

STUDY THE EFFECTS OF THE POLLUTED WASTE WATER ON THE ENVIRONMENT

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Abstract

To study the distribution and the pollution in the environment (water, plants and farmers) in the south of Baghdad (Babil city Aliskanderia) with heavy metallic mercury (Hg).

Samples of waste water from industrial units using the mercury in its process, also samples from the two plants (Wheat and Trefoil) from that area were taken in order to determine the concentration of the mercury.

To shed a light on the possibility of relationship between the time exposure

(their living time in that village) and mercury level in their blood ,using serum samples obtained from(40) farmers living in the selected village not far from the contaminated water .The farmers were divided in to five groups according to their period of living in the village (exposure period from 1 – 3, 4 –6, 7 – 10 and more than 10 years) , the fifth group consisted of (10) healthy volunteers that were living far away from the contaminated area The mercury levels were determined using Atomic Absorption Spectrophotometer with cold vapor .It was noticed that an increasing in the average of concentration of mercury in the industrial waste water used for and under consideration in the plants samples (Wheat and Trefoil)of agriculture with industrial waste water . The present study showed some evidences concerning effect of the period of using polluted water with the concentration of mercury in the blood of the farmers living near the contaminated rivulet.

Introduction

A poison defines as any agent that is capable of producing injury or death when ingested or absorbed , then as pointed out by Paracelsus over

400 years ago (all substances are poisons; there is none which is no poison. The right dose differentiates a poison and remedy) (1) . Mercury is a highly toxic substance that has found its way into our food chain and can

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cause health problems for people who are exposed to it. As pregnancy precaution, the formation of a fetus is very much at risk to mercury in its mother's blood, so the continuous release of mercury from polluted food may be responsible for abortion or the birth defects seen in society today.

Elevated levels of mercury are harmful to everyone. Mercury adversely affects fetal development of the brain and central nervous system and infants can be further exposed to mercury from their mother's breast milk. Exposures at these early stages are particularly dangerous and can affect the development of memory, attention and language skills(2).

Heavy metals affect the immune system when the body recognizes the toxic metal such as Mercury (Hg), the white blood cell (WBC) count goes up dramatically. The toxicity of Mercury has been known before 200 years (1, 3).

Mercury is a heavy metal, it is stable in air and with water, it is un-reactive towards acids except concentrated (HNO_3) and alkalis (4,5).

Metallic mercury, methyl mercury and mercury vapor are the most toxic forms, also it is the most toxic non-radioactive element on earth. Metallic mercury has limited but

toxicologically significant solubility in water ($20\mu\text{g/L}$) and in organic solvents ($2.7\mu\text{g/L}$).

The birth of the industrial age gave rise to increased releases of mercury.

Since the late 18th century and the dawn of the industrial revolution, it has been used in products such as light bulbs, batteries, thermometers, barometers, pesticides and paints. It is released from the burning of fossil fuels in hospital incinerators (6).

To shed light on the blood mercury levels and fish consumption, the primary source of non occupational exposure to mercury is through the consumption of contaminated fish. Since 1994, the Louisiana Department of Environmental Quality has reported mercury contamination in fish obtained from bodies of water through the state and has issued fish consumption advisories accordingly.

The toxicology of metals including their uses, occurrence, and effects is very important for research. In this research or study we will deal with the mercury which is one the environmentally important elements.

The mechanism of toxic action or most hazardous chemicals occur due to binding to receptor molecules in a cell, tissue, organ.

Mercury is ubiquitous in the environment. Once introduced to

the body through food, water or vapor, it is rapidly absorbed and accumulates in several tissues, leading to increase oxidative damage, mitochondrial dysfunction, and cell death. Mercury primarily affects neurological tissue, resulting in numerous neurological symptoms and also affects the kidneys and the immune system. It causes increased production of free radicals and decrease the availability of antioxidants. It also has devastating effects on the glutathione content of the body, giving rise to the possibility of increased retention of other environmental toxins (7).

A direct mechanism involving mercury's inhibition of cellular enzymatic process by binding with the thiol group (SH) in amino acids appears to be a major part of the connection to allergic immune reactive conditions such as autism, schizophrenia, eczema, psoriasis and allergies(8).

Toxicity of various forms or salts of mercury is related to cation mercury phase whereas solubility, biotransformation and tissue distribution are influenced by valence state and anionic component (1).

Acute toxic exposure are rare , and there have been cases of elemental mercury accidentally being released in to the blood stream such as when a rectal

thermometer breaks , or when several grams of mercury were swallowed intentionally , without any reported adverse effects from the mercury .

Exposure to mercury can occur from many different sources including diet, water, air and occupational exposure (9).

It is difficult to assess what quantities of mercury come from human activities and what quantities from natural sources (1).

From another side of study, maternal-fetal transfer of metallic mercury

via the placenta and milk, the study concluded that the metallic mercury

can be transferred to the fetus via the placenta and secreted to a new born

via milk in the women who had been occupationally exposed to metallic mercury(10).

Materials And Methods

The general laboratory chemicals and standard solutions are of the highest available purities were purchased from Fluka, Switazerland and E . Merk, W. Germany.

Several instruments were used in the experimental work as follow:

Atomic absorption spectrophotometer cold vapor system (A.A.S.C.V.)

U.K. Centrifuge (MSE, England).

Procedures

1- Samples from contaminated study area (Aliskandaria) natural agriculture water and plants as Wheat and Trefoil were collected to study the concentration levels of mercury present and the effect of the contaminated industrial waste water used for agriculture, were shown in the table (1).

The period of taking the samples was from September 1999- June 2000 .

a- Determination of mercury in water

- Samples of water (50ml).
- Acidify with nitric acid.
- Evaporation of the solution until 10 ml.
- A.A.S.C.V. was used to determinate the concentration of mercury

in water samples and stock solutions (as standard).

The results were listed in table (1).

b- Determination of mercury levels in plants:

- Samples of roots, leaves, crops of (Wheat and Trefoil) were collected

from selected areas near and far away from the source of contamination.

- Crushing the above samples and evaporate the water until dryness

- Mixture of (1:3) sulfuric acid and nitric acid was added.

- Digestion, cooling and filtration have been done.

- Determination of mercury concentration of samples using (A.A.S.C.V.), the results were listed in table (2).

2- Determination of mercury in blood serum:

- Volunteers (50 farmers) from different areas (polluted and non-polluted) were divided into five groups according to the period

of their living in the selected area :

- Exposure period from (1-3) years (group B).
- Exposure period from (4-6) years (group C).
- Exposure period from (7-10) years (group D).
- Exposure period from (more than 10) years (group E).
- The non- exposure farmers (group A).

Note: The control group (group A) were not suffering from alleged

signs and symptoms of some diseases .

Procedure of analysis:

- a- Into anti coagulant tube 5 ml of blood samples were taken from farmers used for determination of mercury levels, left for one hour at room temperature for clotting.

b- To 2 ml of blood serum 2.5 ml of ethanol were added.

- 250 micro liter of concentrated HNO₃ and 250 micro liter of KMnO₄ added to the samples.

- Complete the volume to be 5 ml.

- The same mentioned above added to the blank and to the standard solutions .

c- Blood serum was diluted to 1:10 then atomized by atomic absorption spectrophotometer .

The absorbance (A) was recorded ,and the concentration of the samples calculated by the following equation :

$$\text{Concentration(mg/L)} = \frac{A_{\text{sample}} \times \text{Standard concentration}}{A_{\text{standard}}}$$

Note: The concentration of the mercury was determined by using cold vapor atomization and sodium borohydride at wave length of 253.7 nm.

As shown in table (3) .

Results And Discussion

Concerning to the mercury concentration and the period of exposure (period of living in selected area) due to the using the contaminated waste water, the results were shown as follows:

1- The concentration of the mercury in the contaminated water increase as near as from the sources waste water

contamination as shown in table (1).

2- From the study it was found that traces of mercury were found in the(root, leaf, stem, product) of Wheat and Trefoil

irrigated by contaminated industrial waste water as shown in table(2)

3- Table (3) shows that the concentration of mercury in serum of blood increased as the period of exposure (period of living of farmers in the selected area) increased comparing with the control group (A).

Table (1) Relationship of mean value mercury concentration in industrial waste water used for irrigation and distance from the source of contamination.

Conc. Of Hg mg/L.	Distance meter
1.951±0.186	500
1.553±0.125	1000
0.651±0.063	2000
0.587±0.076	3000
0.323±0.047	3500
0.242±0.062	4000
0.185±0.011	4500

Table (2) Represents the mean level concentration of mercury in parts of plants (Wheat and Trefoil)

Part of plants	Conc. of Hg p.p.m. Wheat		Conc. of Hg p.p.m. Trefoil	
	Non contaminated	contaminated	Non contaminated	contaminated
root	0.222	1.253	0.183	2.656
stem	0.121	0.242	0.141	1.653
leaf	0.186	0.584	0.162	1.854
product	0.193	0.426	/	/

(Note: Normal level of mercury concentration 0.005-0.5 p.p.m.) (10)

Table(3)relation of concentration of mercury in serum of blood of farmers with the period of living in contaminated area (period of exposure).

no. of sample	Period of living in area exposure	group	conc.of Hg mg/100ml
10	/	A	0.102 ± 0.062
15	1-3	B	0.625 ± 0.235
12	4-6	C	0.943 ± 0.132
13	7-10	D	2.324 ± 0.115
10	more than 10	E	3.215 ± 0.423

Conclusions

The data presented in this study illustrate the following points:

1- There is serious contamination with mercury in industrial waste water. 2- The plants (Wheat and Trefoil) were contaminated with mercury due to using of contaminated waste water for irrigation.

3- The increase of mercury level in the serum of blood of farmers with the period of exposure (time of living in the polluted area).

* The report and the study with solutions of the problem sent to future. Authorities as a working and research for

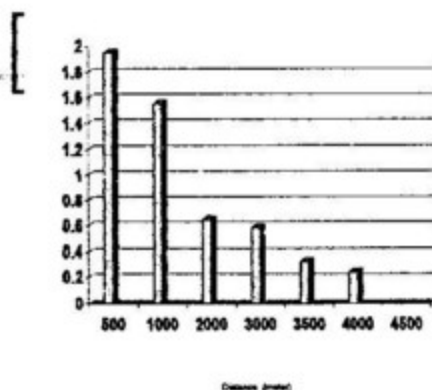


Fig (1) Relation between mean value of mercury concentration in industrial waste water and distances from the source of contamination

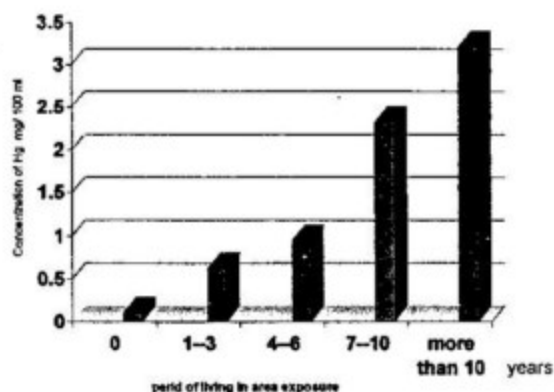


Fig (2) Relation between concentration of mercury in serum of blood farmers with the period of living in contaminated area (period of exposure)

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الخلاصة

لدراسة انتشار وتلوث البيئة (الماء، النباتات والاشخاص) المتواجدة في منطقة محددة في جنوب بغداد (محافظة بابل منطقة الاسكندرية) بالمواد الفلزية الثقيلة كالزئبق. اخذت نماذج من المياه الناتجة من الوحدات الصناعية المستخدمة للزئبق في مساراتها الانتاجية ونماذج من نباتي (الحنطة و البرسيم) من تلك المنطقة لتحديد تراكيز الزئبق.

تم تسليط الضوء على احتمالية وجود علاقة بين وقت التعرض (مدة بقاء) ومستوى تركيز الزئبق في دم المزارعين المتواجدين في القرى المنتخبة والمتواجدة قريبا من مصادر المياه الثقيلة الملوثة وعددهم (40) مزارع. قسم المزارعون الى اربعة مجاميع اعتمادا على مدة معيشتهم (بقائهم في القرى المنتخبة وكما يأتي: 1-3، 4-6، 7-10، واكثر من 10 سنوات)، ومجموعة خامسة من منطقة بعيدة عن مصادر التلوث وعددهم 10 اشخاص.

لغرض ايجاد مستوى تركيز الزئبق استخدمت طريقة التنزيه اللهبية مع منظومة البخار البارد باستخدام مطياف الامتصاص الذري لوحظ زيادة في معدل تركيز الزئبق في المياه الخارجة من الوحدات الصناعية و المستخدمة في الري وكذلك زيادة في مستوى تركيز الزئبق في النباتات (الحنطة والبرسيم).

الدراسة الحالية قد بينت من ان هنالك دلائل واضحة من تأثير مدة استخدام المياه الصناعية الملوثة بالزئبق على تسمم المزارعين المتواجدين المستخدمي سواقي المياه الملوثة.