ESTIMATION OF SOME HEAVY METALS RESIDUES IN BLOOD SERUM AND TISSUES OF CAMELS

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ABSTRACT

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A total of 75 samples of serum, muscles, lungs, livers and kidneys of slaughtered camels (15 of each) were collected from Banha abattoir in Kalubia Governorate and they were analyzed for the presence of heavy metals (Lead, Cadmium, Copper and Zinc) by using Atomic Absorption Spectrophotometer. The obtained results indicated that the mean values of Lead concentrations in the examined samples of serum, muscle, lung, liver and kidney were 0.014 μg/ml, 0.107, 0.81, 0.66 and 0.57 mg/kg wet weight respectively. Results showed that mean concentrations of lead in lungs and livers were significantly higher ($p\leq0.05$) than that reported in kidneys and muscles. However, the mean values of Cadmium concentrations in the examined samples of serum, muscle, lung, liver and kidney were 0.007 μg/ml, 0.07, 0.39, 0.52 and 1.28 mg/kg wet weight respectively. Significant differences ($p\leq0.05$) in the mean concentrations of cadmium were recorded between the studied tissues as the highest mean concentration was reported in the kidneys, then in the livers, while the muscles contained the minimum mean concentration. Meanwhile, the mean values of Copper concentrations in the examined samples of serum, muscle, lung, liver and kidney were 1.29 μg/ml, 1.37, 2.75, 3.94 and 3.25 mg/kg wet weight respectively. Significant differences ($p\leq0.05$) in the mean concentrations of Copper were recorded between the studied tissues as the highest mean concentration was reported in the liver. Whereas, the mean values of Zinc concentrations in the examined samples of serum , muscle, lung, liver and kidney were 1.96 μg /ml, 16.94, 10.68, 22.22 and 8.43 mg/kg wet weight respectively. Significant differences ($p\leq0.05$) in the mean concentrations of Zinc were recorded between the studied tissues as the highest mean concentration was reported in the liver and muscles. All examined heavy metals were within the normal level in serum. Generally, lungs, livers and kidneys were found to have the highest significant levels of Pb and Cd and muscles the lowest levels.

Key words: *Heavy metals, Residues in blood serum, Tissues, Camels.*

INTRODUCTION

Pollution of the environment with heavy metals is a serious problem in most countries of the world. Industrial evolution, the intense use of raw materials, and agricultural technology lead to polluting of natural environment. Also, air pollution of local and distant origin may contribute to the metals load of natural terrestrial ecosystems. (Abou Arab *et al.,* 2012).

These elements are accumulated in soils and plants when animals are fed with these plants, high levels of these elements accumulate in their bodies, some heavy metals (copper and zinc) are essential for growth and development of plant and animals, others (lead and cadmium) are toxic even in trace amounts. One of a main source of heavy metals for human is meat. Meat is a very essential source of protein for healthy growth of people.

Dromedaries (camels) are of great important in the Arab and African world. In these countries .Where the meat of camel play an important role as source of protein. (El Bahri *et al.,*1999).

Meat is an important source of a wide range of essential trace metals for humans, but may also carry toxic metals as residues, Contamination with heavy metals is a serious threats, not only because of their

toxicity but also because of bioaccumulation in the food chain (Demirezen and Uruc, 2006). Kidney and liver are the tissues and organs that have a propinquity to bioaccumulate toxic metals as Cd and Pb. The residues measured in these animal organs may also indicate the degree of pollution of the grazing area and drinking water (Mokgalaka *et al.,* 2008 and Sedki *et al.*, 2003). These organs can also serve as a rich source of essential microelements (notably Fe, Cu, Zn and Se) in the human diet (Nriagu *et al.,* 2009). Kidney, liver and lung are low in cost and are a component of some traditional Egyptian diets, thus toxic residues can affect those with low incomes who may not have access to medical care.

Serious health problems can develop as a result of excessive accumulation of these metals in the human body through dietary intake (Oliver, 2007). Although some metals such as Zn and Cu are essential at low concentrations, their excessive concentrations in food are of great concern because of their toxicity to humans and animals at relatively higher concentrations (Akotol *et al.,* 2014, Kabata- Pendias and Mukherjee 2007). Pb and Cd are considered potential carcinogens and are associated with etiology of a number of diseases especially cardiovascular, kidney, nervous system, blood as well as bone diseases (Järup, 2003).

The aim of the present study was to investigate the levels of lead, cadmium, copper and zinc in serum, meat, lung, liver and kidney of camel slaughtered in Benha abattoir at Kalubia Governorate in order to detect their possible toxic levels on human health.

MATERIALS and METHODS

Animals: 15 healthy male camels (Camels dromedaries) from local breed with mean age of 5-7 years were used in this study.

Serum samples: Before slaughtering, blood samples were collected from jagular vein using vacutainer tubes without heparin. Serum were collected by centrifugation for 3000 rpm/15min and packed in Eppendorf tubes, and then stored at -20 ℃ until subsequent analysis.

Tissue samples: The animals were slaughtered in Banha abattoir at Kalubia Governorate and samples of muscle, lung, liver and kidney were taken from each camels for determination of the mineral elements. Samples were frozen prior to shipment to the laboratory.

Determination of heavy metals and trace elements:

1.1. Washing procedure (Lopez *et al.* 2000):

The test tubes, polyethylene tubes and glassware were soaked in water and soap for 2 hours then rinsed several times with tap water. Moreover, the glassware was rinsed once with distilled water, once with cleaning mixture (520 ml deionized water, 200 ml concentrated HCL and 80 ml H2O2) and once with washing acid (10% HNO3). Finally, they were washed with deionized water and then air-dried in incubator away from contamination or dust**.**

1.2. Digestion procedure (Chowdhury *et al.*, 2005 and Miranda *et al.*, 2005):

One gram of each sample (1ml serum) was processed by a sharp scalpel in a screw capped tube and 5 ml of the digestion mixture (60 ml nitric acid "60%" and 40 ml perchloric acid"70 %") were added. The tubes were tightly closed and the contents were vigorously shaken and allowed to stand overnight. Further, the tubes were heated for 3 hours in water bath at 70°C to ensure complete digestion of the samples. The digestion tubes were vigorously shaken at 20 minutes intervals during the heating period. Therefore, the tubes were cooled at room temperature and then diluted with 5 ml deionized water and filtered through Wattman filter paper No 42. The filtrate was collected in polyethylene tubes and kept at room temperature until analysis.

1.3. Preparation of blank and standard solutions (Rahimi and Rokni, 2008):

Blanks and standard solutions were prepared in the same manner as for wet digestion and by using the same chemicals. Blank tubes were used to determine the contamination that may be present in the chemicals used for wet digestion. While, serial standard solutions were prepared for the element by using pure certified metal standard at ideal adequate strength.

2. Determination:

Instrumental procedures for various analyses of heavy metals were based on those suggested in the operator manual of the flame Atomic Absorption Spectrophotometer (UNICAM969AA Spectronic, USA). Accurately, the apparatus was adjusted at wave lengths of 217.0 nm for lead and 228.8 nm for cadmium, for 324.8 nm copper and 346.7 nm for zinc. Absorbance and concentration of the metal were recorded on the digital scale of the apparatus. The obtained results of such metal levels in the examined samples were calculated as mg/kg on wet, and μg/ml for serum.

Stastistical analysis:

Data collected were presented as mean and standard error and were subjected to one way analysis of variance (ANOVA) $P \leq 0.05$ to assess wither each heavy metal varied significantly between serum and tissues of camel. All statistical calculations were performed with SPSS Inc (Version17.0 for Windows) (Ozdamar, 1991).

RESULTS

The obtained results in this study are summarized in table 1, 2.

Table 1: Mean values of heavy metal concentrations of serum (µg/ml), muscle and organs (mg/kg) of camels.

Meatls		Serum µg/ml	Different organs			
			muscle	lung	liver	kidney
Lead Pb(mg/kg)	Min. - Max.	ND-0.02	ND-0.27	ND-1.46	ND-1.18	ND- 0.97
	mean±SE	0.014 b ±0.004	0.11 b ±0.06	0.81 a ±0.15	0.66 a ±0.13	0.57 a ±0.13
	[1]MPL(ppm)	-	0.1	0.5	0.5	0.5
Cadmium Cd(mg/kg)	Min. - Max.	ND-0.01	ND-0.16	ND-0.7	ND-0.89	ND-2.01
	mean±SE	0.007 c ±0.003	0.07 bc ±0.045	0.39 bc ±0.12	0.52 b ±0.11	1.28 a ±0.22
	[1]MPL(ppm)	-	0.05	0.5	0.5	1
Copper Cu(mg/kg)	Min. - Max.	0.19-2.99	0.65-2.11	01.3-4.16	1.86-5.53	1.42-5.10
	mean±SE	1.29 c ±0.31	1.37 c ±0.16	2.75 b ±0.28	3.94 a ±0.43	3.25 ab ±0.41
	[2]MPL(ppm)	-	20	20	20	20
Zinc Zn(mg/kg)	Min. - Max.	0.41-3.85	6.21-30.65	2.43-21.87	10.15-39.98	1.96-18.33
	mean±SE	1.96 d ±0.37	16.94 ab ±2.63	10.68 bc ±1.96	22.22 a ±3.20	8.43 c ±1.77
	[3]MPL(ppm)	-	50	50	50	50

[1]MPL: Maximum Permissible Limit stipulated by E.O.S (2010)
[2]MPL: Maximum Permissible Limit of Food Stuffs Cosmetics and Disinfectant Act (2002)
[3]MPL: Maximum Permissible Limit stipulated by FAO/WHO (2000)
S.E= Standard error of mean ND: non detectable
a-b Mean values withen the same raw with different superscript letters are statistically different at P≤0.05

Table 2: Acceptability of examined samples (n = 15) of camels meat and organs based on their concentrations of heavy metals according to E.O.S (2010), FAO/WHO (2000) and Food Stuffs Cosmetics and Disinfectant Act (2002).

samples	Acceptability		Lead	Cadmium	Copper	Zinc
muscle	ND	NO	9	10	-	-
		%	60	66.67	-	-
	WPL	NO	5	4	15	15
		%	33.33	26.66	100	100
	OPL	NO	1	1	-	-
		%	6.67	6.67	-	-
lung	ND	NO	4	8	-	-
		%	26.67	53.33	-	-
	WPL	NO	4	4	15	15
		%	26.67	26.67	100	100
	OPL	NO	7	3	-	-
		%	46.66	20	-	-
liver	ND	NO	6	6	-	-
		%	40	40	-	-
	WPL	NO	4	5	15	15
		%	26.67	33.33	100	100
	OPL	NO	5	4	-	-
		%	33.33	26.67	-	-
kidney	ND	NO	6	6	-	-
		%	40	40	-	-
	WPL	NO	5	4	15	15
		%	33.33	26.67	100	100
	OPL	NO	4	5	-	-
		%	26.67	33.33	-	-

ND: Non detected value. **WPL**: Withen permissible Limits.
OPL: Over permissible Limits.
E.O.S. (2010): 0.1 ppm for muscles and 0.5 ppm for lung, liver and kidney for Lead . 1 ppm for kidney and 0.5 ppm for muscles, lung and liver for Cadmium.
Food Stuffs Cosmetics and Disinfectant Act (2002): 20 ppm for Cupper.
FAO/WHO (2000): 50 ppm for Zinc

DISCUSSION

Heavy metals ranged between toxic or essential elements, their toxicities varies between CNS- disturbances, hepato-, nephro-, immunotoxicties or reproduction dysfunctions. In addition their long term toxicities may be induce mutagenicity or carcinogenicity such as Lead, Cadmium, but the essential elements needed for feed requirements by recommended levels over dose may cause also toxicities such as Iron, Copper, Zinc. (Klassen *et al.,* 1986)

Table 3: Data on metal levels in camel serum and tissues from different region of world.

Study/country	Animal	organ	Pb	Cd	Cu	Zn	units
Sharkawy *et al.* 2002 Egypt	Camel	serum	0.15	0.23	1.95	14.5	ppm
	<6year	Muscle	0.06	0.25	6.11	31.32	
		Lung	2.64	0.29	8.32	24.07	
		Liver	2.85	0.36	54.52	29.64	
		Kidney	8.13	0.40	6.86	23.33	
Abdel Basset *et al.* 2014	camel	Liver	1.33	0.25	14.77	10.88	mg/kg
Morocco		Lung	0.86	0.023	1.65	4.05	
		Muscle	0.71	0.12	1.10	9. 48	
		Kidney	0.96	0.69	1.45	4.17	
Abdelrahman *et al.* 2013 Saudia	camel	serum			57.5	76	µg/dl
Arabia		Liver			16.2	89.89	ppm
		Kidney			4.2	20.56	
		fresh			1.67	45.68	
		muscle					
Alturiqi and Albedair 2012	camel		5.48	1.07	1.33	16.74	µg/g
Saudia Arabia		muscle					
Al Busadah 2003	camel	serum			113.5	103.4	µg/dl mg/kg
Saudia Arabia		Liver			265.1	148.7	
Badis *et al.* 2014	camel	muscle	2.01	0.08			µg/g
Algeria							
Jalal *et al.* 2010	camel	serum	3.73	0.91	2.82	23.51	ppm
Saudia Arabia							
Elrayah *et al.* 2014	camel	serum			0.20	0.22	µg/ml
Sudan							

Lead (Pb)

In the present study, the mean detectable concentrations of lead (Pb) levels in examined serum, muscle, lung, liver and kidney samples of camel were; 0.014 µg/ml, 0.107 mg/kg, 0.81 mg/kg,0.66 mg/kg and 0.57 mg/kg respectively. (Table 1). These differences in Lead concentrations in the examined samples of blood serum, fresh meat and edible offals were significant different ($p \leq 0.05$).

Lead was accumulated mainly in camel's lung, liver and kidney samples. The highest concentration of this metal was observed in lung 0.81 mg/kg while the lowest concentrations was observed in muscle 0.11 mg/kg. It shows that Pb get into the body through breathing. Air born sources like industrial emission and combustion of fuel having Pb additives may affect grazing animals, (Mehmood *et al.,* 2014). According to the safe permissible limit stipulated by E.O.S. (2010) for lead in. fresh meat 0.1 mg/kg , and 0.5 mg/kg for offals, it was indicated that 6.67%, 46.66%, 33.33% and 26.67% of the examined fresh samples of muscles, lung, liver and kidneys respectively, were not in accordance with this limit (Table, 2). When compared to results of similar studies from other countries. This higher trend was supported by the result of Abdel Basset *et al.* (2014) that indicated higher Pb concentrations as 1.33 mg/kg in liver, 0.86 mg/kg in lung and 0.69 mg/kg in kidneys of camel in Morocco. Much higher levels as 2.64 ppm,2.85 ppm and 8.13 ppm of Pb in lung, liver and kidney of camel respectively has been recorded by Sharkawy *et al.* (2002) in Assuit abattoir (Egypt).

Lead content of camel muscle were 0.11 mg/kg and this is lower than that obtained by Abdel Basset *et al.* (2014) who reportd mean lead concentrations of 0.71 mg/kg for muscles. And also lower than those recorded by Badis *et al.*(2014) who detected mean lead concentrations of 2.01 ppm in Algeria, While, it is higher than that reported by Sharkawy *et al.* (2002) as 0.06 ppm. The level of heavy metals in meat from different animals depends on factors such as environmental conditions, type of pasture and industrialization development. (Kadim *et al.;* 2013). Regarding to Lead level in serum (0.014 µg/ml) and

this is lower than that recorded by Sharkawy *et al.* (2002) as 0.15ppm. Also, higher results (3.73 ppm) recorded by Jalal *et al.* (2010) in camel serum from Saudia Arabia. (Table, 3).

Low blood Pb levels can influence neurobehavioral performance in children and may be a contributor to Attention – Deficit /Hyperactivity Disorder (ADHD) (Kwaansa *et al.*, 2012). Lead toxicity can cause colic, constipation and anemia. It may also induce increased blood pressure, cardiovascular disease, liver dysfunction, renal damage and peripheral neuropathy in adults. Foetal neuro-developmental effects and reduced learning capacity in children are among the most serious effects of lead toxicity (Bolger *et al.*, 2000). An increase in the maternal blood lead level may contribute to reducing gestational duration and birth weight. Also lead is immunotoxic and classified as a 2B carcinogen by the International Agency for Research on Cancer (IARC) (Goyer and Clarkson, 2001).

Cadmium (Cd)

The mean detectable concentrations of Cadmium (Cd) levels in examined serum, muscle, lung, liver and kidney samples of camel were ; 0.007µg/ml, 0.07 mg/kg, 0.39 mg/kg, 0.52 mg/kg and 1.28 mg/kg respectively (Table, 1).

The highest Cd concentration was observed in the kidneys of camel (1.28 mg/kg). and this is in line with the suggestion that the kidney is the main storage organ in animals subjected to chronic low-levels of cadmium exposure García-Fernández *et al.* (1996). The excretory mechanism for such metal, which is based on low molecular compounds with –SH groups, was poorly developed in vertebrates and could not cope with high levels of such metal contaminations (Pompe-Gotal and Crnic, 2002).

According to the legal standard (0.05 mg/kg) in meat, (0.5) mg/kg in offals except kidney (1 mg/kg) recommended by E.O.S. (2010) 33.33% of kidney, 26.67% of liver, 20 % of lung and 6.67% of muscle exceeded the permissible limits for Cadmium. (Table, 3).

The results of the present study were higher than those noticed by Sharkawy *et al.* (2002) who recorded (0.40 ppm) in kidneys, (0.36 ppm) in liver and (0.29 ppm) in lungs of camel in Egypt. Also, Abdel Basset *et al.* (2014) reported this low trend of Cd accumulation in kidneys (0.69 mg/kg), in liver (0.25 mg/kg) and in lung (0.023 mg/kg) of camel in Morocco. Cadmium content of camel muscle were 0.07mg/kg and this is in agreement with that obtained by Badis *et al.* (2014) who estimated 0.08 ppm in camel fresh meat from Algeria and lower than that obtained by Abdel Basset *et al.* (2014) who detected that the concentration of Cd were 0.12 mg/kg in muscle of camel in Morocco. Also, lower than those found by Alturiqi and Albedair (2012) in Saudia Arabia, who reported that camel meat contained 1.07 µg/g of Cadmium. The mean value of Cadmium level in serum of camel (0.007µg/ml) is lower than results obtained by Sharkawy *et al.* (2002) who detected 0.15 ppm of Cd residue in camel serum from Egypt. Also, Jalal *et al.* (2010) recorded high levels of Cd (0.91 ppm) in camel serum from Saudia Arabia. (Table, 3).

Vos *et al.* (1987) stated that Cd may accumulate in the human body and may induce kidney dysfunction, skeletal damage and reproductive deficiencies.

Copper (Cu)

The mean detectable concentrations of Copper (Cu) levels in examined serum, muscle, lung, liver and kidney samples of camel were; 1.29µg/ml, 1.37 mg/kg, 2.75 mg/kg, 3.94 mg/kg and 3.25 mg/kg respectively (Table, 1). Moreover, Table, 2 showed that all examined samples of serum, muscle, lung, liver and kidney of camel were accepted based on their copper content according to Food Stuffs Cosmetics and Disinfectant Act (2002) which stated that copper should not exceed 20 mg/kg in fresh meat and offals.

Table, 3 revealed that Copper was detectable in all the samples but was highest in the liver with a mean concentration of 3.94 mgkg. The ranges of hepatic Cu in different countries were reported to be as follows: 54.52 ppm in Egypt (Sharkawy *et al.* 2002), 16.2 mg/kg in Morocco (Abdel Basset *et al.* 2014) and 265.1 mg/kg Saudia Arabia (Al Busadah 2003). Our results were similar to those obtained by Alturiqi and Albedair (2012) and Abdel Basset *et al.* (2014) who recorded that the concentrations of Cu in muscle of camel were 1.33 µg/g, 1.10mg/kg respectively. While, higher concentrations of Cu (6.11ppm) in muscle were recorded by Sharkawy *et al.* (2002).

Meanwhile, The results from this study were higher than those reported in the lung (1.65 mg/kg), Muscle (1.10 mg/kg) and kidney (1.45 mg/kg) by Abdel Basset *et al.* (2014) in Morocco. In contrast, higher levels of Copper 8.32 ppm and 6.86 ppm in Lung and kidney of camel respectively was reported by Sharkawy *et al.* (2002) in Egypt. The mean value of Copper level in serum of camel (1.29µg/ml) is lower than results obtained by Sharkawy *et al.* (2002) who detected 1.95 ppm of Cu residue in camel serum from Egypt. Also, Jalal *et al.* (2010) recorded high levels of Cu (2.82 ppm) in camel serum from Saudia Arabia. (Table, 3).

Copper is an essential component of various enzymes and it plays a key role in bone formation, skeletal mineralization and in maintaining the integrity of the connective tissues. Copper is essential for good health, but very high intake can cause health

problems such as liver and kidney damage (ATSDR, 2004). In humans, 10-30 mg of orally ingested copper from foods stored in copper vessels might cause intestinal discomfort, dizziness and headaches, while excess accumulation of copper in liver may result in hepatitis or cirrhosis and in a hemolytic crisis similar to that seen in acute copper poisoning (Johnson, 1993).

Zinc (Zn)

Zinc is an essential trace element for animals, being involved in protein synthesis and as a constituent of many metalloenzymes. Consumption of excess Zn in the diet can result in haematological effects such as anemia and induction of Cu deficiency by hindering its absorption (ATSDR, 2005).

The mean detectable concentrations of Zinc (Zn) levels in examined serum, muscle, lung, liver and kidney samples of camel were; 1.96µg/ml, 16.94mg/kg, 10.68 mg/kg, 22.22 mg/kg and 8.43 mg/kg respectively. in Table 1. All examined samples of serum, muscle, lung, liver and kidney of camel were accepted based on their Zinc content according to FAO / WHO (2000) which stated that copper should not exceed 50 mg/kg in fresh meat and offal.

The concentrations of Zn (22.22 mg/kg) in the liver were significant higher at $P \leq 0.05$ compared with those of the muscles, lung and kidney. This high trend of Zinc accumulations in liver have been recorded by Sharkawy *et al.* (2002) who reported higher concentration 29.64ppm in liver of camel in Egypt; Abdel Basset *et al.* (2014) who reported 10.88 mg/kg in Morocco; Abdel Rahman *et al.* (2013) who reported 89.89 ppm in Saudi Arabia and Al Busadah (2003) who reported 148.7 mg/kg in Saudi Arabia. Table (3). The results from this study were lower than31.32 ppm, 24.07 ppm and 23.33 ppm reported by Sharkawy *et al.* (2002) in muscles, lung and kidney respectively. They were also lower than those reported in muscles (45.68 ppm) and (20.56 ppm) kidney by Abdel Rahman *et al.* (2013). In contrast, our results were higher than that obtained by Abdel Basset *et al.* (2014) who reported that mean concentrations of Zn were 9..48, 4.05, 4.17 mg/kg in muscles, lung and kidney respectively. Blood Zinc levels (1.96µg/ml) were higher than that recorded by Elrayah *et al.* (2014) as 0.2296µg/ml in Sudan. Abdelrahman *et al.* (2013) also reported 76 µg/dl in Saudia Arabia. In contrast, Jalal *et al.* (2010) recorded higher levels of Zn in serum (23.51ppm) of camel from Saudia Arabia, On the other hand, higher levels of Zn (14.5 ppm) were reported by Sharkawy *et al.* (2002) in Egypt.

The distribution of copper and zinc among the tissues of animals varies with the age, sex, diet composition and physiological status (Doyle, 1980).

The Cd/Zn ratio in the kidney was 0.15, while it was 0.02 in liver and 0.03 in lung and 0.04 in muscle. Thus, the low zinc concentration in the kidney is attributed to higher cadmium accumulation in that organ. Cadmium causes reductions in both intestinal zinc absorption and hepatic zinc reserves. Smith *et al.* (1991), Although mechanisms of their interactions are not clearly defined, interactions between toxic and essential metals may disrupt the metabolism of essential metals such as Zn and Cu. Metallothioneins binds tightly with toxic metals, reducing their availability within cells and therefore reducing their toxic potentials. The synthesis of MT which is induced by the presence of Cd causes great accumulation of Zn in the tissues as a result of competition for the cation-binding sites of metallothionein (MT). Cherian and Goyer, (1987) and Goyer (1997).

Heavy metals accumulate in various tissues and are associated with increases in today's biggest killers: Cardiovascular disease and cancer. Reducing these heavy metals from the body has been a challenge to modern day medicine. Metal-mediated formation of free radicals causes various modifications to DNA bases, enhanced lipid peroxidation, and altered calcium and sulfhydryl homeostasis, McDonagh and Sheehan (2008) and Jalal *et al.* (2010). Lipid peroxides, formed by the attack of radicals on polyunsaturated fatty acid residues of phospholipids, can further react with redox metals finally producing mutagenic and carcinogenic malondialdehy 4-hydroxynonenal and other exocyclic DNA adducts (etheno and/or propanoadducts), Bartsch and Nair (2002). Whilst iron (Fe), copper (Cu), chromium (Cr), vanadium (V) andcobalt (Co) undergo redox-cycling reactions, for a second group of metals, mercury (Hg), cadmium (Cd) and nickel (Ni), the primary route for their toxicity is depletion of glutathione and bonding to sulfhydryl groups of protein Figueiredo-Pereira *et al.* (1998) and Kern *et al.* (2007). However, other mechanisms, involving formation of hydrogen peroxide under physiological conditions, have been proposed Flora *et al.* (2005) and Liu *et al.* (2001). The unifying factor indetermining toxicity and carcinogenicity for all these metals is the generation of reactive oxygen and nitrogen species Valavanidis *et al.* (2005). Common mechanisms involving the Fenton reaction, generation of the superoxide radical and the hydroxyl radical appear to be involved for iron, copper, chromium, vanadium and cobaltprimarily associated with mitochondria, microsomes and peroxisomes, Moriwaki *et al.* (2008).

CONCLUSION

The results obtained in this study showed that heavy metals such as Cd and Pb are significantly more likely to be found in the kidney, liver and lung of camels even at the lower detection levels than in meat

(muscle tissue). Thus, the meat of animals grazing in polluted areas with heavy metals can be safe for human consumption. While, provided liver, kidney and lung are discarded, as the toxic metals appear to bioaccumulate in these tissues.

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قياس متبقيات بعض المعادن الثقيله في امصال وانسجه الجمال

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يعتبر تلوث اللحوم والاحشاء ببعض المعادن الثقيله مثل الرصاص والكادميوم والنحاس والزنك ذو اهمية كبيره لما له من اثار سميه تراكميه تمثل خطوره بالغه علي صحة الانسان. ولذلك اجريت هذه الدراسه علي عدد ٧٥ عينه من مصل ولحوم و رئة وكبد وكلاوي الجمال المذبوحه بمجزر بنها بمحافظة القليوبيه بواقع ١٥ عينه من كل نوع وذلك لمعرفه مدي تلوثها بهذه المعادن الثقيله. وقد دلت نتائج هذه الدراسه علي ان متوسطات تركيز الرصاص في عينات المصل واللحوم والرئه والكبد والكلاوي كانت ٠,٠١٤ميكروجرام/ملليجرام ١٠٧,. و ٠,٨١و ٠,٦٦ و ٠,٥٧ مليجرام /كيلوجرام علي التوالي وبمقارنه النتائج مع الحدود القصوي المسموح بها لهذا العنصر وجد ان نسب العينات التي تجاوزت الحدود القصوى في كل من اللحوم والرئه والكبد والكلاوي كانت ٢٦,٦٧ % و ٤٦,٦٦ % و ٦,٦٧% علي التوالي . اما بالنسبه للكادميوم في عينات المصل واللحوم والرئه والكبد والكلاوي كانت٠٠٧ ,٠ميكروجرام/ملليجرام ٠٧,. و ٠,٣٩و ٠,٥٢ و ١,٢٨ مليجرام /كيلوجرام وبمقارنه هذه النتائج مع الحدود القصوي المسموح بها لهذا العنصر وجد ان نسب العينات التي تجاوزت الحدود القصوى في كل من اللحوم والرئه والكبد والكلاوي هي ٦,٦٧% و٢٠% و٢٦,٦٧% و ٣٣,٣٣% علي التوالي . اما بالنسبه للنحاس في عينات المصل واللحوم والرئه والكبد والكلاوي كانت٢٩ ,١ميكروجرام/ملليجرام و ١,٣٧ و ٢,٧٥و ٣,٩٤ و ٢٥, ٣ مليجرام /كيلوجرام وبمقارنه هذه النتائج مع الحدود القصوي المسموح بها لهذا العنصر تبعا لمؤسسة الغذاء لعام٢٠٠٢م (٢٠مجم/كجم) وجد ان جميع العينات التي تم فحصها لم تتجاوز الحدود المسموح بها لهذا العنصر اي مقبوله صحيا. وبالنسبه لعنصر الزنك في عينات المصل واللحوم والرئه والكبد والكلاوي كانت٩٦ ,١ميكروجرام/ملليجرام و ١٦,٩٤ و ١٠,٩٨و ٢٢,٢٢ و ٨,٤٣ مليجرام /كيلوجرام وبمقارنه هذه النتائج مع الحدود القصوي المسموح بها لهذا العنصر تبعا لمنظمه الفاو لعام ١٩٩٩م (٥٠مجم/كجم) وجد ان جميع العينات التي تم فحصها لم تتجاوز الحدود المسموح بها لهذا العنصر اي مقبوله صحيا. هذا وقد تمت مناقشة الخطورة الصحية لهذه المعادن مع بيان المصادر المختلفة لتلوث لحوم واحشاء الجمال بتلك الملوثات الخطيرة.