

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-

ponent in *Torula* yeast affects onset of exudative diathesis.

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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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tories, North Chicago, for menadione sodium bisulfite and menadione; Merek Sharp & Dohme, Rahway, N. J., for vit. K_1 ; and Chas. Pfizer & Co., Terre Haute, Ind., for vit. A and B-vitamins.

TABLE I. Composition of Basal Diet.

	%		%
Ground yellow corn	65.4	Ground limestone	.7
Soybean oil meal (50% protein)	31.0	Iodized salt	.4
Defluorinated phosphate (34% Ca & 17% P)	1.8	Micro-ingredients*	.7

* Supplies/lb of feed: 2268 I.U. vit. A, 10 μ g vit. B₁₂, 340 I.C.U. vit. D₃, 2 mg riboflavin, 9 mg calcium pantothenate, 18 mg niacin, 261 mg choline chloride, 10 mg terramycin, 2 mg oleandomycin, 57 mg santonin, 9 mg iron, 0.9 mg copper, 90 μ g cobalt, 5 mg iodine, 45 μ g zinc, 80 mg manganese sulphate, and 35 mg manganous oxide.

necessary to prevent excessive mortality due to internal bleeding during an outbreak of coccidiosis. Later reports(2,3) indicated that addition of menadione sodium bisulfite complex† to a Vit. K-low diet would significantly reduce mortality of chicks suffering from cecal coccidiosis. The purpose of this work was to determine the effect of feeding graded levels of MSBC to chicks when they were submitted to the stress of acute cecal coccidiosis, and to compare the relative value of various sources of Vit. K activity by their protection against mortality from coccidiosis.

Methods. Four experiments have been conducted with day-old Vantress X White Plymouth Rock chicks. In the first 2 experiments, diets were fed which contained graded levels of MSBC (0.0 to 4.56 g/ton of feed). In the third and fourth experiment diets containing various levels of MSBC, menadione and Vit. K₁ were fed. The composition of the Vit. K-low basal diet is shown in Table I. Six replications of 7 males and 7 females, and 5 replications of 6 males and 6 females were used in Exp. 1 and 2, respectively. Six replications of 5 males and 5 females per treatment were used in Exp. 3 and 4.

All chicks were reared in electrically heated batteries equipped with thermostatic temperature controls and raised wire floors. Experimental diets were fed *ad libitum*, from one day of age through the entire experimental period. Water was also kept before birds at all times. The water was changed every other

day and the containers were cleaned and disinfected with a chlorine solution to minimize bacterial synthesis of Vit. K.

Birds were inoculated at 21 days of age with sporulated oocysts of *Eimeria tenella*, with each bird receiving 50,000 oocysts in Exp. 1, and 40,000 in Exp. 2, 3 and 4. One replicated group was not inoculated in Exp. 1 and 2, which served as a control to establish normal gain for the experimental period.

Individual body weight of chicks in Exp. 1 and 2 was obtained at 3 and 6 days post inoculation. Rate of gain during this 4-day period was used as a criterion of morbidity.

Results. Fig. 1 shows that as the level of dietary MSBC was increased from 0 to 1.14 g/ton of feed, mortality of chicks suffering from cecal coccidiosis was reduced linearly to approximately 40 to 50%.

Internal bleeding has been shown to be the primary cause of death from coccidiosis(1). Almquist(4) reported that dosage of Vit. K and prothrombin time has a linear relationship. The present data suggest that MSBC is effective by decreasing the internal bleeding caused by the disease.

Morbidity of chicks was reduced as level of MSBC was increased (Fig. 2). Growth rate of all inoculated birds was severely depressed

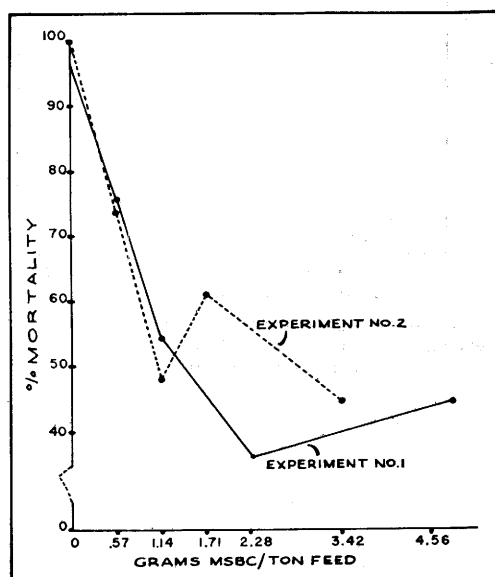


FIG. 1. Mortality of chicks receiving various levels of MSBC when suffering from cecal coccidiosis.

† Menadione sodium bisulfite complex is defined to contain not less than 63% menadione sodium bisulfite U.S.P., hereafter referred to as MSBC.

as normal birds gained 65 and 50 g in Exp. 1 and 2, respectively. The relationship between morbidity and dietary level of MSBC also appears to be linear; however, differences were not as great as was reflected by mortality rates, indicating that mortality would be a better measurement of Vit. K activity from different sources.

Results from 2 experiments (Table II) based on mortality from coccidiosis indicate that MSBC on a weight basis is 6 to 7 times as effective as menadione. It also appears that Vit. K₁ may be 4 times as effective as MSBC. Comparative value of these sources of Vit. K are not in complete agreement with earlier reports(5,6,7). However, it should be

TABLE II. Mortality of Chicks from Coccidiosis When Fed Various Levels and Sources of Vitamin K.

Vit. K source	g/ton	% mortality*
	0	98.1 ^a
MSBC	.36	83.3 ^{ab}
Menadione	2.07	77.3 ^{bc}
"	4.14	68.1 ^{cd}
"	6.21	64.6 ^{cde}
MSBC	.72	60.6 ^{def}
K ₁	.68	57.8 ^{def}
MSBC	1.08	54.8 ^{def}
K ₁	.23	52.5 ^{ef}
K ₁	.46	46.3 ^f

* Means having different exponential letters are significantly different according to Duncan's Multiple Range Test (1955).

pointed out that these workers were using sulfaquinoxaline, a Vit. K antagonist, which may not have indicated the chicks' true ability to utilize the source of Vit. K.

Summary. Data have been presented which indicate that increased dietary levels of MSBC result in a decreased mortality and morbidity of chicks suffering from cecal coccidiosis. Based on mortality from coccidiosis on a weight basis, MSBC is 6 to 7 times as effective as menadione. Vit. K₁ appears to be 4 times as effective as MSBC.

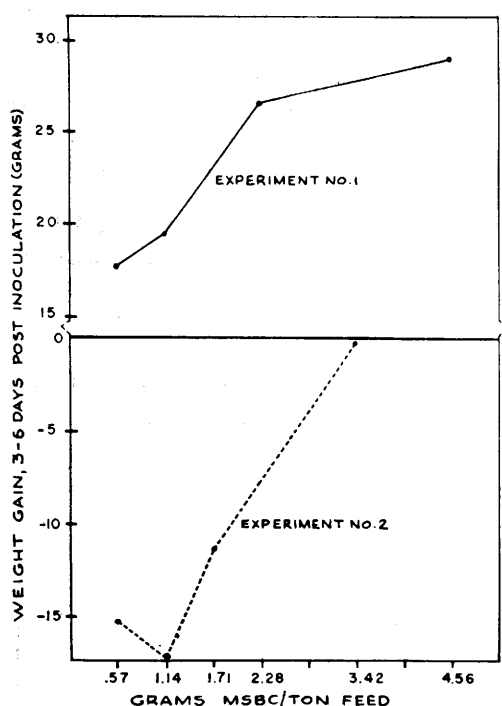


FIG. 2. Weight gain of chicks, 3-6 days post inoc., receiving various levels of MSBC when suffering from cecal coccidiosis.

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