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EVALUATION OF SOME HEAVY METALS IN BLOOD AND TISSUES OF MALE CAMELS AS INDICATOR OF ENVIRONMENTAL POLLUTION AND ITS RELATION TO AGE

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ABSTRACT :

Our investigation was carried out to determine the concentrations of lead (pb), cadmium (Cd), manganese (Mn), iron (Fe), copper (Cu) and zinc (Zn) in camel's blood and tissues, and its relation to age. Twenty male camels were divided into two groups, the first includes animals less than six years old and the second includes animals more than six years old. Blood, liver, kidneys, lung, and muscles samples were collected from each animal. Pb, Cd, Mn, Fe, Cu and Zn concentrations were estimated using Atomic Absorption Spectrophotometer. Results from both groups revealed that lead and iron concentrations were the highest in kidney samples, while the highest concentration of manganese and copper were observed in the liver. Cadmium concentration was high in kidney and liver of the second group, Zn was higher in liver and muscles. The authors conclude that there has been a relation between the old age camels and the concentration of Cd and pb.

INTRODUCTION :

Heavy metals are natural components of the environment, but in recent years industrial and agricultural development has been responsible for the diffusion of these substances in the environment, causing pollution of water, soil and atmosphere. These elements are accumulated in soils and plants and when animals are fed with these plants, high level of these elements accumulate in their bodies. Some heavy metals (iron, copper and zinc) are essential for the growth and development of plant and animal (Cralley, 1972), others (Lead and cadmium) are detrimental to them (Davidson et al., 1959) even in trace amounts. One of a main source of heavy metal for human is meat. Meat is a very essential source of proteins for the healthy growth of people. Dromedaries (Camels) are of great important in arid countries of the Arab and African world. In these countries, meat of camel play

important role as a source of protein (El-Bahri et al., 1999).

Environmental pollution is one of the most deleterious agents to the biological life. Industrialization offered additional hazards to the environment surrounding man and animals. Grazing animals are often a reliable indicator of environmental pollution either by food, water or air, they receive contaminants which transferred through the food chain to human being (Antoniou et al., 1995). Because of the wide distribution of heavy metals throughout the earth crust, as well as the remarkable environmental pollution, it is inevitable that even small levels of these metals can be detected in all animal tissues. Some of these metals (Pb and Cd) are major contaminants and have toxic effects, whereas others such as Mn, Cu, Fe and Zn are essential for all living organisms. However, these essential metals can also be dangerous at higher concentrations. Because heavy metals, such as lead and cadmium, are chemically stable when released in the environment, they are potentially a cause of toxic effects until removed (Oehme, 1978).

Lead is a toxic metal, has a wide range applications and its production and use result in contamination of the environment, including food and drinking water. Biochemical interference with heme biosynthesis can be detected as a result of current lead exposures, Anemia also detected in case of lead poising (Grandjean, 1978). Central nervous system could be affected by lead toxicity (Luthman et al., 1992).

Cadmium, a toxic heavy metal, has a number of industrial applications, but it is used mostly in metal plating, pigments, batteries, and plastics. However, for most people the primary source of cadmium exposure is food (WHO, 1992), since food materials tend to take up and retain cadmium. Cadmium in air, drinking water and food has the potential to affect the health of whole populations (WHO, 1994). Cadmium is not known to have any beneficial effects, but can cause a broad spectrum of toxicological and biochemical dysfunctions (Funakoshi et al., 1995). Also, cadmium is a cumulative toxicant in the continental ecological cycling, it accumulates mostly in the liver and kidney (Zasadowski et al., (1999).

Manganese considered as an essential element for all living animals. Mn toxicity represents a serious health hazard in human. Toxic intake of Mn may result in sever pathological changes particularly in the CNS, neural damage, reproductive and immune system dysfunction, nephritis, testicular damage, pancreatitis and hepatic damage (Donaldson, 1987; Keen and Leach, 1987 and Keen and Zidenberg-Cherr, 1990). Iron is known to be a protoplasmic toxin, which, if it accumulates in tissues at sufficient concentration, results in iron-induced lipid peroxidation and organelle dysfunction, such as mitochondrial death mediated by free radical production (Abdel-Mageed and Oehme, 1999). Iron fumarate caused hepatic cirrehosis and death in neonatal foals when it was administered in a paste shortly after birth (Mullaney and Brown, 1998). Copper is an essential trace element, a normal constituent of animal tissues and fluids, crucial in hemoglobin synthesis and other enzymes functions. Both deficiency and excess of copper in the mammalian system result in untoward effects (Hostynek et al., 1993).

Zinc is a common element in the human environment and is essential for many biological functions (Prasad, et al., 1963 and Halsted, et al., 1972). Toxicity of zinc seems to be low, however, various toxic reactions such as the

metal fume fever in which the victum suffering from pulmonary distress, fever and gastroenteritis following ingestion of zinc salts have been reported in man (Murphy, 1970 and Prasad, 1979). Long-term feeding of very large amounts of zinc salts to rodents resulted in growth retardation, anemia and metabolic effects, and ruminants appear more susceptible to zinc than rodents (Campbell, and Mills, 1979). Underwood (1977) mentioned that zinc does not accumulated with continued exposure, but body content is modulated by homeostatic mechanisms that act principally on absorption and liver levels.

This study was planned to estimate the concentration of Pb; Cd; Mn; Cu; Fe and Zn in camels blood, liver, kidney and muscles in relation to age.

MATERIALS AND METHODS :

MATERIALS:

A total number of 20 apparently healthy male camels were taken randomly from Assiut slaughtered houses for this study. These animals were divided into two groups, first less than six years and second more than six years old. Blood, liver, kidney, lung and muscles samples were taken from each animal of both groups. In case of kidney samples, whole single organs were delivered to the laboratory, while muscle, liver and lungs, the samples weighted between 200–250 g. All samples were packed in plastic bags and kept in a frozen state till analysis. Blood samples were collected in clean heprenized tubes and kept for analysis. Samples were analyzed for estimation of Pb; Cd; Mn; Cu; Fe and Zn. All glass used in this study were rinsed with 20% nitric acid and deionized-distilled water to minimize contamination with any of the will determined metals.

METHODS:

Estimation of metals:

One ml of blood or 5 g from homogenized fresh tissues was digested by using a mixture of $HClO_4$-HNO_3 according to the method of Antoniou et al., (1995). Pb; Cd; Mn; Cu; Fe and Zn were determined by using atomic absorption spectrophotometer GBC 906 according to Moffat et al (1986).

Statistical analysis:

Statistical analysis has been done using student's "t" test for comparison between the concentration of metals in first and second group (Kalton, 1967).

RESULTS :

Results were summarized in the Table (1) and Figures (1–6). Lead and cadmium in blood of the second group were significantly increased compared to that in the first group. Lead and zinc levels were significantly increased in muscles in the second group in comparison with the first group. Iron levels in liver and lung were significantly increased by age. In contrast the copper concentrations were significantly decreased by age.

Table (1): Levels of heavy metals in blood and tissues of male camel (ppm).

Tissue	Age	Lead	Cadmium	Manganese	Iron	Copper	Zinc
Blood	< 6 years	0.15±0.02	0.23±0.03	1.22±0.04	1.13±0.02	1.95±0.05	14.5±1.59
	> 6 years	0.30±0.03 **	0.48±0.05 **	2.02±0.61	2.03±0.18	3.27±0.64	17.24±3.89
Liver	< 6 years	2.85±0.56	0.36±0.06	2.14±0.38	10.47±1.27	54.52±10.99	29.64±5.81
	> 6 years	5.21±1.21	0.53±0.01	2.55±0.30	14.49±0.97 *	22.50±1.65*	34.72±3.36
Kidney	< 6 years	8.13±2.78	0.40±0.01	1.43±0.24	19.08±1.79	6.86±1.89	23.33±3.45
	> 6 years	10.46±1.13	1.10±0.03	1.59±0.42	21.21±3.56	4.86±0.59	19.76±1.95
Lung	< 6 years	2.64±0.57	0.29±0.12	1.75±0.21	3.95±1.13	8.32±1.02	24.07±4.11
	> 6 years	4.74±0.95	0.21±0.04	0.82±0.24 *	9.97±1.39 *	3.51±0.54	16.90±0.71
Muscles	< 6 years	0.06±0.02	0.25±0.03	1.50±0.32	8.71±1.13	6.11±1.77	31.32±2.35
	> 6 years	0.16±0.03 *	0.25±0.10	1.04±0.01	10.85±1.02	2.82±0.98	46.67±2.17**

-The obtained results are mean of ten animals ± S. E.
- * : Significantly different from the first group at $p < 0.05$
- ** : Significantly different from the first group at $p < 0.001$

DISCUSSION :

During recent years, there has been considerable concern over the extent of contamination of the environment with toxic metals and its relationship to human health. An excess of a given metal through dietary, occupational, or environmental exposure may lead to depletion or repletion of an essential metal at molecular, cellular, tissue or organ, and systemic levels. One of the most common and important pollutant is lead which deposited directly from the atmosphere on the exposed surface of terrestrial communities. Although soil retards the movement of lead through these communities, some lead may be leached from highly contaminated soils or blown with the wind. Thus a certain amount of soil lead may be taken up by plants and passed on to animals, but most of the time it will remain accumulated at the surface of root cells. Lead poisoning in live animals may occur through their ingestion of polluted feed, water, soil and / or dust. In all cases, the concentration in animals is directly related to environmental lead levels and contamination with lead is generally distributed over all foods, including water. (WHO, 1989).

Our results presented in Table (1) and illustrated in Fig. (1) revealed that, liver and kidney of both groups have the highest lead levels other than blood and other investigated tissues. This is in agreement with FAO and WHO, (1972) in there observation where the liver and kidneys contain higher pb than other foods. In this study, lead content in blood was 0.15 and 0.3 ppm for both groups and this is higher than that recorded by Clarke et al. (1981) and Bartik and Piskac (1981) as 0.05-0.25 and 0.1 – 0.13 ppm respectively. Liver and kidney lead contents here were higher (2.85 and 5.21 ppm for liver and 8.13 and 10.46 ppm for kidney) than that mentioned as 0.1 – 1.0 ppm for liver (Bartik and Piskac, 1981), and < 0.5 ppm for kidney (Kreuzer and Rosopulo, 1981). Lead content of muscles were 0.06 and o.16 ppm for both groups and this is higher than obtained by Hecht (1979) as 0.015 ppm and Kreuzer and Rosopulo (1981) as 0.05 ppm.

Cadmium is a major environmental pollutant that has aroused serious global concentration. It is released during combustion of coal and mineral oils, smelting, alloy processing and mining operation. More than

50% of the total body burden of Cd accumulates in liver, kidney and testes inducing cellular and functional damage (Friberg et al., 1974). Our results revealed that Cd concentrations were higher in kidney tissues than in the liver in all examined samples. These results contradict that of Patra et al., (1999), who recorded higher concentration in the liver than kidney. Zasadowski et al., (1999) found that the concentration of cadmium in cattle less than 2 years old being much lower than the levels found in cattle aged more than 2 years. They also found that cadmium is gradually and progressively accumulated in animal tissues, especially kidneys and higher cadmium concentrations were accompanied by lower levels of copper and zinc, or of one of these elements. Our results were inagreement with these results where the concentration of cadmium in kidneys of camel less than six years old was 0.40 ppm and 1.10 ppm for kidneys of camel more than 6 year. Our results revealed elevation of Cd concentrations of all tissues and blood compared with normal values recorded in muscles (0.002 ppm) by Holm, (1976), (0.005–0.3 ppm) in liver and (0.04–1.66 ppm) in kidney by Bartik and Piskac, (1981), (0.38 ppm) in blood by Underwood, (1977). As recommended by FAO/WHO commission of experts 1972, the total daily intake of cadmium by man should not be higher than 1 μg/kg body mass, and the weekly intake by average person should not exceed 400-500 μg Cd. However, there are certain recommendation [finished meat products (up to 1 ppm), meat or muscles (up to 0.1 ppm), kidney and liver (up to 0.5 ppm)]. It is being considered whether the highest admissible concentration of Cd in the kidneys should be increased to 1 ppm Cd wet matter (Bartik and Piskac, 1981).

Manganese concentrations in blood (1.22 and 2.02 ppm), kidney (1.43 and 1.59 ppm) and muscles (1.50 and 1.04 ppm) were higher than that recorded by Underwood (1977) who recorded 0.02 ppm for blood, 1.2 ppm for kidneys and 0.18 ppm for muscles. Iron concentrations in blood (1.13 and 2.03), liver (10.47 and 14.49), kidney (19.08 and 21.21) and muscles (8.71 and 10.85) levels were lower than that obtained by many authors. Underwood (1977) mentioned blood iron as 5.53 ppm and Koivistoinen (1980), for liver (61 ppm), for kidney (120 ppm) and for muscles (15 ppm).

The distribution of copper is complex because of its role in enzyme function, numerous other metabolic processes and structural. Copper levels in investigated blood and tissues in this study revealed that blood copper (1.95 and 3.27) and muscles (6.11 and 2.82) were higher than that recorded by Underwood (1977) as 0.5–1.5 ppm for blood and 0.72 ppm for muscles (Koivistoinen, 1980). On the other hand, copper content in the second group was lower (22.5 ppm) than that obtained by the previous author (59 ppm). In the first group copper content in kidneys was higher (6.86 ppm) than that (4.3 ppm) obtained by Koivistoinen (1980). Zinc concentrations in examined liver samples (29.64 and 34.72 ppm) were lower than that mentioned by Koivistoinen, (1980) (46 ppm). Kidney and lung zinc concentrations (23.33 & 19.76 and 24.07 & 16.90 ppm) lies within that of (21 ppm). In the second group, zinc content was higher in muscles (46.67 ppm) than that recorded by Koivistoinen (1980) as 38 ppm. Blood zinc levels (14.5 and 17.24 ppm) were higher than that recorded by (Underwood, 1977) (8.8 ppm).

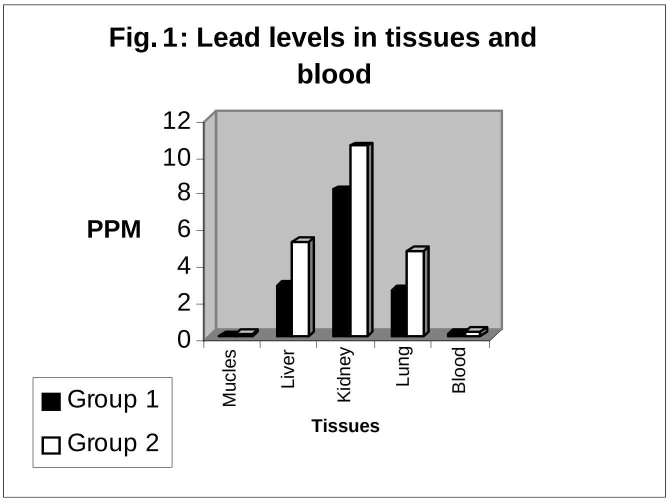
Fig. 1: Lead levels in tissues and blood
PPM
12
10
8
6
4
2
0
Mucles
Liver
Kidney
Lung
Blood
Tissues
Group 1
Group 2

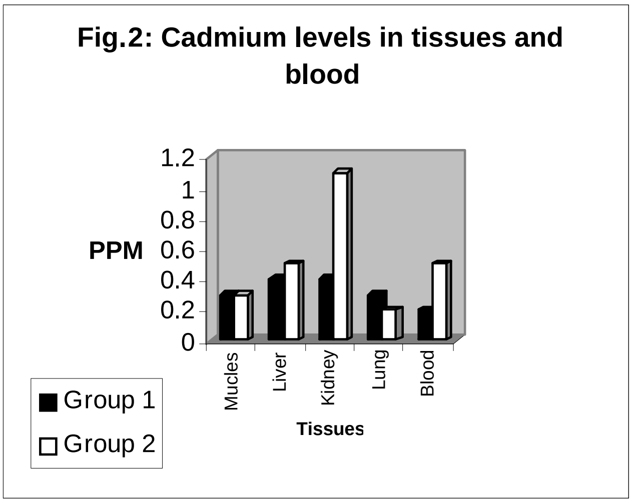
Fig.2: Cadmium levels in tissues and blood
PPM
1.2
1
0.8
0.6
0.4
0.2
0
Mucles
Liver
Kidney
Lung
Blood
Tissues
Group 1
Group 2

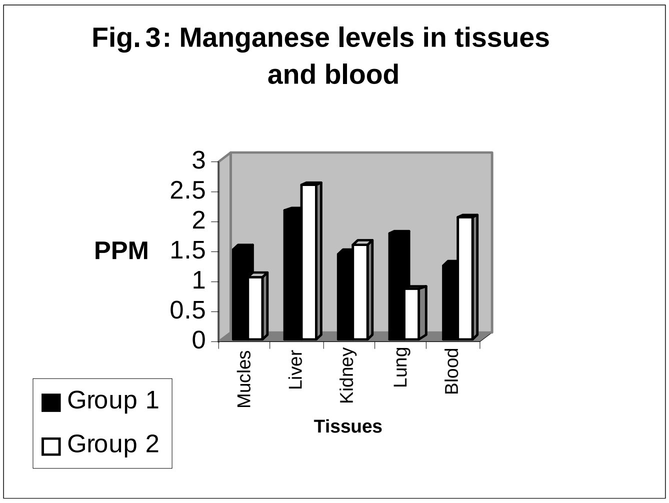
Fig. 3: Manganese levels in tissues and blood
PPM
3
2.5
2
1.5
1
0.5
0
Mucles
Liver
Kidney
Lung
Blood
Tissues
Group 1
Group 2

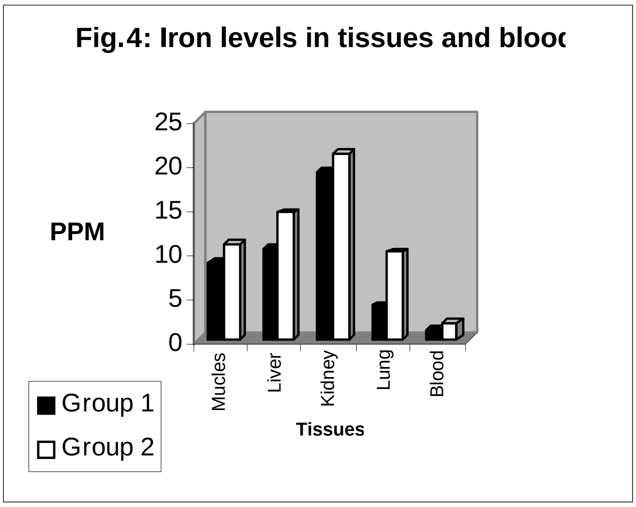
Fig.4: Iron levels in tissues and blooc
PPM
25
20
15
10
5
0
Mucles
Liver
Kidney
Lung
Blood
Tissues
Group 1
Group 2

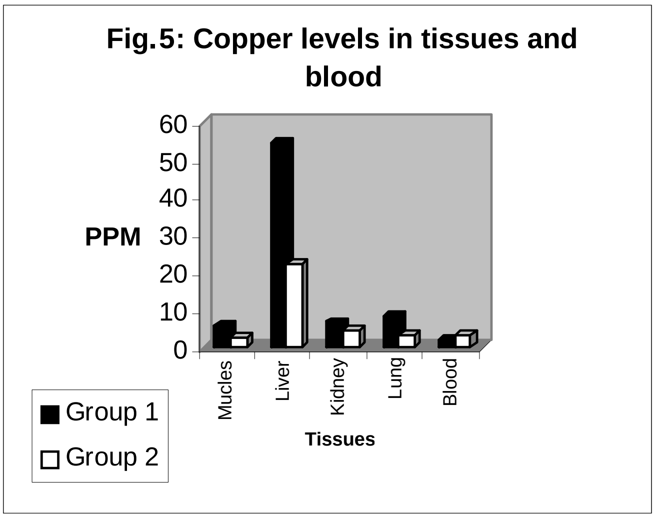
Fig.5: Copper levels in tissues and blood
PPM
60
50
40
30
20
10
0
Mucles
Liver
Kidney
Lung
Blood
Tissues
Group 1
Group 2

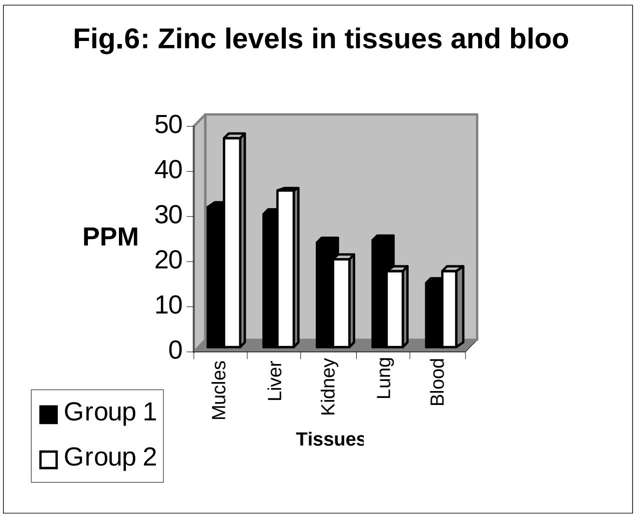
Fig.6: Zinc levels in tissues and bloo
PPM
50
40
30
20
10
0
Mucles
Liver
Kidney
Lung
Blood
Tissues
Group 1
Group 2

possible long-term dangers to human and animal health.

CONCLUSION :

Prevention and control of trace elements deficiencies or excesses in human dietaries can often be achieved by an intelligent choice of foods, involving either a restriction on intakes of types known to be rich or poor in metal content, or an increase in administration of certain types of foods. The opportunities provided by food choice for safe and satisfactory trace elements intakes by man should increase greatly as continued research offers more information on the distribution of these elements in foods and particularly on their biological availability and metabolic interactions with other metals and compounds. The food and water normally supplies a major amounts of total daily heavy metals intakes by animals and man. From this study we observed that lead and cadmium were significantly increased in the second group in blood and muscles in spite of no significant changes were recorded in other tissues. For the health view and its availability to human consumption, the meat obtained from these slaughtered camels are suitable for human consumption where WHO (2000) recommended that the maximum pb content in meat not more than 2 ppm and cadmium not more than 1 ppm but liver and kidneys from these animals not suitable for consumption by human. But, with the rise of modern industrial technology and with the increasing urbanization and motorization of large sections of populations, these sources of heavy metals, together with contamination of the water supplies, may constitute an increasing significant source of these heavy metal with

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تقييم مستوى بعض المعادن الثقيلة في دم وأنسجة ذكور الجمال كمؤشر للتلوث البيئي ومقارنتها بالعمر

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تمت هذه الدراسة لبيان نسبة المعادن الثقيلة فى دم وأنسجة الجمال كمؤشر لمدى التلوث البيئي بالمنطقة المحيطة مقارنة بعمر الحيوان. وقد تم أخذ عشرون جملا حيث قسمت تبعا للعمر إلى مجموعتين ، الأولى أقل من ست سنوات والثانية أكبر من ست سنوات. أخذت عينات من الدم والكبد والكلى والرئتين والعضلات من كل من هذه الحيوانات. تم قياس مستوى بعض العناصر الثقيلة متمثلة في الرصاص والكادميوم والمنجنيز والحديد والنحاس والزنك فى هذه العينات باستخدام جهاز الامتصاص الذرى.وعمل مقارنة بين تركيزاتها في اللحوم وعلاقة ذلك بالعمر.

تبين من النتائج وجود ارتفاع بين كل من نسب الرصاص والحديد فى كلى الحيوانات فى كل من المجموعتين. كما أظهرت أيضا ارتفاع نسبتى الكادميوم فى الكبد والزنك فى العضلات.