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## **HEAVY METAL RESIDUES IN BLOOD AND TISSUES OF DUCK IN EL-MANZALA REGIONS IN DAKAHLIA PROVINCE**

(With 3 Tables)

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**بقايا المعادن الثقيلة في دم وانسجة البط في منطقة المنزلة بمحافظة الدقهلية**

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تم بصوره عشوائية تجميع عدد ٩٠ عينة (٣٠ عينة من العضلات و ٣٠ عينة من الكبد و ٣٠ عينة من الكلاوى) من ٣٠ ذبيحة من البط المجمع من الاسواق المختلفة المنتشرة في مركز المنزلة بمحافظة الدقهلية وكذلك عدد ٣٠ عينة من الدم من نفس البط وجمع ١٠ عينات من الماء من الصرف الزراعى وبحيرة المنزلة وذلك للكشف عن التلوث بعناصر الكاديوم والرصاص والنحاس والحديد وتم قياس هذه العناصر بواسطة جهاز الامتصاص الذرى. وقد اظهرت نتائج البحث ارتفاع نسبة التلوث بعنصر الكاديوم في الكلاوى ثم في الكبد ثم في العضلات بمتوسط  $0.830 \pm 0.054 \pm 0.316$  جزء في المليون على التوالي. بينما كانت نسبة تلوث الرصاص هي  $4.79 \pm 3.47 \pm 1.06$  جزء في المليون في الكبد ثم في العضلات ثم الكلاوى على التوالي. اما نتائج تلوث النحاس كانت  $1.94 \pm 2.66 \pm 2.82$  جزء في المليون في الكبد ثم في العضلات ثم في الكلاوى على التوالي. واطهرت النتائج ارتفاع نسبة تلوث الحديد في الكلاوى ثم الكبد ثم العضلات وقيمة تواجده كانت  $43.42 \pm 23.90$  جزء في المليون على التوالي. كما لوحظ ايضا احتواء الكبد على اعلى تركيز من الرصاص عنة في العضلات والكلاوى. بينما متوسط عناصر الكاديوم والرصاص والنحاس والحديد في دم البط هي  $0.270 \pm 3.06 \pm 2.74 \pm 37.61$  جزء في المليون على التوالي. وأيضا اظهرت النتائج ان متوسط القيم لعناصر الكاديوم والرصاص والنحاس في عينات الماء هي  $1.158 \pm 1.063 \pm 1.632$  جزء في المليون على التوالي. وتعتبر هذه المركبات لها اثر ضار على صحة الانسان.

### **SUMMARY**

The study was conducted on 90 random samples (30 for each of muscles, liver and kidney), which were collected from 30 duck carcasses, from different markets of El-Manzala regions in Dakahlia Province, also 30 blood samples from the same duck and 10 water

samples (collected from agricultural drainage and Manzala lake). Contamination by cadmium, lead, copper and iron were detected by using Flame Atomic Absorption Spectrophotometer and the results revealed cadmium concentration in kidney, liver and muscle and the values were 0.830, 0.54 and 0.316 ppm respectively. While the lead level contamination were  $4.79 \pm 3.47 \pm 1.56$  ppm in liver; muscle and kidney respectively. The copper level in liver; muscle and kidney were  $2.82 \pm 2.66 \pm 1.94$  ppm respectively. Also the iron level in kidney, liver and muscle respectively, were  $43.42 \pm 23.90 \pm 10.44$  ppm. Our results showed that, the highest contamination of cadmium level in kidney then in liver, while the highest level of lead level was in liver then in muscle. Meanwhile the values of cadmium, lead, copper and iron were  $0.270 \pm 3.56 \pm 2.74 \pm 37.61$  ppm in blood serum samples of ducks. Also the results showed that the mean values of cadmium; lead and copper in water samples were  $1.158 \pm 1.063 \pm 1.632$  ppm respectively. Cadmium and lead level detected in our results in duck tissues and water may have a critical impact on public health.

*Key words: Heavy metals, cadmium, lead, copper, iron, ducks.*

## INTRODUCTION

Environmental pollution is one of the major problems which create a health hazard to human being and animals. Heavy metals are one of the most important reasons of this pollution. They have a tendency to accumulate in tissue and organs of animals (Mahaffey, 1997; EL- Shorbagy, 2004). Metals are extensively used in the work place and employer and can result from numerous domestic agricultural and industrial effluents, geologic weathering, mining effluents, leaching, rain fall which are being discharged into surface water (Zaki, 1988). Heavy metals in soil and water may enter the food chain through the biologic cycle which includes bio concentration by plant and animals (Goyer, 1992).

The heavy metals cadmium and lead although naturally present in Marine environment, they are nutritionally non essential. Dietary exposure to high levels of these metals can be toxic to avian consumers (Scheuhammer, 1987). Other metals such as copper and iron are essential elements, but may also become toxic if excessively high concentrations are accumulated in tissues (Elliott and Scheuhammer, 1997).

Heavy metals are directly related to healthy diseases in humans. The presence of cadmium, lead, copper and iron residues in meat and edible offal's duck at significant concentration level are considered as a potential health hazard for consumers (Medani and Ahmed, 1999). Cadmium toxicity affects many target tissues such as appetite and pain centers (in brain), heart and blood vessels, kidney, liver and lungs (Iwegbue, 2008). This toxicity may cause anemia, dry and scaly skin, emphysema, fatigue, hair loss, heart disease, depressed immune system response, hypertension, joint pain, kidney stones or damage, liver dysfunction or damage, loss of sense of smell, lung cancer, pain in the back and legs as well as yellow teeth in humans (Kocak *et al.*, 2005).

Lead is recognized as a toxic substance, which accumulates in the body due to its low rate of slow elimination. Lead can adversely affect many organs, systems and numerous conditions such a hypotension, anemia, kidney damage, mental retardation. When lead level elevated in women it resulted in short gestation period, while young children suffer from mental and physical development retardation (Wagner, 1995; Kocak *et al.*, 2005).

Copper occurs in foods in many chemical forms and has important role in the physiological activities of living bodies. Abnormal high level of copper in the human blood may associate with several diseases as Mediterranean anemia, hemochromatosis, liver cirrhosis and Wilson's disease (Under Wood, 1977). High tissues level of iron correlate with increased risk of myocardial infection (Harvey and Champe, 1994).

Ducks have been recognized as an important source of protein for human consumption. In Egypt, the peoples nowadays prefer to consume ducks meat as it is more palatable and contain more fat content in comparison with those of other poultry of similar age or weight (Brahma *et al.*, 1987).

The objective of this study was to detect concentrations of cadmium, lead, copper and iron residues in livers, kidneys, muscles and serum from ducks as well as the water samples from El-Manzala regions.

## **MATERIALS and METHODS**

### **1 - Collection of samples:**

a- The present study was carried out on thirty fresh prepared duck carcasses from different markets of El-Manzala regions in Dakahlia

Governorate. Ninety specimens of muscle, liver and kidney (30 of each) were collected from investigated ducks in the period between late of May to July 2011. The samples were separately placed in polyethylene bags and kept frozen at - 20°C until analysis.

**b-** Thirty blood samples were collected from investigated duck in plastic centrifuge tubes and left to clot for 3 hours at 4°C, after that the blood samples were centrifuged to separate the serum and kept in glass vials at -20 °C until used.

**c-** Ten water samples from agricultural drainage and Manzala lake were prepared according to method described by Eaton *et al.* (1995). Each sample (8ml) was put in screw-capped tube then boiled for 1-3 hours at 130°C till complete dryness. 10 ml of 1 N Nitric acid was put on the sample and boiled till near dryness, then diluted to 20ml by using deionized water. The solution was filtrated and diluted to make 100 ml with deionized water and stored in refrigerator till analysis.

## **2 - Preparation of samples:**

The samples of muscle, liver and kidney were prepared and digested according to the technique recommended by Al-Ghais, (1995). Two grams from each sample was macerated in screw capped test tube by sharp scalpel. 10 ml of digestion mixture (4 parts of Nitric acid and one part of perchloric acid) were added to the tissue samples. The tubes were tightly closed. The contents were gently shaken and allowed to stand overnight at room temperature for complete digestion. The tubes were warmed at 95 °C until completely evaporated and then allowed to cool. The residues were re-dissolved in 10 ml of 1 N nitric acid. The resulting solutions were filtered through ashless Whatman paper No1.

## **3 - Estimation of heavy metals:**

Assessment of cadmium, lead, copper and iron concentration levels in prepared duck organs, serum and water samples were carried out using Flame Atomic Absorption Spectrophotometer (Perkin Elmer, model 3100 made in USA) according to Scheuhammer and Bond, (1991). The estimation of heavy metals residues of each sample was in ppm.

## **4 - Statistical analysis:**

Statistical analysis was carried according to Petrie and Watson (1999).

**Table 1:** The concentrations of heavy metals residues (ppm) in muscle, kidney and liver of duck (n=30 for each)

| Heavy metals | cadmium |      |                   | Lead     |      |                  | Copper   |      |                 | Iron     |       |            |
|--------------|---------|------|-------------------|----------|------|------------------|----------|------|-----------------|----------|-------|------------|
|              | Organs  | Min. | Max               | Mean±S.E | Min  | Max.             | Mean±S.E | Min  | Max.            | Mean±S.E | Min.  | Max.       |
| Muscle       | 0.01    | 0.92 | 0.32±0.04         | 0.38     | 4.22 | 3.47±0.57        | 0.34     | 5.15 | 2.66±0.26       | 2.95     | 29.36 | 10.44±1.18 |
| Kidney       | 0.19    | 3.10 | 0.83±0.14         | 0.07     | 3.56 | 1.56±0.22        | 0.20     | 5.48 | 1.94±0.29       | 23.58    | 77.98 | 43.42±2.77 |
| Liver        | 0.05    | 1.08 | 0.54±0.07         | 0.56     | 5.14 | 4.79±0.51        | 0.22     | 6.35 | 2.82±0.32       | 7.81     | 44.27 | 23.90±2.09 |
| P.L.         |         |      | 0.05 <sup>a</sup> |          |      | 0.5 <sup>a</sup> |          |      | 20 <sup>b</sup> |          |       |            |

<sup>a</sup>(P.L.) permissible limits(ppm) for tissues FAO / WHO, (1992). (Pb, Cd)

<sup>b</sup>(P.L.) permissible limits(ppm) for pearson, (1976) for (Cu)

**Table 2:** Mean ( $\pm$ S.E.) concentrations of heavy metals (ppm) in serum samples of examined ducks. (n=30)

| Heavy metals | Min.  | Max.  | Mean $\pm$ S.E.   |
|--------------|-------|-------|-------------------|
| Cadmium      | 0.010 | 0.690 | 0.270 $\pm$ 0.035 |
| Lead         | 0.181 | 4.01  | 3.56 $\pm$ 0.538  |
| Copper       | 0.417 | 5.22  | 2.744 $\pm$ 0.263 |
| Iron         | 8.22  | 75.24 | 37.614 $\pm$ 2.70 |

**Table 3:** Analytical results for heavy metals residues (ppm) in water samples collected from AL-manzala regions: (n=10)

| Heavy metals | Min.  | Max.  | Mean $\pm$ SE     | P.L |
|--------------|-------|-------|-------------------|-----|
| Cadmium      | 0.208 | 2.125 | 1.158 $\pm$ 0.208 | 0.7 |
| Lead         | 0.427 | 2.54  | 1.063 $\pm$ 0.188 | 0.5 |
| Copper       | 0.681 | 3.55  | 1.632 $\pm$ 0.278 | 2.0 |

- 10 samples examined. P.L. is the permissible limits by ppm. Permissible limits according to WHO, (1993).

## DISCUSSION

The analytical results listed in Table (1) showed that the mean cadmium concentration levels in muscle, kidney and liver of duck carcasses were 0.316 $\pm$ 0.043, 0.83 $\pm$ 0.137 and 0.54 $\pm$ 0.065 ppm respectively, exceeded the permissible limits of cadmium in poultry tissues (0.05ppm), recommended by FAO / WHO, (1992). The obtained results are coincide with Medani and Ahmed, (1999); Abdel-Dayem, (2004) and Sanya El-Ghamry *et al.* (2008). The levels of cadmium in examined ducks were highest in kidney followed by liver and muscles. These findings agreed with those reported by Lee *et al.* (1989); Abd El-Kader and El-Atabanay, (1994), which stated that the kidney as being the major storage site for cadmium. Cadmium bound to albumin and other high molecular weight proteins, and then the liver takes up cadmium from plasma, where it induces synthesis of metallothionein. Mainly, the cadmium-metallothionein in plasma is effectively filtered

through the renal glomeruli then reabsorbed in the proximal tubule where it gradually accumulates (Koriem *et al.*, 2009). Thus the elimination of cadmium from the kidney is very slow, with a biological half-life of several decades (FAO/ WHO, 1992).

Table (1), declared that the mean values of lead in muscle, kidney and liver of ducks were  $3.47 \pm 0.57$ ,  $1.56 \pm 0.22$  and  $4.79 \pm 0.51$  ppm respectively. These exceeded the permissible limits of lead in poultry tissues (0.5 ppm), recommended by FAO / WHO, (1992). These findings were much higher than that previously determined by Medani and Ahmed, (1999); Abdel-Dayem, (2004); Sanya El-Gamry *et al.* (2008). It was found that the liver have the highest value of lead followed by muscles and kidney. The obtained results agree with, (Abdel-Kader and Atabany 1994) and Ahmad, (2002), who found that the high concentration of lead in liver, muscle and kidney of examined ducks may be attributed to the dietary habit of ducks. Regarding to public health significance, lead is a cumulative poison that causes both acute and chronic intoxication, acute poisoning is rare but chronic poisoning is more common and serious (Gossel and Bricker, 1990). Also severe and chronic exposure of lead causes hematological, gastrointestinal and neurological dysfunction and may also lead to chronic nephropathy, hypertension and reproductive impairment, (Friend, 1987).

Concerning copper in different tissues of ducks, Table (1) showed that the mean concentration in muscle, kidney and liver were  $2.66 \pm 0.26$ ;  $1.94 \pm 0.29$  and  $2.82 \pm 0.32$  ppm respectively. In this respect, Nassar *et al.* (1998), determined 3.6 and 3.8 ppm copper residues in muscle and liver of broiler. The obtained results were lower than the permissible limits of copper in poultry tissues (15, 20 ppm) recommended by Pearson, (1976) and FAO / WHO, (1992). Moreover, similar results were reported by Sanya El-Ghamry *et al.* (2008) in liver (2.23 ppm), while in muscle recorded (0.83 ppm). Copper is known to be essential at low concentrations but it's toxic effect at high levels. Accordingly ingestion of an excessive dose of copper may lead to sever nausea, hypertension, jaundice and bloody diarrhea. Moreover, chronic copper poisoning may result in what known Wilson's disease which manifested by destruction of nerve cells, liver cirrhosis, edema, ascitis and hepatic failure (Gossal and Bricker, 1990).

The mean values of iron in muscles, kidney and liver of ducks were  $10.44 \pm 1.18$ ;  $43.42 \pm 2.77$  and  $23.90 \pm 2.09$  ppm respectively. It was

noticed that the kidney exhibits the highest level of iron followed by liver and muscles. These results are agreed with VanWyk *et al.* (2001), who found that the highest level of iron in kidney then in liver and muscle.

Concerning heavy metals residues in serum samples Table (2) showed that the mean values of cadmium, lead, copper and iron were 0.270, 3.56, 2.74 and 37.61 respectively. The obtained results coincided with those reported by VanWyk *et al.* (2001), who found that the high levels of heavy metals in blood resulted from pollution of soil, water and air through mining, refining and smelting operations. Other sources of environmental contamination of heavy metals include the combustion of fossil, fuel, municipal waste incineration and agricultural practices including the use of phosphate fertilizers and sludge amendment for soil, (Friberg *et al.*, 1986; Goyer, 1986).

Regarding to heavy metal levels in water samples collected from different regions of El-Manzala, Table (3) showed that the mean values of cadmium, lead and copper residues were 1.158, 1.063 and 1.632 ppm respectively. These concentrations were exceeded the permissible limit recommended by WHO, (1993). It is obviously clear that the water of El-Manzala were heavily polluted with such heavy metals. The obtained results nearly agree with those recorded by Aeria, (1998); Medani and Ahmed, (1999) and Ahmad, (2002). The obtained results could be interpreted as El-Manzala water mainly receives from Bahr El-Baqar, which carries the untreated sewage of four Governorates, Cairo, Qallyobia, Sharkia and Dakhalia (Khalil and Salib, 1986). Heavy metal pollution in water is generally associated with industrial, agricultural and municipal discharges (Zaghloul, 2000; El-Dessouky *et al.*, 2007). The highly concentrations of heavy metals (cadmium, lead and copper) among the water samples collected from different locations in El-Manzala could be attributed to the differences in the effluents (waste municipal, agricultural drainage water also from the decomposition of the organic matter and the use of fertilizers and other chemicals in agriculture. This is in agreement with Nagdi and Shaker, (1998); Zaghloul, (2000); El-Dessouky *et al.* (2007). When ducks repeat consumption of water polluted by such heavy metals, irreversible progressive will occur in their body as accumulative effect reaching as high as in water, a process called biological magnification. It reflects the toxic effect of these metals on duck or human consumes their meat



in form of serious diseases on the long run. Metal levels in blood provide information about recent exposure (Mautino and Bell, 1986; Evers *et al.*, 1998). Further more, blood levels of certain metals are influenced by total body burden or levels in organs such as liver and kidney. This is because of a continual process of equilibration between levels of metals in blood and various soft tissues in which metals may be stored over the long-term, (WayLand *et al.*, 2001; Olsson *et al.*, 2005).

From the above mentioned results, it can be concluded that the presence of heavy metals contaminants in duck meat and organs may act as an additional source of hazard for human causing considerable economic loss.

Preventive measures intended for minimizing the heavy metals residues in duck tissues are of significant concern.

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