weeks). Two protein levels (20 and 23%) each with an energy concentration of 2800 Kcal ME (kg diet and four supplemental methionine levels (0.1, 0.2, 0.3 and 0.4%) were tested. At the end of 6 — week feeding period, a common finisher ration was fed to 10 weeks of age.

Under our experimental circumstances with diets having 23% protein and metabolizable energy of 2800 Kcal ME/kg diet and based on assumed methionine and cystine content of feeding stuff, the quantitative requirement for methionine of broiler chicks up to six weeks of age were about 0.53% diet which is equivalent to 2.3% of the dietary protein (or TSSA of 0.85 per cent diet, that is 3.7 per cent protein). Higher supplemental methionine at this protein and energy levels resulted in deterioration in liveweight gain and slight but non-significant improvement in feed/gain ratio. The rations containing 20% protein performed poorly relative to those containing 23%. Feeding of high quality common finisher rations neutralized the initial gains due to supplemental methionine within each protein level, but did not offset the gains due to different dietary proteins.

INTRODUCTION

Methionine has three major functions in the animal body; as an essential component for protein synthesis, as methyl donor and as precursor of cysteine. A physiological relationship exists for both methionine and cysteine, hence when cysteine is deficient and methionine is in exces, methionine is probably converted to cysteine. This metabolism achieves two functions (a) it removes excess methionine which is extremely toxic (b) it overcomes the deficiency of cysteine. The reverse of the methionine-to-cysteine pathway does not occur. On the other hand, cystine has been shown to be capable of replacing part but not all of the methionine.

A large number of reports have been published on the subject of methionine and total sulphur amino acid (TSAA) requirements and their supplementation. The published figures have varied and at times are contradictory. Some of the factors contributing to these variations have been listed (Bornstein and Lipstein, 1966) viz (i) use of calculated and not assayed values of methionine content of the feedingstuff used for the trial (ii) the great variability of the assumed values employed in these calculations (iii) variations in biological availability of TSAA in different dietary constituents (Njike, *et al*, 1975) (iv) the dependence of the methionine requirement on dietary protein and energy level (v) the effect of processing and storage on the feeding stuff particularly animal and oil seed protein sourses (vi) genetic differences regarding methionine requirement as indicated by the work of Hess *et al* (1962), (vii) the effect of hot climate on methionine requirement (Camp and Couch, 1959).

Recognising these variables and because of paucity of information on TSAA requirements of chicks under tropical conditions we undertook this study to determine the optimum methionine requirement of broiler chicks under Nigerian conditions. it is hoped that the results of this experiment will be used along with other data collected from other ecological zones of Nigeria in compiling poultry feed standards in the tropics.

RESULTS

Experiment 1:

The results obtained in this trial are set out in Tables 2, 3 and 4. At 0—3 weeks of age the beneficial effects of methionine supplementation on feed intake, liveweight gain and feed/gain ratio were significant (P ≮ 0.05). Increasing levels of methionine in the diet at both protein levels showed a tendency towards improvement in liveweight gain and feed efficiency and this was more with rations containing 23% protein. The improvement continued with 20% protein up to 0.4% level of supplementation but max-

TABLE 2

Average feed consumption, liveweight gain and feed efficiency of broiler chicks (0—3 weeks) receiving different levels of methionine

Diet No.	*Protein (%)*	*Supplemental Methionine (%)*	*Feed Consumption* (g)*	*Liveweight gain (g)*	*Feed efficiency (g feed eaten/g weight gain)*
1.	20	0.0	432.9[de]	108.8[f]	2.395[a]
2.		0.1	461.5[c]	191,5[ef]	2.41[a]
3.		0.2	471.1[bc]	200.5[de]	2.35[ab]
4.		0.3	466.1[c]	209.1[d]	2.23[c]
5.		0.4	444.8[d]	199.5[de]	2.23[c]
6.	23	0.0	476.5[bc]	208.5[d]	2.285[bc]
7.		0.1	560.7[a]	249.2[a]	2.251[c]
8.		0.2	544.7[a]	252.8[b]	2.155[d]
9.		0.3	486.9[b]	247.8[b]	1.965[e]
10.		0.4	423.9[e]	234.8[c]	1.805[e]
Standard error		—	4.7	3.61	0.0196

*Means bearing the same superscript do not differ significantly (P ≮ 0.05).

TABLE 3

Average feed consumption, liveweight gain and feed efficiency of broiler chicks (3—6 weeks) receiving different levels of methionine

Diet No.	*Protein level (%)*	*Supplemental Methionine (%)*	*Feed consumption* (%)*	*Liveweight gain (g)*	*Feed efficiency (g feed eaten/g weight gain)*
1.	20	0.0	1171.5[f]	470.5[f]	2.490[a]
2.		0.1	1204.0[ef]	481.5[f]	2.50[a]
3.		0.2	1179.2[f]	476.7[f]	2.474[a]
4.		0.3	1231.2[de]	499.0[e]	2.468[a]
5.		0.4	1296.2[bc]	520.0[d]	2.498[a]
6.	23	0.0	1291.1[c]	533.5[cd]	2.420[bc]
7.		0.1	1271.0[cd]	532.9[cd]	2.385[bc]
8.		0.2	1493.3[a]	632.3[a]	2.360[c]
9.		0.3	1323.5[b]	561.4[b]	2.358[c]
10.		0.4	1288.7[c]	547.7[bc]	2.353[c]
Standard error		—	22.78	9.59	0.057

1 Means bearing the same superscript do not differ significantly (P ≮ 0.05).

TABLE 4

Average feed consumption, liveweight gain and feed efficiency of broiler chicks (0—6 weeks) receiving different levels of methionine

Diet No.	Protein level (%)	Supplemental Methionine (%)	Feed consumption* (%)	Liveweight gain (g)	Feed efficiency (g feed eaten/g weight gain)
1.	20	0.0	1670.4[e]	651.2[g]	2.565[a]
2.		0.1	1702.0[e]	673.0[f]	2.53[ab]
3.		0.2	1679.4[e]	672.2[f]	2.48[bc]
4.		0.3	1759.5[d]	708.1[e]	2.485[bc]
5.		0.4	1770.3[d]	719.5[e]	2.461[bcd]
6.	23	0.0	1818.7[c]	742.0[d]	2.451[cd]
7.		0.1	1920.1[b]	802.1[b]	2.394[de]
8.		0.2	2105.3[a]	891.6[a]	2.361[e]
9.		0.3	1904.4[b]	809.2[b]	2.354[e]
10.		0.4	1848.2[c]	782.5[c]	2.362[e]
Standard error		—	21.6	13.5	0.0219

*Means bearing the same superscript do not differ significantly ($P < 0.05$).

imum liveweight gain was reached at 0.2% methionine for rations containing 23% protein. At 3—6 weeks of age this trend towards improvement continued but was more pronounced. At this stage it was only the 20% ration supplemented with 0.4% methionine that showed no statistical difference from those of 23% protein supplemented with zero and 0.1% methionine. The 23% protein ration supplemented with 0.2% was the best, although the difference was small and did not differ significantly from the other rations containing 23% protein having 0.3 and 0.4% methionine supplementation. In general, all the chicks on 23% protein — as expected — performed better than those on 20% protein level both in terms of liveweight gains and feed/gain ratios, and these differences were statistically significant ($P < 0.05$). The computations at 0—6 weeks showed significant differences in food consumption, liveweight gain and feed/gain ratio, the chicks on rations containing 23% performing better than those on 20% protein. The 23% protein with 0.2% methionine supplementation was decidedly the best ration and liveweight gain of 891.6g was significantly higher than the others. The data indicate that it requires 0.3% methionine supplementation to ahieve the best feed efficiency (2.354). This figure, however, is not significantly different from those of the rations, supplemented with 0.2 and 0.4% methionine. Also feed consumption was significantly higher for rations containing 23% protein than those containing 20% protein and since this tendency resulted in greater gains and better feed utilization, it means that formulations at 23% protein make for better amino acid balance than at 20%.

Experiment 2:

The purpose of this experiment was to find out whether a good quality finisher ration (20% protein diet) could offset variations in chick performance consequent upon initial dietary treatments. the results are summarized in Table 4. Again, chicks of 23% protein performed significantly ($P < 0.05$) better than those on 20% protein diets. Feeding of the finisher rations resulted in offsetting the differences in feed consumption, feed efficiency and liveweight gain for chicks on rations containing 23% protein but for chicks on 20% protein diet only the mean liveweight gain figures showed no significant differences but feed consumption and feed efficiency data showed significant differences ($P < 0.05$). However, for the two protein levels there was tendency towards greater efficiency in feed utilization with increases in methionine level.

DISCUSSION

The addition of amino acids to supplement the protein diets of broilers provides a means of increasing the efficiency with which feed proteins are converted to meat proteins. Comparing the calculated methionine and TSAA in the diets used (Table 1) with NRC (1977) requirements, it is clear that all the rations are low for TSAA but only the unsupplemented rations (Diets 1 and 6) are low for methionine. We have not considered simultaneous supplementation of lysine and methionine in the trial because an earlier report (Unpublished data from this laboratory) showed that lysine supplementation to broiler diets gave varied responses but its addition was not economic. However, Olomu and Offiong (1980) indicate supplemental requirement of 0.25% lysine for broilers. Also Wethli *et al* (1975) showed that groundnut meal supplemented with methionine and lysine was as efficient as herring meal. But the latter authors did not consider in their trial diets supplemented with methionine alone. In the present trial, the data showed that consideration must be given to the total protein content of the diet as well as daily feed consumption. At 6 weeks of age (Table 4) the weekly feed consumption ranged from 1670.4 to 1770.3g for rations containing 20% protein while those on 23% were of the order of 1818.7 to 2105.3g. Thus, it is evident that formulations at 23 encouraged greater feed consumption and hence higher methionine (and other amino acid) intake. And in all instances, the rate of feed consumption was directly related to liveweight gains and inversely to feed/gain ratios. The data of Bornstein and Lipstein (1966) indicate that methionine requirement for growth may be slightly higher at 3 weeks of age than at 5 weeks. This is also the procedure followed in the NRC (1977) recommendations of 0.93 and 0.5% for TSAA and methionine respectively for 0—3 weeks, and 0.72 and 0.38 TSAA and methionine for 3—6 weeks of age. This tendency was not evident in the present trial, the 0.2% level of methionine supplementation (Diet 8) was consistently better than the other rations containing 23% protein level, but better feed efficiency was apparent at 0.3% level although the difference was small and not significantly different from the others.

The result herein reported showed that under the conditions of this experiment, the quantitative requirements for methionine is 0.53% of diet (or TSAA of 0.85% of diet). This figure agrees with the results of Bornstein and Lipstein (1966). These authors showed that under temperat climate the requirement of broilers up to 55 weeks of age for TSAA was 3.5 per cent protein, while under hot summer conditions the requirements for TSAA were 3.7 and 3.9 per cent protein for maximal growth and feed efficiency, respectively. Our recommendation of 0.85 per cent diet is equivalent to 3.7 per cent protein.

At 10 weeks of age the initial gains made as a result of different dietary treatments were completely reversed by feeding high quality common finisher rations (Table 5) but the compensatory growth was evident within the protein levels only. This result tends to confirm

TABLE 5

Average feed consumption, liveweight gain and feed efficiency of broiler chicks (0—10 weeks) receiving different levels of methionine

Diet No.	*Protein level (%)*	*Supplemental Methionine (%)*	*Feed consumption* (g)*	*Liveweight gain*	*Feed efficiency*
1.	20	0.0	4043.7^{de}	1422.9^{b}	2.842^{a}
2.		0.1	3906.3^{ef}	1424.2^{b}	2.744^{bc}
3.		0.2	3995.8^{e}	1445.4^{b}	2.744^{bc}
4.		0.3	3957.7^{e}	1492.4^{b}	2.653^{cd}
5.		0.4	3766.1^{f}	1448.9^{b}	$2.\ \ 6^{de}$
6.	23	0.0	4405.3	1758.9^{a}	2.507^{ef}
7.		0.1	4406.7^{a}	1758.9^{a}	2.487^{f}
8.		0.2	4395.7^{a}	1796.8^{a}	2.447^{f}
9.		0.3	4360.4^{ab}	1785.6^{a}	2.442^{f}
10.		0.4	4292.0^{ab}	1758.9^{a}	2.441^{f}
Standard error		—	110.2	35.2	0.056

*Means bearing the same superscript do not differ significantly ($P < 0.05$)

reports (Babatunde and Fetuga, 1976) that 24% all-vegetable protein, unsupplemented with any amino acid(s), is capable of supporting excellent growth in broiler chicks. It also contradicts the findings of Wethli *et al.* (1975) that cereal — groundnut meal could not support maximum liveweight gain or maximum feed efficiency of feed utilization due to amino acid imbalance.

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