ESTIMATED DAILY METHIONINE + CYSTINE REQUIREMENTS OF BROILER CHICKEN

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THE daily methionine + cystine (MC) requirement of cobb-broiler chicken was estimated in three consecutive experiments.

In experiment 1, three groups of 30 day-old birds were fed one of eight diets. The diets contained between 0.52% and 1.08% MC in 0.08% stepwise increments. Liveweight gain peaked at 0.84% and 0.76% MC levels during 1-21 days (period 1) and 21-42 days (period 2) growth phases, respectively. MC intake/bird/d at these 0.84% and 0.76% MC levels was 0.21g and 0.42g respectively. Efficiency of feed utilisation was maximized at 0.76% MC level during each of the growth phases.

In experiments 2, three groups (25/group) of 42-day old birds were fed one of eight diets. The diets contained between 0.48% and 1.04% MC in 0.08% stepwise increments. Liveweight gain and feed utilisation efficiency were maximized at 0.64% MC level during each of 42-63 days (period 3) and 63-84 days (period 4) growth phases. However, MC intake/bird/d was 0.58g during period 3 and 0.82g during period 4. Experiment 3 involved 9 diets arranged in a 3 x 3 factorial design (Three energy levels: 2,800, 3,200 and 3,600 Kcal ME/kg diet; and three MC levels: 0.68%, 0.76% and 0.84). Each diet was fed to triplicate group of 30 day-old birds. The daily MC intake requirement of 1-28 day-old birds was 0.37g at 2,800 KcalME/kg diet; while that of 28-56 days old birds was 0.83 at 3,600 KcalME/kg diet.

such studies did not determine amino acid requirements experimentally, rather calculations of the requirements for amino acids were based on experimentally estimated protein levels. Such study led Scott (1968) to suggest between 0.50% and 0.52% dietary methionine for optimum performance of broilers. In the tropics, the few reports available estimated the protein requirements of broiler chicks to be higher than those of their temperate counterparts. Calculations of the methionine levels in diets found to be adequate in terms of crude protein suggest 0.50% (Shingari *et al* 1976). While Babatunde *et al* (1976) suggested 0.93% methionine + cystine (MC), Olomu (1978) reported between 0.74% and 0.84% for optimum performance of broiler chicks.

Since ambient temperature, dietary energy concentration and protein level specification act together to influence feed intake that affects growth performance, calculating MC requirements from adequate protein levels may not be appropriate. Instead, graded levels of MC should be used to evaluate the poult's requirements, requirements should in fact be expressed on daily intake basis in conformity with the growing tendency to base diet formulation on daily nutrient intake.

In order to gain additional information on these points, the present series of studies were designed to evaluate the dietary MC intake need of broiler starters and finishers under varying dietary situation and growth phases.

INTRODUCTION

In recent years, a great deal of work has been reported on the amino acid requirements of broiler chicken. Most of

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MATERIALS AND METHODS

The composition of basal diets used in these studies is shown in table 1. The basal diets were balanced for all essential amino acids except methionine. Dietary methionine + cystine (MC) level varied from 0.52% to 1.08% in a 20% crude protein (Nx6.25) diet in experiment 2 contained between 0.48% and 1.04% MC levels. These MC levels were arrived at by supplementing the basal diets with DL-methionine in 0.08% stepwise increments

at the expense of glutamic acid nitrogen. Protein content of diet in experiment 3 was maintained at 20% while dietary metabolizable energy (ME) levels of 2,800, 3,200 and 3,600 Kcal/kg were used. Differences in dietary energy levels were obtained by adjusting the addition of palm oil, rice husk and cassava flour in the basal diets. 0.68%, 0.76% and 0.84% MC levels were fed at each dietary energy level.

TABLE I
Composition(%) of Basal Diets Use in Experiments 1, 2 and 3

INGREDIENTS	EXPT. 1	EXPT. 2	EXPT. 3 KCALME/KG DIET		3600
			2800	3200	
Yellow maize	56.70	62.07	—	—	—
Guinea corn	—	—	37.51	37.51	37.51
Groundnut cake	31.03	25.75	33.43	33.43	33.43
Cassava four	—	—	11.00	14.50	10.00
Rice husk	5.00	5.00	13.00	5.00	2.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Oystershell	0.50	0.50	0.50	0.50	0.50
Vitamin premix*	0.55	0.55	0.55	0.55	0.55
Sodium chloride	0.25	0.25	0.25	0.25	0.25
Manganous sulphate	0.02	0.02	0.02	0.02	0.02
Choline chloride	0.15	0.15	0.15	0.15	0.15
Palm oil	2.00	2.00	—	4.50	12.00
L — Threonine	0.08	0.03	0.17	0.17	0.17
L — Isoleucine	0.10	0.12	0.10	0.10	0.10
L — Lysine-HCl	0.49	0.43	0.50	0.50	0.50
DL— methionine	0.08	0.08	0.16	0.16	0.16
L — glutamic acid	0.55	0.55	0.16	0.16	0.16
L — Tryptophan	—	—	—	—	—
Zinc oxide	50ppm	50ppm	50ppm	50ppm	50ppm
Ethoxyquin	+	+	+	+	+
Determined analysis					
Crude protein %	20.35	18.30	20.39	20.54	20.58
Total methionine %	0.28	0.26	0.39	0.39	0.39
Total Lysine %	1.16	1.03	1.16	1.16	1.16
Methionine + cystine %	0.52	0.48	0.68	0.68	0.68
KcalME/kg diet (calculated)	3,043	3,084	2,855	3,258	3,653

*A Pfizer Liverstock Feeds Products, Supplying the following nutrients per kg of ration: Vitamin A; 11,785,51U; D, 1964.31CU; Riboflowin 5.40mg; Pantothenic acid 9.82mg; Nicotinic acid, 24.55mg; Folic acid, 0.98mg; Choline Chloride, 147.32gm; Vitamin E, 4.91 units; Vitamin K, 2.20mg; Vitamin B 12,0.01mg; Methionine 245.53mg; Cobalt, 1.23mg; Iodine, 0.98mg; Copper, 9.82mg; Manganese.

In all the experiments, the ME values used when calculating their energy content in Kcal/g feedstuff, were as follows: maize 3.43, guinea corn 3.35, groundnut cake 2.73, rice husk 1.63, cassava flour 4.31, palm oil 8.50. These values are based upon reports by Oyenuga (1968); Peterson (1972); Maust *et al* (1972); and McDonald *et al* (1973).

Day-old broiler type (Cobb) chicks imported from Holland and purchased from Mitchell Farm Limited, Lagos were sorted into group (30 chicks/group). Each group was allocated to a separate pen and brooded on wood shavings. Another batch of day-old cobb broiler chicks initially raised on 24% crude protein commercial broiler starter diet until 42 days old were sorted into 27 groups (25 chickens/group) and used for experiment 2. Average initial liveweight for each group was 37.26 ± 0.08 g/bird; 615.6 ± 0.42 g/bird and 38.16 ± 0.12 g/bird in experiments 1, 2 and 3, respectively. Each of the experimental diets in experiments, 1, 2 and 3 were respectively fed to three pens with 30, 25 and 30 poults per pen.

Four birds from each pen were randomly selected during each experimental period and used for a 7-day nitrogen balance study in specially designed metabolism cages. The first four days were taken as adjustment period while droppings were collected for the last three days. Feed consumed during the balance study was noted and dropping was daily weighed, syrayed with 1% boric acid solution and refrigerated at 5°C until required for analyses. The analyses for moisture and nitrogen on the stored, bulked samples were done according to AOAC 1975 methods of analyses. Feed consumed in each pen, corrected for mortality, was determined at each weighing period. Throughout the duration of each experiment, the birds were supplied with feed and water *ad libitum*. Data were subjected to analysis of variance and the Duncan's

multiple range tests (Snedecor and Cochran 1977), employing weight gain, MC intake, feed/gain ratio and nitrogen retention as dependent variables. Average data from three groups of poults fed similar diet were used for all computation.

RESULTS

Experiment 1

Figure 1, shows the growth performance of broiler starters. During period 1 (1-21 day growth phase), liveweight gain and feed intake initially improved with increasing dietary MC level, reaching an optimum at 0.84% and 0.92% MC levels,

Fig. 1 Growth performance of broiler starters.

respectively. Similar increases during period 2 (21-42 day growth phase) initially peaked at 0.76% MC level for liveweight gain and 0.64% MC level for feed intake. After these peaks, weight gain during periods 1 and 2 and feed intake during period 1 tended to decrease with increasing MC level. There seems to be no relationship between feed efficiency and dietary treatments as shown in the shape

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TABLE 2.
Methionine + Cystine Intake of Broiler Starters (g/bird/day)

Period (Days)	METHIONINE + CYSTINE LEVEL (% DIET)								Mean	
	0.52	0.60	0.68	0.76	0.84	0.92	1.00	1.08		
1 (1-21)	0.12 ^a	0.14 ^a	0.16 ^a	0.19 ^{ab}	0.21 ^b	0.26 ^b	0.22 ^b	0.28 ^b	0.20	0.03 ^{**}
2 (21-42)	0.27 ^a	0.34 ^a	0.39 ^a	0.42 ^{ab}	0.45 ^b	0.54 ^b	0.50 ^b	0.61 ^b	0.44	0.07 ^{**}
Mean (1-42)	0.20 ^a	0.24 ^a	0.28 ^a	0.31 ^{ab}	0.33 ^b	0.40 ^b	0.36 ^b	0.45 ^b	0.32	0.04 ^{**}

In this and Table 3-5, a, b, c . . . means not followed by the same superscript in the same horizontal line are significantly (P .05) different. * = (P .05); ** = (P .01) $\pm \frac{SE}{m}$ = Standard error of mean.

of the response curve. However, the best efficiency of feed utilisation was obtained from poult fed 0.76% dietary MC level during each of the two growth phases. Generally, MC intake (g/bird/d) — Table 2-tended to increase with increasing dose level in the diets. During each of the two growth phases, MC intake after 0.76% MC level was significantly ($P < .01$) higher than the intake at lower dietary MC level. The nitrogen retention data are

shown in table 3. During period 1, poult fed 1.00% dietary MC level retained lesser (P .01) nitrogen (g/bird/d) than poult offered between 0.52% and 0.92% dietary MC levels. Gram nitrogen retained/bird/d increased ($P < .01$) between 0.52% and 0.69% MC levels during period 2, plateauing until 0.92% level was reached. Further increases in MC level resulted in decreased nitrogen retention. Percentage nitrogen intake retained bet-

TABLE 3
Nitrogen Retention of Broiler Starters Fed Graded Levels of Dietary Methionine + Cystine

Parameters	Periods (Days)	METHIONINE + CYSTINE LEVEL (% DIET)								+ SE -m
		.52	.60	.68	.76	.84	.92	1.00	1.08	
Nitrogen retained (g/bird/day)	1									
	(1-21)	0.49 ^b	0.51 ^b	0.58 ^b	0.58 ^b	0.51 ^b	0.58 ^a	0.38 ^a	0.46 ^{ab}	0.03 ^{**}
	(21-42)	0.77 ^a	0.22 ^b	0.27 ^b	1.01 ^{ab}	1.05 ^{ab}	1.17 ^{ab}	0.49 ^a	0.83 ^a	0.06 ^{**}
	Mean									
	(1-42)	0.63 ^a	0.86 ^{ab}	0.93 ^b	0.80 ^{ab}	0.82 ^{ab}	0.88 ^b	0.66 ^a	0.65 ^a	0.05 ^{**}
Nitrogen retained (% Intake retained)	1									
	(1-21)	52.13 ^b	51.52 ^b	55.96 ^b	53.70 ^b	45.79 ^a	47.15 ^a	44.70 ^a	45.54 ^a	0.30 ^{**}
	(21-42)	46.66 ^a	67.22 ^c	51.21 ^b	48.33 ^{ab}	49.76 ^{ab}	53.18 ^b	48.46 ^{ab}	50.30 ^{ab}	0.55 ^{**}
	Mean									
	(1-42)	49.40 ^a	59.37 ^b	53.49 ^{ab}	51.12 ^a	48.28 ^a	50.17 ^a	46.53 ^a	47.92 ^a	

ween 0.84% and 1.08% MC levels was similar and significantly ($P = .01$) lower than the percentage nitrogen intake retained between 0.52% and 0.76% MC levels during period 1. Although the percentage nitrogen intake retained between 0.68% and 1.08% MC levels during period 2 was similar, the quantity retained initially increased ($P = .01$) between 0.52% and 0.60% MC levels.

Experiments 2.

The pattern of changes in growth performance with increasing MC levels for broiler finishers appears in figure 2. In each of periods 3 (42-63 days growth phase) and 4 (63-84 days growth phase), the increases in liveweight gain with increasing does level peaked twice. Neither was the peak at 0.96% MC level during period 3 superior to that at 0.64% level nor was the peak at 0.88% level during period 4 superior to that at 0.64% level. The initial increases in feed intake between 0.48% and 0.72% MC levels during period 3 tended to decrease thereafter, while the initial increases between 0.48% and 0.72% MC levels during period 4 became inconsistent with further methionine supplementation. Again dietary treatments appear not to influence feed efficiency but poult fed 1.08% MC

Fig 2 Growth performance of broiler finishers

level produced a feed efficiency approximately 50% lesser than that obtained at any other MC level during period 3. Table 4 shows the MC intake of the broiler finishers. During each of periods 3 and 4, MC intake between 0.48% and 0.64% dietary MC levels was similar and significantly ($P = .01$) lower than the similar intake between 0.80% and 1.04% MC levels.

TABLE 4.
Methionine + Cystine Intake of Broiler Finishers (g/bird/day)

METHIONINE + CYSTINE LEVEL (% DIET)										
Period (Days)	0.48	0.56	0.64	0.72	0.80	0.88	0.96	1.04	Mean	+ SE _m
3 (42-63)	0.40 ^a	0.49 ^a	0.58 ^a	0.66 ^{ab}	0.71 ^b	0.79 ^b	0.80 ^b	0.83 ^b	0.66	0.99**
4 (63-84)	0.52 ^a	0.71 ^a	0.82 ^a	0.93 ^{ab}	0.96 ^b	1.20 ^b	1.16 ^b	1.28 ^b	0.95	0.17**
Mean (42-84)	0.46 ^a	0.60 ^a	0.70 ^a	0.80 ^{ab}	0.84 ^{ab}	1.00 ^b	0.98 ^b	1.10 ^b	0.81	0.13**

The nitrogen retention data are shown in table 5. Dietary treatments had no significant effect on gram nitrogen retained/bird/d during periods 3 and 4. Percentage nitrogen intake retained was similar between 0.48% and 0.64% MC levels during period 3, followed by significant ($P < .01$) but inconsistent increases

was significant ($P < .01$). This was largely caused by the significant ($P = .05$) decreases in intake between 2,800 and 3,200 KcalME/kg diet. Energy intake at 3,600 KcalME/kg diet was significantly ($P < .01$) higher during period 1 and significantly ($P < .05$) lower during period 2 than intake at either

TABLE 5.
Nitrogen Retention of Broiler Finishers Fed Graded Levels of Dietary Methionine + Cystine

METHIONINE + CYSTINE LEVELS (% DIET)										
Parameters	Periods (Days)	0.48	0.56	0.64	0.72	0.80	0.88	0.96	1.04	+ SE -m
Nitrogen retained (g/bird/day)	3 (42-63)	1.18	1.24	1.23	1.24	1.15	1.82	1.52	1.35 0.16	NS
	4 (63-84)	1.73	1.83	1.82	1.56	1.25	1.02	1.59	1.94 0.16	NS
	Mean (42-84)	1.46	1.54	1.53	1.50	1.35	1.42	1.56	1.65 0.16	NS
Nitrogen retained (% Intake) retained)	3 (42-63)	33.62 ^a	34.93 ^a	33.88 ^a	43.36 ^b	38.88 ^{ab}	49.19 ^b	46.21 ^b	58.19 ^c 1.54	**
	4 (63-84)	61.82 ^d	61.69 ^d	61.70 ^d	47.42 ^c	38.34 ^b	28.73 ^a	43.44 ^c	51.60 ^b 1.50	**
	Mean (42-84)	47.72 ^{ab}	48.31 ^{ab}	47.79 ^{ab}	45.39 ^a	38.66 ^a	38.96 ^a	44.83 ^a	54.90 ^b 1.48	**

with increasing dietary MC level. After the similar retention values between 0.48% and 0.64% MC level during period 4, percentage nitrogen intake retained significantly ($P < .05$) decreased until a minimum was reached at 0.88% MC level. Thereafter retention tended to increase with increasing MC level.

Experiment 3

Average feed, energy and MC intake of the poults are shown in table 6. During period 1 (1-28 day growth phase) and 2 (28-56 day growth phase), the interaction between MC and energy on feed intake

3,200 or 2,800 KcalME/kg diets when means were pooled over the three MC levels.

The weight gain and feed efficiency data appear in table 7. Neither the single effect of dietary MC and energy levels nor the interaction between MC and energy significantly influenced liveweight gain and feed efficiency during period 1. During period 2, the similar liveweight gain between 2,800 and 3,200 KcalME/kg significantly ($P < .01$) improved at 3,600 KcalME/kg diet, while feed efficiency tended to improve ($P < .05$) between 2,800 and 3,600 KcalME/kg diets.

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TABLE 6
Average Feed and Energy Intake of Broiler Fed Varying Levels of Dietary Energy and Methionine + Cystine

METHIONINE + CYSTINE			METABOLIZABLE ENERGY (kcal/kg diet)			
	PERIOD (DAYS)	LEVEL (% DIET)	2800	3200	3600	MEAN
FEED INTAKE (g bird/d)	1	0.68	55.05 ^{bI}	47.01 ^a	44.01 ^a	48.69
	(1-28)	0.76	52.89 ^b	47.87 ^a	48.30 ^{ab}	49.70
		0.84	54.86	52.04	52.83	53.24
		Mean	54.27 ^{YII}	48.97 ^X	48.38 ^X	50.54 ± 1.05
	2	0.68	158.11 ^b	142.56 ^a	119.13 ^a	139.95
ENERGY INTAKE (kcalMe/kg diet)	(28-56)	0.76	164.20 ^b	137.68 ^a	115.08 ^a	138.99
		0.84	151.93 ^b	143.63 ^a	108.18	134.58
		Mean	158.08 ^Y	141.29 ^Y	114.13 ^X	137.84 ± 3.43
	1	0.68	154.14	150.43	158.44	154.34
	(1-28)	0.76	148.09	153.18	173.88	158.38
0.84		153.61	166.53	190.19	170.11	
Mean		152.96 ^X	156.70 ^X	174.17 ^Y	160.94 ± 3.14	
METHIONINE - CYSTINE INTAKE (g bird/d)	(28-56)	0.68	442.71	456.19	428.87	442.59
		0.76	439.76	440.58	414.29	438.21
		0.84	425.40	459.62	389.45	424.82
	Mean	442.62 ^Y	452.13 ^Y	410.87 ^X	435.21 ± 5.26	
	1	0.68	0.37	0.32	0.30	0.33
(1-28)	0.76	0.40	0.36	0.37	0.38	
	0.84	0.46	0.44	0.44	0.45	
	Mean	0.41	0.37	0.37	0.39 ± 0.07	
METHIONINE - CYSTINE INTAKE (g bird/d)	(28-56)	0.68	1.08	0.97	0.81	0.95
		0.76	1.25	1.01	0.87	1.04
		0.84	1.28	1.21	0.91	1.13
	Mean	1.20	1.06	0.86	1.04 ± 0.05	

In this and subsequent tables: a, b, . . . means followed by same superscript are not significantly (P > 0.05) different. Treatment main effect means not followed by the same suffix are significantly different (P > 0.05).

DISCUSSION

From the illustrations in figures 1 and 2, poult s tended to eat less of the methionine deficient diets, such that MC intake (g/bird/d) increased significantly after 0.76% and 0.72% dietary MC levels, respectively. However, MC and energy levels acted together in determining the quantity and pattern of feed consumption in experiment 3. The decreased feed consumption with increasing energy level was similar to an earlier report (Farrel *et al* 1973; Olomu 1976) that feed intake is inversely related to dietary energy concen-

tration. Generally, when dietary MC level was respectively higher than 0.84%, 0.76%, 0.64% and 0.64% during periods 1,2,3 and 4 (experiments I and 2), liveweight gains and feed efficiency were poorer than those observed at lower MC levels. Again, the apparent increases in gram nitrogen retained tended to decrease. Even though feed and MC intake decreased with increasing energy level in experiment 3, average daily caloric intake increased between 2,800 and 3,600 kcalME/kg diet during period 1 and between 2,800 and 3,200 kcalME/kg diet during period 2. The energy intake pro-

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TABLE 7

Average Weight Gain and Feed Efficiency of Broilers Fed Varying Levels of Dietary Energy and Methionine + Cystine.

CRITERION	PERIOD (DAYS)	METHIONINE + CYSTINE	METABOLIZ- ABLE ENERGY	3200	3600	MEAN
		LEVEL (% DIET)	(Kcal/kg diet) 2800			
WEIGHT GAIN (g/bird/d)	1	0.68	20.03	21.90	21.90	21.23
	(1-28)	0.76	21.65	21.26	18.03	20.31
		0.84	22.97	22.05	22.23	22.42
		Mean	21.55	21.74	20.72	21.34 ± 0.35
	2	0.68	38.04	38.83	41.66	39.51
(28-56)	0.76	38.80	40.54	46.64	41.99	
	0.84	38.88	40.65	47.10	42.21	
	Mean	38.57X	40.01X	45.13Y	41.24 ± 1.32	
FEED EFFICIENCY (Feed/gain)	1	0.68	2.75	2.15	2.01	2.30
	(1-28)	0.76	2.44	2.25	2.68	2.46
		0.84	2.39	2.36	2.38	2.38
		Mean	2.53	2.25	2.36	2.38 ± 0.14
	2	0.68	4.16	3.67	2.86	3.56
(28-56)	0.76	4.23	3.40	2.47	3.37	
	0.84	3.93	3.50	2.30	3.25	
	Mean	4.10Y	3.53XY	2.54X	3.39 ± 0.35	

bably enhanced an efficient metabolism of ingested nitrogen, such that almost every increase in feed energy tended to result in improved nitrogen retention (g/bird/d). Similarly, the improved growth performance with increasing energy level, especially during period 2, may be attributed to a lower heat increment usually associated with high energy diets.

The liveweight gain that peaked at 0.84%, 0.76%, 0.064% and 0.64% MC levels during periods 1,2,3 and 4 respectively suggest that 0.21g, 0.42g, 0.58g and 0.82g MC intake/bird/d would be adequate for growth during the respective growth phases. The 0.84% MC level during period 1 is lower than the requirement of 0.93% reported (Babatunde *et al* 1976) for broiler starters and the 0.92% reported (NCR 1977) for 0-21 day old broiler; but agrees with the requirements of 0.84% MC level reported by Olomu (1978) for broiler starters. The 0.64% MC level obtained during periods 3 and 4 is

obviously out of line with the 0.74% reported (NRC 1977, Olomu 1978) for broiler finisher. However, the MC intake between 0.76% and 0.92% MC levels was similar in experiment 1 while the intake between 0.64% and 0.72% MC levels in experiment 2 was equally similar, emphasizing the importance of MC intake rather than dietary MC level in amino acid requirement studies. Since the single effect of either MC or energy was not significant on liveweight gain and MC intake during period 1 (1-28 days growth phase-experiment 3), it follows that 0.37g MC intake/bird/day would meet the poult's requirement at 2,800 KcalME/kg diets. The liveweight gain at 3,600 KcalME/kg diet was however, better than liveweight gain at either 3,200 or 2,800 KcalME/kg diets during period 2 (28-56 day growth phase-experiment 3), again suggesting that 0.86g MC intake/bird/d met the bird's requirement at 3,600 KcalME/kg diet. These 0.37g and 0.86g MC intakes closely approximate the 0.32g

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TABLE 8.

Nitrogen Retention of Broilers Fed Varying Levels of Dietary Energy and Methionine + Cystine

CRITERION	PERIOD (DAYS)	METHIONINE + CYSTINE	METABOLIZ- ABLE ENERGY	3200	3600	MEAN
		LEVEL (% DIET)	(kcal/kg/diet) 2800			
N-RETAINED (g/bird/d)	1	0.68	1.39	1.22	1.31	1.31
	(1-28)	0.76	1.40	1.55	1.32	1.42
		0.84	1.34	1.33	1.64	1.44
		Mean	1.38	1.37	1.43	1.39 ± 0.06
	2	0.68	1.76	1.99	2.21	1.99
	(28-56)	0.76	1.42	2.09	2.33	1.95
		0.84	1.65	2.26	1.61	1.84
		Mean	1.61X	2.11Y	2.05Y	1.92 ± 0.17
	1	0.68	0.26	0.22	0.24	0.24
	(1-28)	0.76	0.25	0.29	0.26	0.27
0.84		0.25	0.24	0.29	0.26	
Mean		0.25	0.25	0.26	0.25 ± 0.01	
N-RETAINED g/0. 1kg Metabolic body size	2	0.68	0.10	0.15	0.16	0.14
	(1-28)	0.76	0.25	0.29	0.26	0.27
		0.84	0.25	0.24	0.29	0.26
		Mean	0.25	0.25	0.26	0.25 ± 0.01
	2	0.68	0.10	0.15	0.16	0.14
	(28-56)	0.76	0.11	0.14	0.16	0.14
		0.84	0.11	0.16	0.10	0.12
		Mean	0.11	0.15	0.14	0.13 ± 0.01
	1	0.68	44.73	37.78	49.64	44.05
	(1-28)	0.76	40.00	45.61	46.74	44.12
0.84		47.68	41.51	52.41	47.20	
Mean		44.14	41.63	49.60	45.12 ± 3.87	
N-RETAINED (% INTAKE) RETAINED)	2	0.68	43.14	33.43	55.11	50.56
	(28-56)	0.76	41.52	47.89	57.11	48.84
		0.84	49.55	44.49	45.48	46.47
		Mean	44.74X	48.51XY	52.57Y	48.62 ± 1.67

and 0.83g MC intake/bird/d earlier reported (Amubode and Fetuga, 1981) when graded levels of MC were fed at three protein levels.

The results as discussed, all tend to indicate that 0.21g, 0.42g, 0.58, and 0.82g MC intake/bird/day would meet the broiler requirements during 1-21 day, 21-42 day, 42-63 and 63-84 growth phases, respectively. However, if the

starter and finisher growth phases are restricted to 1-28 day and 28-56 days as suggested by Olomu (1976), 0.32g and 0.83g MC intake/bird/d could be construed as being the respective requirements. Although these MC intakes were encountered at dietary MC levels lower than those specified for birds of similar strains (Babatunde *et al* 1976; NRC 1977), the intakes were essentially

similar between 0.76% and 0.92% MC levels for experiment 1 and between 0.64% and 0.72% MC levels for experiment 2. This observation emphasizes the fact that the physiological requirements (g/bird/d) for sulphur amino acids is the same under widely varying climatic conditions, hence there is a need for a reappraisal of the presently held view that protein and therefore amino acid requirements are higher for birds reared under hot humid conditions than those reared under temperate conditions.

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