Evaluation of Some Chemical Pollutant Levels in Quail Tissues

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ABSTRACT

Fifty quail bird samples were collected from Sharkia Governorate markets for detection and determination of organochlorine pesticide, polychlorinated biphenyl (PCBs) and heavy metal residues in their muscles and livers and comparison the levels of these chemical pollutants with their permissible limits. The obtained results revealed that the mean values of αBHC, βBHC, γBHC, ΔBHC, heptachlor, heptachlor epoxide, aldrin, γchlordane, pp-DDE, pp-DDD and pp-DDT were 1.132, 1.641, 2.066, 1.177, 0.402, 2.987, 2.728, 0.729, 3.185, 0.251 and 1.118 ppb respectively in the examined muscle samples. Liver samples had αBHC, γBHC and pp-DDT with the mean values of 0.925, 0.924 and 4.545 ppb respectively, the other organochlorine pesticides were not detected in liver samples, endrin was not detected in all the examined samples. The detected organochlorine pesticides were below the permissible limits in all samples.

Concerning polychlorinated biphenyls (PCBs), four congeners of PCBs were detected in the present study, the mean levels of PCB18, PCB44, PCB101 and PCB105 were 0.0009, 0.0041, 0.0099 and 0.1847 ppb respectively, the mean residues of the total PCBs was 0.2029 ppb. Only PCB101 was found in liver samples with the mean value of 0.015 ppb. PCBs 28, 138, 152, 180, 192 and 194 were not detected in all the examined samples. The total PCBs were below the permissible limit in all the examined samples.

The mean values of the heavy metal residues in the examined muscle samples were 32.43, 0.037, 0.177, 0.716 and 5.55 ppm for lead, cadmium, zinc, copper and iron respectively; while, the average levels of these metals in liver samples were 36.08, 0.017, 0.49, 1.432 and 0.386 ppm respectively. All the detected lead in both muscle and liver samples were above the permissible limits; while, cadmium residues were above the permissible limits in 9 (18%) and 4 (8%) of muscle and liver samples respectively. Zinc and copper were below the permissible limits in all the examined samples.

INTRODUCTION

The breeding of quail (*coturnix coturnix*) was rapidly developed in Egypt during the last few decades. This bird has many benefits, it characterized by short breeding period (50 day), high conversion rate, early sexual maturity, high egg production (300 per year) and resist to the hostile environmental conditions. On the other hand, quail meat is high in quality. It has low fibers with the good distribution of fine fat granules which give a soft texture and good taste. Furthermore, quail meat is very cheap compared with other domestic birds as pigeons and ducks. For these reasons, the future of the quail production in Egypt is promising.

Quail feeding and breeding resample other domestic birds as poultry or ducks; it fed a formulated ration and bred in cages or on deep litter. Because many studies recorded considerable levels of different environmental pollutants in domestic birds in Egypt***(1,2,3)***. Thus, quail exposed to all the chemical environmental pollutants as other domestic birds. The most important and serious chemical pollutants in the environment are organochlorine pesticides, polychlorinated biphenyls (PCBs) and heavy metals.

Organochlorine pesticides are a group of synthetic compounds developed in 1940s for use mainly as insecticides***(4)***. In spite of their efficacy against different insects, they are highly lipophilic, stable in the environment

and pass through the food chain*(5)*. Owing to their environmental persistence and serious risks on the public health, organochlorine pesticides were prohibited in several progressed countries. Although banning of this pesticide group in Egypt since 1980*(6)* many recent studies recorded organochlorine residues in foods *(7,8,9)* and in human breast milk *(10)*. These residues explained by long persistence or illegal using of this pesticide group.

Polychlorinated biphenyls (PCBs) are toxic industrial chemical pollutants. Because of their widespread, uncontrolled industrial application, PCBs have become a persistent and ubiquitous contaminant in the environment. As a result, certain foods and animal feeds contain PCBs as unavoidable, environmental contaminants. Furthermore, PCBs are transmitted to the food portion (meat, milk and eggs) of food producing animals and birds ingesting PCB – contaminated animal feed *(11)*. As organochlorine compounds, PCBs are long persistence in the environment due to their lipophilic properties *(12)*. Moreover, PCBs are divided into 209 congeners supplied by the commission of the European community according to their chemical structure.

From the public health point of view, organochlorine pesticides and PCBs can cause serious toxic symptoms including developmental abnormalities and growth suppression, disruption of the endocrine system, impairment of immune function, and cancer promotion *(12)*.

Heavy metal pollution is one of the most serious global environmental problems, the source of these pollutants are industrial or / and agricultural process. Lead and cadmium were non essential heavy metals and have no known beneficial biological function; they cause many harmful to health. Chronic lead poisoning leads to neuropathy and kidney damage *(13)*. Also, lead exposure can produce chromosomal abrasion and cancer *(14)*. Cadmium toxicity may be manifested by renal dysfunction *(15)*, growth retardation and testicular damage *(16)*. Moreover, cadmium was classified as class one human carcinogen *(17)*. Zinc, copper and iron are essential metals for the biological processes in human and animals, but when these metals exceed their permissible limits in food, they exhibit their toxic symptoms. Chronic zinc ingestion can produce anemia and leucopenia *(18)*. Meanwhile, chronic copper exposure leads to hepatorenal or hepatocerebral degeneration or Wilson's disease *(19)*. Iron poisoning is seldom, the symptoms of its toxicity are hemorrhagic gastroenteritis associated with diarrhea and vomiting *(20)*.

Because the knowledge of occurrence of organochlorine pesticides, PCBs and heavy metal residues in quail tissues in Egypt is unavailable; thus, in this study these mentioned pollutants were measured in quail tissues and their levels were compared with the recommended permissible limits.

MATERIAL AND METHODS

A total of 50 quail birds (*coturnix coturnix*) were collected from Sharkia Governorate markets during summer 2005 for detection and determination of 12 oganochlorine pesticides (αBHC, βBHC, γBHC, ΔBHC, heptachlor, heptachlor epoxide, aldrin, endrin, γchlordane, pp-DDE, pp-DDD and pp-DDT, ten polychlorinated biphenyl (PCBs) congeners [PCB18 (2,2′,5), PCB28 (2,4,4′), PCB44 (2,2′,3,5′), PCB101 (2,2′,4,5,5′), PCB105 (2,3,3′,4,4′), PCB138 (2,2′,3,4,4′,5′), PCB152 (2,2′,3,5,6,6′), PCB180 (2,2′,3,4,4′,5,5′), PCB192 (2,3,3′,4, 5,5′,6) and PCB194 (2,2′,3,3′,4,4′,5,5′)] and five heavy metal residues (lead, cadmium, zinc, copper and iron) in muscles and livers of these examined quail samples.

I. Collection of samples

The examined quails were slaughtered, pecked up and eviscerated. The whole quail carcass and liver were taken and placed in polyethylene bags. The samples were identified and kept frozen till the analysis was conducted.

II. Analysis of the tested chemical pollutants

A. Organochlorine and Polychlorinated biphenyl analysis

Exactly 40 gm. from each quail muscles was taken for organochlorine and PCBs analysis. Liver tissues of each six or seven quails were pooled and weighted to produce equal eight 20 gm. of quail liver samples. Adequate muscle and liver tissues from each quail carcass were remained for heavy metal analysis.

1-Extraction and preparation of samples

Extraction of tissue samples was conducted as previously described ***(1).*** Grinded and weighted tissue samples were placed in high speed blinder jar, 8 ml. n-hexane – acetone (1:1) and 2 gm. sodium sulphate anhydrous were added for each one gm. of tissue sample. The sample and solvents were blended for ten minutes and the extract was washed several times with distilled water in separatory funnel. The sample moisture was dried with anhydrous sodium sulphate and evaporated at 40 °C in rotary evaporator till dryness.

Partitioning technique performed to remove the dissolved fat from the extract ***(21).***

2-Clean up of samples

Sample extracts applied to chromatography columns in 2-3 ml of hexane were eluted successively with hexane florisil (60/100 mesh) was activated at 250 °C for 12-15 hours, placed in a desiccator until cool, deactivated with 0.5% H_2O, stored in a sealed container in a desiccator overnight, and then used within 72h. Columns were rinsed the with 100 ml hexane collecting eluant in beaker. Stop the flow before the top of the solvent reaches the top of sodium sulphate. Discard the eluant into the waste container. Samples extracts were applied to the columns in 2-3ml. hexane, elute the column with 60ml hexane, to elute the polychlorinated biphenyls (PCBs) and pp-DDE, collecting eluant in the 100 ml flask as fraction 1 (F1). Next, add 35 ml of 30% dichloromethane in hexane, next add 45 ml of 50% dichloromethane in hexane to column and elute it to dryness, to elute all organochlorine in the sample. Reduce each fraction to 0.5ml ***(9).***

3-Preparation of blank solution

The same volumes of solvents (n-hexane- acetone) and sodium sulphate anhydrous which used in muscle and liver extraction were subjected to the same extraction, partitioning and clean up procedures as the examined samples to detect any possible traces of the studies pesticides or PCBs in the solvents or distilled water.

4-Gas chromatographic analysis

Hewlett Packard GC Model 6890 equipped with Ni^{63} – electron capture detector. GC conditions: HP- 5MS capillary column (30m length X 0.32mm internal diameter (i.d..), X 0.25µm film thickness), carrier gas: N_2 at a flow rate of 4 ml/min; injector and detector temperatures were 300°C and 320°C respectively: The initial column temperature was initial oven temperature, 180°C for 2 min., raised at 3 °C/min. and then held at 220°C for 1 min., then raised at 9°C /min. to 280°C and then held to 2 minutes, until a total time of 30 minutes had elapsed, DB-17 (J & scientific) capillary column (30m length X 0.32mm initial diameter (i.d.) X0.25 µm film thickness). Operating temperature were: column temperature was programmed 160°C to 230°C at a rate of 3°C /min. and to 260°C at a rate 10°C then hold 10 minutes. Injector temperatures were 300°C and detector temperature 320°C with nitrogen carrier gas flow at 4 ml./ min. was used to confirm the detected pesticides.

The organochlorine residue components were identified by comparing their retention times with those of the standards quantified by extrapolation of corresponding sample peak areas with those from standard curves prepared for each pesticide standard. Small variations in retention times and response factors of each compound during the experiments were corrected for by obtaining fresh chromatograms of the standard mixture after every nine injections. Standard solutions of

concentrations ranging from 0.01 to 0.04 ppm were prepared for each pesticide standard and 1µl was injected into the GC. Peak areas of standard solutions were plotted against their concentrations. A line of best fit was drawn through the points and the limits of detection were taken at 5 times the detector noise level.

5-Determination of percentage rate of recovery

The reliability of analytical method was examined by fortifying the tested samples with known quantities of tested pesticides following the same procedures of extraction, partitioning, clean up and analysis. The percentage rate of recovery of organochlorine pesticide ranged from 65.90% to 93.75% for pp-DDT and γchlordane respectively, while in the PCBs, the percentage rate of recovery varied from 80.11% to 99.98% for PCB18 and PCB138 respectively.

B- Heavy metal analysis

1- Preparation and digestion of samples

The examined tissue samples were prepared according to described method ***(22).*** One gram of tissue samples (muscle or liver) from each examined quail was transferred to a clean screw capped glass bottle and digested with 10ml of digesting solution (nitric acid/ perchloric acid 4:1). Initial digestion was conducted for 4 hours at room temperature, followed by heating at 40-45°C for one hour in water bath, then temperature raised to 75°C until the end of digestion. After cooling at room temperature, the digest was dilute to 20ml. with deionized water and filtered through 0.45µm Whatman filter paper. The filtrate was kept in refrigerator till analysis was carried out.

2- Preparation of blank solution

Ten ml. solution of nitric/ perchloric acid (4:1) were put in a screw capped glass bottle and exposed to the same digestion, dilution and filtration procedures as previously described in preparation of quail tissue to detect any traces of the studied metals in acids or deionized water.

3-Quantitative determination of the examined metal residues

Quantitative determination of lead, cadmium, zinc, copper and iron residues was conducted by using Jhermo Jarrell Ash Atomic Absorption Spectrophotometer. The concentrations of metal (ppm) in the examined samples were calculated according the following equation:

Concentration of metal in samples= AXB÷W, where A= metal concentration (ppm) in the prepared sample from the digital scale reading of Atomic Absorption Spectrophotometer, B= the final volume of the prepared sample, W= weigh of sample in gram.

III. Statistical analysis

Statistical analysis of data of organochlorine, PCBs and heavy metal residues was conducted ***(23).***

RESULTS AND DISCUSSION

Regarding the organochlorine pesticide residues in the examined quail tissues, Table 1 showed that the mean values of αBHC, βBHC, γBHC, ΔBHC, heptachlor, heptachlor epoxide, aldrin, γchlordane, pp-DDE, pp-DDD and pp-DDT in the examined quail muscle samples were 1.132±0.3533, 1.641±0.5565, 2.066±0.4159, 1.177±0.4482, 0.402±0.1571, 2.987±0.8146, 2.728±0.9145, 0.729±0.2691, 3.185±2.232, 0.251±0.1235 and 1.118±0.5068 ppb respectively. Only αBHC, γBHC and pp-DDT were detected in quail liver samples with the mean values of 0.925±0.6026, 0.924±0.6053 and 4.545±0.9754 ppb respectively, the other mentioned organochlorine pesticides were not detected in all the examined liver samples. Endrin could not be detected in all the examined muscle and liver samples. The obtained results nearly coincide with those reported in muscle and liver of chicken hens ***(1)*** and broilers ***(3)*** in Egypt. Moreover, another studies in Spain ***(24)*** and USA ***(25)*** recorded organochlorine pesticide in chicken muscles in the levels agreed with those in the present investigation. In contrast, higher organochlorine levels were

reported in wiled bird tissues in Canada *(26)* and Iceland *(27)* than our figures. The statistical analysis revealed no significant difference between organochlorine levels in the examined muscle and liver samples.

From the results recorded in Table 2, it is clear that all the detected organochlorine pesticide levels in the examined quail muscle and liver samples were lower than the recommended permissible limits; while, the permissible limit of ΔBHC in poultry meat or any other meat was not available. Furthermore, the obtained results revealed that all the tested orgaochlorine pesticides were detected in lower than 50% of the examined tissue samples.

Table 1. Organochlorine pesticide concentrations in the examined quail tissue samples (ppb).

organichlorine pesticides	Muscles (n=50)			Liver (n=8)		
	Min.	Max.	Mean±S.E.*	Min.	Max.	Mean±S.E
αBHC	1.95	8.31	1.132±0.3533	1.10	4.90	0.925±0.6026
βBHC	3.20	17.0	1.641±0.5565	N.D.**	N.D.	N.D.
γBHC	2.13	9.48	2.066±0.4159	3.55	3.84	0.924±0.6053
ΔBHC	5.00	12.30	1.177±0.4482	N.D.	N.D	N.D
Heptachlor	2.72	3.79	0.402±0.1571	N.D.	N.D	N.D
Heptachlor epoxide	2.12	21.00	2.987±0.8146	N.D.	N.D	N.D
Aldrin	12.85	22.22	2.728±0.9145	N.D.	N.D	N.D
γChlordane	3.22	7.12	0.729±0.2691	N.D.	N.D	N.D
pp-DDE	75.60	83.65	3.185±2.232	N.D.	N.D	N.D
pp-DDD	2.40	3.81	0.251±0.1235	N.D.	N.D	N.D
pp-DDT	7.58	16.10	1.118±0.5068	18.10	18.26	4.545±0.9754

*: Non detected organochlorine pesticide was considered zero for mean calculation.
**: N.D.= Not detected

Table 2. Frequency distribution of organochlorine pesticide residues in the examined quail tissues compared with the recommended permissible limits.

Organochlorine Pesticides	P.L.* (ppb)	Muscle samples(n=50)						Liver samples(n=8)					
		N.D.		Within P.L.		Over P.L.		N.D.		Within P.L.		Over P.L.	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
αBHC	200*(28)*	40	80	10	20	0.0	0.0	5	62.5	3	37.5	0.0	0.0
βBHC	100*(29)*	41	82	9	18	0.0	0.0	8	100	0.0	0.0	0.0	0.0
γBHC	50*(30)*	29	58	21	42	0.0	0.0	6	75	2	25	0.0	0.0
ΔBHC**	-	43	86	-	-	-	-	8	100	0.0	0.0	0.0	0.0
Heptachlor+ Heptachlor epoxide	200 *(30)*	33	66	17	34	0.0	0.0	8	100	0.0	0.0	0.0	0.0
Aldrin	200*(30)*	42	84	8	16	0.0	0.0	8	100	0.0	0.0	0.0	0.0
γChlordane	500*(30)*	43	86	7	14	0.0	0.0	8	100	0.0	0.0	0.0	0.0
Total DDT	300*(30)*	39	78	11	22	0.0	0.0	6	75	2	25	0.0	0.0

*: P.L.: Permissible Limits
**: The permissible limit of ΔBHC in poultry meat or in any other meat type was not mentioned.

In spite of a relatively lower organochlorine concentrations were detected in the examined samples in the current study, the presence of these toxic and prohibited compounds even in low concentrations is of concern because they were banned since several years ago as previously mentioned. Recent study in Japan *(31)* showed that organochlorine compounds were sharp declined in the first ten years after banning; then, they were slowly decreased. Thus human being consuming meat of such birds will have levels of organochlorine pesticides intake and such levels of intake may cause a serious build up of pesticide in the body and become of public health hazard.

Concerning polychlorinated biphenyl (PCB) residues in the examined quail tissues, the recorded results in Table 3 indicated that the incidence of PCB18, PCB44, PCB101, PCB105 and total PCBs in the muscle samples were 4%; 8%, 14%, 34% and 54% respectively; while, the mean levels of the same PCBs were 0.0009±0.0007, 0.0041± 0.0023, 0.0099 ±0.0039, 0.1847±0.0496 and 0.2029±0.0503 ppb respectively. Only PCB101 was detected in two quail liver samples (25%) with an average of 0.015±0.0105 ppb, the other mentioned PCBs were not found in liver samples. Meanwhile, PCB28, PCB138, PCB152, PCB180, PCB192 and PCB194 were not detected in both the examined muscle and liver samples. The obtained results nearly coincide with those estimated in poultry meat in Canada which detected 0.7 ppb of total PCBs *(32).* In contrast, another studies in Yugoslavia *(33),* Slovenia *(34)* and USA *(35),* recorded very high PCBs residues in bird tissues in compared with our figures. On the other hand, the permissible limit of the total PCBs in poultry tissues which recommended by FDA is 3 ppm (3000 ppb) *(11).* Since the maximum level of the total PCBs in the present investigation was 1.559ppb; therefore, it is clear that all the recorded levels of total PCBs in the current study is obviously very lower than the permissible limit. The statistical analysis revealed no significant differences between PCBs residues in muscle and liver samples.

Table 3. Incidences and concentrations (ppb) of polychlorinated biphenyls (PCBs) in the examined quail muscle and liver samples.

PCBs congeners	Muscle samples (n=50)					Liver samples (n=8)				
	+ve samples		Min.	Max.	Mean ±S.E.*	+ve samples		Min.	Max.	Mean ±S.E.
	No.	%				No.	%			
PCB18	2	4	0.015	0.031	0.0009 ±0.0007	ND	ND	ND	ND	ND**
PCB44	4	8	0.018	0.087	0.0041±0.0023	ND	ND	ND	ND	ND
PCB101	7	14	0.032	0.123	0.0099 ±0.0039	2	25	0.04	0.08	0.015 ±0.0105
PCB105	17	34	0.021	1.481	0.1847 ±0.0496	ND	ND	ND	ND	ND
Total PCBs	27	54	0.015	1.559	0.2029 ±0.0503	2	25	0.04	0.08	0.015 ±0.0105

*: Non detected PCB was considered zero for mean calculation.
**: ND= Not detected.

Because there are no available previous data about PCB pollutions in quail or poultry tissues in Egypt, we can not know whether PCB levels are decreasing or increasing in quail tissues in Egypt. These low levels of PCBs may be attributed to some industrial pollutants in quail feed. Generally, this result indicates that the rural areas in Egypt which contained the most quail farms suffered from very low PCB contaminations in compared with Egyptian Mediterranean coast as recorded in previous study ***(12)***.

Regarding the heavy metal residues in the examined quail tissue samples, Table 4 showed that the mean concentrations of the tested heavy metals in quail muscles were 32.43 ±2.744, 0.037±0.0075, 0.177 ±0.0637, 0.716 ±0.0561 and 5.55 ±1.981 ppm of lead, cadmium, zinc, copper and iron respectively; while, the average residues of these metals in the quail liver samples were 36.08 ±2.783, 0.017 ±0.0026, 0.49 ±0.0395, 1.432 ±0.0577 and 0.386 ±0.0569 ppm respectively. The present study recorded high lead levels compared with those in the previous studies in Egypt in layer hens ***(2)***, broilers ***(36)*** and pigeons ***(37)***. Moreover, other investigations in Slovenia ***(38)***, Kuwait ***(39)*** and USA ***(40)*** detected lower lead residues in bird tissues than our figures. In contrast, another investigation in USA ***(41)*** recorded lead residues in levels (63.6ppm in liver and 21.22ppm in muscles) nearly coincide with those in the present study. Cadmium residues in the current study agreed with those obtained in Egypt in layer hens***(2)*** and ostrich meat ***(42)***. Also, cadmium detected in poultry muscles in a study in Slovakia ***(43)*** in level 0.021ppm which agreed with those in the present study. Higher findings of cadmium residues than our levels were recorded in poultry tissues in Egypt ***(36)***. Zinc and copper levels in the current study were lower than those in all the available other studies ***(36,38,44,45)***. Low zinc levels in quail tissues may be explained by the storage of zinc in excess requirement in the bone of quail ***(46)***. Low copper concentrations may be attributed to high lead levels which conflict the copper absorption ***(47)***. Iron levels in the examined quail tissues were lower than those reported in poultry tissues in Poland ***(45)*** and Egypt***(44)***. Other metals as cadmium, copper and zinc can interfere the iron absorption ***(47)***.

The statistical analysis showed an insignificant variance between lead residues in muscle and liver. Meanwhile, both cadmium and iron were significantly higher in muscle than those in liver samples. On contrast, liver samples showed significant higher zinc and copper levels than those in the muscles. In the most available literatures, no significant differences can recorded in cadmium, iron and lead residues between poultry muscle and liver samples ***(2,36,38,44)***. Meanwhile, many investigations coincide with our estimations and recorded significantly higher zinc and copper levels in poultry liver samples than those in the muscles ***(36,37,45)***.

Concerning the comparison between the estimated levels of heavy metals in the quail tissue samples and the recommended permissible limits, Table 5 revealed that all the detected lead in both muscle and liver samples were above the permissible limits; whereas, lead was not detected in 6 (12%) of muscle samples. Cadmium exceed the permissible limits in 9 (18%) and 4 (8%) of muscle and liver samples respectively and it was not found in 11 (22%) and 12 (24%) of muscle and liver samples respectively. The levels of both zinc and copper were below the permissible limits in all the examined samples. Zinc was not detected in 29 (58%) and 1 (2%) of muscle and liver samples respectively. Meanwhile, copper was not detected in 4 (8%) of muscle samples and it detected in all the liver samples. Iron was not detected in 18 (36%) and 10 (20%) of muscle and liver samples respectively. Iron permissible limit in poultry meat or any other meat or meat product was not judged in Egyptian standards of heavy metals and other available international standard. Whereas, the comparison between the estimated iron in our study and other previously literatures indicates an obvious low iron levels in the current investigation.

Table 4. Heavy metal concentrations (ppm, wet weight) in the examined tissues of quail.

Tissue / Metal	Muscles (n=50)			Liver (n=50)		
	Min.	Max.	Mean±S.E.*	Min.	Max.	Mean±S.E
Lead	4.4	75.7	32.43±2.744	2.30	75.50	36.08±2.783
Cadmium	0.001	0.21	0.037±0.0075[a]	0.001	0.067	0.017±0.0026[b]
Zinc	0.02	2.19	0.177±0.0637[b]	0.03	0.98	0.49±0.0395[a]
Copper	0.11	1.48	0.716±0.0561[b]	0.75	2.57	1.432±0.0577[a]
Iron	0.18	72.6	5.55±1.981[a]	0.01	1.81	0.386±0.0569[b]

*: Non detected metal was considered zero for mean calculation.

N.B.: The difference between letters within the same category (muscle or liver) means the variation between the values of tissue residues is significant at level ($p \leq 0.05$).

Table 5. Frequency distribution of heavy metal concentrations in the examined quail tissues compared with the recommended permissible limits.

Metal	P.L.* (ppm)	Muscle samples(n=50)						Liver samples(n=50)					
		N.D.		Within P.L.		Over P.L.		N.D.		Within P.L.		Over P.L.	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Lead	0.5*(48)* *(49)*	6	12	0.0	0.0	44	88	0.0	0.0	0.0	0.0	50	100
Cadmium	0.05*(49)*	11	22	30	60	9	18	12	24	34	68	4	8
Zinc	20*(48)*	29	58	21	42	0.0	0.0	1	2	49	98	0.0	0.0
Copper	15*(48)*	4	8	46	92	0.0	0.0	0.0	0.0	50	100	0.0	0.0
Iron**	-	18	36	-	-	-	-	10	20	-	-	-	-

*: P.L.: Permissible Limits

**: The permissible limit of iron in poultry meat is not judged in Egyptian standard.

The obtained results revealed that the quail tissues suffered from high levels of lead contaminations. Although cadmium concentrations in the most samples were below the permissible limits, we can not be neglect the hazardous of cadmium pollutions in the present study. Because the quail farms often located in rural areas far from the industrial pollutants; thus, the most probable source of metal contamination is feeding rather than atmosphere. In spite of leaded gasoline was prohibited in Egypt since few years ago, high concentrations of lead may be found in road side soil due to the previous using of leaded gasoline *(47)*. Meanwhile, the sources of cadmium pollution were fungicides, herbicides, phosphate fertilizers, organic manure, decaying plant and animal residues *(50)*.

Conclusion and Recommendations

1- The organochlorine pesticide residues in this study recorded low levels which agreed with the most other previously recent studies in Egypt. This result reflects the efficiently protective measures. Continuous organochlorine monitoring is highly recommended to detect any probable illegal using of this prohibited pesticide group.

2- The present study recorded obviously low levels of PCBs which indicates the low exposure of the examined quails to the industrial pollutants.

3- Lead and cadmium residues were in high levels; thus, application of some fungicides, herbicides, phosphate fertilizers and sewage sludge should be kept under control.

4- Zinc supplementation for quail farms which suffered from lead and cadmium pollutions is advisable to reduce cadmium and lead accumulations in tissues.

5- Further studies should be enhanced to investigate the probable indistinctive sources of lead and cadmium pollutions in our feed and environment.

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الملخص العربي

تقييم مستويات بعض الملوثات الكيميائية في أنسجة السمان

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أجريت هذه الدراسة لإستبيان مدي تواجد و مستويات بعض المبيدات الكلورينية و مركبات الفينيل عديدة الكلور (PCBs) و المعادن الثقيلة في أنسجة السمان بأسواق محافظة الشرقية.

تم تجميع عدد ٥٠ من طيور السمان خلال صيف ٢٠٠٥ لقياس الملوثات سالفة الذكر، و قد أسفرت الدراسة عن النتائج التالية.

كانت متوسط مستويات المبيدات الكلورينية ١,١٣٢ ،١,٦٤١، ٢,٠٦٦، ١,١٧٧، ٠,٤٠٢، ٢,٩٨٧، ٢,٧٢٨، ٠,٧٢٩، ٣,١٨٥، ٠,٢٥١، ١,١١٨ جزء في البليون من ألفا- بنزين هكساكلوريد، بيتا- بنزين هكساكلوريد، جاما- بنزين هكساكلوريد، دلتا- بنزين هكساكلوريد، هيبتاكلور، هيبتاكلور إيبوكسيد، ألدرين، جاما- كلوردان، بارابارا- دي دي إي، بارا بارا- دي دي دي و بارا بارا- دي دي تي علي التوالي في عينات عضلات السمان، في حين تواجد ألفا و جاما بنزين هكساكلوريد و بارابارا دي دي تي في عينات الكبد بمتوسط ٠,٩٢٥ ، ٠,٩٢٤ و ٤,٥٤٥ جزء في البليون علي التوالي، ولم تتواجد باقي المركبات الكلورينية المذكورة في عينات الكبد، في حين لم يتواجد الإندرين في أي من العينات مختبرة. و قد كانت تركيزات كل المبيدات الكلورينية أقل من الحدود المسموح بها في كل العينات.

كان متوسط تركيزات مركبات الفينيل عديدة الكلور (PCBs) في عضلات السمان ٠,٠٠٠٩ ، ٠,٠٠٤١ ، ٠,٠٠٩٩ و ٠,١٨٤٧ جزء في البليون من مركبات الفينيل عديدة الكلور أرقام ١٨ ، ٤٤ ، ١٠١ ، ١٠٥ في حين كان متوسط إجمالي المركبات المذكورة ٠,٢٠٢٩ جزء في البليون. كان متوسط مركب الفينيل عديد الكلور رقم ١٠١في الكبد ٠,٠١٥ جزء في البليون في حين لم تتواجد باقي المركبات المذكورة في الكبد، من ناحية أخري لم تتواجد مركبات الفينيل عديدة الكلور أرقام ٢٨ ، ١٣٨ ،١٥٢، ١٨٠ ، ١٩٢و ١٩٤ في كل العينات المختبرة، و قد كان متوسط إجمالي المركبات المذكورة أقل من الحدود المسموح بها في كل العينات.

كان متوسط تركيزات المعادن الثقيلة في عينات عضلات السمان المختبرة هو ٣٢,٤٣ ، ٠,٠٣٧ ، ٠,١٧٧ ، ٠,٧١٦ و ٥,٥٥ جزء في المليون للرصاص، الكادميوم، الزنك، النحاس و الحديد علي التوالي، في حين كان متوسط تركيزات المعادن المذكورة في عينات الكبد ٣٦,٠٨ ، ٠,٠١٧ ، ٠,٤٩ ، ١,٤٣٢ و ٠,٣٨٦ جزء في المليون علي التوالي. كانت مستويات الرصاص أعلي من الحدود المسموح بها في كل العينات المحتوية علي الرصاص، في حين كانت مستويات الكادميوم أعلي من الحدود المسموح بها في ٩ (١٨%) و ٤ (٨%) من عينات العضلات و الأكباد علي التوالي، من ناحية أخري كانت مستويات الزنك و النحاس أقل من الحدود المسموح بها في كل العينات المختبرة، في حين لم تذكر المواصفات المصرية الحدود المسموح بها للحديد في لحم الدواجن أو أي أنواع لحوم أخري.

من هذه الدراسة نستخلص أن كلا من المبيدات الكلورينية و مركبات الفينيل عديدة الكلور تواجدت بمستويات آمنة إلي حد ما في عينات أنسجة السمان في حين تواجد الرصاص و الكادميوم بمستويات عالية يمكن أن تهدد الصحة العامة، لذلك نوصي بالمزيد من الأبحاث العلمية لمعرفة مصادر التلوث بالرصاص و الكادميوم و كذلك طرق الحد من ذلك التلوث كما نوصي بإستمرار متابعة مستويات المبيدات الكلورينية و مركبات الفينيل عديدة الكلور في مختلف الأغذية لمعرفة أي تلوث محتمل بأي منهما.