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SURVEY OF LEAD, CADMIUM AND MERCURY IN CATTLE MACROENVIRONMENT IN BENI-SUEF GOVERNORATE, EGYPT

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ABSTRACT :

Concentrations of lead, cadmium and mercury in cattle macroenvironment (water and animal feedstuffs) in six districts, El-Fashn, Beba, Somosta, Ahnasia, Beni-Suef, and Naser at Beni-Suef Governorate were evaluated. Samples of water, Green corn (Darawa) & Wheat straw (Tibn) were collected from the six districts, subjected to analysis for quantitative estimation of lead, cadmium and mercury concentration. The obtained results revealed that, lead levels in water samples were 0.07±0.002, 0.091±0.0019, 0.107±0.036, 0.0879± 0.014, 0.086±0.019, 0.089±0.0034 ppm in El-Fashn, Beba, Beni-Suef, Somosta, Naser and Ahnasia districts, respectively *while lead concentrations in feedstuffs* reached 3.123±0.2, 2.478±0.09, 2.201±0.38, 2.204±0.17, 2.283±0.28, 2.670±0.33 in Darawa and 2.507±0.24, 1.888±0.056, 2.078±0.084, 2.226±0.11, 4.2±0.56, 2.13±0.27 ppm in Tibn in El-Fashn, Beba, Beni-Suef, Somosta, Naser and Ahnasia districts, respectively. Cadmium levels in water samples in Beni-Suef Governorate revealed no increase in cadmium levels than the international standards except in area of Beni-Suef district, which has an average of 0.0136 ppm and a maximum concentration of 0.023 ppm while cadmium concentrations in Darawa were 2.7±0.5, 2.391±0.59, 0.75±0.17 ppm in Beni-Suef and Somosta and Beba districts in the same time Tibn contained cadmium concentrations of 1.93±0.6, 1.28±0.55, 1.32±0.33, 0.743±0.19 and 0.529±0.093 ppm in Beni-Suef, Somosta, Ahnasia, El-Fashn and Naser respectively. The analytical results of mercury in water samples were 0.0014±0.0061, 0.00573±0.0034, 0.096.3±0.0091, 0.0018±0.0003, 0.0018±0.0003, 0.0026±0.0011 ppm in El-Fashn, Beba, Beni-Suef, Somosta, Naser and Ahnasia districts, respectively. Analysis of feedstuffs for mercury revealed that Darawa contained 0.0726±0.0435, 0.1163±0.0695, 0.423±0.012, 0.059±0.012, 0.11±0.052, 1.071±0.344 ppm while Tibn contained 0.716±0.41, 0.0165±0.0042, 0.369±0.003, 0.297±0.068, 0.217±0.049 and 0.094±0.057 in El-Fashn, Beba, Beni-Suef, Somosta, Naser and Ahnasia districts, respectively.

INTRODUCTION:

Heavy metal toxicity represents an uncommon yet clinically significant medical condition. If unrecognized or inappropriately treated, heavy metal toxicity can result in significant morbidity and mortality. The most common heavy metals implicated in acute and/or chronic conditions include lead, arsenic, cadmium and mercury. In non-industrial situations, the major exposure of human and animal to toxic elements occurs principally through their food supply (Sunderman, 1998).

Lead occurs in nature principally as lead ores containing galena (lead sulfide) usually in association with zinc blend (zinc sulfide) (Liptrot 1974). Lead source of particular consideration is the lead tetra-alkyls used as petrol (gasoline) additives. Lead derived from petrol additives contributes not only to the intake through inhalation but also to the intake through ingestion as a result of fallout from vehicle exhaust on near by food crops WHO (1972a). Lead is also found in batteries, solder dyes and insecticides. Lead is easily taken into the body by inhaling lead dust, absorbing lead-based chemicals). Zadnik and Jazbec (1996) identified a new source of lead, namely gravel from the mine and smelter which used for roads and as landfill in swampy areas, including farmland. Lead and its compounds can enter the environment at any time during mining, smelting or processing. Food, air, water and dust or soils are the main potential sources of exposure of infants and young children (WHO 2000). Lead is one of the important metals present naturally in some areas of the world, used on a large scale in industry and causing poisoning in farm animals. It occurs in nature principally as lead ores containing galena (lead sulfide) usually in association with zinc blend (zinc sulfide). It is naturally present in the soil and is commonly introduced into the environment by industries and through exhaust fumes from lead petrol used in vehicles. Lead is also found in batteries, solder dyes and insecticides. Lead is easily taken into the body by inhaling lead dust, absorbing lead-based chemicals through the skin or ingesting lead present in food and water. Lead may be present in drinking water because lead pipes were formerly installed for domestics plumbing and lead-based solder is used with copper pipes. (Liptrot, 1974;UNEP, 1992 and Ellenhorn, 1997).

Cadmium is a non-essential trace metal that has had increasing industrial use during the past 50 years its main use is for electroplating metals especially iron as rust-proofing. Cadmium is also used industrially in pigments and paints, in plastic such as polyvinyl chloride as cathode material for batteries, in neutron rods in the nuclear industry and in fungicides and fertilizers. Environmental exposures to cadmium include cigarette smoking, contaminated foodstuffs such as rice and exposure during lead and zinc smelting (Peter, 1998). There are many sources for cadmium pollution including the mining company which releasing effluents into the river and many industrial companies as those of pigments and stabilizer for plastics. Mine drainage sewage sludge applied to land and phosphate fertilizer and also significant sources of cadmium to the environment (Mason, 1991). Cadmium is a by-product of zinc or lead production it is used in metal plating, alloys, small cadmium-nicked batteries and antiseborrheic shampoos (cadmium sulfide). Cadmium accumulates moderately in plants fertilized with cadmium contained sewage sludge or fertilizer (Gary, 1996).

Cadmium has no biochemical or nutritional function, and it is highly toxic to both plants and animals. In humans and animals, there is strong evidence that kidney is the main target organ of cadmium toxicity, following extended exposure. Animals' studies have confirmed that inhalation exposure to cadmium leads to respiratory injury (USPHS, 1997 and WHO, 1993a). Cadmium and certain cadmium compounds are listed by the International Agency for Research on Cancer (IARC) as carcinogenic (IARC, 1998). When present in a bio-available form, both aquatic and terrestrial organisms are known to bio-accumulate cadmium. Studies have shown accumulation in aquatic animals at

concentrations hundreds to thousands of times higher than in water (USPHS, 1997).

UNEP (1992) mentioned that man had used mercury for many centuries. It was known to the ancient Chinese and has been found in Egyptian tombs more than 3500 years old. Today it is still commonly used in thermometer, batteries, fluorescent lights and many industrial processes including the production of fungicides and paints. There are three types of mercury:

1-Elemental mercury (Hg) is found in glass thermometer, button batteries, paints and dental amalgams.

2-Inorganic mercury, mercuric chloride the most toxic inorganic form has been used as a disinfectant. mercurous chloride was used as teething powder and laxative. Mercurous fluminate is an explosive compound.

3-Organic mercury as methyl and ethyl mercury are well known as environmental contaminants and concentrated in the aquatic food chain (Peter 1998). Mercury can exist in three valence states, Hg (O), Hg (I), Hg (II). In the atmosphere elemental mercury is by far the most common form, and as a vapor it is responsible for the long range global cycling of mercury. In addition to a far lesser degree, mercury may be associated with particulate, which is removed dry or wet deposition. Atmospheric inputs may be more significant in areas where other sources, such as contaminated rivers are less important or non-existent (USPHS, 1997, WHO, 1993b). Due to the fact that mercury is the only metal that can exist as both a liquid and a vapor at ambient temperature, its environmental behavior differs from that of most other toxic elements (USPHS, 1997, WHO, 1989). Mercury (Hg) pollution has been recognized as a potential environmental and public health problem for over 40 years. In general the primary routes of acute and chronic Hg exposure include inhalation, dermal absorption, and ingestion. Stomatitis, erethism, and renal damage for oral exposure. Schumann (1990) declared that mercury accumulation in the brains of suckling is approximatly 10 times higher than in grown animals and milk increases the bioavailability of mercury. Inorganic mercury is excreted into milk from plasma to a higher extent than methylmercury. It is suggested that methyl-mercury and to some extent inorganic mercury are transferred from plasma into milk using albumin as a passive carrier (Sundberg *et al.* 1999).

Although, determination of heavy metals concentrations in cattle macroenvironment (water and feedstuffs) were performed in many places in Egypt and over the world, the absence of these studies in Beni-Suef Governorate, initiated us to estimate lead, cadmium and mercury in cattle macroenvironment in this area.

MATERIALS AND METHODS:

Six areas (Elfashn, Beba, Somosta, Ahnasia, Beni-Suef, and Naser) at Beni-Suef Governorate were investigated in this study.

Water Samples:

Sixty water samples used for cattle drinking were collected in clean previously acid washed glass containers from the studied areas (ten of each). The samples were digested by using equal volumes of a mixture of nitric and perchloric acids according to (Agermain *et al.*, 1980) then were subjected for determination of lead, cadmium and mercury levels.

Feedstuffs samples:

Thirty random samples of Wheat straw (Tibn) and thirty green corn (Darawa) were collected from the studied areas five from each examined area. The feed stuffs samples were digested using of 20 ml of the acid mixture (750 ml of concentrated nitric acid, 150 ml of concentrated sulfuric acid and 300 ml of 60-62% per-chloric acid) added to 2 g of dried ground plant under ventilation hood according to method described by Chapman and Pratt (1982) then were subjected for chemical analysis of lead, cadmium and mercury.

Chemical analysis :

Lead was quantitatively determined in different samples using atomic absorption spectrophotometer (AAS) according to Campiglio, (1979). Cadmium concentrations were estimated using cadmium specific ion electrode model 94-48 attached to expandable ion analyzer EA 920 Orion according to Gardiner (1974). Mercury concentrations was determined using iodide selective electrode model 94-53 attached to expandable ion analyzer EA 920 Orion according to Overman, (1971).

Statistical analysis:

The obtained data in this study was statistically calculated according to the method described by (Snedecor, 1971).

RESULTS:

The analysis of water samples (Table 1 & Fig. 1, 3, 5) revealed that water contains lead level of (0.07±0.002), 0.091±0.0019, 0.107±0.036, 0.0879±0.014, 0.086±0.019, 0.089±0.0034 ppm in El-Fashn, Beba, Beni-Suef, Somosta, Naser and Ahnasia districts respectively. There was an increase in water lead level above the maximum permissible limit (0.05 mg/L). The highest mean level of lead was found in Beni-Suef district 0.1070±0.0360 ppm. Lead concentrations in feedstuffs are slightly increased than the safe concentration reported by the WHO. The highest mean concentrations of lead were found in Darawa collected from Elfashn 3.123±0.20 ppm and Tibn samples collected from Naser 4.200±0.560 ppm (Table 2 & Fig. 2, 4, 6). There is no increase in cadmium levels in water samples above the international standards in Beni-Suef Governorate except in area of Beni-Suef district 0.1360±0.023 and a maximum level of 0.203 ppm (Table 1). Analytical findings of cadmium in feedstuffs revealed an increase in cadmium concentrations in Darawa above the recommended USA level of (0.05 ppm) in Beni-Suef and Somosta and Beba districts 0.27±0.05, 0.2391±0.059 and 0.075±0.017 ppm respectively. In the same time Tibn had also an increased concentration 0.193±0.06, 0.128±0.055, 0.132± 0.033, 0.0743±0.019 and 0.0529±0.0093 ppm in Beni-Suef, Somosta, Ahnasia, El-Fashn and Naser (Table 2). Mercury levels in water samples (Table 1) and its concentrations in feedstuffs samples (Table 2) were low in all examined samples compared with the international limits.

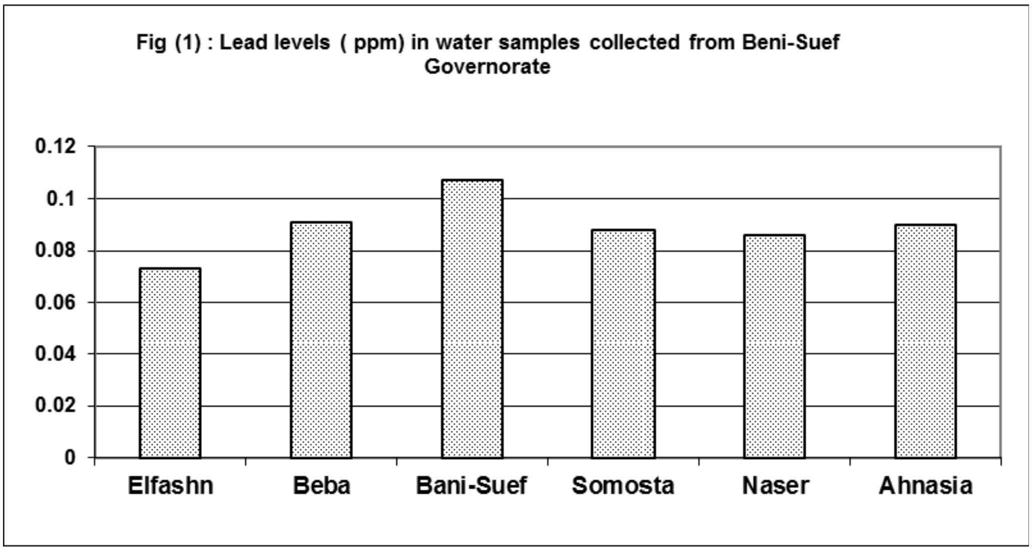
Fig (1) : Lead levels (ppm) in water samples collected from Beni-Suef Governorate
0.12
0.1
0.08
0.06
0.04
0.02
0
Elfashn
Beba
Bani-Suef
Somosta
Naser
Ahnasia

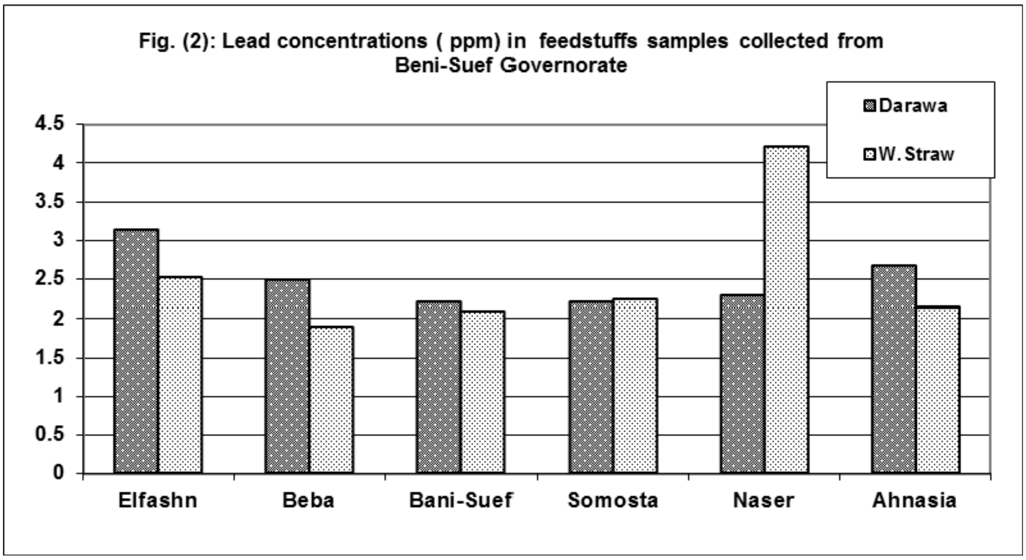
Fig. (2): Lead concentrations (ppm) in feedstuffs samples collected from Beni-Suef Governorate
Darawa
W. Straw
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Elfashn
Beba
Bani-Suef
Somosta
Naser
Ahnasia

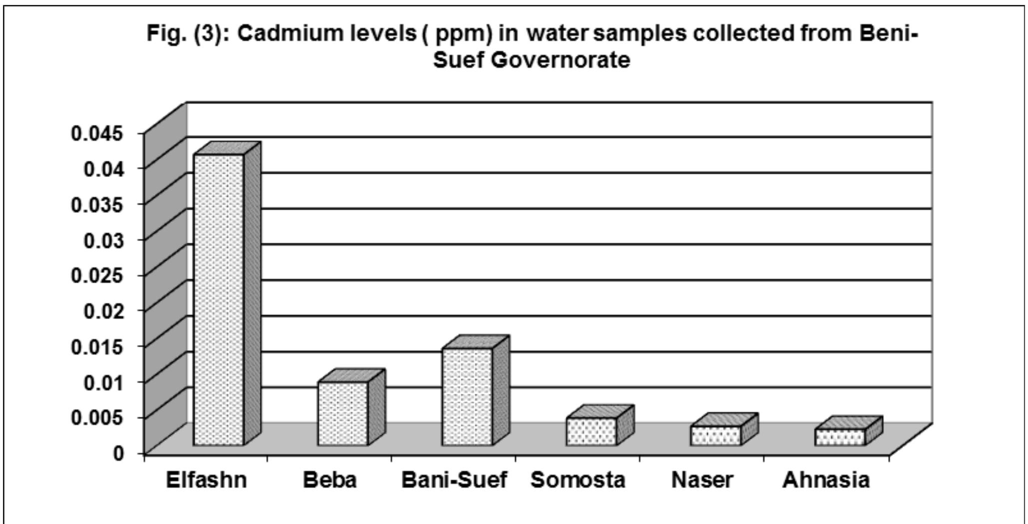
Fig. (3): Cadmium levels (ppm) in water samples collected from Beni-Suef Governorate
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Elfashn
Beba
Bani-Suef
Somosta
Naser
Ahnasia

Fig. (4): Cadmium concentrations (ppm) in feedstuffs samples collected from Beni-Suef Governorate

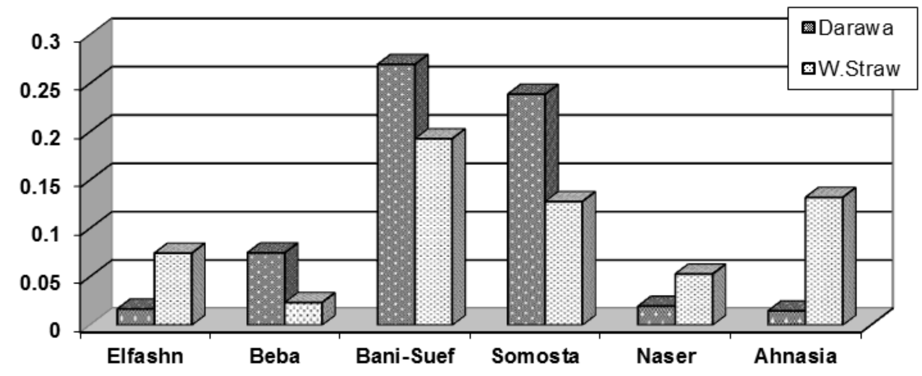

Fig. (5): Mercury levels (ppm) in water samples collected from Beni-Suef Governorate

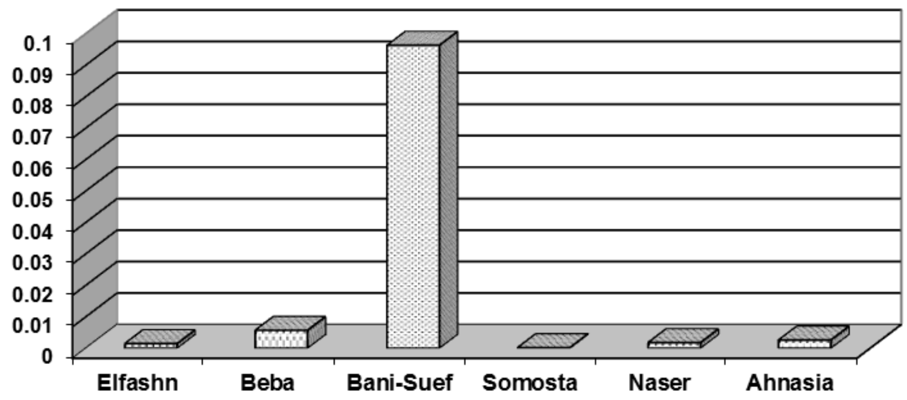

Fig. (6): Mercury concentrations (ppm) in feedstuffs collected from Beni-Suef Governorate

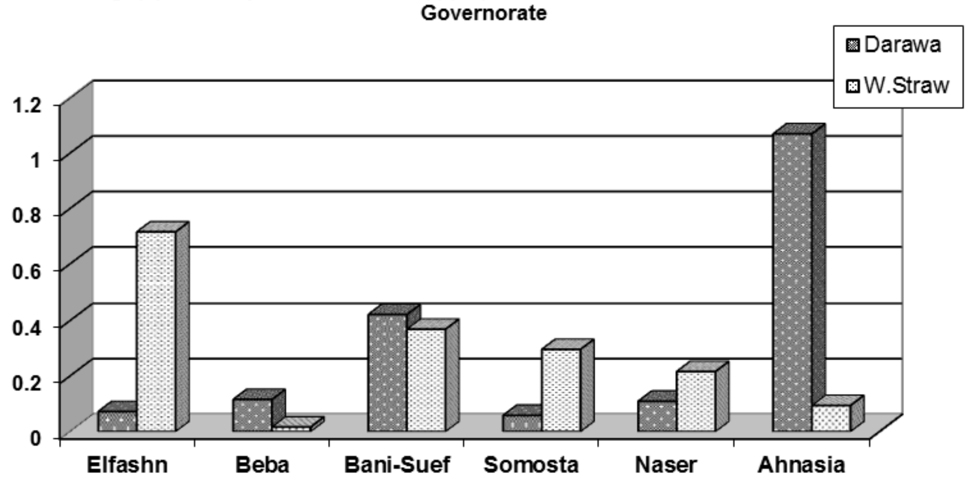

Table (1): Lead, cadmium and mercury levels (ppm) in water samples collected from Beni-Suef Governorate

Districts	Heavy metals		
	Lead	Cadmium	Mercury
El-Fashn	0.073±0.0022	0.0407±0.0049	0.0014±0.00061
Beba	0.0910±0.0019	0.0890±0.013	0.0057±0.0034
Beni-Suef	0.1070±0.0360	0.1360±0.023	0.0963±0.09100
Somosta	0.0879±0.0140	0.0387±0.0036	0.0002±0.00003
Naser	0.0861±0.0190	0.0273±0.0049	0.0018±0.00039
Ahnasia	0.0899±0.0034	0.0229±0.0098	0.0026±0.00011
U.S. EPA guide	(0.015 mg/l) The U.S. EPA action level (Al)	(0.01 mg/l) U.S. EPA (1986) recommended level (0.005 mg/l) U.S. EPA MCL	
WHO guide	(0.01 mg/l) WHO (1993)	(0.003 mg/l) (WHO, 1993)	
N.I.D.W.	(0.05 mg/l)		0.01

N.I.D.W. : National Interim Primary Drinking Water Regulations guide.

Table (2): Lead, cadmium and mercury concentrations (ppm) in feedstuffs samples collected from Beni-Suef Governorate

Districts (Metals / Feedstuffs)	Lead Darawa	Lead Tibn	Cadmium Darawa	Cadmium Tibn	Mercury Darawa	Mercury Tibn
El-Fashn	3.123±0.20	2.507±0.240	0.168±0.049	0.746±0.19	0.0726±0.0435	0.7166±0.4100
Beba	2.478±0.09	1.888±0.056	0.750±0.17	0.235±0.043	0.1163±0.0695	0.0165±0.00425
Beni-Suef	2.201±0.38	2.078±0.084	2.700±0.50	1.930±0.60	0.4230±0.0120	0.3697±0.00310
Somosta	2.204±0.17	2.226±0.110	2.391±0.59	1.280±0.55	0.0590±0.0120	0.2970±0.06800
Naser	2.283±0.28	4.200±0.560	0.197±0.042	0.529±0.093	0.1100±0.0520	0.2172±0.04900
Ahnasia	2.671±0.33	2.130±0.270	0.149±0.0121	1.323±0.33	1.0710±0.3440	0.0943±0.05700
WHO, (2000)	8-340 ppm	8-340 ppm				
UK MAFF, (1997)	0.1- 0.2	0.1- 0.2	0.05	0.05		

Results represented by Mean ± standard error.

DISCUSSION:

1-Lead:

The U S. EPA's MCL, Goal of zero for lead in drinking water is based on occurrence of low-level effects and because the U.S. EPA classifies lead as a class B2 carcinogen (U.S. EPA, 1991). The U.S. EPA has not adopted MCL for lead in drinking water because they regard the development of such a level as not feasible. The U.S. EPA had an action level (Al) (the level at which the authorities must do something to remove the contaminant) of 0.015 mg/l. WHO (1993b) considered (0.01 mg/l) is the recommended level. The highest contaminant level recommended by the National Interim Primary Drinking Water Regulations is 0.05 mg/l (Daniel, 1980) while Bacon *et al.* (1967) considered 0.05 ppm of lead is the concentration, which should not be exceeded, in communal drinking water. The analysis of water samples (Table 1) revealed that water contains a lead level of (0.07±0.002), 0.091± 0.0019, 0.107±0.036, 0.0879±0.014, 0.086±0.019, 0.089±0.0034 ppm (mg/liter) in El-Fashn, Beba, Beni-Suef, Somosta, Naser and Ahnasia districts. All the examined water samples had lead values above the U.S. EPA actions level

(0.01 mg/l), WHO (1993b) recommended level (0.01 mg/l) and the level recommended by National Interim Primary Drinking Water Regulations (0.05 mg/l). Sharkawi (1991) found that the highest amount of recorded soluble level was 0.096±0.005, 0.091±0.0004, 0.078± 0.004 and 0.074±0.006 ppm in the small canal, River Nile, El-Ibrahimia and tap water respectively. Zaki et al. (1994) estimates a high lead concentration in both superphosphate wastewater discharges (6.5 mg/L) and River Nile water in the area of the plant pollution (4.5 mg/L). Other samples in Assiut Governorate revealed that about 33.3% of analyzed water samples contained more than 0.05 mg/L which is the highest contaminant level recommended by the National Interim Primary Drinking Water Regulations. In another survey Salem *et al.* (2001) examined eighty representative water samples from Aswan, Qena, Assiut and Beni Suef cities, the River Nile running water in Aswan, Assiut, Beni-Suef and from Bahr Yousef canal. The results indicated that all cities drinking water samples contained lead with an average below 0.1-mg/L, while all surface water contained more than 0.1-mg/L lead. This finding could be attributed to the pollution of surface water and/or air with lead after emission from high way or motor boat traffic, industrial and agriculture discharge. Abu-Sharar (2001) found that Jordan has a serious shortage of good quality water for domestic and agricultural consumption. Runoff water from Amman-Zerqa metropolitan area is contaminated with lead as shown by the relatively high lead concentration. Average lead concentration may reach 29 and 31 mg/l in surface and bottom water, respectively.

Lead levels in feed stuffs (Table 2) reached 3.123±0.2, 2.478±0.09, 2.201±0.38, 2.204±0.17, 2.283±0.28, 2.670±0.33 in Darawa and 2.507± 0.24, 1.888±0.056, 2.078±0.084, 2.226±0.11, 4.20±0.56, 2.13±0.27 ppm in Tibn in El-Fashn, Beba, and Beni-Suef, Somosta, Naser and Ahnasia districts respectively. These results are more less than amounts recorded by WHO, (2000) in a recent study in a non-industrialized area of the united kingdom, where the concentrations of lead ranged from 8 to 340 ppm in plant materials, the value being greater for grasses> herbs> vegetables> cereals> fruits. Root vegetables tended to have higher concentrations than other plant stuffs, at 20 – 125 ppm. Carrots, Leeks and Onions have the largest amounts. The European Commission Regulation, proposed lead limits of 0.1-0.2 mg/kg for cereals, legumes and pulses, 0.2 for wheat grain and 0.1 for vegetable (UK MAFF, 1997). From the above-mentioned data of water and feed stuff analysis, water in the aforementioned districts considered of public health interest, as 100% of water samples are not accepted as safe drinking water either for human or animal purposes. The possible source of lead could be attributed mainly to the water and to a lower extent to feedstuffs. Lead pollution may be attributed to the industrial and agriculture discharge and also due to the lead emission from the highway. WHO, (1989) published that lead concentration are highest in soil and organisms close to roads where traffic density is high. The lead measured is inorganic and derives almost from alkyl lead compounds added to petrol. Lead contamination increases lead levels in plants and animals in areas close roads. These levels are positively correlated with traffic volume and proximity of roads.

Lead has multiple toxic effects on human, it is a probable human teratogen, associated with increased incidence of hypertension and cardiovascular disease, affect the brain development and function causing neurotoxicity and affect the male fertility (Sunderman, 1998; WHO, 2000; Zheng, 2001; Gupta et al. 2003 and El-Sokkary et al. 2003). Metals are intrinsic to

nature, the environmental influences may alter the form or valence of a metal, but as elements, metals can not be destroyed. Redistribution of metals in the environment exposes humans and animals to toxic forms of metals that are not normally accessible. The spill of heavy metals (Pb, Cadmium and Mercury) in water may entered the food chain, because of their extreme persistence, high toxicity, and its tendency to accumulate (Hernandez et al. 1999).

2-Cadmium:

The investigation of water samples in Beni-Suef Governorate (Table 1) revealed no increase in cadmium levels than the recommended limit (0.01 mg/l) by the U.S. EPA (1986) except in area of Beni-Suef district, which has an average of 0.0136 ppm and a maximum concentration of 0.023ppm while all the examined samples were above the U.S. EPA MCL (0.005 mg/l) of cadmium in drinking water (Kegley & Andrews, 1998 and Stephen, 1998) and (0.003 mg/l) WHO guide (WHO, 1993a). These results are identical to that estimated before where water from the River Nile in Aswan, Assiut and Beni-Suef regions have cadmium averages of 0.011±0.005, 0.011±0.01 and 0.013±0.007 mg/L. Bahr Yousef Canal contained the highest cadmium average of 0.023 ± 0.02 mg/L (Salem *et al.* 2001). Zaki *et al.*, (1994) found that 48.72% of analyzed water samples of Assiut Governo-rate contained more than 0.005-mg/l cadmium (the maximum contaminant level recommended by the Public Health Service Drinking Water Standard (Thomas & Robert, 1973).

Cadmium in water reached its highest levels at areas of Gaz El-Akrad and Manqabad (0.042±0.004 and 0.045±0.0097mg/L) while the lowest values were recorded at Ilwan and El-Twabiya which recorded 0.014±0.0039 and 0.017±0.0016 mg/L. the concentration of cadmium in water from Dairut area was 0.004± 0.0003 mg/L (Manal, 2001). About 54% of 727 surface water samples in United states contained less than 0.001 mg cadmium/l, 42% contained cadmium in the range of 0.01 to 0.001 mg/L and about 4% the cadmium concentration exceeded 0.01 mg/L, the maximum cadmium concentration was 0.13 mg/L (Durum *et al.,* 1971). The source of cadmium and lead can arise from mine drainage water, wastewater from the processing of ores, and overflow from the tailing ponds and rain water run-off from the general mine areas as documented by Carvalho *et al.* (1984).

Crops might contain undesirable cadmium levels without exhibiting signs of plant toxicity. Factors influencing crop uptake include soil pH, uptake is reduced when the soil pH is higher than 6.5, crop selection, crops vary in cadmium content and distribution. Corn grain is lower in cadmium than wheat, oats, soybeans or sorghum, other metals as copper may increase the cadmium content of crop foliage, grain or both whereas zinc, selenium or molybdenum may decrease the cadmium content (Gary 1996). The allowable values of cadmium concentration in rice were estimated to be in the range of 0.05-0.020 ppm, representing values lower than the 0.4-ppm provisionally adopted by the Japanese government (Osawa *et al.* 2001). Analytical findings of cadmium in feedstuffs (Table 2) Darawa revealed an increase in their cadmium concentrations (0.27±0.05, 0.2391±059, 0.075± 0.017 ppm) than the recommended USA level of (0.05 ppm) in Beni-Suef and Somosta and Beba districts. In the same time Tibn has also an increased levels (0.193±0.06, 0.128±0.055, 0.132±0.033, 0.0743±0.019 and 0.0529±0.0093 in Beni-Suef, Somosta, Ahnasia, El-Fashn and Naser. The present data indicates a possible source of cadmium pollution in the mentioned districts but in the lower borderline of the permissible limits. These results are in

accordance with that found by Manal (2001) who found cadmium concentrations of feedstuffs in the vicinity of Assiut superphosphate factory at Gaz El-Akrad and Manqabad at about 0.055±0.0022 and 0.030± 0.0012 mg/kg and recorded a higher levels than the area of El-Twabia, Ilwan and Dairut which reached 0.029±0.0018, 0.025± 0.0019 and 0.024±0.0055 mg/ kg. The extent of cadmium uptake by plants is highly positively correlated to cadmium soil concentration. Potential hazards such, as sewage sludge must be evaluated. For the general population the main exposure to cadmium is via food and vegetables products (cereals bulb crops, leafy vegetables) (Burgat *et al.* 1996).

***Cadmium* is a toxic metal with extremely long biological half life time of 15-20 years in human, cadmium exposure can cause a variety of adverse health effects among which kidney dysfunction, lung disorders, disturbed calcium metabolism and bone effect are most prominent. Cadmium and most compounds give rise to lung cancer after inhalation. Since the blood -brain barrier keeps cadmium outside the CNS reported neurotoxic effect of cadmium during development are likely to be secondary to an interference of cadmium with zinc -metabolism (Jin *et al.* 1998). Many of the various species of cadmium are quite soluble in water, and also tend to bioaccumulate in fish and plants. Cadmium considered as a toxic water pollutant was demonstrated in Japan, in areas where water from Jinzu River used to irrigate rice fields. Many people in this area, particularly older women, suffered from Itai-Itai disease. The river in the affected area was highly polluted by a mining operation, (Karen and Thomas, 1996). Water may carry poisonous substances introduced by pollution or added to the water as a result of corrosive processes as cadmium and lead. About 48.72% of analyzed water samples from Assiut Governorate contained more than 0.01 mg/L cadmium (The maximum contaminant level recommended by the public health service) Drinking Water Standard, Cadmium accumulates in the soft tissues at all concentration levels down to 0.1 mg/L in drinking water resulting in anemia, poor metabolism and possible adverse arterial changes in the liver of man (Zaki *et al.* 1994).**

3- Mercury:

Jeff (1998) considered the MCL for mercury is 0.01 mg/L. The analytical results of mercury in water (Table 1) were 1.44±0.61, 0.573±3.4, 96.3±91.0, 0.18±0.03, 1.79±0.398, 2.65±0.11 ng/liter in El-Fashn, Beba, Beni-Suef, Somosta, Naser and Ahnasia districts, respectively. The present results of mercury could be considered low but Cooper and Gillespie (2001) found an average mercury concentrations in water, soil, lake sediments and fish samples collected from Mississippi River alluvial flood plain located in Northwestern Mississippi of: 2.16 µg/L, 55.1, 14.5 and 125 µg/kg, respectively. Mercury concentrations were low but showed a greater tendency to concentrate in fish tissues.

The mean mercury concentration in miscellaneous cereals greens vegetables other vegetables 0.004, 0.0004 and 0.0006 mg/kg (UK MAFF, 1997). The analytical findings are near the values obtained by Bonzongo *et al.* (1996), who determined concentration of mercury in surface waters and associated riverbank sediment samples in a river reservoir system contaminated by mine wastes. The distribution of total and methylmercury in surface waters along the Carson River (USA) was similar to that measured in riverbank sediments and influenced flow regimes. High levels of mercury (up to 7585 and 7.2 ng Hg/L for total and

metylmercury respectively) determined on surface water samples. Elemental mercury (Hg^o) increased from 0.02ng/L in the non-contaminated region to 2ng / L in the reservoir. The source of mercury could be associated with the disposal of sewage water and municipal wastes are important aspects of water pollution, which should be considered in the context of wider environmental problem. This wastewater contains high amounts of heavy metals as mercury, lead, cadmium and copper, which are toxic to plant, human and animal (Kanwar and Sandha 2000).

Mercury in plant tissues is derived from atmosphere not the soil. Tissue concentration by area was closely related to the respective growing season length and other climatic measures as growing degree-days and actual evapotranspiration. These relationships imply that both foliar uptake of HgO from the atmosphere and effluxes of Hg from the soil system depend on biological activity (Fleek *et al.* 1999).

Mercury contamination of food depends to a greater extent on the chemical forms that are placed in the environment. Mercury levels of most plant foods and meat are generally considered to be quite low, with recent estimation for meat produces in the United States indicating a range of 1-7 ppb. Mercury levels of other food including potatoes, legumes and cereals are generally less than 50 ppb WHO has suggested a provisional tolerable intake of mercury 0.3 mg total/week that is not to include more than 0.2mg of methylmercury (Takayuki and Leonard 1993).

Analysis of feedstuffs for mercury (Table 2) revealed concentrations in Darawa as 0.0726± 0.0435, 0.1163±0.0695, 0.423±0.012, 0.059±0.012, 0.11±0.052, 1.071±0.344 ppm. While Tibn had 0.0743±0.019, 0.0235±0.0043, 0.193±0.055, 0.0529±0.0093, 0.1323±0.033 in El-Fashn, Beba, Beni-Suef, Somosta, Naser and Ahnasia districts, respectively.

In the same way Doberschutz *et al.* (1998) analyzed grass, grass silage and hay, maize and maize silage from six areas in Northern Germany for heavy metals. The areas included a rural district, district near a cement works, lignite area and mine treated with sewage sludge. The results showed that grass was most contaminated near a cement works.

The present results are near that obtained by Amonoo-Nazer *et al.* (1996) who collected samples of soil and plant from the title gold mining town and its environs. The distribution of mercury in these samples from 14 sampling sites was determined. The annual average concentrations of Mercury from plant and grass samples show the mean and SD of 1.85±2.04 (range 0.12-9.68 mg/kg D.W). Plant: soil concentration ratios of Mercury showed elevated values for the grass samples, especially from sites within 4km of the treatment plant.

In the same direction, Cappon (1981), found that the edible tissue mercury contents of sludge-grown crops average four and two times higher, respectively than that crops grown on untreated soil. Crops from sludge and untreated soil had methylmercury levels averaging 14.0 and 4.4% respectively of the total tissue mercury content. The obtained results are considered low this could be attributed to the fact that mercury accumulation by the herbage decreased in the sequence: roots> leaves> shoots> below ground storage organs> reproductive organs. Root mercury contents were three folds higher than in the herbage. Herbage mercury contents did not exceed permissible levels (Kralovec and Slavikl, 1997).

There was an increase in water lead levels in all water samples collected from the six districts in Beni-Suef Governorate above the maximum permissible limit (0.05 mg/L). Lead concent-

rations in feedstuffs are slightly increased than the safe concentration reported by the WHO. We can conclude that, water is considered of public health interest, as 100% of water samples are not accepted as safe drinking water either for human or animal purposes. The possible source of lead pollution in the macro-environment could be attributed mainly to the water and to a lower extent to feedstuffs. There is no increase in cadmium levels in water samples in Beni-Suef Governorate above the international standards except in area of Beni-Suef district. Increased cadmium concentrations in green corn (Darawa) above the recommended USA level of (0.05ppm) in Beni-Suef, Somosta and Beba districts and also in Beni-Suef, Somosta, Ahnasia, El-Fashn and Naser for wheat straw. The present data indicates a possible source of cadmium pollution in the mentioned districts but in the lower borderline of the permissible limits. Mercury levels in water samples and its concentrations in feedstuff samples were low as mercury shows a greater tendency to concentrate in fish tissues. Elevated levels of mercury in environment remote from industrial sources have been broadly attributed to long-range atmospheric transport and deposition of anthropogenic mercury.

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مسح لمستويات الرصاص والكادميوم والزئبق في البيئة الخارجية للماشية بمحافظة بنى سويف -مصر

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نظراً لأهمية دراسة التلوث البيئى بالمعادن الثقيلة وما لـه من مدلولات خطيرة على صحة الإنسان والحيوان، فقد أجرى هذا البحث بغية توضيح وقياس مستوى الرصاص والكادميوم والزئبق فى مصادر طعام وشراب الماشية فى ستة مراكز من محافظة بنى سويف للمرة الأولى كنوع من أنواع التقييم البيئى بالمحافظة، وكذلك لتوضيح الأثر السام لهذه المعادن على صحة الحيوان، وأيضا أثرها الضار الناجم من تناول هذه اللحوم، وقد تم تجميع ٦٠ عينة من عينات المياه ومثلها من عينات الغذاء (٣٠ عينة من التبن، ٣٠ عينة من الدراوة) من المراكز السابق ذكرها.

وأسفرت النتائج عن وجود عنصر الرصاص فى عينات المياه بنسب ٠,٠٧، ٠,٠٩، ٠,١٠٧، ٠,٠٨٧٩، ٠,٠٨٦، ٠,٠٩ جزء من المليون (مجم/لتر) بمناطق الفشن، ببا، بنى سويف، سمسطا، ناصر وأهناسيا علي التوالي أما في الغذاء فوصل مستوي الرصاص إلى: ٣,١٢٣، ٢,٤٧٨، ٢,٢٠١، ٢,٢٠٤، ٢,٢٨٣، ٢,٦٧١ في الدراوة، أما بالنسبة للتبن فكانت مستويات الرصاص كالتالي: ٢,٥٠٧، ١,٨٨٨، ٢,٢٢٦،٢,٠٧٨، ٢، ٤,٢، ٢,١٣ جزء من المليون في الفشن، ببا، بنى سويف، سمسطا، ناصر وأهناسيا علي التوالي. وتوضح هذه النتائج ارتفاع مستوى الرصاص عن الحد المسموح به (٠,٠٥ مجم/لتر) فى جميع عينات المياه التى تم جمعها من جميع مراكز محافظة بنى سويف بينما كان مستوى الرصاص فى طعام الحيوانات أقل من المستوى المسموح به لدى منظمة الصحة العالمية مما يرجح أن يكون المصدر الأساسى للتلوث بالرصاص هو تلوث المياه. أما الكادميوم فلم يتعد المستوي الدولي فيما عدا مركز بنى سويف، والتي بلغت متوسط نسبته إلى: ٠,٠١٣٦ جزء من مليون، وقد بلغ أعلى تركيز لـه ٠,٠٢٣ جزء من المليون. وبتحليل نسبة الكادميوم في الدراوة وجد أن تركيزه كان ٢,٧، ٢,٣٩، ٠,٧٥ جزء من المليون في مراكز بنى سويف، سمسطا وببا على التوالى بينما كان تركيز الكادميوم في التبن كالتالي: ١,٩٣، ١,٢٨، ١,٣٢، ٠,٧٤، ٠,٥٢٩ جزء من المليون في مركز بنى سويف، سمسطا، أهناسيا، الفشن وناصر علي التوالي. ويتضح من النتائج ارتفاع مستوى عنصر الكادميوم في عينات المياه التى تم جمعها من مركز بنى سويف فقط عن المعايير الدولية (٠,٠٠٥ جزء فى المليون)، وكذلك فى عينات الدراوه بنى سويف وسمسطا وببا، وأيضا فى عينات التبن الخاصة ببنى سويف وسمسطا وأهناسيا والفشن وناصر مما يعنى أن هناك مصدراً من مصادر التلوث بالكادميوم فى هذه المناطق.

وبتحليل عينات المياه وجد أن تركيز الزئبق بها كان كالتالي: ٠,٠٠١٤، ٠,٠٠٥٧، ٠,٠٩٦، ٠,٠٠٠٢، ٠,٠٠١٨، ٠,٠٠٢٦ جزء فى المليون في المراكز: الفشن، ببا، بنى سويف، سمسطا، ناصر وأهناسيا علي التوالي، أما تركيز الزئبق في عينات الدراوة فكانت ٠,٠٧٢٦، ٠,١١٦، ٠,٤٢٣، ٠,٠٥٩، ٠,١١، ١,٠٧١ جزء من المليون، بينما كان تركيز الزئبق في عينات التبن كالتالي: ٠,٧١٧، ٠,١٦٥، ٠,٣٧، ٠,٢٩٧، ٠,٢١٧، ٠,٠٩٤علي التوالي. وقد كان مركز أهناسيا أقل

المراكز تلوثاً بعنصر الزئبق بينما كان مركز سمسطا من أكثر المراكز تلوثاً مما يدعو إلى ضرورة البحث عن مصادر هذه الملوثات وإيجاد الحلول المناسبة لتقليل أو منع تسربها إلى البيئة المحيطة، وهذا يحتاج إلى مزيد من الدراسة.