

phrine, for example, results in depression of ganglionic transmission(7).

One may only speculate that the selective sympathetic inhibition produced by large intravenous doses of iproniazid and harmine in the dog and cat is the mechanism responsible for postural hypotension in man after administration of MAO inhibitors. It is interesting, however, that the predominant autonomic effect of these agents in man appears to be sympathetic depression without parasympathetic block(8).

Summary. Large doses of iproniazid and harmine administered intravenously to the anesthetised cat and dog inhibit transmission

through sympathetic ganglia without depressing the function of parasympathetic ganglia.

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Selenium and Torula Yeast in Production of Exudative Diathesis in Chicks.* (26062)

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Factor 3 and selenium have been shown to prevent exudative diathesis in chicks fed a Vit. E free Torula yeast diet(1,2). This, however, does not indicate that selenium is essential in nutrition of chicks when adequate Vit. E is present in the diet. Schwarz *et al.* (3) have suggested that Vit. E and selenium might participate in alternate pathways in metabolism in spite of marked structural differences. Participation of selenium in certain metabolic reactions has been reported by various workers(4,5,6). This element has also been reported to promote

growth in chicks and rats(1,4,5). Dried brewers yeast, which is free of Vit. E but is a potent source of Factor 3(7), will replace Vit. E in preventing exudative diathesis in chicks (8). A growth response attributed to Vit. E was observed in chicks fed a high fat diet(9) but recent work shows that Vit. E was not needed by chicks fed a diet low in fat(10,11). Bieri *et al.*(12) reported that addition of Torula yeast to an otherwise purified chick diet resulted in production of exudative diathesis in 16-18 days, and provided evidence for existence of factors of a fatty and mineral nature in Torula yeast which stimulated production of exudative diathesis in chicks fed a Vit. E free diet. The experiments reported here were designed to study the effects of selenium, Vit. E and dried brewers yeast on growth of chicks fed a purified diet containing soybean protein, in an attempt to provide additional information on the role of such ingredients in nutrition of chicks. Investigations were also made of the relation between Torula yeast and production of exudative diathesis in the chick.

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TABLE I. Composition of the Basal Diet.

	%		%
Glucose monohydrate	53.84	Wood pulp	3
Drackett C-1 assay protein	32	Vitamins*	1.32
Soybean oil	3	Minerals†	6.84

* The vitamin premix supplied the following/kg of diet: Thiamine hydrochloride, 10 mg; riboflavin, 10 mg; D-calcium pantothenate, 20 mg; pyridoxine hydrochloride, 6 mg; para-aminobenzoic acid, 20 mg; inositol, 500 mg; biotin, 0.2 mg; vit. A, 10,000 I.U.; vit. D₃, 400 I.C.U.; niacin, 75 mg; folic acid, 4 mg; BHT, 500 mg; methionine, 7,500 mg; glycine, 3,500 mg; choline chloride, 1,500 mg; menadione sodium bisulfite, 0.5 mg; vit. B₁₂, 0.02 mg.

† The mineral supplement provided the following /kg of diet: CaCO₃, 10 g; CaHPO₄ · 2H₂O, 38.89 g; NaCl, 6 g; MnSO₄ · H₂O, 0.37 g; MgSO₄ · 7H₂O, 5.27 g; FeSO₄ · 7H₂O, 0.1478 g; CuSO₄, 0.011 g; CoCl₂ · 6H₂O, 0.0016 g; KCl, 7.63 g; Na₂MoO₄ · 2H₂O, 0.00076 g; KI, 0.007 g.

The above diet contains: 25.92% protein, 2.38 calories productive energy/g.

Methods. In the first study day-old New Hampshire chicks were distributed at random in groups of 20 in electrically heated battery brooders with raised wire floors. The birds were fed a purified soybean protein diet (Table I) supplemented with selenium, Vit. E or dried brewers yeast (Table II). In the second study day-old White Plymouth Rock chicks, 20 birds per group, were fed the purified diet shown in Table I, with soybean oil being replaced by Vit. E-free molecularly distilled lard.† Dietary supplements tested in this experiment included selenium (as sodium selenate), Vit. E, dried brewers yeast, *Torula* yeast, salts of sodium, potassium, magnesium and arsenic, and various combinations of these supplements. Feed and water were supplied *ad libitum* and body weights were taken at weekly intervals throughout the studies. Daily observations were made for appearance of symptoms of exudative diathesis. When sufficient birds in the basal group showed symptoms of exudative diathesis, 5 representative birds were removed from each group for biochemical studies. Blood was collected from the chicks by heart puncture and allowed to clot for one hour at room temperature, and was subsequently centrifuged at 3000 rpm for 5 minutes to obtain the serum.

† Obtained from Distillation Products Industries, Rochester, N. Y.

Total serum protein was determined by the method of Kingsley(13) and albumin/globulin ratio (A/G ratio) in the serum was determined using the paper electrophoresis technique.‡ Hemoglobin concentration in blood obtained by wing vein puncture was determined by the alkali hematin method.

Results. Addition of selenium, Vit. E or dried brewers yeast to the basal diet resulted in a marked growth improvement. Dietary supplements of 40 mg of *d*- α -tocopheryl acetate per kg of diet, 0.1 ppm selenium, and 10% dried brewers yeast resulted in growth responses of 9.6 to 11.0% over the birds fed the basal diet. Addition of 0.05 ppm selenium to basal diet resulted in a growth response of about 14% compared to the unsupplemented group. Total serum protein level of the chick, however, did not show any differences attributable to the supplements, indicating that either the selenium or Vit. E in the basal diet was adequate to maintain normal protein level in the serum (Table II). Similarly, no symptoms of exudative diathesis were observed during this experiment (Table II).

The basal diet (Table I) contained soybean oil, which supplied an estimated 4 mg of α -tocopherol per kg of diet. When soybean oil was replaced with Vit. E free lard, the basal diet had no appreciable Vit. E content but might have contained selenium. The birds

TABLE II. Effect of Selenium on Growth of Chicks Fed a Purified Soybean Protein Diet (20 Chicks/Treatment).

Supplement to basal diet	Wt in g, 21 days	Incidence of exudative diathesis, %	Total serum protein, g %, 25th day
None	365 (10.3)§	0	4.3
Vit. E*	406 (11.1)	0	4.1
D.B.Y.†	401 (10.3)	0	4.4
Selenium‡			
.1 ppm	400 (11.8)	0	4.4
.05 "	415 (11.2)	0	4.2

* 40 mg *d*- α -tocopheryl acetate/kg of diet.

† Dried brewers yeast, 10% of diet.

‡ As sodium selenate.

§ Values in parentheses are stand. errors of group means.

‡ Spineo Model R paper electrophoresis apparatus and Spineo Model RB Analytrol, Spineo Division, Beckman Instruments, Belmont, Calif.

TABLE III. Effects of Different Supplements on Growth and Incidence of Exudative Diathesis in Chicks Fed a Purified Soybean Protein Diet for 35 Days (20 Chicks/Treatment).

Supplement to basal diet	Avg wt, g	Incidence exudative diathesis, %	Day of appearance of symptom	Total protein, g/100 ml	A/G ratio	Hemoglobin, g/100 ml
None	503 (12.9)§	5	30	5.84	.60	7.04
Vit. E*	564 (14.3)	0		6.90	.93	8.90
D.B.Y.†	566 (14.1)	0				
Selenium‡	575 (15.0)	0				
Vit. E + D.B.Y.	565 (13.7)	0				
D.B.Y. + selenium	568 (13.5)	0				
Selenium + vit. E	572 (14.0)	0				
Vit. E, D.B.Y. + selenium	571 (13.8)	0				
1% K (KCl) + .07% Mg (MgSO ₄ · 7H ₂ O)		5	30			
.7% sodium (Na ₂ SO ₄ · 7H ₂ O)		6	29			
.5% ppm of arsenic		4	31			
20% Torula yeast		20	18			
30% <i>idem</i>		19	17			

* 40 mg *d*- α -tocopheryl acetate/kg of diet.

† Dried brewers yeast, 10% of diet.

‡ .05 ppm of diet as sodium selenate.

§ Values in parentheses are stand. errors of group means.

fed this diet developed symptoms of exudative diathesis beginning on 30th day of study and by the 35th day, 25% of the birds showed symptoms of the condition (Table III). Affected birds had a mild edema and greenish exudates with subcutaneous hemorrhage in the abdomen, but were otherwise normal. Each of the supplements, selenium, Vit. E and dried brewers yeast, prevented the symptoms of exudative diathesis. It seems evident that any selenium present in the soybean protein was unavailable or available only in traces. It should be noted that Torula yeast contains 1.6 ppm of selenium which is unavailable (14). Total serum proteins and A/G ratios, and hemoglobin contents of the blood of the affected birds were reduced by 16%, 35% and 21% respectively when compared to those of the birds receiving Vit. E (Table III). Reduction in total protein and A/G ratio of the serum was not as marked as has previously been noted in affected birds fed a Torula yeast diet(8). This may be related to the mild symptoms of exudative diathesis observed in chicks fed the soybean protein basal diet. The supplements, singly or in combination, exerted similar growth-promoting effects at the end of the fifth week (Table III) and each of the supplements prevented

exudative diathesis, thus indicating that dried brewers yeast or selenium can replace Vit. E for chicks. Furthermore selenium could account for the beneficial effect of dried brewers yeast on growth of chicks and in prevention of exudative diathesis, since dried brewers yeast has been reported to be a potent source of selenium but to contain no Vit. E(7).

It has been reported that the time needed to produce exudative diathesis in chicks fed a purified soybean protein diet was 30 days, compared to only 17 days when a Torula yeast diet was fed to the chicks(8). The appearance of the deficiency condition was also much less severe in the former case. In the present experiment the use of a diet which contained 20% Torula yeast, purified soybean protein and Vit. E-free stripped lard decreased time of appearance of exudative diathesis from 30 days to only 18 days, while with a similar diet containing 30% Torula yeast the time was reduced to only 17 days (Table III).

Since Torula yeast is rich in potassium and magnesium(15) these minerals were added in combination at levels of 1% and 0.07% respectively to the soybean protein purified diet. Arsenic has been reported to counteract selenium toxicity in chicks(16) and an

excess of sodium will cause potassium excretion and may thus cause an imbalance of the osmotic mechanism. Since exudative diathesis has been shown to be accentuated by additional salts in the diet (17) 2 groups were fed the soybean-protein diet supplemented with 0.7% sodium (from Na_2SO_4) or 0.5 ppm of arsenic (from sodium arsenate). The symptoms of exudative diathesis, however, were neither hastened nor accentuated by these supplements (Table III).

Summary. Vit. E, dried brewers yeast, and 0.05 ppm selenium promoted growth and prevented symptoms of exudative diathesis in chicks fed a purified soybean protein diet. Any of the supplements completely replaced the others and maintained normal values for serum protein, A/G ratio and blood hemoglobin. Chicks fed Vit. E-free diet, containing purified soybean protein as source of protein, developed symptoms of exudative diathesis in 30 days, manifested by mild edema and exudation with subcutaneous hemorrhage in the abdomen. The affected birds had a reduced serum protein level, A/G ratio, and blood hemoglobin level. Addition of 0.7% sodium, 0.5 ppm arsenic or a mixture of 1% potassium and 0.07% magnesium, to above Vit. E-free, soybean-protein diet failed to reduce the time needed for development of exudative diathesis. Addition of *Torula* yeast (20 or 30% of the diet) to Vit. E-free soybean protein diet hastened and increased incidence of exudative diathesis in chicks fed this diet. Thus it appears that some com-

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Comparison of Various Sources and Levels of Vitamin K Activity Using Chicks with Cecal Coccidiosis.*† (26063)

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Harms and Tugwell(1) reported that mortality of chicks was significantly increased by addition of dicumarol to the diet of chicks

suffering from cecal coccidiosis. This indicated that "normal" blood clotting time was

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