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Dried Skim Milk and Other Supplements in the Ration During Caecal Coccidiosis of Chicks.

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The unfavorable influence of dried buttermilk in the ration upon the course of experimental caecal coccidiosis of White Leghorn chicks has been adequately demonstrated by Becker and Waters[1] and Becker and Wilcke.[2] The first-named also made one test ("Experiment 4") comparing the effects of rations made up to 1% with dried skim milk, 6% with dried skim milk, and 6% with dried buttermilk, with results suggestive of an effect from skim milk like that from buttermilk, but not adequate for definite conclusions. Included in this report are further experiments with dry skim milk and buttermilk, and one designed to test the effect of substituting soy bean protein for part of the protein in meat scraps.

All chicks employed in these experiments were purchased from a commercial hatcheryman who conscientiously tests his laying flocks for pullorum disease and markets only vigorous day-old chicks. They were kept in metal brooders with mesh bottoms from the time they were purchased to the completion of the experiment. Immunizing or protective effect of previous infection was ruled out by occasional microscopic examination of caecal eliminations and constant watching of the droppings for traces of blood. Rations to be tested were fed for a period preliminary to the experimental infection, and the latter was accomplished by inoculating a determined-upon number of sporulated oöcysts of *Eimeria tenella* directly into the crop through a rubber catheter attached to a Luer syringe. Every chick that succumbed was examined postmortem to confirm death from caecal coccidiosis.

Experiment 1. The effects of 3 rations were compared: A, with 6 parts (dry weight) dry buttermilk; B, with 6 parts dry skim milk; C, without dried milk, but with 6 parts soy bean oil meal (expeller process) instead. These protein supplements were mixed as needed with the following stock ration whose parts add up to 94: ground yellow corn, 35; ground whole oats, 10; wheat bran, 5; wheat middlings (gray shorts), 30; alfalfa meal, 13% protein, 2; fish meal (sardine), 6; steamed bone meal, 1; fine oyster shell, 2; salt, 1; char-

1 Becker, Elery R., and Waters, Philip C., *Ia. St. Col. J. Sci.*, 1938, **12**, 405.
2 Becker, E. R., and Wilcke, H. L., *Poul. Sci.*, 1938, **17**, 405.

coal, 1; cod liver oil, 1. The estimated total protein of rations A, B, and C, was 16.4%, 16.4%, and 16.8%, respectively.

The White Leghorn chicks were started on the rations at the age of 5 days after a preliminary period of 4 days on a commercial ration. At the end of a 17-day feeding period, or at the age of 22 days, they were inoculated with 50,000 oöcysts per bird. The average weight gains for the feeding period to the fourth day of the infection, by which time there are ordinarily few symptoms of the disease, were as follows: A, 167 g; B, 140 g; C, 145 g. Fatalities for the 3 rations, which occurred on the fifth and sixth days of the infection, were as follows: A, 11 out of 29 chicks; B, 10 out of 28 chicks; C, 3 out of 28 chicks. The birds were kept for 10 days after the last fatality (on the sixth day) without further losses. The weight gains for the survivors over a 30-day period, which included the period of illness, were as follows: A, 257 g; B, 236 g; C, 234 g.

It is evident that the losses for both dried milks were appreciably greater than those for the soy bean oil meal, or lack of dry milk.

Experiment 2. A ration (D) with 6 parts dry skim milk was compared with 3 rations (E, F, G) with drastically reduced milk content. Since 3 cases of partial paralysis had appeared among chicks on ration C, 1 part of dry skim milk was used to forestall its recurrence. The supplements were as follows: (E) skim milk 1, casein (fine, commercial) 2, ground yellow corn 3; (F) skim milk 1, soy bean oil meal (expeller process) 4, casein 1; (G) skim milk 1, fish meal 3, ground yellow corn 2. Each ration was made by mixing 6 parts of appropriate supplement with 94 parts of the following stock ration: yellow corn meal, 41.5; ground whole oats, 10; wheat middlings (gray shorts), 25; bran, 5; alfalfa meal (13% protein), 2; soy bean oil meal, 1; meat scraps, 2; sardine meal, low temperature, 2; steamed bone meal, 0.75; fine limestone, 2; fine charcoal, 1; salt, 0.75; cod liver oil, 1. The estimated protein content of rations D, E, F, and G was 15.0, 15.3, 15.8, and 15.5, respectively.

Four-day-old White Leghorns were started on the 4 rations, and inoculated with doses of 185,000 oöcysts at the age of 27 days. Mean weight gains for the 4 lots to the fourth day of infection were as follows: D, 195.6 g; E, 203.7 g; F, 213.8 g; G, 185.7 g. Mortality records: D, 16 out of 29 chicks; E, 9 out of 27; F, 10 out of 29; G, 6 out of 18. If the chi-square method is used to compare mortality data for recipients of 6 parts skim milk (D) with total recipients of 1 part skim milk (E, F, G), a significant difference is indicated.

Weight gains from the fourth to the twelfth day of the infection,

which included the fifth and sixth days on which fatalities occurred, were (D) 60 g, (E) 66 g, (F) 67 g, and (G) 62 g. These records are averages based on individual weighings of survivors. They indicate no essential difference in the rate of recovery.

Experiment 3. The writers' experiments have shown a more favorable prognosis in caecal coccidiosis when soy bean oil meal is substituted for a considerable part of the customary dry milk concentrate in the ration. This experiment and the next were planned to test the effect of substituting soy bean oil meal for part of the dried meat element in meat scraps, and a special low-temperature fish meal for the dry milks.

There were 4 lots of White Leghorn chicks: L1 and L2 on a ration (I) consisting of meat scraps, 8 pt, steamed bone meal, 1 pt, soy bean oil meal, 5 pt, dried skim milk, 5 pt, and other ingredients in somewhat the same proportions as in Experiment 2; L3 and L4 on a ration (J) with about the same composition, except that meat scraps were reduced to 2 parts, soy bean oil meal was raised to 11 parts, and steamed bone meal to 3 parts. The total protein content of I was 17.5%; of J, 16.7%. The chicks were put on the special rations at the age of 7 days, and infected at the age of 21 days. L1 and L3 received 100,000 oöcysts per chick; L2 and L4, 200,000 oöcysts per chick.

The mortality for the 4 lots was as follows: L1, 12 out of 31 chicks; L2, 14 out of 32; L3, 14 out of 33; L4, 13 out of 30. Thus, there was no significant difference between the losses in the 4 lots. Weight gains were recorded, but they too differ little.

Experiment 4. The stock ration used for these tests was, in general, like that in Experiment 2, except that middlings was reduced to 8 parts and ground oats raised to 21 parts. Ration K contained 6.5 pt dried buttermilk; L, 6.5 pt dried skim milk; M, 6 pt special low-temperature sardine meal from the Pacific Coast. The chicks were put on the rations at the age of 6 days, and infected with doses of 50,000 oöcysts at the age of 3 weeks. The losses on the 3 rations were as follows: K, 10 out of 29 chicks; L, 12 out of 30; M, 11 out of 30. Thus, the 3 lots suffered about the same and the rations were without differential effect. Likewise, weight gains were not appreciably different.

Summary. Further evidence is supplied for the unfavorable effect of dry buttermilk in the ordinary type of growing ration when White Leghorn chicks become infected with sizable doses of *Eimeria tenella*. It is now shown that dry skim milk has an effect similar to that of dry buttermilk. It made little difference when soy bean oil

meal (expeller process) was substituted for a considerable part of the meat element in meat scraps, or when a fine grade of low-temperature sardine meal was substituted for dry milks.

Further, it was brought out in chicks on 2 different rations that there was no difference in mortality from infective inoculations of 100,000 and 200,000 oöcysts (Experiment 3).

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Tests for the Eye-Color Hormones of Drosophila in Other Insects.

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Diffusible substances hormone-like in nature are concerned in the eye-color development of Drosophila[1] and certain other insects (Ephestia,[2] Bombyx,[3] and Habrobracon[4]). It has been shown that the substances in Ephestia, Habrobracon and Drosophila are not species-specific.[4] Many of the chemical properties of these substances have been determined.[5, 6] In Drosophila they are active when injected (extract form) into,[7] or fed to,[8] appropriate test larvae. The v^+ substance brings about a modification of the eye color of vermilion brown *(v bw)* test larvae from a pale pink towards brown, and the cn^+ substance induces a similar modification of cinnabar brown *(cn bw)* eye color from colorless towards brown.

A question of interest in regard to the nature of these hormone-like substances is: Are they normal constituents of tissue; are they restricted to certain insect groups, or is their occurrence general throughout the class Insecta? It is the purpose of this paper to pre-

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1 For review of literature see Ephrussi, B., *Am. Naturalist*, 1938, **72**, 5.

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