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## Introduction

Results presented in previous Poultry Field Day reports (A.S. Series 73-18, 74-19) have shown 5 to 10 ppm mercury as methylmercury to lower production and reproductive efficiency of hens. Reports from other stations have indicated the existence of a mercury-selenium interrelationship whereby the toxicity of one is reduced by the presence of elevated dietary levels of the other. The studies reported herein were for the purpose of determining the extent that this interrelationship may serve to reduce the detrimental effects of methylmercury or selenium in layers.

## Methods

Babcock-300 pullets approximately 24 weeks of age were allotted to nine treatments as shown in table 1. Methylmercuric chloride and sodium selenite were used as sources of mercury and selenium. Each of the mercury-selenium combinations were fed to four cages of four hens each. In each treatment, two of the cages were fed a standard 16% protein layer mash, while the two other cages were fed a semi-purified diet based principally upon glucose, isolated soy protein, vitamins and minerals. Data from the two types of diets are pooled for purposes of calculating treatment averages for this report.

Egg production was measured daily and egg quality measurements were made monthly on a one-day collection of eggs. After 10 weeks on treatment, the hens were inseminated artificially and a maximum of 30 eggs per cage (120 eggs for each of the nine treatments) were incubated. The chicks, upon hatching, were placed in batteries and fed a 20% protein starter diet. Growth and survival of the chicks were measured over a 4-week period.

## Results

Average body weight of the hens was lowered in most instances by the selenium treatments and to a lesser extent by mercury. However, mortality occurring during the course of the study did not differ significantly among treatments. Percent hen-day egg production appeared to be reduced by mercury or selenium with mercury

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exerting the greatest effect. Average hen-day production was 61.7% for the controls and only 36.8% for those fed 10 ppm mercury with no added selenium. Either 4 or 8 ppm of selenium partially prevented the detrimental effect of 10 ppm mercury.

Average egg weights were lower for hens fed mercury or selenium. However, higher Haugh units were often associated with the smaller egg size. Average egg shell thickness was not affected by treatment. These data concerning egg quality differ from those obtained in our previous study in which eggs having thinner shells and lower Haugh units were obtained from hens that had been fed mercury from the time of hatching.

Percent hatchability was lowered by either mercury or selenium alone. Hatchability associated with 10 ppm mercury was only 26% compared with 87% in the controls. Either 4 or 8 ppm dietary selenium fed with the 10 ppm mercury allowed a 56 to 61% hatching rate which was considerably greater than that for mercury alone and was slightly greater than the 50 and 56% observed for 4 and 8 ppm selenium alone. This effect on hatchability is probably the most pronounced of the beneficial interactions observed between mercury and selenium where either one appeared to reduce the toxic effects of the other.

An important interrelationship was also observed concerning the mercury and selenium contents of the various hen tissues at termination of the experiment after 10 months on treatment (table 2). Selenium fed in conjunction with mercury greatly increased the mercury content of some tissues, most notably liver and brain. Corresponding increases in tissue selenium levels associated with mercury treatments occurred in all tissues examined except feathers. It is concluded that, even though tissue levels of these elements, i.e., mercury and selenium, are increased to a greater extent when fed in combination rather than alone, the higher levels accumulated under this condition were associated with a lower degree of toxicity. Whether this is due to a chemical combination rendering each less biologically available to the tissues is a subject of speculation at this time.

Feathers represent a tissue of special interest in that they accumulate very high levels of mercury but relatively low levels of selenium. The high solubility of methylmercury in lipids led to the postulation that mercury in this form may gain access to feathers through the oily uropygial gland secretion used by birds for preening. Subsequent studies on four birds administered methylmercury by i.p. injection failed to show high levels of mercury in either the intact gland or its secretion.

Table 1. Average Production of Hens Fed Natural and Semipurified Diets with Various Combinations of Methylmercury and Selenium

| Treatment: Se Level | Treatment: Hg Level | Average body weight | Mortality | Daily feed | Hen-day egg production | Egg weight | Shell thickness | Haugh units | Hatchability |
|---|---|---|---|---|---|---|---|---|---|
| ppm | ppm | kg | % | gm | % | gm | mm | | % |
| 0 | 0 | 1.20 | 34.0 | 115 | 61.7 | 63.2 | 0.335 | 70.8 | 87 |
| 4 | 0 | 1.14 | 24.5 | 110 | 52.6 | 61.1 | 0.327 | 71.0 | 50 |
| 8 | 0 | 1.05 | 13.6 | 105 | 50.1 | 61.3 | 0.338 | 71.4 | 56 |
| 0 | 5 | 1.17 | 23.6 | 105 | 50.0 | 58.8 | 0.348 | 70.6 | 61 |
| 4 | 5 | 1.04 | 25.8 | 105 | 52.7 | 59.8 | 0.346 | 70.4 | 64 |
| 8 | 5 | 1.03 | 29.0 | 94 | 41.0 | 55.3 | 0.348 | 75.0 | 64 |
| 0 | 10 | 1.10 | 25.0 | 105 | 36.8 | 56.7 | 0.347 | 66.7 | 26 |
| 4 | 10 | 1.16 | 33.6 | 104 | 50.7 | 59.9 | 0.346 | 74.2 | 56 |
| 8 | 10 | 1.01 | 20.4 | 94 | 46.3 | 55.0 | 0.339 | 75.4 | 61 |
| Average for natural diet | | 1.11 | 29.1 | 110 | 63.0 | 61.3 | 0.354 | 68.3 | 59 |
| Average for purified diet | | 1.09 | 21.9 | 98 | 35.2 | 59.4 | 0.329 | 75.1 | 57 |

Table 2. Hg and Se (ppm) in Body Tissues and Eggs of Hens Fed Natural and Semipurified Diets with Various Combinations of Methylmercury and Selenium

| Treatment | | Liver | | Kidney | | Muscle | | Brain | | Feathers | | Eggs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Se Level | Hg Level | Hg | Se | Hg | Se | Hg | Se | Hg | Se | Hg | Se | Hg | Se |
| ppm | ppm | | | | | | | | | | | | |
| 0 | 0 | 0.5 | 0.6 | 0.8 | 0.7 | 0.4 | 0.3 | 0.2 | 0.3 | 0.3 | 0.9 | 0.2 | 0.4 |
| 4 | 0 | 0.3 | 2.4 | 0.8 | 1.8 | 0.2 | 0.4 | 0.2 | 0.5 | 0.0 | 2.1 | 0.1 | 1.2 |
| 8 | 0 | 0.4 | 3.5 | 1.1 | 2.7 | 0.4 | 0.5 | 0.4 | 0.6 | 0.0 | 2.2 | 0.6 | 1.7 |
| 0 | 5 | 27.3 | 2.5 | 23.4 | 1.6 | 10.6 | 0.4 | 9.5 | 0.5 | 164.6 | 0.9 | 10.4 | 0.4 |
| 4 | 5 | 51.9 | 12.5 | 22.1 | 3.1 | 12.0 | 0.9 | 13.7 | 2.7 | 137.0 | 2.2 | 11.0 | 1.3 |
| 8 | 5 | 49.3 | 14.2 | 20.4 | 4.3 | 13.1 | 1.1 | 18.3 | 4.1 | 140.7 | 2.5 | 13.4 | 1.9 |
| 0 | 10 | 76.6 | 3.6 | 53.1 | 2.0 | 22.4 | 0.4 | 24.6 | 0.6 | 376.6 | 1.5 | 19.2 | 0.4 |
| 4 | 10 | 99.6 | 18.7 | 37.8 | 4.6 | 22.0 | 1.2 | 30.1 | 4.5 | 392.0 | 1.8 | 21.9 | 1.6 |
| 8 | 10 | 154.3 | 28.8 | 43.0 | 5.3 | 19.0 | 1.3 | 29.6 | 6.6 | 319.4 | 2.1 | 24.2 | 2.0 |
| Average for natural diet | | 52.2 | 9.4 | 23.1 | 3.4 | 10.8 | 0.9 | 15.9 | 2.9 | 93.2 | 2.0 | 10.2 | 1.4 |
| Average for purified diet | | 50.1 | 9.9 | 21.9 | 2.5 | 11.5 | 0.5 | 12.2 | 1.6 | 247.0 | 1.5 | 12.2 | 1.1 |