EFFECT OF SOME HEAVY METALS CONTENTS ON GENERAL HEALTH AND BLOOD CONSTITUENTS OF SHEEP

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ABSTRACT

The present investigation studied the effect of drinking water from the drainage irrigation canal from agricultural farms using superphosphate fertilizers and in the vicinity of a superphosphate factory at one of the villages of Dakahlia Governorate. In this respect the amount of five heavy metals (copper, zinc, cadmium, iron and lead) were estimated and compared with healthy tap water. In addition these heavy metals were estimated in the blood serum of sheep drinking from drainage canal and other sheep drinking from tap water. Furthermore, blood serum constituents of urea, creatinine and alkaline phosphatase were estimated. The general health status of sheep drinking from the drainage canal showed marked emaciation, dullness, depression, unthriftiness, pale mucous membranes and rough coat while sheep drinking from tap water were clinically healthy without any abnormal changes.

The obtained results pointed to the presence of high levels of heavy metals copper, zinc, cadmium, iron and lead when compared with tap water. These increases were reflected on the blood serum of sheep drinking water from the drainage canal. The same increases were obtained with regards to blood urea, creatinine and alkaline phosphatase.

Introduction

Heavy metals are chemically stable when released in the environment, they are potentially a cause of toxic effect until removed ***(Oehme, 1978).*** Unclean drinking water from drainage canals and uncontrolled industrialization where these heavy metals are released eventually have hazard effect on animals and man ***(Marquita, 1997)***. ***Khalaf et al. (1994)*** declared that the levels of copper, zinc, cadmium, iron and lead in drinking water were 2.4, 1.5, 0.01, 0.3 and 0.01 ppm respectively. Eventually, the increase in the levels of heavy metals than the permissible limits exerts toxic effects on the animal body which will be clearly seen on blood constituents namely enzymatic system especially alkaline phosphatase ***(Meyer et al., 1992).*** Furthermore, the blood serum urea and creatinine are affected depending on the effect of these heavy metals on the excretory organs responsible for the removal of these metals.

Clark and Myra (1978) indicated that the range of heavy metals in sheep blood serum like other animals varies depending on the surrounding environment especially drinking water contents. In this respect blood serum lead as an example of one of the popular heavy metals has a range of 0.05-0.30 ppm of healthy sheep. Naturally fresh water probably contains no more than 0.005 mg / liter while in water supply pouring in the tap water about 0.01 mg / liter but the international standers for drinking water suggests a tentative limit up to 0.1 mg / liter ***(Seddek et al., 1992).***

It is worthy to mention that with increasing population and industrialization in Egypt the water quality is bound to change, and it has become increasingly necessary to assess the quality of Nile water and the different canals whether coming from the river or draining the water to it for domestic, agricultural and industrial purposes (***El-Sherbini and Moatassem, 1994)***. Special attention must be paid to the problem of water pollution especially from the drainage canals, which are draining agricultural farms and those near the sources of industrial waste products.

The aim of the present work which is a part of comprehensive program of research to follow up the effect of drinking water coming from the drainage canals pouring in the River Nile on the blood serum constituents of animals drinking from this water. In this respect this study will concentrate on the estimation of five main heavy metals contents ***(copper, iron, zinc, cadmium and lead)*** in the fresh water of a drainage canal at Dakahlia Governorate and comparing these constituents with those found in healthy tap water. At the same time some of the blood constituents ***(urea, creatinine and alkaline phosphatase)*** were estimated in sheep blood drinking water of the drainage canal and those drinking from the tap water, in addition to the studied heavy metals in the water resources.

MATERIALS & METHODS

The present investigation was directed to evaluate the contents of some important heavy metals found in the fresh water of one of the drainage canals pouring in the River Nile at Dakahlia Governorate and at the same time in the healthy tap water. In addition estimating the amount of these minerals in the blood serum of sheep drinking from these water. The reflection of both water heavy metal contents was studied on the blood serum constituents of urea, creatinine and alkaline phosphatase as 3 important parameters reflecting the effect of high metal contents on the health of sheep under investigation.

Materials:

The present study was carried out on 12 adult male sheep 2-3 years old divided into 2 groups (6 of each). The first group (control) constituted of 6 adult male sheep drinking from healthy tap water. The second group was drinking from the surface water of one of the drainage irrigation River Nile canals at a village belonging to Dakahlia Governorate near one of the factories producing superphosphate fertilizer which is used in the surrounding farms where this drainage canal drains the excess water from these farms. All animals under investigation were examined for iron, zinc, copper, cadmium and lead in blood serum in addition the levels of urea, creatinine and alkaline phosphatase were estimated.

Samples:

Surface water samples were collected from both drainage canal and tap water. Blood from all animals were collected from jugular vein in a clean sterile test tube without anticoagulant for serum biochemical analysis.

Adopted methods:

-Estimation of heavy metals: Cu, Zn, Cd, Fe and Pb were estimated in water samples and blood serum using atomic absorption spectrophotometer following the method of ***Hessel (1968).***

- Estimation of blood serum urea: Using test kits supplied by ***Biolab (France)*** after the methods of Searcy ***et al. (1976).***

-Estimation of blood serum creatinine: Using test kits supplied by ***Bio-Merieux (France)*** according to methods of ***Brod and Sirata (1984).***

-Estimation of blood serum alkaline phosphatase: Using of test kits supplied by ***Bio-Merieux (France***) after methods described by ***Belfield and Galberg (1971).***

Statistical analysis:

Obtained data were subjected to a software program ***(SPSS,Ver. 10) according to Borenstein et al. (1997).*** Differences between means were compared independently using paired t-test [P (T</= t) two-tail] with unequal variance.

RESULTS

Heavy metals constituents:-

As shown in table (1) the concentration of heavy metals of water pointed to the greater increase in the contents of these metals in the water of the drainage canal especially cadmium in ppm (0.098), iron (0.210) and zinc (2.10) when compared with the contents in the tap water which were 0.006, 0.011 and 1.62 ppm respectively.

The contents of these heavy metals in the blood serum were significantly higher in sheep of group II drinking from the water drainage canal when compared with sheep of group I drinking from the healthy tap water especially the content of cadmium, zinc and iron which were in the blood serum of those drinking from the drainage canal(0.015± 0.0007 ,2.737 ±0.026 and 3.058±0.194 ppm)respectively in comparison with those drinking from tap water which were 0.008 ±0.0009, 1.023 ±0.058 and 2.138±o.127ppm) respectively, as in table (2).

The general health status of sheep drinking from the drainage canal showed marked emaciation , dullness, depression, unthriftiness, pale mucous membranes and rough coat while sheep drinking from tap water were clinically healthy without any abnormal changes.

Concerning blood serum creatinine, urea and alkaline phosphatase contents as seen in table 3 highly significant increase was found in sheep drinking from the drainage canal which were 4.082 ±0.148 mmol/l, 150.56 ±1.617 mmol/l and 179.94 ±1.977 IU/l respectively when compared with the contents of blood serum of the sheep drinking from the tap water which were 2.460 ±0.037, 123.423 ±1.634 and 108.59 ±0.519 respectively.

Table(1):heavy metals concentrations in water from drainage canal and tap water.

	Cu	**Zn**	**Cd**	**Fe**	**Pb**
Drainage canal	1.09	2.10	0.098	0.210	0.080
Tap water	0.12	1.62	0.006	0.011	0.002
Permissible limits	1.00	0.50	0.050	0.150	0.058

Table. 2: Heavy metal concentrations in blood serum of Control and Exposed sheep (ppm).

		Cu	Zn	Cd	Fe	Pb
Group 1	Mean	0.93	1.023	0.008	2.138	0.307
	SD	0.034	0.058	0.0009	0.127	0.016
	Min	0.89	0.96	0.007	1.99	0.29
	Max	0.99	1.1	0.009	2.33	0.33
Group 2	Mean	1.125	2.737	0.015	3.058	0.453
	S D	0.019	0.026	0.0007	0.194	0.007
	Min	1.08	2.67	0.012	2.34	0.43
	Max	1.21	2.82	0.017	3.81	0.48
P-value		0.001	0.001	0.001	<0.01	0.001

Table3: Blood serum creatinine, urea and AP levels in sheep drinking from healthy tap water and those drinking from contaminated drainage canal.

		Creatinine mmol/l	Urea mmol/l	AP IU/l
Group 1	**Mean**	2.46	123.4233	108.59
	SD	0.037	1.634	0.519
	Min	2.41	121.01	108.03
	Max	2.51	126.01	109.11
Group 2	**Mean**	4.082	150.56	179.94
	SD	0.148	1.617	1.977
	Min	3.94	148.53	177.41
	Max	4.31	153.07	183.11
P-value		0.001	0.001	0.001

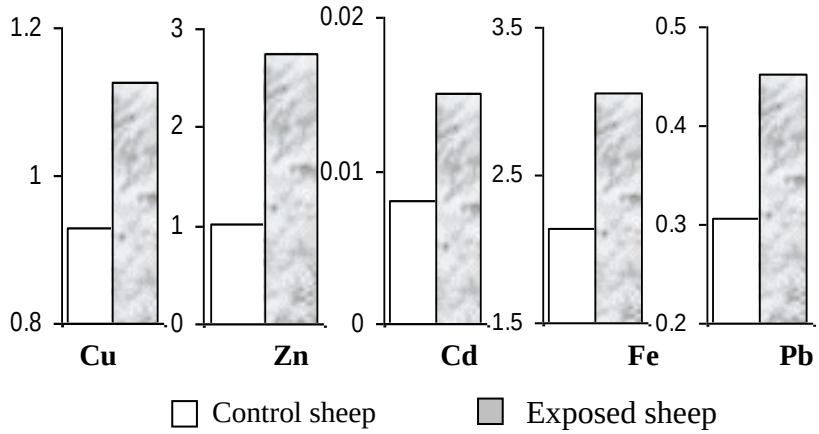

Fig. 1: Mean values of blood serum heavy metal concentrations in control and exposed sheep (ppm).

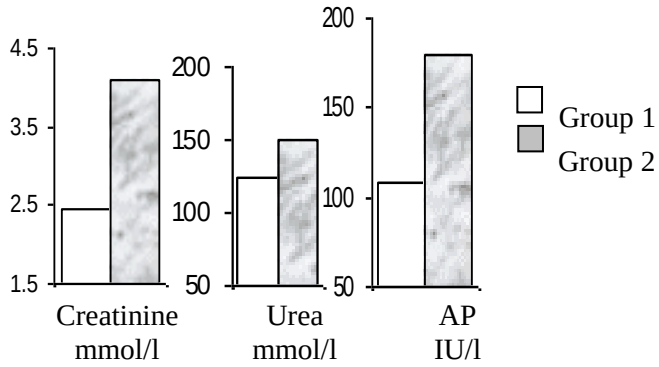

Fig. 2: Blood serum creatinine (mmol/l), urea (mmol/l) and AP (IU/l) levels in sheep drinking from healthy tap water and those drinking from contaminated drainage canal

DISCUSSION

The problem of environmental pollution has nowadays great importance especially water of River Nile in Egypt and its branches and the drainage irrigation canals that drain water from the farms and those near industrial factories especially those producing fertilizers ***(Ibrahim, 1983 and Seddek, 1988)***. In this aspect the present study was directed to pay particular attention to the present heavy metals concentrations in vicinity of drainage irrigation water canal in an area near a superphosphate factory at Dakahlia Governorate, Egypt.

The released heavy metals in the irrigation canal under investigation exerted certain changes on the blood constituents of sheep drinking from this water. Consequently, these changes when compared with other sheep that drink from healthy tap water gave significant variations whether in the contents of heavy metals in the blood serum or the other health biochemical constituents namely creatinine, urea and alkaline phosphatase.

As shown in table 1 it is evident that the amount of heavy metals under investigation is increasingly high in the drainage canal when compared with tap water. Consequently, this increase was reflected on the health of sheep drinking from the water of drainage canal, where emaciation,dullness,depression and rough coat appeared on these animals with pale mucous membrane and unthriftiness. These abnormal unhealthy changes could be attributed to the toxic effect of heavy metals especially cadmium, zinc, and iorn to a certain extent lead where these metals exerted their toxicity on the animals ***(East, 1993; Edens et al., 1993,Radostits et al., 2000 and Bosel et al., 2001).*** This is clearly manifested on the blood serum constituents of sheep drinking from the water of this drainage canal. At the same time sheep drinking from tap water has normal constituents of these heavy metals.

From the obtained results of water of the drainage canal the amount of zinc in ppm (2.10), cadmium (0.098) and iron (0.210) are exceedingly

high than the permissible limits according to the Egyptian law of environment which gave these levels to be not more than 0.50, 0.050 and 0.150 ppm respectively ***(Egyptian Ministry of Industry and Metal Wealth, 1999)***. While copper and lead did not exceed the standard permissible limits of the Egyptian law of environment. The increased levels of these heavy metals ***(cadmium, zinc and iron)*** in the drainage canal could be attributed to the fertilizer used in the agricultural farm where the excess water are drained into the canal and also to the liberation of the waste products from the factory of superphosphate fertilizer in the vicinity of the area. These conclusions come in accordance with ***Ibrahim (1983), Morsi and Zidan (1994) and Ghazi et al. (1999).***

With respect to the amount of heavy metals in sheep, it is clearly evident that there were significant increases of these heavy metals in the blood serum of sheep drinking from the drainage canal which were exceedingly high in cadmium, zinc and iron where these levels reaches 0.008 ±0.0009, 1.023 ±0.058 and 2.138 ±0.127 ppm respectively while the increase of copper and lead were not exceedingly high. This could be attributed to the presence of both lead and copper in the water where both metals interfere with the amount of absorption of each ***(Doyle and Younger, 1984)*** with resultant not so high level in the blood serum of sheep in spite of high levels of both copper and lead in the water of the drainage canal (1.09 and 0.080 ppm respectively) when compared with those of tap water (0.12 and 0.002 ppm respectively).

The blood serum constituents of creatinine revealed significant high level (4.082 ±0.148 mmol/l) in those drinking from water of drainage canal (Group Π) when compared with that of sheep drinking from the healthy tap water (2.460±0.037 mmol/l).This pointed to the hazard effect of heavy metals resultant increase of this metabolite creatinine.This hazard effect was emphasized by the significant increase of both urea and alkaline phosphatase in the blood serum of sheep of group Π drinking from the drainage canal(150.65±1.617 mmol/l and 179.94±

1.977 IU/l respectively) when compared with sheep of group I (control) drinking from the healthy tap water (123.423 ±1.634 mmol/l and 108.59 ± 0.519 IU/l respectively). These findings and attribution came in accordance with ***Ibrahim, 1983; El-Sangary, 1999 and Radostits, et al 2000).***

Finally it could be concluded that there were a great hazard effects of drainage water irrigation canals which drain water from the farms using fertilizers and near factories especially superphosphate ones which emit their pollutants through water and air to reach the drainage canals in the vicinity of the area. In addition it is better to avoid and do not allow sheep or other domestic animal to drink from the water of the drainage irrigation canals and must give them healthy clean water namely from the tap water ensuring other health and sanitary conditions.

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تأثير بعض العناصر الثقيلة على الحالة الصحية وبعض مكونات الدم في الأغنام

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تناول البحث دراسة مقارنة عن اثر النسب العالية لبعض المعادن الثقيلة (النحاس والزنك والكادميوم والحديد والرصاص) في مياه أحد المصارف الزراعية بمحافظة الدقهلية على نسب هذه المعادن وكذلك نسب اليوريا والكرياتنين وإنزيم الفوسفاتيز القاعدى في سيرم دم الأغنام التي تشرب من هذه المياه ومقارنتها مع الأغنام التي تشرب من مياه الصنبور العادي الصالح للشرب. هذا وقد أتضح من الدراسة وجود نسبة عالية معنوية من هذه المعادن الثقيلة في مياه المصرف عند مقارنتها بمياه الصنبور الصالح للشرب, كما انعكست نسبة هذه المعادن الثقيلة على سيرم دم الأغنام التي شربت من مياه المصرف عند مقارنتها بالأغنام التي شربت من مياه الصنبور مع ملاحظة إن أعلى نسب ارتفاع كانت في عناصر الكادميوم والزنك والحديد. كما لوحظ إن نسب المعادن الثقيلة محل الدراسة كانت في معدلاتها الطبيعية والصحية في مياه الصنبور وكذلك في سيرم دم الأغنام التي شربت من مياه

الصنبور. إما عن نسب اليوريا والكرياتينين وإنزيم الفوسفاتيز القاعدي فكانت نسبها عالية في سيرم دم الأغنام التي تشرب من مياه المصرف عند مقارنتها بالأغنام التي تشرب من مياه الصنبور.