

Some Heavy Metal Residues in Poultry

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ABSTRACT

A total of 60 random samples of poultry broiler were collected from various farm located in different districts in Sharkia Governorate were sampled and examined for determining the existences and levels of some heavy metals.

Poultry samples were placed in ice box and immediately taken to laboratory for determination of Pb, Cd, Cu and Zn concentration by Atomic Absorption Spectrophotometer The obtained results revealed that the concentration of Pb, Cd, Cu and Zn in poultry meat were 2.58 ± 0.399 , 0.915 ± 0.077 , 1.136 ± 0.207 and 6.610 ± 0.990 (ppm) respectively while the corresponding concentration in liver samples were 2.921 ± 0.264 , 0.979 ± 0.069 , 1.739 ± 0.330 and 14.212 ± 1.789 ppm, but the concentration of metals in kidney were 2.722 ± 0.227 , 1.48 ± 0.077 , 1.298 ± 0.215 and 8.144 ± 0.426 ppm, respectively. The results revealed that 100% of poultry samples were polluted with lead and cadmium over than permissible limit, but copper and zinc were within the permissible limit in muscle, liver and kidney.

INTRODUCTION

Poultry meat is considered as a good source of animal protein with high biological value as it contain all essential amino acids many vitamins and minerals which are required for human nutrition.

In 2003-2004, the U.S. Department of Agriculture food Safety and Inspection Service (FSIS) conducted an exploratory assessment to determine the occurrence and levels of cadmium and lead in randomly collected samples of kidney, liver, and muscle tissues of mature chickens (1).

The contamination of poultry feed and water has been considered as the main source of metal residues in poultry meat.

Leozio and Massi (2) revealed that the accumulation of persistent heavy metals in tissues of birds and subsequent excretion via eggs constitute an important excretory pathway for these compounds in avian species. Hence, the residue level of heavy metals in eggs reflect the total body burden of the laying bird and may indicate the extent of the general contamination of bird population with such compounds (3).

Moreover, the distribution of metals in tissue of birds may influenced by routes,

chemical forms of metal intake and chronic or acute exposure (4).

The presence of heavy metals in chicken tissues, even in low levels, can lead to considerable concentration in human body. Metals that can not metabolized (as cadmium and lead) persist in the body and exert toxic effect in form of cellular disturbance or clinical manifestation (5, 6). Copper and zinc are essential elements and when given in excess are also toxic to man and animal (7).

This study was decided to determine Pb, Cd, Cu and Zn level in the muscle tissues, liver and kidney of poultry in Shrkia province to evaluate the degree of the safety for human consumption.

MATERIAL AND METHODS

Collection of samples

Sixty random broiler samples were collected from various poultry farms at Sharkia province. The specimens were individually placed in clean polyethylene bags and immediately taken to the laboratory where they were kept frozen until preparing for digestion and analysis.

Digestion of samples

The frozen poultry tissues, were digested according to the recommended method (8) in which 2 grams of muscle, liver

and kidney were digested with 10ml of analytical grade nitric / perchloric acid mixture (4:1) in a clean acid washed digestion flask.

Initial digestion was performed at room temperature for 3-4 hours, followed by careful heating in water bath at 40°C for one hour to prevent frothing. The temperature was then raised to 70- 80°C with gentle shaking until the digestion was completed (within 3 hours). The resulting digests were allowed to cool to room temperature and diluted up to 20 times with deionized water, then filtered through whatman paper No. 1. Blank and standard solutions were also prepared and analyzed for quality control purpose.

Heavy metal analysis

Determination of heavy metal concentrations was conducted at the central laboratory, Faculty of Veterinary Medicine, Zagazig University, Egypt by using Buck Scientific Atomic Absorption Spectrophotometer 210 VGP, equipped with background corrector, autosamples and recorded Cd, Pb, Cu and Zn using Air Acetylene flame (AAS).

RESULTS AND DISCUSSION

Figure 1 illustrates the residual concentration of heavy metals in the analyzed muscles, liver and kidney of examined poultry samples.

Lead

The lead level in poultry muscle has been affected by age due to bioaccumulation of the metal in poultry muscles and organs, higher level of Pb induce plumbism in human consuming (9) Table 1 showed that Pb concentration in poultry muscle ranged from 0.922 to 4.902 with a mean value of 2.557 ± 0.399 ppm. Many previous studies were carried out to detect the level of lead in muscle, liver and kidney. The Pb concentration in liver ranged from 2.060 to 5.238 with a mean value of 2.971 ± 0.264 ppm, but in kidney ranged from 1.694 to 4.070 with a mean of 2.722 ± 0.227 . Similar findings were determined by other studies (10, 11),

in which lead was determined in liver with a mean value of 63.6 mg /kg while in muscle it was found at a level of 21.2 mg/kg. On the other hand many researchers (3, 4,12-14) determined lead in low levels than those obtained in the present study.

Table 1. Lead concentration (ppm) in examined poultry samples.

Organs	Min	Max	Mean	\pm S.E
Muscle	0.922	4.902	2.557	0.399
Liver	2.060	5.238	2.971	0.264
Kidney	1.694	43.070	2.722	0.227

It was found that the liver has the highest value of lead followed by kidney and muscles. The obtained results are in agreement with other investigators (3, 11,15) who recorded that the lead was accumulated primarily in liver and kidney than bone in acute poisoning whereas under chronic low level exposure, the highest accumulation of lead was in bone. The biological half life of lead in Korean birds have highest value in bones of than feather, liver, kidney and muscles (4).

Cadmium

The results recorded in Table 2 showed that the average cadmium concentrations in muscle, liver and kidney of chicken were ranged from 0.569 to 1.372 with a mean of value 0.915 ± 0.076 ppm in muscle, while in liver it ranged from 0.566 to 1.256 with a mean value 0.979 ± 0.069 , while in kidney ranged from 0.606 to 1.468 with a mean value of 1.48 ± 0.077 ppm, respectively higher cadmium values were determined in liver and kidney of birds (4). However, higher cadmium value in broilers muscle and liver has been reported by Nassar et al. (16). On the other hand, results of *Abd Elkader and Deganoc* (3,13) were lower than our results.

Table 2. Cadmium concentration (ppm) in examined poultry samples

Organs	Min	Max	Mean	\pm S.E
Muscle	0.569	1.372	0.915	0.0769
Liver	0.566	1.256	0.979	0.069
Kidney	0.606	1.468	1.48	0.077

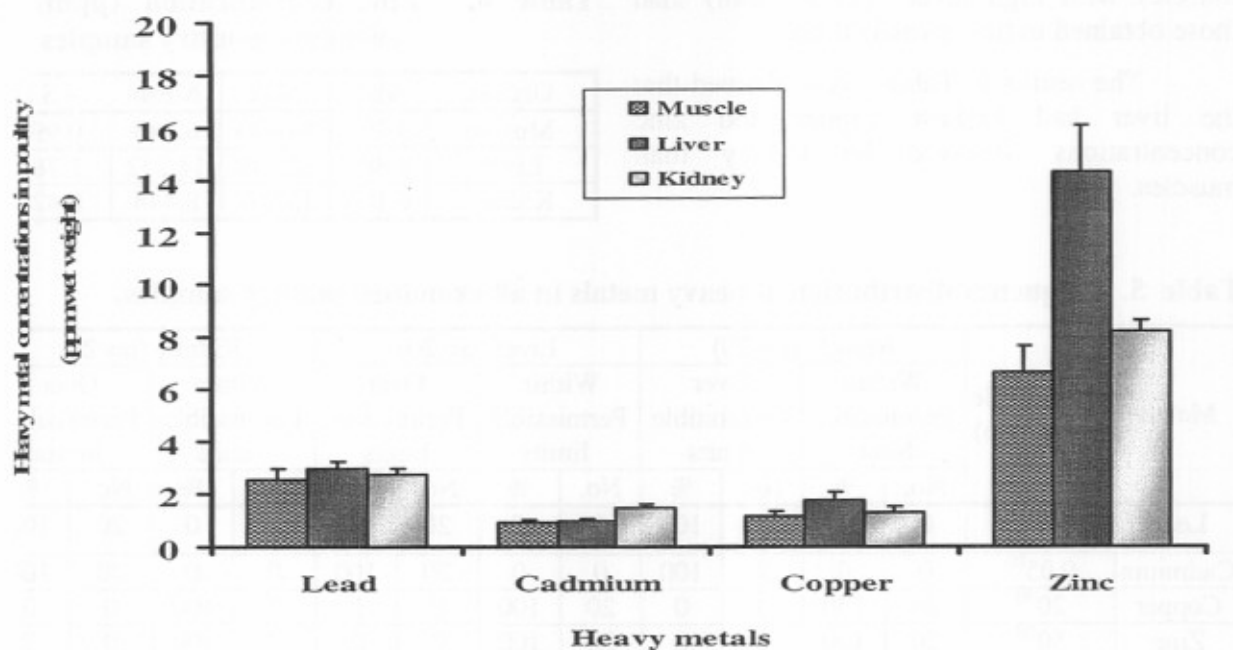


Figure 1. Heavy metal concentration in examined of poultry samples

The level of cadmium in examined poultry muscle were higher in kidney followed by liver and muscles (Table 2). These findings are in agreement with other studies (3,4) which reported that the kidney, as being the major storage site for cadmium. Moreover, when cadmium was experimentally added to feed, the accumulation was greater in kidney and liver (17). The obtained results indicated that liver and kidney are considered the critical organs for cadmium detoxification by marked accumulation in these organs.

Copper

The mean values of copper (Table 3) in the muscle, liver and kidney of the examined poultry were ranged from 0.300 to 2.887 with the mean value 1.136 ± 0.207 in muscle, but in liver it was ranged from 0.394 to 4.101 with a mean value of 1.739 ± 0.330 while in kidney was ranged from 0.409 to 2.825 with a mean 1.298 ± 0.215 ppm. These results are relatively lower than that recorded in birds by other investigators (11, 18, 19) who detected 2.42, 13.71 and 11.28 ppm copper residues in muscle, liver and kidney of chicken at 7 weeks of age, respectively. Moreover, Nassar *et al.* (16) recorded 3.6 and

3.8 ppm copper residues in muscle and liver of broiler respectively.

Table 3. Copper concentration (ppm) in examined poultry samples

Organs	Min	Max	Mean	+ S.E
Muscle	0.300	2.887	1.136	0.207
Liver	0.394	4.101	1.739	0.330
Kidney	0.409	2.825	1.298	0.215

Zinc

Zinc residues were detected in poultry tissues (Table 4) and ranged from 3.190 to 14.943 with a mean value of 6.610 ± 0.990 , but in liver it was ranged from 3.885 to 22.170 with a mean value of 14.212 ± 1.789 ; while in kidney it ranged from 6.100 to 10.792 with mean of 8.144 ± 0.426 . These results are nearly similar with those previously recorded (16) who reported zinc concentration of 6.92 ppm in muscles of poultry. However Doganoc (13) found that the level was 4.2 ppm zinc in chicken muscles, Nonetheless, higher zinc levels than our figures in both liver and kidney was reported (20) in chicken

muscles with high level (17.55 ppm) than those obtained in this investigation.

The results in Table 3 & 4 showed that the liver had highest copper and zinc concentrations followed by kidney than muscles.

Table 4. Zinc concentration (ppm) in examined poultry samples

Organs	Min	Max	Mean	± S.E
Muscle	3.190	14.943	6.610	0.990
Liver	3.885	22.170	14.212	1.789
Kidney	6.100	10.792	8.144	0.426

Table 5. Frequency distribution of heavy metals in all examined poultry samples.

Metals	Permissible limit (ppm)	Muscle (n= 20)				Liver (n= 20)				Kidney (n= 20)			
		Within Permissible limits		Over Permissible limits		Within Permissible limits		Over Permissible limits		Within Permissible limits		Over Permissible limits	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Lead	0.5 ^(a)	0	0	20	100	0	0	20	100	0	0	20	100
Cadmium	0.05 ^(a)	0	0	20	100	0	0	20	100	0	0	20	100
Copper	20 ^(b)	20	100	0	0	20	100	0	0	20	100	0	0
Zinc	50 ^(b)	20	100	0	0	20	100	0	0	20	100	0	0

(a) *FAO/WHO (1992) (21)*

(b) *Pearson (1976) (22)*

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الملخص العربي

بعض بقايا المعادن الثقيلة في الدجاج

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تم أخذ ٦٠ عينة من مزارع الدجاج من أماكن مختلفة بالشرقية وجمعت العينات لتحديد قياس نسبة المعادن الثقيلة بها من رصاص وكاديوم ونحاس ووزنك وتم قياسها في لحوم الدجاج والأكباد والكلى ٢٠ عينة لكل منهما وجددت متوسط نتائجها كالاتى فى العضلات ٢,٥٥٧ رصاص والكاديوم ٠,٩١٥ والنحاس ١,١٣٦ بينما كانت نسبة الزنك ٦,٦١٠ أما فى الأكباد فكانت نسبة الرصاص ٢,٩٧١ والكاديوم ٠,٩٧٩ والنحاس ١,٧٥٩ والزنك ١٤,٢١٢ أما الكلى فكانت متوسط نسبة الرصاص ٢,٧٢٢ الكاديوم ١,٤٨ والنحاس ١,٢٩٨ والزنك ٨,١٤٧

وأظهرت النتائج أن العشرين عينة من عضلات الدجاج تزيد عن الحد المسموح به والعشرين عينة فى الأكباد أعلى من الحد المسموح أما فى الكلى فنسبة الكاديوم تزيد عن الحد المسموح أما الرصاص فظهرت نفس النتائج زيادة عن الحد المسموح أما بالنسبة للنحاس فكانت فى الحد المسموح به بالعضلات والأكباد والكلى أما بالنسبة للزنك فكانت فى الحد المسموح به فى العضلات والأكباد والكلى وهذا يوضح أن نسبة الكاديوم والرصاص كمعادن ثقيلة موجودة بأكثر من الحد المسموح