**BENHA VETERINARY MEDICAL JOURNAL, VOL. 24, NO. 1, JUNE 2013: 161-171**

BENHA UNIVERSITY
FACULTY OF VETERINARY MEDICINE

# HEAVY METAL RESIDUES IN FRESH AND READY - TO – EAT EDIBLE OFFAL

Hassan, M. A.a; Reham, A. Amina¬; El- Ekhnawy, K. I. band Naglaa, A. El-Taibb
[a]*Food Control Department, Fac. Vet. Med., Benha University.* [b]*Food Hygiene, Animal Health Research Institute, Tanta*

**A B S T R A C T**

A total of 90 random samples of fresh and ready - to – eat (RTE) cattle edible offal represented by kidney, liver and spleen (30 of each organ: 15 as fresh samples and 15 as RTE samples) were collected from different butcher's shops and edible offal serving establishment masmats in Zifta and Tanta cities at Gharbia governorate and directly transferred to the laboratory for determination of their contents of lead, cadmium, copper and mercury. The obtained results indicated that the mean values of lead concentration in the examined samples of fresh kidney, liver and spleen were 0.98 ± 0.06, 0.72 ± 0.03 and 0.57 ± 0.02 mg/kg wet weight, respectively, while such values in RTE samples were 1.23 ± 0.07, 0.95 ± 0.04 and 0.69 ± 0.03 mg/kg wet weight, respectively. According to 'EOS [5] the percentages of unaccepted fresh kidney, liver and spleen samples were 33.33%, 20% and 6.67%, respectively, while, 46.67%, 40% and 20%, respectively, in RTE samples. However, the mean values of cadmium concentration in the examined samples of fresh kidney, liver and spleen were 1.87 ± 0.14, 1.48 ± 0.10 and 1.04 ± 0.07mg/kg wet weight, respectively, while such values in RTE samples were 2.39 ± 0.15, 2.01 ± 0.08 and 1.44 ± 0.09 mg/kg wet weight, respectively. According to EOS [5] the percentages of unaccepted fresh kidney, liver and spleen samples were 13.33%, 13.33% and zero%, respectively, while, 26.67%, 20% and 6.67%, respectively, in RTE samples. Meanwhile, the mean values of copper concentration in the examined samples of fresh kidney, liver and spleen were 5.28 ± 0.30, 2.35 ± 0.17 and 4.96 ± 0.26 mg/kg wet weight, respectively, while such values in RTE samples were 5.52 ± 0.34, 2.76 ± 0.18 and 5.07 ± 0.29 mg/kg wet weight, respectively. According to [7] all the examined samples of fresh and RTE edible offal were accepted. Whereas, the mean values of mercury concentration in the examined samples of fresh kidney, liver and spleen were 0.29 ± 0.02, 0.25 ± 0.01 and 0.11 ± 0.01 mg/kg wet weight, respectively, while such values in RTE samples were 0.37 ± 0.02, 0.28 ± 0.01 and 0.16 ± 0.01 mg/kg wet weight, respectively. According to[8], the percentages of unaccepted fresh kidney, liver and spleen samples were 6.67%, zero% and zero %, respectively, while, 6.67%, 6.67 % and zero%, respectively, in RTE samples. The differences between the examined samples of fresh and RTE edible offal were highly significant ($p < 0.01$) according to their lead, cadmium, copper and mercury contents. Public health significance and the possible sources of contamination of such fresh and RTE edible offal, as well as some recommendations to improve the quality of such food articles were discussed.

**Key words:** Lead, cadmium, copper, mercury, kidney, liver, spleen, fresh and ready to eat edible offal.

**(BVMJ-24 [1]: 161-171,** 2013**)**

## 1. INTRODUCTION

Today, the environmental pollution by heavy metals is considered as one of the most serious problems in the world over the last few decades. Emissions of heavy metals to the environment occur via a wide range of pathways, including air, water, soil, natural and anthropogenic sources, rapid industrialization, increase in road traffic, consumer habits and life style [33]. Environmental exposure through food is increasingly recognized as an important source of heavy metal exposure in developed countries [15]. Heavy metal pollutants can contaminate the products during processing through raw materials, cooking utensils, food packaging and spices used during processing of meatball, corned beef, beef burger and sausages [27]. Street food vendors obtain their pots and utensils from both formal and informal manufactured using scrap metal obtained from diverse sources such as derelict cars, car batteries and industrial machinery Heavy metals from these pots could reach into the food [19].

Heavy metal toxicity could be present in different ways depending on its route of ingestion, its chemical form, dose, tissue affinity, age and sex, as well as whether exposure is acute or chronic [15].

Contamination of meat and other edible tissues with heavy metals is a matter of great concern for food safety and human health due to progressive irreversible bioaccumulation in human body organs, especially kidney, liver and spleen. Furthermore, heat treatment of food for long period of time cannot destroy heavy metals. Thus, there is a great risk associated with the consumption of RTE edible offals if they are manufactured from already contaminated raw edible offal [4].

Owing to their toxicity persistence and tendency to accumulate, heavy metals when occurring in higher concentrations, become severe toxins for human being and all living organisms through alteration of physiological activities and biochemical parameters in blood and tissues, through affecting nervous, cardiovascular, renal and reproductive systems and through defects in cellular uptake mechanisms in the mammalian liver and kidney, inhibiting hepatic and renal sulfate / bicarbonate transporter causing sulfaturia [14]. With respect to human health impacts, lead, cadmium, copper and mercury are of primary concern because of their known toxicity to human being [26].

Lead is recognized as a toxic substance which accumulates in the body due to its low rate of elimination. The classic symptoms of lead poisoning are colic, abdominal pain, anemia and encephalopathy. As well as, lead is considered as one of immunosuppressive agents in human [3].

Cadmium is a very toxic heavy metal, which accumulates inside the body particularly kidneys leading to kidney stones. Generally, the ingestion of cadmium may result in acute gastroenteritis which is characterized by sudden onset of vomition, diarrhea and abdominal pain. Moreover, cadmium poisoning may result in a case called Itai - Itai or Ouch - Ouch disease which is characterized by severe pain, soft bones and death which may occur as a result of renal failure[16].

Copper is known to be essential at low concentrations, but toxic at high levels. However, ingestion of excessive doses of copper may lead to severe nausea, bloody diarrhea, and hypotension and jaundice. Chronic copper poisoning may lead to Wilson,s disease which is manifested by destruction of nerve cells, liver cirrhosis, aschitis, edema and hepatic failure. Also, copper poisoning is characterized by Kayser Fleischer ring which is a golden brown ring of accumulated copper in the cornea of the eye[8].

Meanwhile, mercury compounds are highly toxic, because they are fat soluble and easily absorbed and accumulated in erythrocytes and CNS. The early symptoms of methyl mercury poisoning "Minamata disease" included loss of sensation at the extremities of fingers and toes and areas around the mouth, loss of coordination, slurred speech, diminution of vision (tunnel vision) and loss of hearing [9].

Therefore, the aim of the present study was to throw out a light on determination of the residual concentrations of lead, cadmium, copper and mercury in some fresh and RTE cattle edible offal (liver, kidney and spleen) and determination of the acceptability of the examined samples of fresh and RTE edible offal based on their heavy metals contents through comparing the obtained results with the safe permissible limits recommended by international organizations.

## 2. MATERIALS AND METHODS

• Collection of Samples:

Ninety random samples of fresh and ready- to –eat cattle edible offal represented by liver, kidney and spleen (30 of each organ: 15 as fresh samples and 15 as ready-to-eat samples) were collected from different butcher's shops and masmats edible offal serving establishment in Zifta and Tanta cities at Gharbia governorate. The collected samples were directly transferred to the laboratory for determination of their contents of lead, cadmium, copper and mercury.

• Digestion Procedure:

One gram of each sample was macerated by sharp scalpel in a screw capped tube. Five milliliters of the digestion mixture (60 ml nitric acid 65% and 40 ml perchloric acid 70-72%) were added to the tissue sample. The tubes were tightly closed and the contents were vigorously shaked and allowed to stand overnight. Then the tubes were heated for 3 hours in water bath adjusted at 70°C to ensure complete digestion of the samples. The digestion tubes were vigorously shaked at 30 minutes intervals during the heating period. Finally the tubes were cooled at room temperature and then diluted with 5 ml de-ionized water, and filtered by using filter paper (Wattman No. 42). The filtrate was collected in polyethylene tubes. These tubes were capped with polyethylene film and kept at room temperature until analyzed for heavy metal contents.

• Determination and Analysis:

The concentration of heavy metals in the digested samples, blank and standard solutions were determined by using Atomic Absorption Spectrophotometer (AAS) (UNICAM 969 AA Spectrophotometer) which was adjusted at 217.0 nm for lead, 228.8 nm for cadmium, 324.8 nm for copper and 253.7 nm for mercury. Absorbance and concentration were recorded on the digital scale of AAS.

• Calculation and Quantitative determination of heavy metals:

The concentrations of heavy metals were calculated as ppm (mg/kg) on wet weight of the examined samples according to the following equation:

Metal concentration (mg/kg) wet weight = C x V/W

Where C is the concentration of the metal in the sample extract as determined by AAS (mg/L), V is the volume of the extract (ml) and W is the weight of the sample (g).

Mercury absorbance was recorded directly from the digital scale of AAS, and the concentration was calculated according to the following equation:

$C1= (A1/A2) \times C \times (D/W)$.

C1=Concentrations of heavy metals (mg/kg) wet weight.

A1=Absorbance reading of the sample solution.

A2=Absorbance reading of the standard solution.

C=Concentration of heavy metals (mg/kg) of the standard solution.

D=Dilution of the sample.

W=Weight of each sample.

• Statistical Analysis:

All the obtained results were evaluated statistically according to analysis of variance "ANOVA" test [28].

## 3. RESULTS

**Table (1): Statistical analytical results of lead levels (mg/kg) in the examined samples of fresh and ready to eat cattle edible offal (n=15)**

| Treatment | Fresh | | | Ready – to - Eat | | |
|---|---|---|---|---|---|---|
| Offal | Min. | Max. | Mean ± S.E | Min. | Max. | Mean ± S.E* |
| Kidney | 0.31 | 1.56 | 0.98 ± 0.06 | 0.46 | 2.05 | 1.23 ± 0.07 |
| Liver | 0.19 | 1.34 | 0.72 ± 0.03 | 0.30 | 1.61 | 0.95 ± 0.04 |
| Spleen | 0.12 | 1.08 | 0.57 ± 0.02 | 0.18 | 1.22 | 0.69 ± 0.03 |

***S.E=** Standard error of mean.
= High significant differences (P<0.01)

Table (2): Acceptability of the examined samples of fresh and ready to eat cattle edible offal based on their contents of lead (n=15)

| Offal | Maximum Permissible Limit (mg/kg)* | Positive samples | | Unaccepted Samples | |
|---|---|---|---|---|---|
| | | No. | % | No. | % |
| *Kidney:* | | | | | |
| Fresh | 0.5 | 8 | 53.33 | 5 | 33.33 |
| Ready – to - Eat | 0.5 | 9 | 60.00 | 7 | 46.67 |
| *Liver:* | | | | | |
| Fresh | 0.5 | 6 | 40.00 | 3 | 20.00 |
| Ready – to - Eat | 0.5 | 8 | 53.33 | 6 | 40.00 |
| *Spleen:* | | | | | |
| Fresh | 0.5 | 3 | 20.00 | 1 | 6.67 |
| Ready – to - Eat | 0.5 | 5 | 33.33 | 3 | 20.00 |

*Egyptian Organization for Standardization "EOS" (2005).

Table (3): Statistical analytical results of cadmium levels (mg/kg) in the examined samples of fresh and ready to eat cattle edible offal (n=15)

| Treatment / Offal | Fresh | | | Ready – to - Eat | | |
|---|---|---|---|---|---|---|
| | Min. | Max. | Mean ± S.E | Min. | Max. | Mean ± S.E* |
| Kidney | 1.02 | 2.96 | 1.87 ± 0.14 | 1.28 | 3.14 | 2.39 ± 0.15 |
| Liver | 0.79 | 2.53 | 1.48 ± 0.10 | 0.91 | 2.85 | 2.01 ± 0.08 |
| Spleen | 0.36 | 1.71 | 1.04 ± 0.07 | 0.57 | 2.08 | 1.44 ± 0.09 |

***S.E=** Standard error of mean.
= High significant differences ($P<0.01$)

Table (4): Acceptability of the examined samples of fresh and ready to eat cattle edible offal based on their contents of cadmium (n=15)

| Offal | Maximum Permissible Limit (mg/kg)* | Positive samples | | Unaccepted Samples | |
|---|---|---|---|---|---|
| | | No. | % | No. | % |
| *Kidney:* | | | | | |
| Fresh | 2.0 | 5 | 33.33 | 2 | 13.33 |
| Ready – to - eat | 2.0 | 6 | 40.00 | 4 | 26.67 |
| *Liver:* | | | | | |
| Fresh | 2.0 | 4 | 26.67 | 2 | 13.33 |
| Ready – to - eat | 2.0 | 5 | 33.33 | 3 | 20.00 |
| *Spleen:* | | | | | |
| Fresh | 2.0 | 2 | 13.33 | 0 | 0 |
| Ready – to - eat | 2.0 | 4 | 26.67 | 1 | 6.67 |

*Egyptian Organization for Standardization "EOS" (2005)

Table (5): Statistical analytical results of copper levels (mg/kg) in the examined samples of fresh and ready to eat cattle edible offal (n=15)

| Treatment / Offal | Fresh | | | Ready – to - eat | | |
|---|---|---|---|---|---|---|
| | Min. | Max. | Mean ± S.E | Min. | Max. | Mean ± S.E* |
| Kidney | 2.66 | 7.39 | 5.28 ± 0.30 | 2.74 | 7.61 | 5.52 ± 0.34 |
| Liver | 1.14 | 4.07 | 2.35 ± 0.17 | 1.35 | 4.29 | 2.76 ± 0.18 |
| Spleen | 2.31 | 7.12 | 4.96 ± 0.26 | 2.36 | 7.33 | 5.07 ± 0.29 |

*S.E= Standard error of mean.
= High significant differences ($P<0.01$)

Table (6): Acceptability of the examined samples of fresh and ready to eat cattle edible offal based on their contents of copper (n=15)

| Offal | Maximum Permissible Limit (mg/kg)* | Positive samples | | Unaccepted Samples | |
|---|---|---|---|---|---|
| | | No. | % | No. | % |
| ***Kidney:*** | | | | | |
| Fresh | 20 | 15 | 100 | 0 | 0 |
| Ready – to - Eat | 20 | 15 | 100 | 0 | 0 |
| ***Liver:*** | | | | | |
| Fresh | 20 | 15 | 100 | 0 | 0 |
| Ready – to - eat | 20 | 15 | 100 | 0 | 0 |
| ***Spleen:*** | | | | | |
| Fresh | 20 | 15 | 100 | 0 | 0 |
| Ready – to - eat | 20 | 15 | 100 | 0 | 0 |

*Food Stuffs Cosmetics and Disinfectant Act (2002).

Table (7): Statistical analytical results of mercury levels (mg/kg) in the examined samples of fresh and ready to eat cattle edible offal (n=15)

| Treatment / Offal | Fresh | | | Ready – to - Eat | | |
|---|---|---|---|---|---|---|
| | Min. | Max. | Mean ± S.E | Min. | Max. | Mean ± S.E* |
| Kidney | 0.16 | 0.52 | 0.29 ± 0.02 | 0.19 | 0.60 | 0.37 ± 0.02 |
| Liver | 0.13 | 0.37 | 0.25 ± 0.01 | 0.14 | 0.47 | 0.28 ± 0.01 |
| Spleen | 0.04 | 0.18 | 0.11 ± 0.01 | 0.06 | 0.26 | 0.16 ± 0.01 |

*S.E= Standard error of mean.

= High significant differences (P<0.01)

Table (8): Acceptability of the examined samples of fresh and ready to eat cattle edible offal based on their contents of mercury (n=15)

| Offal | Maximum Permissible Limit (mg/kg)* | Positive samples | | Unaccepted Samples | |
|---|---|---|---|---|---|
| | | No. | % | No. | % |
| ***Kidney:*** | | | | | |
| Fresh | 0.5 | 3 | 20.00 | 1 | 6.67 |
| Ready – to - eat | 0.5 | 3 | 20.00 | 1 | 6.67 |
| ***Liver:*** | | | | | |
| Fresh | 0.5 | 2 | 13.33 | 0 | 0 |
| Ready – to - eat | 0.5 | 3 | 20.00 | 1 | 6.67 |
| ***Spleen:*** | | | | | |
| Fresh | 0.5 | 2 | 13.33 | 0 | 0 |
| Ready – to - eat | 0.5 | 2 | 13.33 | 0 | 0 |

*FAO/WHO (2000)

## 4. Discussion

Heavy metals are considered as the main toxic byproducts causing serious health hazards to human and animal populations through progressive irreversible accumulation in their bodies because of repeated consumption of small amounts of these elements [4]. Thus, it is of great importance to determine the concentrations of heavy metals in edible offal, which became an essential part of human fast food.

It is evident from results recorded in table (1) that the concentrations of lead in the examined samples of fresh kidney, liver and spleen ranged from 0.31 to 1.56 with a mean value of 0.98 ± 0.06, 0.19 to 1.34 with a mean value of 0.72 ± 0.03 and 0.12 to 1.08 with a mean value of 0.57 ± 0.02 mg/kg, respectively, and from 0.46 to 2.05 with a mean value of 1.23 ± 0.07, 0.30 to 1.61 with a mean value of 0.95 ± 0.04 and 0.18 to 1.22 with a mean value of 0.69 ± 0.03 mg/kg in the corresponding RTE examined samples, respectively. These differences between the examined samples of fresh and RTE edible offals were highly significant ($p < 0.01$). The obtained results were nearly similar to those reported by [17]; on the other hand lower results were reported [20, 25]. While, higher results were obtained [21, 30].

According to the safe permissible limit stipulated by EOS [5] for lead in fresh and RTE edible offals (0.5 ppm), it was indicated that 33.33%, 20% and 6.67% of the examined fresh samples, and 46.67%, 40% and 20% of the examined RTE samples of kidney, liver and spleen, respectively, were not in accordance with this limit (table 2).

The higher lead concentrations in the examined RTE samples than in the examined fresh samples may be attributed to the heat treatment during cooking processing, leaching from utensils, corrosion of packing materials, using raw materials, water and food additives as spices, pepper which contain higher levels of lead (> 2.2 ppm) as recorded by [29]. It has been reported that using of old ceramic dinnerware and dishes containing uranium and copper glazes for microwave heating of common foods may lead to leaching and ingestion of large amounts of lead as previously recorded [31].

Results achieved in table (3) revealed that the concentrations of cadmium in the examined samples of fresh kidney, liver and spleen ranged from 1.02 to 2.96 with a mean value of 1.87 ± 0.14, 0.79 to 2.53 with a mean value of 1.48 ± 0.10 and 0.36 to 1.71 with a mean value of 1.04 ± 0.07 mg/kg, respectively, and from 1.28 to 3.14 with a mean value of 2.39 ± 0.15, 0.91 to 2.85 with a mean value of 2.01 ± 0.08 and 0.57 to 2.08 with a mean value of 1.44 ± 0.09 mg/kg in the corresponding RTE examined samples, respectively. These differences between the examined samples of fresh and RTE edible offal were highly significant ($p < 0.01$). Nearly similar results were obtained by [23] and lower results were reported by [10, 1] while higher results were obtained by [11].

Table (4) showed that 13.33%, 13.33% of the examined fresh kidney and liver samples, respectively, and 26.67%, 20% and 6.67% of the examined RTE samples of kidney, liver and spleen, respectively, exceeded the safe permissible limit recommended by EOS [5] for cadmium in fresh and RTE edible offal (2 ppm). While, all the examined samples of fresh spleen were accepted according to such this limit.

The high significant differences between the examined samples could be attributed to different breeding environments, variations in the daily sources of food, and the individual inherent capacity of the animals to excrete heavy metals through their urine and dung. However, the higher cadmium concentrations in the examined RTE samples than in the examined fresh samples may be due to adding cooking spices and herbs (garlic, onion and pepper) which contain cadmium and pesticides may be a source of cadmium as recorded by [18].

Furthermore, table (5) indicated that the concentrations of copper in the examined samples of fresh kidney, liver and spleen ranged from 2.66 to 7.39 with a mean value of 5.28 ± 0.30, 1.14 to 4.07 with a mean value of 2.35 ± 0.17 and 2.31 to 7.12 with a mean value of 4.96 ± 0.26 mg/kg, respectively, and from 2.74 to 7.61 with a mean value of 5.52 ± 0.34, 1.35 to 4.29 with a mean value of 2.76 ± 0.18 and 2.36 to 7.33 with a mean value of 5.07 ± 0.29 mg/kg in the corresponding RTE examined samples, respectively. These differences between the examined samples of fresh and RTE edible offal were highly significant ($p < 0.01$). similar lower results were obtained [12, 22]. Higher results were obtained [13, 1].

Moreover, table (6) showed that all the examined samples of fresh and RTE edible offal were accepted based on their copper content according to FAO [6] which stated that the maximum permissible limit for copper should not exceed 20 mg/kg in fresh and RTE edible offal.

Copper is an important constituent in a number of different enzymes in man and animals; it accumulates mostly in muscle and liver acting as essential element for haemoglobin formation and hair keratin. However, it may be toxic for both animals and humans causing liver cirrhosis and liver debilitating condition in continuous ingestion. Accordingly, ingestion of excessive doses of copper may lead to Wilson's disease which manifested by destruction of nerve cells, liver cirrhosis, aschitis oedema and hepatic failure [13].

It is evident from results recorded in table (7) 7 that the concentrations of mercury in the examined samples of fresh kidney, liver and spleen ranged from 0.16 to 0.52 with a mean value of 0.29 ± 0.02, 0.13 to 0.37 with a mean value of 0.25 ± 0.01 and 0.04 to 0.18 with a mean value of 0.11 ± 0.01 mg/kg, respectively, and from 0.19 to 0.60 with a mean value of 0.37 ± 0.02, 0.14 to 0.47 with a mean value of 0.28 ± 0.01 and 0.06 to 0.26 with a mean value of 0.16 ± 0.01 mg/kg in the corresponding RTE examined samples, respectively. These differences between the examined samples of fresh and RTE edible offal were highly significant ($p < 0.01$). The obtained results were nearly similar to those reported by [12] and [20]. On the other hand, lower results were reported by. [35]. While, higher results were obtained by [24] and [32]. According to the safe permissible limit stipulated by FAO [6] for mercury in fresh and RTE edible offals (0.5 ppm), it was indicated that 6.67%, 6.67% and of the examined fresh, RTE kidney and RTE liver samples, respectively, were not in accordance with this limit, while, all the examined samples of fresh liver, spleen and RTE spleen were in accordance with this limit (table 8).

Therefore, the variations observed in the concentrations of mercury residues in the examined raw samples may be due to differences in pasture, amount and type of sludge treatment and differences in the type of feed offered to cattle. Moreover, excessive use of sludge to fertilize the soil or to compensate the mechanically eroded soil may be the direct cause of elevated levels of mercury residues as reported previously [2].

Methyl mercury crossed effectively both the blood–brain and the placenta barriers, resulting in higher concentrations of mercury in the brain of fetus than that of mother. Moreover, methyl mercury is eliminated mainly via bile and faeces. Neonatal animals have a lower excretory capacity than adults. Methyl mercury is toxic to the nervous system, kidney, liver and reproductive organs as recorded by WHO [34].

Finally, it can be concluded that excessive use of sewage (as pasture top dressing) or phosphatic fertilizer (superphosphate), together with environmental pollution from industrial mining and smelting sources, leaching from equipment and utensils and contamination during heating and cooking processing leads to elevated levels of heavy metals (especially lead and cadmium) in both fresh and RTE edible offal was reported [29].

## REFERENCES


1. Abdelfattah, M. E.; Hanan, M. T. E.; El-Sabey, E. S. (2011): Heavy metal residues in local bovine meat and edible offal in Zagazig city. Conference paper : Proceeding of the 4th Scientific Conference of Animal Wealth Research in the Middle East and North Africa, Fo Agricultural Relations (FAR), Egypt, 3-5 October 2011 pp. 134-143.
2. Abou-Arab, A.K. (2001): Heavy metal content in Egyptian meat and the role of detergent on their levels. Food and chemical Toxicology, **39**: 593-599.
3. Bryson, P. D. (1989): Comprehensive review in toxicology. Second Ed. Aspen publishers, Inc. Rock Vile, Maryland, Royal Cambridge wells. Chap. 39, Pp. 456-484.
4. Chitmanat C. and Traichaiyaporn, S. (2010): Spatial and temporal variations of physical-chemical water quality and some heavy metals in water, sediment and fishes of the Mae Kuang River, Northern Thailand. Int J Agric Biol, **12**: 816–820.
5. Egyptian Organization for Standardization Quality and Control ‘‘EOS’’ (2005): Detection of poisons and control. Report No. 1796.
6. Food and Agricultural Organization (FAO, 2000): Report of the Codex Committee on Food Additives and Contaminants. Available on www.FAO/drocrep/meeting/005
7. Food Stuff Cosmetic and Disinfectant Act (2002): Act 54.of 1972. Regulation governing the maximum limit of pesticid that may be present in food stuff. Published under government Notice 246 I in Government Gazatte 15486 of 11 February amended by GNR 525 GG. 2336103/5/2002 Pretoria: Doh.
8. Gossel T. A. and Bricker J. D. (1990): Principles of clinical Toxicology. Second Ed. Raven Press Ltd. New York. pp. 162-192.
9. Gupta PK (2010): Elements of Biotechnology, 3rd Edition. Rastogi Publication Meerut. A Position Paper10.
10. Harlia E., and Balia, R. L. (2008): The food safety of livestock products studied from heavy metal residues contamination. Animal Production, **12**(1): 50-54. Faculty of Animal Science Padjadjaran University, Jln. Raya Bandung- Sumedang. Indonesia.
11. Hala, S. M. and Shireen, M. N. (2009): Estimation of some heavy metals in chicken shawarma. Egypt. J. Comp. Path. and Clinic. Path., **22**(3): 24 – 36.
12. Helmy, N. Z. (1999): Heavy metals residues in goat tissues in urban and ruralareas, M. V. Sc. Thesis (Meat Hygiene) Fac. Vet. Med, Zagazig University.
13. Irfana, Mariami, Shehla, I. and Saeed, A. N. (2004): Distribution of some trace and macro minerals in beef, mutton and poultry. Int. J. Agriculture and Biology **6**(5): 816-820.
14. Javed, I.; Jan, I.; Muhammad, F.; Zia-ur-Rahman, M.; Zargham, B. and Aslam, J. I. Sultan (2009): Heavy metal residues in the milk of cattle and goats during winter season. Bull. Environ. Contam. Toxicol., **82**: 616-620.
15. Johri, N.; Jacquillet, G. and Unwin, R. (2010): Heavy metal poisoning: the effects of cadmium on the kidney. Biometals, **23**: 783-792.
16. Kazantzis, G. (2004): Cadmium, osteoporosis and calcium metabolism. J. Biometals, **17**(5): 493- 498.
17. Koréneková, B.; Skalická, M. and Nad, P. (2002): Veternarski Ashiv. **72**, 259.

18. Krejpcio, Z.; Krol, E. and Sionkowski, S. (2007): Evaluation of heavy metal contents in spices and herb available on the polish market. Polish J. Environ. Stud., **16**(1): 97-100.
19. Mensah, P.; Yeboah - Manu, D.; Owusu - Darko, K. and Ablordey, A. (2002): Street foods in Accra, Ghana: how safe are they? Bulletin of the World Health Organization, **80**(7): 546–554.
20. Mervate K. I. and Nabila F. S. (2009) :some heavy metal residues in fast foods (ready to eat) collected from Alexandria governorate Mansoura ,Vet. Med. J. vol. XI, No. 2, p. 149-158.
21. Miranda, M.; López-Alonso, M.; Castillo, C; Hernádez,J.; Benedito. J. (2005): Effects of moderate pollution on toxic and trace metal level in Calves Spain. J. Environ. From pollouted area of Northen Sci., **l31**:543-548.
22. Miranda M, Benedito JL, Blanco-Penedo I, Lopez-Lamas C, Merino A, Lopez-Alonso M ( 2009). Metal accumulation in cattle raised in a Serpentine-soil area: Relationship between metal concentrations in Soil, Forage, and Animal tissues. J. Trace Elem. Med. Biol., **23**:231-238.
23. Morcombe, P. W.; Petterson, D. S.; Ross, P. J. and Edwards, J. R. (1994): Soil and agronomic factors associated with cadmium accumulation in kidneys of grazing sheep. Australian Vet. J., **71**(12): 404.
24. Neveen, H. I. (1998): Heavy metals residues in beef tissues and organs with relation to its public health. Zagazig Vet. V. (2) pp. 5- 55.
25. Nwude, D. O.; Okoye, P. A. C. and Babayemi, J. O. (2010): Heavy metal level in animal muscle tissue. A case study of Nigeria raised cattle. Res. J. Appl. Sci., **5**: 146-150.
26. Okoronkwo, A. E. and Olasehinde, E. F. (2007): Investigation of lead binding to Tithonia diversifolia. J. Applied Sc., **7**(12): 1589-1595.
27. Raikwar, M.; Kumar, P.; Singh, M. and Singh, A. (2008): Toxic effect of heavy metals in livestock health. Vet. World **1**(1): 28-30.
28. Rosner, B. (2002): Fundamentals of biostatistics. 4th ed. Publishing Co. (ed. W. Kent), California,USA.
29. Santhi, D.; Balakrishnan, V.; Kalaikannan, A. and Radhakrishnan, K. T. (2008): Presence of heavy metals in pork products in Chennai (India). Am. J. Food Technol., **3**(3): 192-199.
30. Sawsan, M. A. (2008): Some heavy metals residues in edible offals and meat of native cattle at Alexandria governorate. Mansoura Vet. Med. J., **10**(2): 65-81.
31. Sheets R.W. Turpen SL. and Hill p. (1996): Effect of microwave heating on leaching of lead from old ceramic dinnerware. Sci. Total Environ 1996 : **182**:187-91
32. Seady, N. I. (2001): Evaluation of heavy metals in meat and offals of various animal species slaughtered in Menoufia governorate. PhD thesis, Faculty of Veterinary Medicine, Moshtohor, Zagazig University, Benha Branch.
33. Voutsaand, D. and Samara, C. (2011): Labile and bioaccessible fractions of heavy metals in the airborne particulate matter from urban and industrial areas. Atmospheric Environ. 3583-3590.
34. World Health Organization "WHO" (2004): Toxicological evaluation of certain food additives and contaminants. Technical Report Series No 52, (Geneva: WHO).
35. Zarski, T. P.; Zarska, H.; Samek, M. and Siluk, I. (1997): Mercury contamination of the tissues of cattle from various regions of Poland. Vet. Med., **20**: 107-111.

BENHA UNIVERSITY
FACULTY OF VETERINARY MEDICINE
مجلة بنها للعلوم الطبية البيطرية

# متبقيات المعادن الثقيلة فى الاحشاء الطازجة والجاهزة للأكل

**محمد احمد حسن*، ريهام عبد العزيز أمين*، خالد ابراهيم الاخناوى**، نجلاء عباس الطيب****
*قسم مراقبة الأغذية – كلية الطب البيطري بمشتهر – جامعة بنها، **معمل بحوث صحة الحيوان الفرعي بطنطا

## الملخص العربي

يعتبر تلوث الاحشاء الطازجة والجاهزة للأكل ببعض المعادن الثقيلة مثل الرصاص، الكادميوم والنحاس والزئبق ذو أهمية كبيرة لما له من أثار سمية تراكمية تمثل خطورة بالغة على صحة المستهلك. لذلك أجريت هذه الدراسة على عدد تسعون عينة (90) من "كلاوى، كبدة، طحال" بواقع ثلاثين عينة (30) من كل نوع: 15 عينة طازجة و15 عينة جاهزة للأكل وذلك لمعرفة مدى تلوثها بتلك المعادن الثقيلة. وقد دلت نتائج الدراسة على أن متوسطات تركيز الرصاص فى عينات الكلاوى، الكبد، الطحال الطازجة كانت (0٫98 ±0٫06)، (0٫72 ± 0٫03)، (0٫57 ± 0٫02) مجم/ كجم على التوالي، بينما، (1٫23 ± 0٫07)، (0٫95 ± 0٫04)، (0٫69 ± 0٫03) مجم / كجم على التوالي فى العينات الجاهزة للأكل. وبمقارنة هذه النتائج مع الحدود القصوى المسموح بها لهذا العنصر)، وجد أن نسب العينات التي تجاوزت الحدود القصـــوى فى كل من الكلاوى، الكبد، الطحال الطازج كانت 33،33% و20% و6،67%على التوالي، بينما 46.67%، 40% و20% على التوالي فى العينات الجاهزة للأكل. أما بالنسبة للكادميوم فى عينات الكلاوى، الكبد، الطحال الطازجة فإن متوسطات تركيزه هي (1٫87±0٫14)، (1٫48±0٫10)، (1٫04± 0٫07) مجم / كجم على التوالي، بينما (2٫39 ±0٫15)، (2٫01 ±0٫08)، (1٫44 ± 0٫09) مجم / كجم على التوالي فى العينات الجاهزة للأكل. وبمقارنة هذه النتائج مع الحدود القصـــوى المســـموح بها لهذا العنصر، وجد أن نسب العينات التي تجاوزت الحدود القصوى فى كل من الكلاوى، الكبد، الطحال الطازج كانت 13.33%، 13.33% على التوالي، بينما 26.67%، و20% و6.67% على التوالي فى العينات الجاهزة للأكل. وبالنسبة للنحاس فى عينات الكلاوى، الكبد، الطحال الطازجة فإن متوسطات تركيزه هي (5٫28±0٫30)،( 2٫35±0٫17)، ( 4٫96 ± 0٫26) مجم / كجم على التوالي، بينما (5٫52 ± 0٫34) ، (2٫76± 0٫18)، ( 5٫07 ± 0٫29 ) مجم / كجم على التوالي فى العينات الجاهزة للأكل. وبمقارنة هذه النتائج مع الحدود القصوى المسموح بها لهذا العنصر تبعا لمؤسسة الغذاء لعام2002 م (20 مجم / كجم)، وجد أن جميع عينات الاحشاء الطازجة والجاهزة للأكل التي تم فحصها لم تتجاوز الحدود القصوى المسموح بها لهذا العنصر أي مقبولة صحيا. وبالنسبة للزئبق فى عينات الكلاوى، الكبد، الطحال الطازجة فإن متوسطات تركيزه هي (0٫29±0٫02، 0٫25 ± 0٫01، 0٫11 ± 0٫01) مجم / كجم) على التوالي، بينما (0٫37 ±0٫02، (0٫28 ± 0٫02)، (0٫16 ± 0٫01) مجم / كجم على التوالي فى العينات الجاهزة للأكل. وبمقارنة هذه النتائج مع الحدود القصوى المسموح بها لهذا العنصر، وجد أن نسب العينات التي تجاوزت الحدود القصوى كانت فى الكلاوى فقط الطازجة والجاهزة للأكل وكانت 6.67%، 6.67% مجم/كجم على التوالي وفى عينات الكبد الجاهزة للأكل 6067% مجم/ك جم. اما باقي العينات المفحوصة لم تتجاوز الحدود القصوى أي مقبولة صحيا. هذا وقد تمت مناقشة الخطورة الصحية لهذه المعادن الثقيلة مع بيان المصادر المختلفة لتلوث الاحشاء الطازجة والجاهزة للأكل بتلك الملوثات الخطيرة.

**(مجلة بنها للعلوم الطبية البيطرية: عدد 24 (1)، يونيو 2013: 161-171)**