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DETERMINATION OF SOME HEAVY METAL RESIDUES IN SERUM AND TISSUES OF OSTRICH AND QUAILS

SAFAA SAYED ABD EL-HAMID

Dep. of Biochemistry, Animal Health Research Institute.

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SUMMARY

Contaminations with heavy metals and its relationship to public health have a considerable concern in the last few years. Lead, cadmium and copper residues were determined in thirty birds (Fifteen from each of ostrich and quails). Ostrich samples were collected from specific ostrich abattoir while quails samples were collected from different local markets at Cairo and Giza Governorate. The residues of these heavy metals were detected in serum and thigh muscles of ostrich and quails carcasses by atomic absorption spectrophotometer. The present results were evaluated according to the permissible limits of Food and Agriculture Organization/World Health Organization "FAO/WHO" (1972); WHO (1972); Egyptian Organization for Standardization and Quality Control "E.O.S.Q.C." (1993) and FAO (1996). Public health importance and the hazardous toxic effects of these heavy metals as well as the suggestive recommendations to minimize pollution with these heavy metals were discussed.

INTRODUCTION

Environmental pollution is considered as one of the most important problems affecting quality of poultry meat during processing due to persistence of chemical pollutants in the tissues of birds. The most important route to poultry is water contamination with heavy metals which are arising from industrial activity (Srikanth et al., 1 993 and Abdel-Dayem, 2004). The concentration of toxic elements in poultry tissues mainly depends on the dietary concentrations and absorption of the element, concentrations of other tissue elements, homeostatic control, mechanism of the body and species of animal involved (Underwood, 1977).

Lead is a toxic substance which accumulates in the body from old house paints. Lead arsente contains large quantities of lead and acts as a possible source of lead for both man and animal. Chronic lead poisoning is particularly characterized by anemia, liver dysfunction, muscular pain, lead nephropathy and neuropathy (Goldfrank et al. 1990). Its potential carcinogenic nature has also been shown by Zawurska and Medras (1988).

Cadmium is a toxic substance accumulates in the body tissues with advanced age and causes renal failure (Gracey and Collins, 1992). Cadmium had a significant role in the incidence of some diseases as human hypertension, anemia and diabetes mellitus (Watanabe and Murayama, 1974; Merali and Singhal, 1977 and Nishiyama et al., 1986). Air pollution with cadmium from industrial sources (Manufacturing of plastics, nickel, cadmium batteries, photocells and rubber tries) may be transmitted to man through contaminated vegetables used as a food stuffs or through food of animal origin (Carstensen and Poulsen, 1974).

Copper is widely distributed in nature and also present in food. It is important in formation of erythrocytes, development of bone, C.N.S. and connective tissues. Acute exposure to copper causes hypotension and haemolytic anemia but chronic exposure to copper causes jaundice in human (Gossel and Bricker, 1990).

Therefore, the present study is carried out to determine the residues of lead, cadmium and copper in serum and tissues (thigh muscles) of ostrich and quails. The safety of these tissues to human consumption through comparing with the permissible limits are discussed.

MATERIAL AND METHODS

Collection of birds:

A total of 30 birds, 15 each of ostrich "Struthio camelus" and quails " Quternix quails " were examined. Ostrich samples were collected from specific abattoir for slaughtering ostrich at Ismailia Governorate, while quails were collected from different markets at Cairo and Giza Governorate.

Collection of blood samples:

Blood samples were collected from slaughtered ostrich and quails in sterilized screw bottles and allowed to clot. Blood samples were centrifuged at 3000 r.p.m for 10 minutes for collection of serum samples. Serum samples were stored at - 18 °C: - 20°C in deep freezer until examined for presence of heavy metals (lead, cadmium and copper) by atomic absorption spectrophotometer according to the method described by Meret and Henkin (1971) and Khan et al. (1995).

Collection of tissue samples:

Each carcass was represented by thigh muscles (50 gm in case of slaughtered ostrich and 10 gm in case of slaughtered quails). The collected samples were washed with deionized water and separ-

ately wrapped in acid washed polyethylene bags and then stored in frozen condition at - 20°C until analysis were carried out.

Digestion and analysis of samples:

Each tissue sample was thoroughly minced and digested according to the technique recommended by Khan et al. (1995). One gram of each sample was macerated in 250 ml flask and ten ml of 7:3 mixture of ultra pure concentrated nitric acid : perchloric acid (HNO3 : HClO4) were added. The flask was tightly closed. The contents were gently shaken and allowed to stand overnight at room temperature for complete digestion. The flask was warmed at 95°C until completely evaporated and then allowed to cool. The residues were redissolved in 10 ml of 1N nitric acid. The solutions were filtered through Whatman paper No. 1. The filterat was collected in tubes and kept in room temperature until analysis by using Air/Acetylene Flame Atomic Absorption Spectrophotometer (UNICAM 696 AA Spectrophotometer) for determination of lead, cadmium and copper in examined muscles.

Statistical analysis:

The obtained data were statistically analyzed according to the method recommended by Petrie and Watson (1999).

RESULTS

The concentrations of lead, cadmium and copper in serum and tissues of slaughtered ostrich and quails were statistically analyzed and summarized in Table (1) and (2). The recommended levels of heavy metals in food were illustrated in table (3).

Table (1): Concentrations of lead, cadmium and copper (p.p.m) wet weight in serum and thigh muscles of slaughtered ostrich.

Metals	No. of examined samples	Type of examined samples	Min.	Max.	$\bar{X}$	±S.E.
Lead (Pb)	15	Serum	0.092	0.225	0.144	0.010
	15	Thigh muscles	0.075	0.192	0.118	0.009
Cadmium (Cd)	15	Serum	0000	0.061	0.021	0.006
	15	Thigh muscles	0.000	0.036	0.010	0.003
Copper (Cu)	15	Serum	0.372	3.720	1.478	0.256
	15	Thigh muscles	0.350	3.451	1.353	0.230

p.p.m: Part per million.
Min. Minimum value.
Max.: Maximum value.
$\bar{X}$: Mean values
± S. E. : Standard Error.

Table (2): Concentration of lead, cadmium and copper (p.p.m) wet weight in serum and thigh muscles of slaughtered quails.

Metals	No.of examined samples	Type of examined samples	Min.	Max.	X	±S.E.
Lead (Pb)	15	Serum	0.00	0.082	0.034	0.009
	15	Thigh muscles	0.000	0.045	0.016	0.004
Cadmium (Cd)	15	Serum	0000	0.059	0.019	0.005
	15	Thigh muscles	0.000	0.040	0.012	0.003
Copper (Cu)	15	Serum	0.242	0.360	0.295	0.008
	15	Thigh muscles	0.181	0.341	0.251	0.012

p.p.m: Part per million.
Min. Minimum value.
Max.: Maximum value.
X: Mean values
± S. E. : Standard Error.

Table (3): Recommended levels of heavy metals in food

References	Heavy metals		
	Lead (Pb)	Cadmium (Cd)	Copper (Cu)
WHO (1972)	Human weekly intake 3 mg/person or 0.05 mg/ kg body weight	----------	----------
FAO/WHO (1972)	----------	Not exceed 0.04-0.05 mg/kg in food	----------
Casarett and Doull (1975)	Human daily intake 0.3mg	Human daily intake 0.018-0.20mg	Human daily intake 3.2mg
E.O.S.Q C. (1993)	Human weekly intake 0.05 mg/kg boody weight.	Humann weekly intake 0.0067-0.0083 mg/kg body weight	Daily intake 0.05-0.5 mg/kg body weight
FAO (1996)	----------	2.8µg/Kg	1.2mg/kg

E.O.S.Q.C.: Egyptian Organization for Standardization and Quality Control.
FAO: Food and Agriculture Organization.
WHO: World Health Organization.

DISCUSSION

Heavy metals make up one of the most important groups of pollutants, so it is necessary to monitor the levels of heavy metal contaminations which may be avoidably present in meat.

Lead (Pb):

The recorded results in table (1) showed that the mean values of lead in serum and thigh muscles of ostrich were 0.144 and 0.118 p.p.m wet weight while in serum and thigh muscles of quails were 0.034 and 0.016 p.p.m respectively (Table 2).

The mean values of lead in slaughtered ostrich and quails when changed from p.p.m (mg/Kg) to mg/100 gm as the human daily intake from meat is 100 gm, the obtained findings in table (1) and (2) were within the limits intended by FAO/WHO (1972); WHO (1972); Casarett and Doull (1975) and E.O.S.Q.C. (1993) in table (3). Also the obtained findings in ostrich (Table 1) were agreed with those recorded by Burger and Gochfeld (1990); Falandysz et al. (1994) in poultry and Daoud and Rashed (2002) in ostrich. Also the recorded data of quails (Table 2) were nearly similar to those recorded by Basyoni (2003). Low data of lead residues were recorded by Vose et al. (1990) in broilers muscles and turkeys muscles. Higher results of lead residues were recorded by Hegazy et al. (2004) in ostrich. From the present results it is concluded that low lead levels in serum and tissues (thigh muscles) of ostrich and quails and the results which were reported by some authors may be attributed to the collection of birds from areas subjected to low environmental pollution. This held the view reported by Doganoc (1996).

Cadmium (Cd):

Data displayed in table (1) and (2) revealed that the mean values of cadmium concentrations in serum and thigh muscles of ostrich were 0.021 and 0.010 p.p.m while in quails were 0.019 and 0.012 p.p.m respectively. The obtained data of thigh muscles in table (1) and (2) were within the permissible limits intended by FAO/WHO (1972); WHO (1972); Casarett and Doull (1975) and E.O.S.Q.C. (1993) but higher than the limits intended by FAO (1996). Low cadmium residues were recorded by Vose et al. (1990) in broilers muscles, Falandysz (1991) in ducks, geese, broilers and rabbits, Lopez-Artiguez et al. (1993) and Basyoni (2004) in quails muscles. High cadmium concentrations were recorded in ostrich by Daoud and Rashed (2002) and Hegazy et al. (2004). The high values of cadmium in comparing with the results which recoded by some authors may be due to the collection of birds from areas subjected to industrial pollution which may be increased the level of the element in surrounding environment. The actual extent of absorption depends on a number of dietary factors such as the intake of protein, calcium, vitamin D and other trace metals. Following absorption, cadmium is transported and bound to certain proteins of the plasma and red blood cells to other sites throughout the body. The cadmium is toxic to virtually every system in the body whether ingested or inhaled. However, the metabolism of the cadmium was antagonized with the copper and iron leading to anemia (Underwood, 1977).

Copper (Cu):

Data displayed in table (1) and (2) showed the mean values of copper in serum and thigh muscles in ostrich were 1.478 and 1.353 p.p.m and in

quails were 0.295 and 0.251 p.p.m wet weight respectively. Comparatively, the obtained data in table (1) and (2) were within the permissible limits intended by Casarett and Doull (1975) and E.O.S.Q.C. (1993) but higher than the limits intended by FAO (1996) in table (3). The obtained data in table (1) were agreed with those recorded by Daoud and Rashed (2002) and Hegazy et al. (2004) in ostrich, and also were nearly similar to that recorded by Basyoni (2004) in quails. Low copper concentrations were recorded by Doyle and Spaulding (1978) in chickens.

The hazardous toxic elements are investigated in this study included lead, cadmium and copper. The birds subjected to these hazardous elements differ from country to another according to the excreted from the industrial, insecticidal and dietetic regimens as well as the persistence of these pollutants in the environment. Therefore, the preventive measures intended for minimizing the pollution of meat with such metals are of significant concern, including:

1-Minimizing the use of phosphates and sludge for land fertilization as possible.

2- Regular examination of poultry for heavy metals pollution and their load of heavy metals should be evaluated according to the international guide lines as a fruitful advice to prevent environmental contaminations.

3- Use of pipe system free from polluted metals.

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تقدير بقايا بعض المعادن الثقيلة فى أمصال وأنسجة النعام والسمان

صفاء سيد عبدالحميد

قسم الكيمياء الحيوية - معهد بحوث صحة الحيوان - بالدقى

فى الآونة الأخيرة أصبحت مشكلة التلوث بالمعادن الثقيلة هى إحدى المشكلات الهامة التى تواجه الإنسان بحيث تمثل خطراً داهماً يهدد صحة الإنسان.

وقد تم تقدير ببقايا عنصر الرصاص والكادميوم والنحاس فى عدد ثلاثون طائر (خمسة عشر طائر من كلاً من النعام والسمان) حيث تم تجميع العينات من المجزر الخاص بذبح النعام وتم تجميع السمان من الأسواق المختلفة المتواجدة فى محافظتى القاهرة والجيزة.

وقد تم تقدير بقايا هذه المعادن الثقيلة فى سيرم وعضلات الفخدين لذبائح النعام والسمان بواسطة جهاز إمتصاص الطيف الذرى.

وقد تم تقييم النتائج طبقاً للحدود المسموح بها لمنظمة الأغذية والزراعة / منظمة الصحة العالمية لعام (١٩٧٢) ومنظمة الصحة العالمية لعام (١٩٧٢) والهيئة المصرية العامة للتوحيد القياسى وجودة الإنتاج لعام (١٩٩٣) ومنظمة الأغذية والزراعة لعام (١٩٩٦) وتم أيضاً مناقشة الأهمية الصحية والتأثيرات السامة لهذه المعادن الثقيلة وكيفية الحد من التلوث بهذه المعادن التص تضر بصحة المستهلكين.