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WATER POLLUTION AT ISMAILIA CANAL DUE TO SOME INDUSTRIAL ESTABLISHMENTS

By

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SUMMARY: The present study evaluate the deleterious effect of some industrial establishment disposing their discharge into Ismailia canal at its passage via Abou Zabal and Mostorod (Kaluobia Governorate). We selected four major point sources of pollution where water samples were collected nearby and at some distances from the outlet of the industrial establishment under investigation. Also samples of fish (Tilapia nilotica sp.) were collected from the same sources by fishermen. The level of some heavy metals "lead, cadmium, mercury, and iron" were measured in both water and fish. The results indicated a positive correlation between the location fo the point source of pollution and the load of heavy metals in water and fish. Furthermore the study indicated that fish is a very good indication for water pollution resulted from industrial discharges as it reflects not only water pollution but also the bioavilability of individual metal contaminants In living organisms when present collectively in a mixture.

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INTRODUCTION

Water pollution is a very critical environmental problem facing public health officials. Industrial pollution of surface water especially with heavy metals is among the most important health significance for man and animals consuming such water.

Heavy metals pose special problems because they usually accumulate in living organisms at succesive tropic levels and may reach high concentrations as great as in water, a process called "biological magnification" **(Royce, 1984)**.

Heavy metals and other trace elements have been considered as dangerous substances causing serium health hazards to human and other living organisms, through progressive irreversible accumulation in their bodies as a result of a repeated consumption of small amounts of these elements **(Wheaton and Lawson, 1985)**.

As indicated by **Levensen and Barnard, (1988)** fish have the ability to concentrate heavy metals in their tissues in concentrations higher than those in water so, fish is cosidered as a biological indicator for river health.

(Michiel et al.,) reported that pollution of fresh water sources often contain a great variety of toxicants that interact and influence toxicity. However the environmental risk of pollutants is still judged on the effect of individual compound. Accordingly. **Druz et al., 1993 and Abd el-Aziz, 1996** stated that mixture toxicity studies reflect actual pollution of surface water in a more realistic way. Fish cosider a suitable model for mix-

ture toxicity of effluent in water in which it inhabit. In this respect many studies revelaed that fish accmulate heavy metals from surrouding polluted water in a higher concentrations than the safe permissible limit.

Many effuents whether from municipal or industrial sources containing thousands of potentially toxic chemicals that may or may not be detected by routine chemical analysis. It is difficult to predict the effect of factors as pH, hardeness, dissolved organic carbon on bioavilability of chemicals in effluents, for example, although measured concentrations of a chemical may be high, the bioavilability of the chemical may be low (**Joseph et al., 1992**).

In relation to the hazard health effect of metals under investigation

Cadmium: Is non-essential trace metal that progressively accumulates in the body particulary kidneys. Acute exposure usually occurs in the work place through inhaltion, while chronic exposure produces renal dysfunction, empysema and osteomalacia. Several epidemiological studies are usually associated with elevated renal cadmium levels in hypertensive patients (**Ellenhorn and Barceldux, 1988**).

Iron: Incidence of iron poisoning in children less than five years of age appeared to be greater than in adults. Gastrointestinal tract and liver are the main target of iron toxicity. Iron produces a corresive action on gastrountestinal mucosal cells leading to coagulative necrosis, bleeding and death. (**Bryson, 1989**).

Lead: Bone marrow, muscles of stomach, gut and central nervous system are the traget organs of lead. The biologic halflife of lead in bone may

reach 20 years, while in soft tissues about 7-10 days. (**Gordan et al., 1979**). Anaemia is an important feature for chronic lead toxicity. Lead encephalopathy is common especially in childrens and characterized by irritability, poor memmory, muscle tremors, Seizures, coma and death (**Pincus and Saccar, 1970**). Lead also proudces nephropathy and affect reproduction in men and women (**Needlman et al., 1984**).

Mercury: Toxic effect of mercury are mainly to central nervous system and kidney. The toxicity of mercury was ilustrated in Minimata Bay area in Japan where a total of 111 cases of mercury poisning and 43 deaths were reported among people who had consumed sea food contaminated with mercury waste from a chemical plant that drained into Minimata Bay (**Manahan, 1993**).

The current study aimed to focus a head light on the problem of water pollution in Ismailia Canal due to disposal of the effluent form the local industrial establishments. Furthermore, we used fresh water fish (Tilapia nilotica sp.) as a bioindicator reflecting the actual problem of heavy metals in water and give an additional idea about the bioavilability of individual pollutants in living organism when found in a mixture of others.

MATERIAL AND METHODS

Sampling:

Water samples

Fourty water samples were collected from Ismalia Canal at four localities "ten samples from each locality" nearby and at some distances from the outlet of four industrial establishments as follows:-

(A) **Abou Zaabal:-**

A. Z. Steel Fac.

A. Z. Company for chemical industries.

(B) **Mostorod:-**

Petrolium refinary company

El-Taawon comp. for petroleum industries.

The samples were collected in clean glass bottle and preserved with nitric acid ml/L **(A. P. H. A., 1985).**

FishSamples:-

Fourty fish samples (Tilapia nilotica) were collected from the same sources of water samples. Ten fishes were collected from each locality by aid of fishermen.

Sample preparation for analysis:-

Water samples were filtered through 0.45 u millipore diameter filter paper and preserved with nitric acid till analysis.

Fish samples were washed with tap water to remove slime and mud then eviscerated and filleted using stainless steel knife. The edible of muscular portion of the fish was ground in a blender and packed in aluminum foil then stored at -5°C till examination.

5 gm fish sample was dried at 110°C over night then ashed in muffle furnace at 450°C for 32 to 35 hours. The ash were dissolved in IM nitric acid. Sample preparation was carried out accorrding to **Tenny et al., (1984).**

Detection of heavy metals:-

Determination of heavy metals in water and prepared fish samples was carried out using Atomic Absorption Spectrophotometer (Perkin Elmer, Model 3110) with alteration of burner head, hollow cathod lamp, wave lengh, slit in realtion to the examined metal. Metals detected in this study were: "cadmium, lead, mercury, and iron"

RESUTLS

Table (1):- Incidence of some heavy metals exceeding the permissible limit in water of Ismailia Canal near outlets of some industrial establishments :

Metal	Lead		Cadmium		Mercury		Iron	
Per.limit (ppm)*	0.05		0.005		0.001		0.3	
Samples exceeding P.L.	No **	%	No **	%	No **	%	No **	%
Abou Zabal A.Z. Steel Fac.	9	90	2	20	10	100	8	80
A.Z.comp ch.ind.	8	80	10	100	10	100	7	70
Mostorod Pet.refinary comp.	10	100	9	90	10	100	10	100
El-Tanwan comp for pet.ind.	10	100	10	100	10	100	9	90

* Guide line values of WHO 1984

** No= number of samples exceeding permissible limit

Table (2):- Incidence of some heavy metals exceeding the permissible limit in fish collected from Ismailia Canal near outlets of some industrial establishments :

Metal	Lead*		Cadmium *		Mercury **		Iron ***	
Per.limit (ppm)	0.1		0.1		(1)		------	
Samples exceeding P.L.	No **	%	No **	%	No **	%	No **	%
Abou Zabal A.Z. Steel Fac.	8	80	2	20	1	10	----	----
A.Z.comp ch.ind.	9	90	4	40	3	30	----	----
Mostorod Pet.refinary comp.	8	80	3	30	5	50	----	----
El-Tanwan comp for pet.ind.	10	100	5	50	9	90	----	----

* Egyptian standard, 1992

** Food & Drug Administration , 1979

*** There is no permissible limit for iron in fish in the available literature .

Fig.(1) : Incidence of some heavy metals exceeding the permissible limit in water of Ismailia Canal near out lets of some industrial establishments

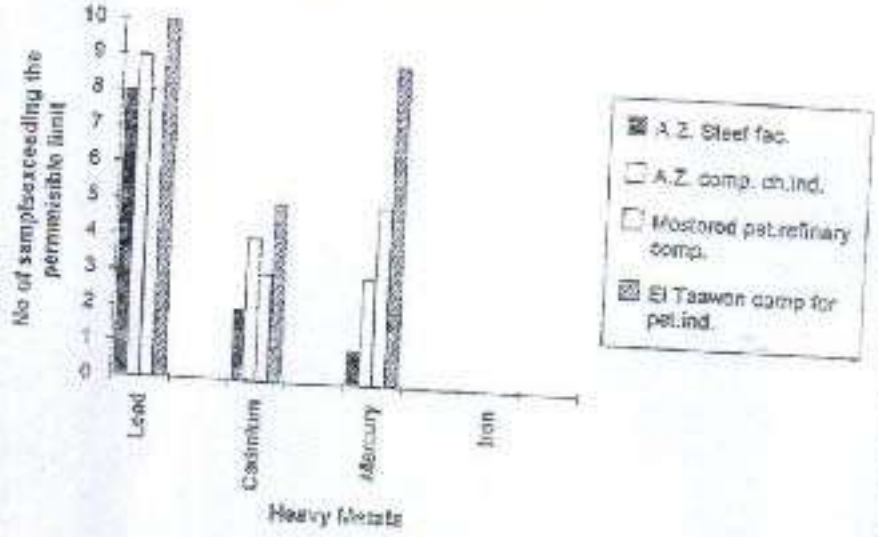

Fig.(2) Incidence of some heavy metals exceeding the permissible limit in fish collected from Ismailia Canal near outlets of some industrial establishments

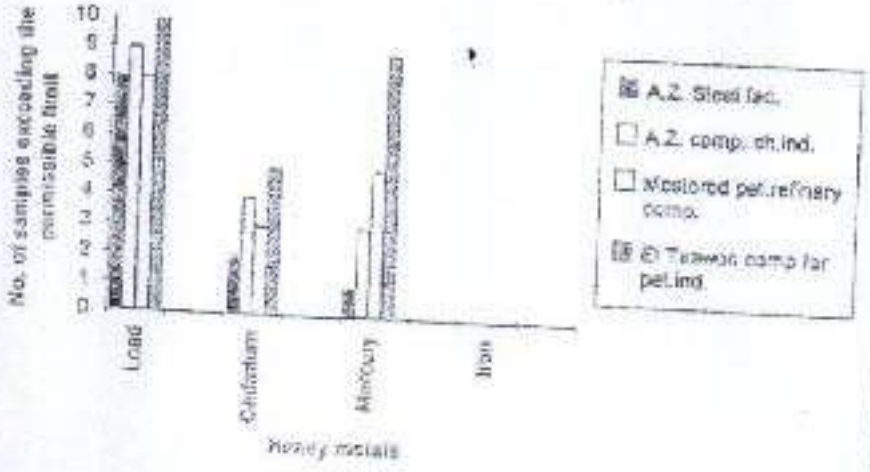

Fig.(3): Concentrations of some heavy metals in water samples collected from Ismailia Canal near outlet of some industrial establishment (mean ±S.E.)

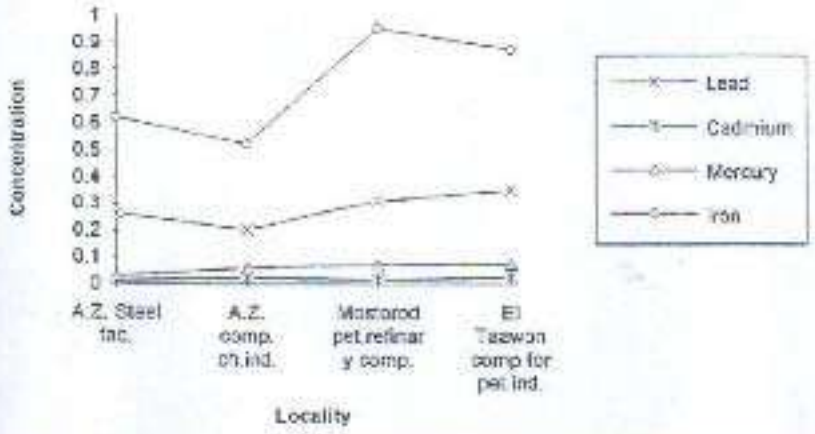

Fig.(4): Concentrations of some heavy metals in fish samples collected from Ismailia Canal near outlet of some industrial establishment (mean ±S.E.)

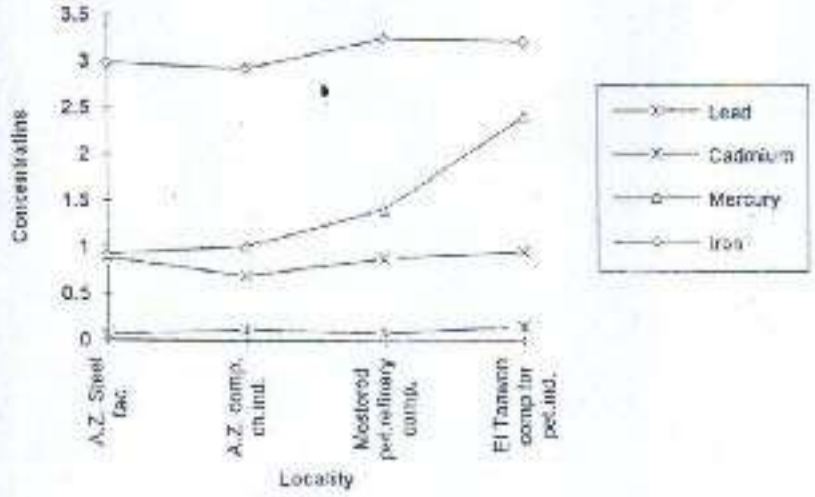

Table (3):- Concentration of some heavy metals(mg/L) in water samples collected from Ismailia Canal near outlets of some industrial establishments (Mean ±S.E.) :

Metal concentration / Locality	Lead	Cadmium	Mercury	Iron
Abou Zabal A.Z. Steel Fac.	0.261±0.050	0.012±0.006	0.03±0.112	0.670±0.103
A.Z.comp ch.ind.	0.204±0.041	0.022±0.009	0.061±0.225	0.522±0.099
Mostorod Pet.refinary comp.	0.310±0.0112	0.015±0.007	0.073±0.187	0.952±0.120
El-Taawan comp for pet.ind.	0.351±0.107	0.025±0.008	0.075±0.199	0.873±0.160

Table (4):- Concentration of some heavy metals (mg/L) in fish samples collected from Ismailia Canal near outlets of some industrial establishments (Mean ±S.E.) :

Metal concentration / Locality	Lead	Cadmium	Mercury	Iron
Abou Zabal A.Z. Steel Fac.	0.887±0.110	0.072±0.006	0.932±0.201	2.987±0.449
A.Z.comp ch.ind.	0.702±0.099	0.122±0.009	1.012±0.302	2.926±0.439
Mostorod Pet.refinary comp.	0.886±0.276	0.091±0.007	1.413±0.400	3.255±0.508
El-Taawan comp for pet.ind.	0.953±0.371	0.156±0.011	2.416±0.440	3.226±0.501

DISCUSSION

In Egypt, inspite of the presence of several natural sources of catching areas, the annual production of fish is relatively low. this may be due to many well known factors including the industrial pollution of surface water which are of major concern.

Heavy metals represent one of the major sources of aquatic pollution and constitute the highly toxic and long retained substances which can't be broken down or destroyed over long time and become permenant additives to aquatic environmet (**Levensen and Barnard, 1988**).

Table (1) shows the incidence of some heavy metals exceeding the permissible limit in water of Ismailia Canal near outlets of some industrialestablishments. It is quiet clear that mercury represent the top problem of water contamination in Ismailia Canal. All samples of water exceeded the permissible limit of murcury in water.

Considering the individual point sources of pollution table (1) shows that the discharge of A. Z. steel factory resulted in excessive levels of some heavy metals exceeded the permissible limit. Percentage of samples exceeded permissible limit was 90%, 80%, 80% for lead, cadmium, and iron respectively, while the corresponding levels of pollution due to A. Z. company for chemical industries are 80%, 100%, 70% of samples exceeded the permissible limit of lead cadmium, and iron respectively.

In Mostored, petroleum refinary company recorded high percentage of samples exceeding permisible limit of lead (100%), cadmium (90%), and iron (100%). Similarly, El-Taawon comp, for pet.ind resulted in percent-

age of samples exceeding permissible limit for lead (100%), cadmium (100%) and iron (90%). Here we have to mention again that all examined sources resulted in pollution of collected water samples with level higher than the safe permissible limit of mercury.

Table (2) shows that fish samples catched near A. Z. steel factory showed 90%, 20%, 10% over the permissible limit of lead, cadmium and mercury respectively. Also A. Z. company for chemical industries increased the percentage of samples exceeding permissible limit of lead, cadmium and mercury to 80, 40, and 30% respectively in fish.

In Mostorod, samples of fish harvested near pet-refinary company showed 80%, 30% and 50% higher than safe permissible limit for lead, cadmium and mercury respectively in fish. Similaryly samples of fsh catched near El-Taawon company for pet-industries showed 100%, 50% and 90% higher permissible limit in fish for lead, cadmium and mercury respectively. Concerning iron, there is no available litrature for its permissible limit in fish.

The formentioned results tabulated in tables (1 & 2) indicated that there is a positive correlation between the levels of heavy metals in water and their residues burden in fish here our rsults is coincided with some previous work e. g. **Draz et al., (1993) and Abd El-Aziz, (1996).**

Table (3) showed that the highest concentrations of lead in examined water samples was recorded in Mostored near El-Taawon company for petroleum industries (0.351±0.107) followed by samples collected near pet. refinary company (0.310±0.112). In A. Z., water samples collected near A. Z. steel factories contained average of (0.216±0.050) lead which also

recorded (0.204±0.041) in A. Z. near A. Z. comp. for chemical industries.

The top concentration of cadmium in examined water samples was recorded near the outlet of El-Taawon company for pet ind (0.025±0.008) followed by A. Z. company for ch. ind. (0.22±0.009), pet refinary comp. (0.015±0.007) then Abou Zabaal steel factory (0.012±0.006). Our results concerning the lead and cadmium are partialy agree with that of Abou Salem. (1987).

The concentrations of Mercury in the examined water samples was (0.053±0.112), (0.061±0.225), (0.073±0.187) and (0.075±0.199) and was recorded near the outlet of A. Z. steel fac; A. Z. comp. ch. ind; pet refinary comp. and El-Taawon comp for pet.ind. Here we should pay a great concern for those levels of mercury in water which is duplicated several time than the permissible limit indicated by WHO, 1984 which is 0.001 ppm.

Concerning to iron, its top concentrations was recorded in water samples near pet.refinary comp at A. Z. (0.952±0.120) followd by samples collected near the outlet of El-Taawon comp for pet. ind (0.873±0.160), A. Z. steel factory (0.620±0.103) and A. Z. comp. for chemical industries (0.522±0.099). It is clear that the point sources of pollution increased the level of iron in the water of Ismalia Canal above the permissible limit (0.3 ppm) as indicated by WHO 1984.

Table (4) showed the concentrations of examined heavy metals in fish due to pollution of Ismalia Canal by industrial establishment under investigation. Fish samples harvested near A. Z. steel factory showed average

concentrations of (0.887±0.110); (0.072±0.006); (0.932±0.201) and (2.987 ± 0.449) for lead, cadmium mercury and iron respectively.

The other source examined in abou Zabaal (A. Z. comp. ch. ind. lead to high levels of lead (0.702±0.099); cadmium (0.122±0.009) mercury (1.012±0.302) and iron (2.926±0.439).

In Mostorod, pet.refinary comp. responsible for the elevated levels of lead, cadmium, mercury and iron as 0.866±0.270; 0.091±0.007; 1.413±0.400 and 3.255±0.508, respectively.

El-Taawon comp. for pet.ind. showed the top concentrations of examined heavy metals where the levels of lead, cadmium, mercury and iron was (0.953±0.371); (0.156±0.011); (2.416±0.440) and (3.276±0.501) respectively.

From the tables (3) and (4) we observed that the high level of lead, cadmium and mercury in water was parallel to a high levels of these metals in fish. This reffered as a "biological magnification" as recorded by **Royce, (1984); Levensen and Barnard, (1988)**. At the same time and in contrast with lead, cadmium and mercury we observed that the excessive levels of iron in water was not accompanied by excessive levels of iron in fish. We suggst that this result may indicate the presence of iron in non soluble form sufficient to be taken up by the surrounding fish or in other form due to lower bioavilability of iron which may also suggested to be due to interfecence with other chemicals present in the effluents. On this bases and form all the above mentioned results we concluded that fish is a very good indicator for water pollution and also for the bioavilability of the individual metal contaminants when present in a mixture like the case

of effluent from point source of pollution.

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