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Effect of Mercury Polution of Drinking Water on Blood, Internal Organs and Endocrine Glands of Two Strains of Chickens

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THE EFFECT of consumption of water containing different concentrations of mercury on blood, endocrine glands and internal organs were studied on two strains of pullets (Alexandria and Fayoumi) The following results were obtained:-

Fayoumi strain accumulated more mercury in their plasma than Alexandria strain. However, its plasma protein concentration was not affected, whereas, Alexandia strain showed a decrease in its plasma protein concentration. Haematocrite value was decreased in both strains by the consumption of mercury.

The effect of mercury on kidneys weight was not similar in the two strains. Glomerulites, necrosis, haemorrhage and tubular destruction were a characteristics of the kidneys of treated birds.

Liver weight was increased in Fayoumi strain but was not noticably affected in the Alexandria strain. Damage to the liver cells, hypertrophy and vacuolation, in the portal areas was seen accompanied by dilation of centeral vein and hepatic sinusoids.

Spleen absolute and relative weight significantly increased in Fayoumi birds.

Concerning the endocrine glands, pituitary weight was not affected by mercury, but thyroid weight was decreased. However, both the absolute and relative weight of thymus and adrenal glands were significantly increased by mercury.

Mercury polution of drinking water of domestic animals occurs as a result of contamination with mercury compounds used as pesticides or from industrial refuge. Kosba *et al.* (1980) had demonstrated adverse ill effects of this polution on egg production, fertility, hatchability and body weight of progeny. Harmful effects on physiological activities and a possible mercury transfer from mother to progeny was suggested.

The above findings prompted us to study the effect of mercury polution of drinking water on body, visceral and some endocrine gland weight of two strains of chicks (Fayoumi and Alexandria) as a manifestation of the hazardous effect of mercury polution on physiological activities. The pathological changes in the organs of the animals were also studied as it is known that alteration in structure would affect the organ function.

Material and Methods

Twelve pullets 12-week old from each of Alexandria and Fayoumi strains of chicks were used in this study. Animal, were fed a standard ration *ad libitum*. Birds of each strain were divided into three groups of four chicks, of aproximately the same total body weight. Water offered to the animal groups contained 0, 100 and 500 ppm Hg as $Hgcl_2$. Three weeks after the start of the experiment birds were weighed individually and sacrificed. A blood sample was taken in a heparinized tube from each bird for the determiplasma nation of Haematocrit value according to Luker and Luker (1971). total protein (Armstrong and Carr, 1964) and plasma mercury concentration according to the method of Ahmed (1980).

The visceral organs (Liver, kidney, heart and spleen and endocrine glands (pituitary, adrenal and thyroid glands) of each individual chick were separated and weighed. These organs and endocrine glands were fixed in 5% formalisaline and a paraffin section of 6U thickness was stained with haematoxylin and eosin (Develander, 1961) and used for histopathological microscopic examination.

Statistical analysis was carried out according to Snedecor and Cochran (1971).

Results and Discussion

The consumption of water containing mercury significantly (P 0·05) increasued mercury concentration in the plasma (Table 1). It has to be noted that although the concentration of mercury in plasma is correlated with the concentration of Hg in the drinking water, however, birds of Fayoumi strain accumulated more mercury in the plasma than those of Alexandria strain. Similar accumulation of mercury in blood of birds treated with mercury was observed by Kiwimae *et al.* (1969).

Haematocrit value decreased to some extent by the administration of mercury to the drinking water (Table 1). The effect was nearly similar in both strains. Sine red blood cells accumulate more than 50% of the Hg in blood (Neathery *et al.*, 1974) the demonstrated decrease in the haemtocrit value might be due to haemolytic action of Hg salts on red blood cells. Plasma protein concentration slightly decreased in Alexandria strain only, in spite of accumulation of more mercury in the plasma of Fayoumi strain than Alexandria strain. It is not evident however, from this study which fraction of plasma protein is affected more.

The treated birds had slightly smaller body weight than untreated ones (Table 2), with Alexandria birds affected more than Fayoumi. These changes, however, were not statistically significant indicating insignificant effect of mercury on weight. March *et al.* (1974); Al-Fayadh *et al.* (1976); Hill and Shaffner (1976); El-Begearmi *et al.* (1977) and Kosba *et al.* (1980) demonstrated also insignificant effect of mercury on chicken body weight. However, mercury caused a decrease in both absolute and relative weights of the heart

TABLE 1. Mean (x) standard deviation (S.D.) of plasma mercury concentration, Haematocrit value and Plasma protein concentration of birds drank water contained, 0, 100 or 500 ppm Hg.

Items	Hg ppm	Fayoumi $\bar{x} \pm$ S.D.	Alexandria $\bar{x} \pm$ S.D.
Plasma mercury (ppm)	0	0.00±0.00	0.00±0.00
	100	0.05±0.04[a]	0.13±0.04[a]
	500	0.29±0.16b	0.19±0.01b
Haematocriit value	0	5.10±0.36[a]	5.03±0.21[a]
	100	4.56±0.15[a]	4.66±0.81a
	500	4.50±0.55[a]	4.76±0.83[a]
Plasma protein (mg/100 ml)	0	2.16±1.70[a]	3.09±0.22[a]
	100	21.0±1.20a	2.74±0.48a
	500	2.16±0.33a	2.63±0.70a

Means of each colum having a common letter are not significantly different at the $P < 0.05$.

of both strains (Table 2). The percentage of decrease from the control was 4·8 and 8·1% for the Fayoumi and 17·1 and 20% for the Alexandria chicks receiving 100 and 500 ppm Hg respectively. Such decrease in the heart weight of treated birds could be due to a direct effect of the element on heart muscles Gardiner *et al.* (1971) found that chicks fed on diet containing 0·33 ppm Hg for eight weeks deposited 0·34 Mg Hg/g of heart. Femreite and Korstad (1971) noted degenerative changes in the myocardium of the red-tailed howk which consisted of nuclear pyknosis and granular swelling of sarcoplasm. Thus the accumulation of mercury in heart might prevent the normal growth of heart muscles. However, the difference in the effect of Hg on the weight of internal organs in different strains reflects strain difference, whereas, Fayoumi birds treated with mercury had an increase in the relative and absolute weight of the spleen of Alexandria strain was affected (Table 2). Similar increase of the weight of spleen of chicks given high dose of Hg (500 ppm) was found by Thaxton and Parkhurst (1973a).

The effect of elemental mecury on kindey was also not similar in the two strains (Table 2). While it caused a decrease in the kindey weight of Alexandria strain it produced an increase in the kidney weight of Fayoumi strain. Histologically the kindey showed glomerulites accompanied by red blood corpuscles in the Bowman's space (Fig. 1). Necrosis occurred in many areas of renal tissue especially in the medulla. Haemorrhage into some of these

TABLE 2. Mean (X) and standard deviation (S.D) of body weight, heart, kidnney, and pleen weights of Fayoumi and Alexandria hens d ank water contained 0, 100 or 500 ppm Hg.

Items (g)	Hg ppm	Fayoumi		Alexandria	
		Abs. $\bar{X} \pm$ S.D.	% * $\bar{X} \pm$ S.D.	Abs. $\bar{X} \pm$ S.D.	% * $\bar{X} \pm$ S.D.
Body weight	0	1238.7±51.70		1438.7±224.50	
	100	1217.5±85.50		1403.7±199.80	
	500	1228.7±90.60		1328.7±115.50	
Heart	0	6.2± 0.90	0.50±0.10	7.0± 1.50	0.49±0.11
	100	5.9± 0.60	0.48±0.07	5.8± 1.60	0.41±0.05
	500	5.7± 0.20	0.46±0.04	5.6± 0.90	0.42±0.06
Kidney	0	9.8± 2.20	0.79±0.19	10.8± 2.1	0.75±0.09
	100	11.2± 1.30	0.91±0.13	9.3± 2.20	0.66±0.21
	500	11.9± 1.60	0.98±0.18	8.9± 1.40	0.68±0.07
Liver	0	27.1± 4.70	2.18±0.18	31.8± 3.90	2.21±0.41
	100	31.8± 4.80	2.61±0.19	31.3± 2.30	2.18±0.53
	500	30.2± 1.80	2.47±0.22	32.2± 3.90	2.45±0.88
Spleen	0	2.9±0.70a	0.23±0.08	2.4± 0.60	0.16±0.05
	100	3.2±0.03a	0.24±0.10	2.3±0.90	0.16±0.08
	500	4.8±1.00a	0.39±0.09	2.6± 1.10	0.20±0.06

* Expressed as gm/g body weight.

areas were also seen. However, the major destructive effect of mercury was found in renal tubular cells. Coloudy swelling and vaculation of the epithalial lining of the convoluted tubules, casts in the lumen of some tubules was observed. The effect of mercury on renal tissue recorded in this study is similar to that observed by Al-Falluji *et al*, (1974) in kidney of birds fed on seeds with fungicide containing mercury and by Sukra *et al* (1976) in embroys injected with Hgcl-. The structural changes in the kidney are due to the progressive accumulation of Hg in kidney tissue (Al-Falluji *et al.*, 1974). These structural changes (cloudy swelling) affect the osmotic pressure of cells leeding to embibition f water (walter and Israel, 1974) and disturbance of its function (Ganong, (1979) . Although the weight of liver was not affected noticably by the drinking of water containing Hg damage to the liver cells in the portal areas areas was seen (Fig. 1) accompained by dilation of centreal veins and hepatic sinusoids. Some of the hepatic cells showed hypertrophy and vaculation. Vacuoles occupies in some cases the entire cytoplasm of the c3ll. Haemorrhage also occured in some areas. The intensity of the lesion seems to be dose dependent, since it increased in birds receiving high doses of mercury. Similar affection of the liver of chickes by mercury was observed by Al-Falluji *et al.* (1974).

Table 3 show the effect of mercury on the weights of pituitary, thyroid, adrenal and thymus glands. The results indicate insignificant differnece, ($P<0.05$ in the case of pituitary and thryoid glands between experimental and control animals However, mecrury in a dose of 100 and 500 ppm had singificantly ($P<0.05$ increased the weight of adrenal and thymus glands. Similar results were reported by Thaxton and Parkhust (1973b). The histological examination of the stuided endocrine glands did not reveal any noticable change to mercury consumption.

The increase in the absolute and relative weights of adrenal glands suggests a hyperfunction stress response. As it is known that hyperfunction and hypertrophy of the adrenal is a physiological response to stress (Siegel, 1971).

It could be concluded that the harmful effect of mercury on chikens performance mediated through its ill effect on internal organs and consequently the physiological activities the body. Therefore, water drinking of chickens should be avoided from being poluted with mercury.

TABLE 3. **Mean ($\bar{x}$) and standard deviation (S.D) of endocrine glands weight of hens darnk water contained 0,100 or 500 ppm Hg for twenty one day.**

Items (mg)	Hg ppm	Fayoumi		Alexand ia	
		Abs. $\bar{x} \pm$ S.D.	% * $\bar{x} \pm$ S.D.	Abs. $\bar{x} \pm$ S.D.	% * $\bar{x} \times$ S.D.
Pituitary	0	10.8± 1.30	0.87±0.05	9.3± 1.30	0.65±1.30
	100	11.3± 0.60	0.92±0.10	8.8± 1.00	0.64±0.02
	500	10.0± 1.00	0.71±0.07	9.5± 1.00	0.72± 0.11
Thyroid	0	134.0±25.90	10.8±2.30	142.0±28.70	9.6±45.30
	100	122.0±26.50	10.0±2.20	130.5±18.60	9.5±1s.40
	500	119.7±30.00	9.7±2.50	117.8±25.20	8.9±19.70
Adrenal	0	105.5±21.00a	8.5±1.20	88.3±29.80[a]	6.0± 4.60
	100	126.5±9.70 b	10.4±2.10	102.8±20.50[b]	7.3±1.10
	500	139.3±18.20c	11.3±1.50	135.8±38.30[c]	10.2±2.70
Thymus	0	3.7± 0.70	0.29±0.10	2.8± 0.70	0.34±0.50
	100	3.5± 0.90	0.29±0.12	3.1±1.60	0.25±0.12
	500	6.0±0.70	0.50±9.12	4.5± 2.50	0.49±0.10

* Experessed as mg/gm body weight $\times 10^{-2}$.

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