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Fatty Liver-Hemorrhagic Syndrome as Affected by Fat,  
Choline and Biotin Supplementation

R. A. Nelson, C. C. Chah and C. W. Carlson<sup>1</sup>

Fatty liver syndrome, now more commonly known as fatty liver-hemorrhagic syndrome (FLHA), has become an increasing problem in recent years, especially in cage-type laying operations. It seems to occur in flocks that are apparently healthy and in good laying condition. Symptoms characteristic of the disease are about a 25% increase in body weight along with a 30% or more decrease in production, an increase in mortality and excessive abdominal and liver fat that leads to hematomas of the liver.

No causes or cures for FLHS are definitely known, but many researchers feel that over consumption of energy and/or the lack of a vitamin involved in fat metabolism are possible causes of the disease.

A preliminary experiment using three replicates of three hens per treatment was conducted to evaluate the supplementation of corn oil, yellow grease, choline and biotin to a 14% protein layer diet. The treatments and results are shown in Table 1.

No definite trends in production and feed efficiency were apparent. The addition of fat to the diet did increase average egg weight and final body weight over that of the control birds, but no definite trends were established with vitamin supplementation.

Some apparent liver differences did occur between treatments. A visual rating score was made at the time the liver was sampled (see Table 2). The control birds showed more fat accumulation than the treatment groups. This was later verified by ether extract analysis. Yellow grease, although fed at equal caloric (M.E.) amounts, caused higher fat accumulation than the corn oil diets. No differences due to choline or biotin were apparent in the liver analysis.

FLHS has been hard to produce in a laboratory situation; it is surprising to note the high percentage of birds that had fat infiltrated in the liver to the extent of causing hemorrhaging. Since individual variation within treatments was quite high, no definite trends were evident. Contrary to expectations, the increase in energy consumption on the fat diets did not cause higher levels of FLHS.

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Table 1. Performance of Laying Hens as Influenced by Corn Oil, Yellow Grease, Choline and Biotin

Treatment	Hen-day production <sup>1</sup> %	Feed/doz. eggs kg	Feed consumed per day gm	Avg. egg wt. gm	Final body wt. kg
Control <sup>2</sup>	82	1.45	100	58.0	1.68
Corn oil <sup>3</sup>	84	1.42	102	62.4	1.77
Corn oil + choline <sup>4</sup>	81	1.48	103	62.9	1.86
Corn oil + biotin <sup>5</sup>	77	1.45	96	58.8	1.72
Corn oil + choline + biotin	82	1.51	106	61.5	1.92
Yellow grease <sup>3</sup>	85	1.41	103	59.7	1.78
Yellow grease + choline	79	1.65	110	60.2	1.99
Yellow grease + biotin	83	1.67	118	59.9	2.03
Yellow grease + choline + biotin	75	1.76	108	59.5	2.06

<sup>1</sup> Average for five 28-day production periods.

<sup>2</sup> 14% protein corn-soybean diet + 0.1% MHA.

<sup>3</sup> 8.5% corn oil or 10% yellow grease replacing corn.

<sup>4</sup> 1500 mg choline/kg.

<sup>5</sup> 1.1 mg biotin/kg.

Table 2. Liver Analysis as Affected by Fat, Choline and Biotin Supplementation

Treatment	Visual score <sup>1</sup>	As received % fat <sup>2</sup>	Moisture free % fat <sup>2</sup>	Livers containing hemorrhages %
Control	4.25	30.6	65.0	87.5
Corn oil <sup>3</sup>	3.25	15.2	41.5	37.5
Corn oil + choline <sup>4</sup>	3.56	14.1	40.0	66.7
Corn oil + biotin <sup>5</sup>	3.38	15.6	43.1	62.5
Corn oil + choline + biotin	3.14	17.1	43.4	57.1
Yellow grease <sup>6</sup>	3.25	17.5	46.8	25.0
Yellow grease + choline	3.78	21.7	52.8	66.7
Yellow grease + biotin	4.11	28.2	62.3	88.9
Yellow grease + choline + biotin	4.22	24.0	56.3	88.9

<sup>1</sup>Visual score of liver at time of sampling

1 = little fat accumulation

2 = moderate fat accumulation

3 = highly saturated with fat

4 = highly saturated with 1-10 hemorrhages

5 = highly saturated with many hemorrhages

<sup>2</sup>Analyzed by ether extract.

<sup>3</sup>Corn oil replaced corn at 8.6% of the diet.

<sup>4</sup>Choline chloride added at 1500 mg per kg of diet.

<sup>5</sup>Biotin added at 1.1 mg per kg of diet.

<sup>6</sup>Yellow grease replaced corn at 10% of the diet.