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Effects of Mercury Polution on the Performance of Laying hens and Offspring

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Thirty hens, 8-months old,from each of Fayoumi and Alexandria chickens, were distributed randomly among three groups of ten hens each. One group from each was offered tap water coutaining 0, 150 or 250 ppm mercury as mercuric chloride. The hens were fed *ad libitum* on standard ration and weekly artifically inseminated. Eggs were collected daily, weighed and recorded. Body weight, feed consumption, fertility and hatchability percent were weekly estimated. The newely hatched chicks were weighed at the date of hatch and every week up to 4-weeks old. The following results were obtained:-

1. The administration of 250 ppm-Hg to drinking water caused a slight insignificant decrease in body weight and egg number.

2. Birds drank water contained 250 ppm.Hg consumed less amounts of feed than did control birds, but those received 150 ppm. Hg consumed more amount of feed than did the control.

3. The treated birds were significantly laid smaller eggs than the control. The continuty of receiving the element had magnituted its ill effect in the Fayoumi strain.

4. Fertility and hatchability were adversely affected by the inclusion of mercury in the drinking water of the layers.

5. Chick hatched from eggs of hens treated with mercury had smaller body weight than those hatched from untreated hens. This decrease in body weight was significant during the seventh and fourteenth days of age. The effect on Fayoumi was more seven than that on Alexandria strain.

Elemental mercury, as a wide spread constituent in many fungicidal compounds in also used during the manufacturing of dlfferent industrial products. The wastes of such industry, containing mercury, are usually discharged through the water canals and sea. This discharge causes the mercury content in the sediments of the surrounding area to accumulate in high concentration (El-Sayed *et al.*, 1979).

Polution of such marine environment with mercury resulted in the accumulation of this element in the fishery products. (Miller, *et al.*, 1972). Also seeds dressed with organomercuries, are known to contain great proportion of mercury. (Al-Falluji *et al.*, 1974). Thus mercury becoming an unavoidable environmental. Mercury is classefied as a teratogenic element and different avian species had feed or water containing mercury, exhibit ill effects on many of their productive traits (Femreite and Korstand, 1971; Spann *et al.*, 1972; Thaxon and Parkhurst, 1973 and Hill and Shaffner, 1974 and 1976).

It is always possible that farmers water their livestock from the water canals available in the village, and feed them the available unsown seed grain. Consumption of such contaminated seeds and water might be harmful to the livestock.

The main scope of this experimental program was to provide a systematic study of the effects of the contamination of drinking water with mercury on some performance of Alexandria and Fayoumi chickens.

Material and Methods

Sixty hens, 30 from each of Alexandria and Fayoumi strains, 8-months old were randomely taken from their population, and individually caged. Egg production was recorded for each bird over six weeks as latest period.

Through out the experimental period, which was nine weeks, ten hens from each strain were offered tap water containing 0, 150 or 250 ppm mercury as mercuric chloride ($Hgcl_2$). The water was provided *ad libitum* in galvanized troughs. The hens were weekly artificially inseminated with 0.1 ml of undiluted pool semen, collected from ten cocks of the same strain at the time of insemination.

Eggs laid were collected daily for each hen , and weighed to the nearest 0.1 g. Body weight and feed consumption were weekly recorded to the nearest 1.0 g. for each bird and group respectively.

Fertility for each hen was calculated by the number of fertile eggs, on the 18^{th} day of incubation in percent to the total number set. Hatchability was also estimated for each hen by the number of healthy hatched chicks relative to the total number of fertile eggs.

The hatched chicks were wing banded and weighed individually at the date of hatch. They were housed in controlled electric battery for four week, during that they were offered *ad libitum* standard feed and tap water. Individual body weight was recorded weekly for four weeks.

The means and standard deviation were estimated for each trait and statistical analysis were carried out according to Snedecor and Cochran(1971).

Results and Discussion

It could be observed from (Table 1) that the administration of 150 ppm Hg to the drinking water increased body weight. While the 250 ppm. Hg decrease it. Analysis of variance however revealed, no significant difference between treated and untreated birds. Similar harmless effect of mercury on body weight were also observed by Henser (1956), March and Soong (1974), Hill and Shaffner (1976) and El-Begearmi *et al.* (1977). The great tendency of mercury to accumulate in feather (Tejning and Vesterberg, 1964) and liver and Kidney (Borg, 1958 and Ulfvarson, 1965) might be considered as a suitable mechanism(5) by which the animal prevents the distribution of mercury at toxic amounts, then becoming harmless to the animal and did not affect its body weight.

Hens watered with the high mercury level, 250 ppm., consumed less amounts of feed than the control (Table 1). However, the opposite was observed for hens treated with the low level, 150 ppm., where they consumed more feed than birds drank tap water. This increase occured during the first three weeks of the experimental period. Similar results were reported by El-Begearmi *et al.* (1977) and Hill and Shaffner, (1976) on quail and by Ansari and Britton (1974) on chickens.

TABLE 1. **Means ($\bar{x}$) and standard deviation (S.D.) of body weight and feed consumption of Fayoumi and Alexandria hens drank water contained 0, 150 or 250 ppm. Hg as $Hgcl_2$ for nine weeks.**

Weeks	Zero		150		250	
	Alex.	Fay.	Alex.	Fay.	Alex.	Fay.
			Body weight kg			
1	1.57±0.41	1.22±0.15	1.61±0.15	1.32±0.32	1.55±0.19	1.23±0.19
3	1.60±0.34	1.26±0.34	1.63±0.17	1.35±0.31	1.57±0.18	1.27±0.18
5	1.69±0.52	1.29±0.15	1.67±0.21	1.42±0.30	1.52±0.19	1.28±0.19
7	1.74±0.41	1.28±0.15	1.72±0.39	1.44±0.31	1.68±0.23	1.25±0.23
9	1.81±0.38	1.35±0.18	1.77±0.19	1.51±0.32	1.77±0.23	1.26±0.23
Av. St.	1.666	1.274	1.659	1.377	1.604	1.253
			Feed consumption g / bird / day			
1	756	516	645	774	718	748
3	748	595	598	618	705	685
5	734	654	677	655	661	661
7	685	610	620	615	572	588
9	595	635	590	580	560	562
Av. St.	702.5	614.9	639.8	638.0	647.3	644.7

Egg production was adverselly effected by mercury supplementation, being more noticable in birds that consumed the high level (Table 2). The effect was magnituted by the continuty of consuming the element. Similar ill effect of mercury on egg production was observed by Al-Falluji *et al.* (1974) and Al-Soudi *et al.* (1976).

Treated birds laid smaller eggs than those drank tap water (Table 2.) Few exceptions, were noticed where few treated birds laid eggs of heavier or comparable weight to the control. A significant depressing effect of mercury on egg weight took place during the fifth, and seventh week of consuming the element. It is interesting to notice that the two strains responded to the two levels of mercury in a different manner. In that the decrease in egg weight caused by the level 250 ppm. Hg was higher than that caused by the 150 ppm.

Hg in the case of Fayoumi strain. The opposite trend however, was seen for the Alexandria strain, where the ill effect of the low level of mercury was greater than the higher one (Table 2). Although no clear trend for the effect of mercury on egg weight with time cane be seen, the continuity of receiving mercury seemed to magnitued its ill effect in the Fayoumi strain only.

Fertility was significantly decreased ($P<0.05$) by administration of mercury to the drinking water (Table 3). The two levels of mercury did not significantly differ in their effect on this trait. Hill and Shaffner (1974) also demonstrated similar adverse effect of mercury on fertility of quail.

TABLE 2. **Means ($\bar{x}$) and standard deviation (S.D.) of egg number and weight of Fayoumi and Alexandria hens drank water contained 0, 150 or 250 ppm. Hg as HgC/2 for nine weeks.**

Weeks	Zero		150		250	
	Alex.	Fay.	Alex.	Fay.	Alex.	Fay.
			Eggs/bird/week			
1	4.4± 1.0	4.3± 1.8	4.6± 1.7	5.4± 1.3	4.3± 1.7	4.6± 2.3
3	4.5± 1.6	4.2± 1.5	4.0± 1.5	4.1± 2.0	4.3± 0.9	4.1± 1.9
5	3.9± 1.8	5.1± 2.0	3.9± 1.4	4.3± 1.9	3.5± 1.8	4.7± 1.4
7	4.4± 1.5	4.5± 1.5	4.4± 1.8	4.1± 1.4	3.9± 2.2	3.7± 1.4
9	4.1± 1.5	4.0± 1.3	4.0± 2.0	4.0± 1.9	3.5± 2.1	3.7± 1.6
Av. St.	4.4	4.5	4.2	4.3	3.9	4.1
			Egg weight			
1	43.5± 3.3	42.7± 5.2	46.7± 2.6	40.4± 8.0	43.8± 9.2	43.1± 5.7
3	46.1± 6.3	40.1± 4.3	45.9± 7.1	43.3±14.1	44.8± 2.0	42.8±10.1
5	45.9±12.4	43.8± 5.0	43.1± 7.4	41.3± 4.9	45.5± 5.9	40.3± 5.8
7	46.0± 2.8	41.6± 8.6	41.8±13.8	36.7± 6.3	45.0± 6.9	38.8±11.6
9	44.0± 6.0	42.3± 4.1	43.1± 6.6	38.9±13.8	43.2± 9.0	37.6±00.8
Av. St.	45.2	42.3	43.2	41.5	44.7	40.2

Hatchability percentage of eggs layed by hens drank water contained either 150 or 250 ppm. Hg was significantly lawer than those layed by hens drank tap water (Table 3). Duncan's test, however revelled no significant difference between the two levels. Similar adverse effect of mercury on hatchability percent was reported by Henrilsson *et al.* (1966) for eagles, Tejning (1967) for chickens, and El-Begearmi *et al.* (1977) for quail.

Chicks hatched from eggs of hens treated with mercury always showed smaller body weights than those hatched from untreated hens, (Table 4). As a result of Duncan's test their were significant differences between the untreated and treated groups in the 7*th* and 14*th* day of age. It is clear that the loss

in body weight caused by the high level of mercury 250 ppm. was greater than that caused by the low level, 150 ppm. Moreover, the severity of mercury effected on body weight was not similar for both strains, being more severe for Fayoumi than from Alexandria strain. The ill effect of mercury on body weight was permenant during the first two or three weeks of life after which the adverse effect sbowed tendency to decrease with age.

TABLE 3. **Means ($\bar{x}$) of fertility and hatchability percent of eggs layed by Fayoumi and Alexandria hens drank water contained 0, 150 or 250 ppm. Hg as $HgCl_2$ for nine weeks.**

Weeks	Zero		150		250	
	Alex.	Fay.	Alex.	Fay.	Alex.	Fay.
			Festility			
1	65.4	62.0	60.6	62.9	52.1	68.5
3	76.4	73.9	63.7	65.9	61.8	60.3
5	66.9	69.3	55.7	60.4	54.0	61.3
7	70.9	71.2	72.4	63.4	74.4	68.8
Av. St.	68.5	70.4	61.6	66.7	63.2	67.0
Average of treatment	69.5^{A}		64.2^{B}		65.1^{B}	
			Hatchability			
1	54.2	57.9	74.3	54.7	53.1	61.2
3	54.0	63.8	83.2	54.7	42.7	29.0
5	50.3	59.5	64.9	47.1	30.9	29.2
7	53.6	70.1	56.8	45.0	51.5	33.2
Av. St.. . .	53.5	59.6	61.3	43.9	40.9	36.6
Average of treatment	59.5^{A}		52.6^{A}		38.8^{B}	

Means of each column having a common letter are not significantly different at the $P < 0 0.5$.

Eggs laid by hens treated with mercry; contained high proportion of this element (Smart and Llyod, 1963)). The egg components are the main source of nutrients for the developing embryo and the newly hatched chick absorb in its body approximately 6% of the total egg yolk. This amount of yolk usually is consumed during the first days of life after hatching. This might mean that mercury will be exist in the metabolism of the developing embryo as well as during the early days of the hatched chick. Such speculation can be supported by that observed in human by Curley *et al.* (1970) who found that pregnant woman ate pork contaminated with mercury accumulate this element in their body tissue and fluids, including the placenta fluid. Moreover,

TABLE 4. Mean ($\bar{x}$) and standard deviation (S.D.) of body weigpt (g) of chicks hatched from eggs of Fayoumi and Alexandria hens, drank water contained 0, 150, or 250 ppm. Hg. for nine weeks.

Period (days)	Zero			150			250		
	Alexandria $\bar{x}$ + S.D.	Fayoumi $\bar{x}$ ± S.D.	A Aversge*	Alexandria $\bar{x}$ ± S.D.	Fayoumi $\bar{x}$ ± S.D.	Average*	Alexandria $\bar{x}$ ± S.D.	Fayoumi x ± S.D.	Average*
1	28.3+ 4.7	28.2±6.7	28.3[a]	29.4±4.3	27.1±6.4	28.3[a]	26.8±4.9	24.8±3.1	25.8*b*
7	43.5+13.1	39.3±9.1	41.4[a]	42.0±4.8	36.4±8.6	39.2*b*	39.3±6.1	33.6±4.4	36.5*c*
14	73.3+10.0	59.8±12.6	66.6[a]	54.5±4.4	56.6±10.6	55.6*b*	72.5±16.7	48.2±13.6	60.4*b*
21	114.3+14.5	88.3±27.6	101.3	109.5±6.9	84.7±20.8	97.1[a]	110.0±24.4	74.6±13.3	92.3*b*
28	163.5+70.7	132.8±61.9	148.2	158.8±47.5	124.0±65.6	141.4	180.7±54.1	122.1±38.4	151.4

* Each rows having a common letter are not significantly different at level of $P < 0.01$.

the new born baby was found to contain mercury in great proportion, indicating the placenttal transfer of mercury. Meanwhile, the tendency of chicks to overcome the ill effects of mercury on body weight with time could be a result of :

a) an increased excretion of mercury through the urinary system,

b) an increased accumulation of mercury in the feather, which increases with age, (c) an increase in the ability of birds to deal with mercury with age. Such speculations can be supported with that observed by Al-Falluji *et al.* (1974), who found that chicks switched from feeding on diet contained mercury to a diet free of mercury, showed no sign of mercuryalsm.

The difference in the susceptibility between the Fayoumi and Alexandria, to mercury may be due to their genetic constitution. Miller *et al.* (1959 and 1967) demonstrated significant difference in mercury retention in the tissues of two strains of chickens, R and S. The liver and kidneys of R strain accumulated more mercury than those of S strain. Those workers stated that R chickens retained more mercury because of their ability to excrete it. They also suggested saturation of available sites for binding mercury in the S strain. According to (Miller *et al.*, 1970) mercury reatention could be controlled by genes.

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تأثير التلوث بالزئبق على انتاجية الدجاج البياض ونسلهم

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استخدمت فى هذه التجربة عدد ٣٠ دجاجة عمر ثمانية أشهر من كل من سلالة الفيومى والاسكندرية وضعت فى أقفاص فردية وتم توزيعها الى ثلاثة مجاميع تتكون كل منها من عشرة دجاجات • وقدم لكل مجموعة ماء للشرب يحتوى اما على صفر أو ١٥٠ أو ٢٥٠ جزء/مليون من الزئبق على شكل مركب كلوريد الزئبق وغذيت الدجاجات بعليقة متزنة • كما تم تلقيحها صناعيا كل سبعة أيام وتم جمع البيض يوميا ودون وسجل وكذا وزن الجسم واستهلاك العلف والخصوبة ونسبة التفريخ • ثم أخذت الكتاكيت الناتجة ووزنت فى عمر يوم ثم أسبوعا الى عمر أربعة أسابيع • وتتلخص نتائج البحث فى الآتى :

١ – أدى اعطاء تركيز ٢٥٠ جزء/مليون الى انخفاض بسيط فى وزن الجسم وعدد البيض عن الكنترول •

٢ – الدجاجات التى تناولت ماء يحتوى ٢٥٠ جزء/مليون زئبق استهلكت كمية أقل من الغذاء عن بالكنترول • ولكن التى أخذت ١٥٠ جزء/مليون زئبق استهلكت غذاء أكثر وان كانت الفروق غير مؤكدة احصائيا •

٣ – كان وزن البيض أقل فى الدجاجات المعاملة عنها فى الكنترول وكان التأثير الضار للزئبق واضحا فى الفيومى مع الوقت أكثر من الاسكندرانى •

٤ – تأثرت نسبتى الخصوبة والتفريخ باعطاء الزئبق فى مياه الشرب حيث أن النسبة انخفضت من الكنترول لكلا المستويات المعاه ١٥٠ أو ٢٥٠ جزء/مليون •

٥ – كان وزن جسم الكتاكيت المفرخة من أمهات معاملة بالزئبق دائما أقل من الكتاكيت المفرخة من أمهات غير معاملة وكانت الفروق معنوية فى اليوم السابع والرابع عشر وكان التأثير على سلالة الفيومى أكبر منه فى الاسكندرانى •