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The Interrelationships between Methionine, Choline, and Sulfate in Turkey Diets[1,2] (41605)

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Abstract. Two experiments were conducted with turkey poults to determine the interrelationship of choline, sulfate, and methionine. The addition of choline significantly increased growth and the addition of sulfate resulted in numerically improved growth. However, when the two were added in combination a further improvement in growth was obtained, indicating that both nutrients must be in the feed for maximum utilization of the other. These data also indicate that a complete understanding of the interrelationships between methionine–choline and methionine–sulfate cannot be accomplished unless all three are studied simultaneously.

Methionine is essential for chick growth and can be converted to cysteine. The latter cannot compensate for a methionine deficiency, even when high levels of choline are supplemented to the basal diet (1). The interchangeable relationship (methyl donorship) of choline and methionine has been a subject of controversy for several years. Recently a report indicated that methionine and choline were interchangeable in a corn–soy chick diet (2). A growth response has been obtained by adding inorganic sulfate to synthetic (3) and practical corn–soy diet (4). It is well known that choline is required to prevent perosis and promote growth in turkeys and chickens (5, 6, 7). Therefore, it seemed desirable to study the interrelationship of methionine, choline, and inorganic sulfate in turkeys fed a practical corn–soy diet.

Materials and Methods. Two identical experiments were conducted using a total of 512 Nicholas Large White turkey poults. The poults were sexed at 1 day of age, wingbanded, and placed in electrically heated, thermostatically controlled, raised-wire floor Petersime batteries. Four male and four female poults were placed in each battery pen. Each experimental diet was assigned to four pens of poults in each experiment. A 2 × 2 × 2 factorial arrangement of treatments was used involving 0 or 0.1% K_2SO_4 added to the diet, 0 or 660 mg of choline/kg diet, and 0 and 0.25% DL-methionine. The composition of the basal diet is shown in Table I. A choline-sulfate-free vitamin–trace mineral premix was formulated for use in both experiments. The ex-

TABLE I. COMPOSITION OF BASAL DIET

Ingredient	Percentage
Yellow corn	48.76
Soybean meal (49% crude protein)	43.17
Dicalcium phosphate (21% Ca, 18.5% P)	2.09
Limestone	1.42
Salt	0.30
Animal fat	3.71
Microingredients (choline and SO_4 free)[1]	0.50
TM-50[2]	0.05

[1] Supplied per kilogram of diet: 6600 IU vitamin A; 2200 ICU vitamin D_3; 11 IU vitamin E; 2.2 mg menadione dimethylpyrimidinol bisulfite (MPB); 4.4 mg riboflavin; 13.2 mg pantothenic acid; 59.6 mg niacin; 22 μg vitamin B_{12}; 110 μg biotin; 125 mg ethoxyquin; $MnCO_3$ 126.1 mg; iron citrate, 300.1 mg; $CuCl_2 \cdot 2H_2O$, 15.97 mg; KI, 1.65 mg; ZnO, 41.85 mg.

[2] Registered trademark for terramycin (110 g/kg), Chas Pfizer, Lee's Summit, Mo. 64063.

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TABLE II. Body Weight and Feed Efficiency of Poults Fed Various Combinations of Sulfate, Choline, or Methionine

Dietary treatment				
SO_4[1]	Choline (mg/kg)	Methionine (%)	Body wt[2] (g)	Feed efficiency (g feed/g gain)
0	0	0	296.3[a]	1.57[a]
0	660	0	335.1[b]	1.62[a]
+	0	0	314.8[a,b]	1.60[a]
+	660	0	379.7[c]	1.61[a]
0	0	0.25	446.9[d]	1.45[b]
0	660	0.25	450.7[d]	1.42[b]
+	0	0.25	452.5[d]	1.40[b]
+	660	0.25	449.9[d]	1.44[b]

[1](+) indicates 0.1% supplemental K_2SO_4.
[2] Means with different superscripts in the same column are significantly different according to Duncan's multiple range test ($P \leqslant 0.05$).

perimental diets and deionized water were supplied *ad libitum* during the 3-week experimental period in both experiments. Feed consumption and body weight data were obtained at the end of the experimental period. The data were subjected to the analysis of variance (8). The experiment × treatment interactions were nonsignificant and the experiments were combined. Significant differences between treatment means were determined by Duncan's multiple range test (9).

Results and Discussion. The addition of choline to the basal diet resulted in a significant 38.8 g increase in growth (Table II). Thus, as has previously been reported (5), when the diet is deficient in methionine the poults responded to supplemental choline. The addition of K_2SO_4 resulted in a numerical increase in growth rate of 18.5 g. This resulted in a cumulative total for choline and sulfate of 57.3 g. However, when K_2SO_4 and choline were supplemented together, growth rate (83.4 g) was significantly improved over that attained when either was supplemented alone. These results indicate that the maximum benefit obtained from either supplement is dependent on the simultaneous presence of each in the diet.

The addition of 0.25% methionine resulted in significantly improved growth (Table II) as compared with that obtained by adding supplemental choline and sulfate. The addition of either sulfate or choline individually or in combination did not improve growth when adequate methionine was present in the diet.

These data indicate that the turkey poult can utilize choline and sulfate to spare a portion of the metabolic function of the sulfur amino acids. The maximum benefit from these nutrients depends upon the presence of the other in the diet. However, when adequate methionine is present in the diet, the turkey poult does not respond to the addition of either choline or sulfate alone or in combination.

The addition of sulfate or choline alone or in combination did not affect feed efficiency in the presence or absence of methionine (Table II). The addition of methionine resulted in a significantly improved feed efficiency.

These data indicate that inorganic sulfate in a practical diet, can spare a portion of the sulfur amino acid requirement of the poult as previously reported (3, 4). However, in order for choline to spare a maximum amount of the methionine, it is necessary that the diet contain an adequate level of sulfate. Further studies are needed to identify the mechanisms involved in the choline and sulfate interaction to spare a portion of the sulfur amino acid need.

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