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The Effect of Amino Acid Supplementation to Raw Soybeans and Cotton-Seed Meal on the Growth and Body Composition of Growing Chicks

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ABSTRACT

A study was conducted with 224 Baladi White (B.W.) laying-type chicks from the age of 1-day old to 8 weeks to investigate the effect of supplementing raw soybeans (RSB) or cottonseed meal (CSM) with probably deficient amino acids on the growth, performance and body composition.

Chicks fed the CSM rations were superior in their body weight than chicks fed the RSB rations indicating the relatively inferior quality of RSB. Addition of amino acids to RSB or CSM rations had practically no effect on the growth of chicks but was effective in reducing the mortality rate in the RSB-fed chicks.

Dressing and boneless meat percentages were higher in chicks fed the CSM as compared to those fed the RSB. Addition of methionine and cystine to CSM or RSB rations was correlated with higher concentrations of these amino acids in the whole chick bodies.

INTRODUCTION

Experimental results concerning the addition of amino acids in poultry rations are controversial. Favourable growth responses were reported by Tipton *et al.* (17). However, McDonald (13) found that responses to amino acid addition were variable among different crosses and sexes. On the other hand, Hartel *et al.* (7) concluded that the effects of amino acids were influenced by sources of protein in the ration.

Featherston and Stephenson (5) found that methionine supplementation significantly improved growth of broiler chicks, which was not further improved by addition of

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glycine or choline. However, Askelson and Balloun (1) reported that maximum growth was obtained only when the 3 amino acids: methionine, lysine and glycine were added. Similar results were reported by Bray (3).

Kobayashi *et al.* (9) concluded that chemical composition of carcass was not significantly changed with any supplements of 0.2% or 0.5% lysine to the diet. Gruhn and Anka (6) indicated the presence of 17 amino acids in the muscles of female chicken. The quantities and proportions of amino acids did not change substantially with age except for glycine which decreased as age increased. Similarly, Olsson (15) reported no effect of methionine supplementation on dressed percentage of carcass.

In addition to gossypol which depresses chick growth, CSM contains lower lysine than required for optimum chick growth (4). The RSB contains some growth depressing factors as trypsin inhibitor and hemagglutinin, besides its low content of S-containing amino acids (11). Amino acid supplementation has been suggested among other methods for improving the quality of these two protein sources.

The present study was undertaken to investigate the effect of supplying rations containing CSM or RSB with probably deficient amino acids on the growth, feed efficiency, mortality rate and composition of the chick body.

MATERIALS AND METHODS

Four rations comparable in their crude protein and starch value were used; rations A and B were based on RSB while rations C and D were based on CSM (Table 1). Rations B and D were supplemented with purified amino acids to satisfy the amino acids

Table 1 Composition and feeding value of the experimental rations

Item	Rations A	B	C	D
	%	%	%	%
Ground yellow corn	48.0	48.0	52.0	52.0
Cottonseed meal	—	—	22.0	22.0
Raw soybeans	28.0	28.0	—	—
Rice bran	17.0	17.0	19.0	19.0
Fish meal	5.0	5.0	5.0	5.0
Bone meal	0.5	0.5	0.5	0.5
$CaCO_3$	1.0	1.0	1.0	1.0
NaCl	0.5	0.5	0.5	0.5
Vitamin mixture	[a]	[a]	[a]	[a]
Total	100.0	100.0	100.0	100.0
Feeding value:				
Crude protein (analyzed)	17.29	17.05	17.85	17.14
Crude protein (calculated)	19.53	19.53	19.54	19.54
Starch value	68.04	68.04	67.52	67.52
Amino acid addition:				
Methionine	—	0.12	—	0.14
Cystine	—	0.14	—	0.13
Arginine	—	0.02	—	—
Lysine	—	—	—	0.03

[a]Vitamin mixture supplied each kilogram of ration with: 10,000 I.U. vitamin A, 1,000 I.C.U. vitamin D_3 and 150 mg dried yeast as a source of B complex vitamins.

requirement for growing chicks (14). Rations A and C were not supplemented and served as controls.

Each ration was fed to 2 replicates of 28 chicks each from the age of 1 day to 8 weeks. Chicks were kept in floor pens, heated with electric heaters. Birds were individually weighed every week and records were kept of feed consumption and mortality rate. Feed and water were offered *ad libitum*.

Four chicks (2 males and 2 females) from each treatment group were slaughtered at the end of the experiment to evaluate the treatment effect on the dressing and boneless meat percentages.

Amino acids of rations and whole chick bodies (fasted chicks were killed, oven-dried and finely ground) were determined using paper chromatographic separation, then the cadmium ninhydrin spots were eluted using redistilled absolute methanol and the optical density measured in Unicum spectrophotometer at 500 mμ (10). Tryptophan was determined using procedure of Blauth *et al.* (2). Data were analyzed by procedures outlined by Steel and Torrie (16).

RESULTS AND DISCUSSION

Effect of feeding RSB and CSM with or without amino acids on growth of chicks

As indicated in Table 2, B.W. chicks fed CSM alone (Treatment C) or with amino acids (Treatment D) were superior in their growth ($P < 0.05$) than those fed rations containing RSB alone (Treatment A) or with amino acids (Treatment B). The amino acid supplementation to either the CSM or RSB rations resulted in slight improvement in body weight up to 8 weeks of age. However, Yen *et al.* (19) reported significant growth improvement due to the addition of 0.3% methionine to diets containing RSB. The relative low growth response obtained in the present study may be due to the low level of the methionine added.

The analysis of variance of body weight indicated highly significant difference ($P < 0.01$) among replicates and treatments (Table 3). Results of Duncan new multiple range test support the previous observation that treatments A and B are not significantly different from each other, and this is also true for treatments C and D. However,

Table 2 Effect of RSB and CSM with or without amino acids on the growth and performance of 8 weeks old B.W. chicks

Treatment	Body weight (g) (Mean ± S.E.)	Feed consumed (g)	Feed efficiency	Mortality %
A (RSB)	221.9 ± 6.0a[a]	193	6.28	16.1
B (RSB + A.A.)[b]	235.2 ± 6.6a	240	5.79	5.3
C (CSM)	292.5 ± 6.8b	234	4.46	0.0
D (CSM + A.A.)	305.3 ± 6.8b	216	4.52	3.5

[a] Means with the same letter are not significantly different at the 5% level of probability.
[b] Amino acids.

Table 3 Analysis of variance of body weight of 8 weeks old B.W. chicks

Source of variation	d.f.	S.S.	M.S.	F
Replicates	7	234657.9	33522.5	33.1[a]
Treatments	3	225735.7	75245.2	77.6[a]
Error	198	191953.6	969.4	
Total	208	652347.2		

[a] $P < 0.01$.

significant differences ($P < 0.05$) were observed between the average final body weight of chicks fed the CSM rations and those fed the RSB rations (Table 2). This indicates that the quality of CSM is higher than that of RSB, and that the addition of amino acids to either CSM or RSB was practically ineffective.

The slow growth of chicks in this experiment may be partly due to the high environmental temperature and its effect in depressing appetite (18), since this experiment started on 13/5/1971 and ended on 8/7/1971.

The regression equations of the treatments were calculated as follows:

$$\hat{Y}_A = -3.7 + 28.5\,X$$
$$\hat{Y}_B = -6.9 + 28.0\,X$$
$$\hat{Y}_C = -24.6 + 37.6\,X$$
$$\hat{Y}_D = -21.6 + 39.1\,X$$

where $\hat{Y}$ = expected average body weight in grams, and X = age of chicks in weeks. This shows that treatments A and B had smaller regression coefficients than those of treatments C and D which means inferior body growth of the former treatments.

Feed consumption, feed efficiency and mortality rate

Table 2 shows that chicks fed CSM rations consumed more feed than chicks fed RSB rations. It also shows that chicks fed CSM rations had better feed efficiency values than those fed the RSB rations. Amino acid supplementation resulted in a slight improvement in feed efficiency of chicks fed RSB.

The mortality rate in chicks fed RSB rations was higher than in chicks fed CSM rations. The addition of amino acids to RSB resulted in reducing the mortality rate.

Dressing and boneless meat percentages

Chicks fed CSM with or without amino acids addition had higher dressing and boneless meat percentages than those fed rations based on RSB (Table 4). Addition of amino acids to CSM improved the dressing and boneless meat percentages. Males had higher dressing and boneless meat percentages than females.

Amino acid composition of the experimental rations

From Table 5 it can be noted that calculated amino acid values differ to a variable extent from their corresponding analyzed values. The difference between the calculated

Table 4 Dressing and boneless meat percentages of 8 weeks old B.W. chicks

Treatment	Dressing %			Boneless meat %		
	Males	Females	Average	Males	Females	Average
A	55.1	51.1	53.1	38.3	33.8	35.0
B	53.5	50.6	52.1	35.3	32.2	33.8
C	59.8	55.4	57.6	42.6	34.8	38.7
D	61.8	58.4	60.1	42.3	40.1	41.2

Table 5 Analyzed (An) and calculated (Ca) amino acid composition of the experimental rations (on dry matter basis)

Amino acid	Rations							
	A		B		C		D	
	An %	Ca %	An %	Ca %	An %	Ca %	An %	Ca %
Cystine	0.32	0.26	0.36	0.40	0.23	0.27	0.29	0.40
Methionine	0.37	0.38	0.43	0.50	0.31	0.36	0.40	0.50
Lysine	0.88	1.06	0.96	1.06	0.94	0.87	0.98	0.90
Histidine	0.39	0.43	0.42	0.43	0.41	0.48	0.37	0.48
Arginine	0.85	1.17	0.95	1.20	0.67	1.59	0.76	1.59
Valine	0.86	1.12	0.90	1.12	0.86	0.96	0.73	0.96
Phenylalanine	1.10	1.04	0.99	1.04	1.00	0.90	0.92	0.90
Leucine + isoleucine	1.46	2.90	1.48	2.90	1.29	2.20	1.19	2.20
Tryptophan	0.21	0.23	0.22	0.23	0.16	0.26	0.21	0.26
Tyrosine	0.31	0.66	0.34	0.66	0.22	0.58	0.32	0.58
Glycine	0.74	1.07	0.86	1.07	1.08	1.00	1.19	1.00

Table 6 Crude protein and amino acid analysis (per 100 g dry matter) of whole body of 8 weeks old B.W. chicks

Item	Treatments			
	A	B	C	D
Cystine	0.52	0.74	0.75	0.81
Methionine	0.85	1.14	0.95	1.46
Lysine	1.63	1.69	2.35	3.70
Arginine	1.85	1.56	1.66	2.32
Histidine	0.91	0.98	0.69	1.23
Valine	1.87	2.14	2.02	3.08
Tyrosine	0.29	0.40	0.32	0.51
Phenylalanine	1.99	1.77	1.57	2.84
Leucine + isoleucine	2.25	2.55	2.81	2.98
Glycine	3.06	2.41	2.90	3.19
Tryptophan	0.39	0.36	0.38	0.40
Crude protein %	23.50	22.45	24.65	25.13

and analyzed amino acid values, as percentage from the analyzed, ranged between −0.5 and +164.5%. The calculated amino acid values were based on tables prepared by Lyman *et al.* (12).

Crude protein and amino acid determination of the whole chick body

Table 6 shows that the crude protein % of the whole body of 8 weeks old B.W. chicks was similar in the different treatments. It can also be seen that supplementation of methionine and cystine for chicks fed rations B and D resulted in a higher amino acid content of these 2 amino acids in the whole chick body. The increase in the S-containing amino acids is probably due to more feathering, since the feather protein contains a higher level of these amino acids (4). Also supplying lysine in ration D resulted in appreciable increase of lysine content. However, adding arginine in ration B was accompanied by a slight reduction in arginine content of the chick body. In this connection, Holmes *et al.* (8) reported that the composition of broiler carcass was constant and the only variation was caused by the increasing contribution of feather protein.

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دراسة تأثير اضافة بعض الأحماض الأمينية في علائق الكتاكيت النامية المحتوية على فول الصويا أو كسب القطن

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المستخلص

شملت هذه الدراسة ٢٢٤ كتكوتاً من نوع البلدي الأبيض من عمر يوم واحد إلى عمـــر ثمانية أسابيع. ويتضح من نتائج هذا البحث أن الكتاكيت التي كانت تغذى على عليقة تحتوى على كسب القطن فاقت في نموها الكتاكيت المغذاه على علائق تحتوي على فول الصويا . كما تبين أيضا أن اضافة بعض الأحماض الأمينية الناقصة إلى هذين النوعين من العلائق لم ينتج عنه أي تحسن ملموس في النمو وسرعته بينما كان لهذه الإضافة تأثير واضح في خفض نسبة الوفيات في المجموعات المغذاه على علائق تحتوى على فول الصويا .

كانت نسبة التصافي والتشافي في المجموعات المغذاه على كسب القطن أعلى من نظيراتها في المجموعات المغذاه على فول الصويا كما أظهرت النتائج ان اضافة الحامضين الأمينيين الميثيونين والسستين كان مصحوبا بزيادة فى كمية هذين الحامضين فى أجسام الكتاكيت المغذاه على علائق بها فول صويا أو كسب القطن .