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MONITORING OF HEAVY METALS EXCEPT LEAD IN THE TAP WATER

By

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ABSTRACT

Tap water samples which were taken from 8 Governorates in Egypt were analyzed by using atomic absorption for the detection of Fe, Cu, Li, Mn, Zn, K and Na. Data indicate that the maximum levels which were detected in water samples for Fe, Cu, Li, Mn, Zn, K and Na were 0.184, 0.336, 2.618, 0.884, 11.016, 11.71 and 13.98 mg/litre respectively, while the minimum levels for the same elements were 0, 0, 0, 0, 0, 0.794 and 10.24 mg/L. respectively.

The guideline values of 1.0, 1.5, 1.0 and 15 mg/litre, has been recommended for Fe, Cu, Mn and Zn in drinking water in Egypt respectively. No maximum levels are conducted by the Egyptian Authorities for Li, K and Na.

Data indicate that the maximum levels which were detected for Fe, Cu, Mn and Zn were well below the acceptable levels recommended by Egypt. While the levels of Mn was more than the acceptable levels in only 6.9% of the samples tested.

INTRODUCTION

Nadeenko et al., 1990 reported that separate and simultaneous adminstration into the animal organism of low doses of copper, lead and nickel with drinking water is accompanied by dose-dependent change in the level of not only administratered but also endogenic elements in animal's organs.

Lopez - Martinez et al., 1987 reported that in 100 samples of drinking water from the city and province of Granada, Spain, lead ranged from undetectable to 0.15 mg/litre. The legal permitted lemit of 0.05 mg/l was exceeded by 14 samples.

The guidlines for drinking water quality are intended for use by countries as a basis for the development of standards, which if properly implemented, will ensure the safety of drinking water supplies.

It must be emphasized that the levels recommended in the guidelines for water constituents and contaminants are not standards in themselves. In order to define standards, it is necessary to consider these recommendations in the context of prevailing environmental, social, economic and cultural conditions.

Durfor and Becker, 1964 reported that lead concentration in the water supplies of most of the 100 largest American cities as determined in 1962 ranged from a trace to 62 µg/litre.

Hassan, et al., 1989 reported that 93.5% of the water samples in Saudi Arabia contained lead below the WHO acceptable levels. it was found that 259 samples (84.1% of the samples) contained chromium below the WHO acceptable levels.

The speciation of aluminium in water is complex and is not well understood (Lazerte, 1984; Campbell et al., 1983 and Driscoll, 1984). Schenk et al., 1989 reported that Alum (aluminium sulphate) is added to drinking water for the purpose of clarification. Theoretically, the addition of alum to water for treatment purposes should not increase the total aluminum concentration of water. however, for many water supplies, the total aluminum is increased after treatment.

Turnquest and Hallenbeck, 1991 reported that the aluminum content of drinking water was 174 µg/l.

Rico et al., 1989 reported that in all cases the cadmium content of water showed the lowest mean levels with a range from 0.1 to 42 ppb, followed by mercury with a range from 0.3 to 6.1, lead range 1.4 to 41.6, copper range 10.5 to 50.2 and zinc range 5.4 to 842.9.

MATERIALS AND METHODS

One hundred and sixteen samples of tap water were collected from Governorates, Cairo, Giza, Qualiobia, Sharkia, Ismailia, Sewiss, Minia and Behera from rural and urban areas.

The samples were identified as rural or urban samples, samples from new buildings or old building with or without storage tanks, samples from houses have or have not connection between water net pipes and water meter.

All samples were stored at 4°C until analysis were performed. Iron, copper, lithium, manganese, zinc, sodium and potassium were analyzed by flame atomic absorption according to the method of Welz, 1985. Chemical analysis of heavy metals was conducted in the Faculty of Science, Zagazig University using flame atomic absorption (model Buck Scientific 2000).

Table 1: levels of heavy metals (Fe, Ca, Li, Mn, Zn, K and Na) in tap water in Great Cairo.

	Fe	Cu	Li	Mn	Zn	K	Na
Guideline values	1	1.5	-	1.0	15	-	-
Urban area :							
New houses without tanks							
* Maximum	0.0368	0.310	2.618	0.588	1.741	8.708	13.98
* Minimum	0.000	0.155	0.476	0.000	0.094	8.008	10.65
** Maximum	0.0368	0.284	0.952	0.000	2.146	8.386	10.79
** Minimum	0.0552	0.077	0.000	0.000	0.135	8.106	10.62
Mean	0.040±0.022	0.191±0.089	0.833 ± 0.76	0.094 ± 0.199	1.630 ± 0.271	8.343 ± 0.363	11.263 ± 1.082
New houses with tanks							
* Maximum	0.0736	0.336	0.952	0.025	2.430	8.246	10.86
* Minimum	0.0184	0.051	0.476	0.000	0.162	8.134	10.72
** Maximum	0.0552	0.233	0.952	0.0122	1.404	8.218	12.56
** Minimum	0.000	0.103	0.000	0.000	0.310	7.700	10.65
Mean	0.038±0.022	0.194 ± 0.088	0.452 ± 0.306	0.0006 ± 0.009	0.888 ± 0.678	8.129 ± 0.155	10.825 ± 0.578
Very old houses							
* Maximum	0.0552	0.233	0.952	0.027	2.0110	8.260	10.72
* Minimum	0.0184	0.25	0.000	0.000	0.1215	8.134	10.62
** Maximum	0.0736	0.243	1.428	0.319	3.793	11.438	13.27
** Minimum	0.000	0.103	0.476	0.000	0.310	7.938	10.72
Mean	0.044±0.023	0.169 ± 0.067	0.666 ± 0.459	0.038 ± 0.099	1.552 ± 1.447	8.5011 ± 1.036	11.1489 ± 0.879
Rural area :							
Giza : Maximum	0.110	0.129	1.666	0.038	6.345	0.804	11.62
Mean	0.0965±0.013	0.1095 ± 0.023	1.19 ± 0.2454	0.0261 ± 0.009	1.406 ± 0.208	0.7993 ± 0.006	10.928 ± 0.438
Minimum	0.073	0.077	0.952	0.013	0.094	0.794	10.17
Qualiobia Maximum	0.167	0.155	2.142	0.884	6.223	11.71	12.18
Mean	0.1201 ± 0.0271	0.125 ± 0.032	1.666 ± 0.307	0.363 ± 0.392	2.037 ± 2.231	9.004 ± 1.353	11.568 ± 0.613
Minimum	0.092	0.077	1.190	0.050	0.324	7.40	10.50

* *Samples from houses without a lead tube.*
** *Samples from houses with a lead tube.*

Table 2: Levels of heavy metals (Fe, ca, Li, Mn, Zn, K and Na) in tap water in 5 governorates

			Fe	Cu	Li	Mn	Zn	K	Na
Ismaillia									
	Urban Area	Maximum	0.092	0.129	0.476	0.025	0.486	8.32	11.40
		Mean	0.082 ± 0.013	0.129	0.476	0.020 ± 0.007	0.544 ± 0.0441	6.336 ± 3.029	11.12 ± 0.375
		Minimum	0.00	0.129	0.476	0.012	0.012	2.85	10.75
	Rural Area	Maximum	0.092	0.155	0.952	0.038	11.016	8.88	10.97
		Mean	0.0790 ± 0.024	0.1229 ± 0.017	0.737 ± 0.208	0.023 ± 0.0009	2.878 ± 3.65	8.095 ± 0.314	11.11 ± 0.096
		Minimum	0.055	0.103	0.476	0.012	0.337	7.91	11.26
El-Minia									
	Urban Area	Maximum	0.110	0.363	2.618	0.038	2.214	8.69	12.09
		Mean	0.092 ± 0.018	0.368 ± 0.347	1.308 ± 0.94	0.017 ± 0.019	1.332 ± 0.967	8.468 ± 0.519	11.57
		Minimum	0.074	0.155	0.952	0.000	0.297	7.920	11.08
	Rural Area	Maximum	0.092	0.181	1.904	0.025	2.227	8.16	11.29
		Mean	0.071 ± 0.012	0.1327 ± 0.046	1.462 ± 0.254	0.0127 ± 0.010	0.939 ± 0.855	7.964 ± 0.131	10.887 ± 0.342
		Minimum	0.055	0.051	1.190	0.000	0.175	7.76	10.24
El-Sewiss Urban Area									
	Urban Area	Maximum	0.147	0.207	2.142	0.884	4.738	11.71	13.37
		Mean	0.077 ± 0.032	0.131 ± 0.051	1.319 ± 0.374	0.140 ± 0.251	1.622 ± 1.714	8.13 ± 2.07	11.67 ± 0.811
		Minimum	0.037	0.051	1.190	0.013	0.013	2.42	11.06
El-Behera									
	Urban Area	Maximum	0.147	0.077	0.74	0.752	1.952	8.58	11.43
		Mean	0.136 ± 0.020	0.190 ± 0.328	0.343 ± 0.294	0.1897 ± 0.257	0.5409 ± 0.605	8.028 ± 0.240	11.212 ± 0.206
		Minimum	0.092	0.00	0.000	0.000	0.108	7.65	10.90
	Rural Area	Maximum	0.147	0.077	0.952	0.145	0.688	8.72	11.50
		Mean	0.0936 ± 0.023	0.032 ± 0.029	0.729 ± 0.167	0.071 ± 0.16	0.930 ± 1.428	8.292 ± 0.269	11.169 ± 0.203
		Minimum	0.055	0.000	0.476	0.013	0.040	7.91	10.69
El-Sharkia									
	Urban Area	Maximum	0.110	0.336	0.476	0.038	2.538	8.180	11.25
		Mean	0.088 ± 0.013	0.232 ± 0.113	0.238 ± 0.150	0.023 ± 0.012	1.17 ± 1.443	7.133 ± 2.089	11.131 ± 0.063
		Minimum	0.073	0.077	0.000	0.025	0.000	2.89	11.08
	Rural Area	Maximum	0.184	0.284	0.952	0.600	1.593	9.506	13.98
		Mean	0.072 ± 0.033	0.249 ± 0.028	0.865 ± 0.565	0.1194 ± 0.175	0.758 ± 0.581	8.478 ± 0.550	11.866 ± 0.922
		Minimum	0.028	0.207	0.238	0.000	0.135	7.980	10.98

RESULTS AND DISCUSSION

All heavy metals concerned were detected in every analysed sample as reported in tables 1 and 2.

In all cases their were great differences between the levels of these metals in tap water in all governorates. Also differences are clear between the water from old and new water nets and between samples from houses have or have not storage tanks.

Iron Levels :

Iron levels in the tap water seems to be higher (0.044 mg/L.) in old houses samples than in new building (0.040 mg/L.) and its level was less in urban areas in Greater Cairo, than in rural areas (0.0965 mg/L) in Giza and (0.1201mg/L) in Qualiobia.

Water samples from each governorates showing that Fe levels are 0.082, 0.092, 0.077, 0.136 and 0.088 mg/L for Ismailia, El-Minia, El-Sewiss, El-Behara, and El-Sharkia governorates in urban areas, while in rural areas these levels are 0.0790, 0.071, 0.0936 and 0.072 mg/L for Ismailia, El-Minia, El-behara and El-Sharkia respectively.

Fe levels at all water samples from all governorates tested were below the accepted levels conducted by the Egyptian authorities, (1.0 mg/L).

Copper levels:

New building water samples contained high levels of Cu when compared with old houses or rural areas water samples in Greater Cairo. Copper levels were higher in all governorates in urban areas than in rural areas except in El-Sharkia governorate. Copper levels also were well below the acceptable level conducted by the Egyptian authorities (1.5 mg/L).

Zink levels:

All the tested samples contained Zn levels less than the acceptable level. There is a great differences between tap water samples in their contents of Zn. The maximum allowable level of Zn in water as recommended by US EPA is 5 mg/L. More than 5 samples exceeded this level in Ismailia, Giza and Qualiobia.

Li, Na and K levels :

The contents of the tested water samples varied greatly from their contents of Li, Na and K. No guidelines for these levels are recommended in drinking water in Egypt.

Now measurable amounts of heavy metals in our water present a variety of problems. If a chemical is nontoxic to human being and causes no harm to living cells, residual amounts in water or food could be tolerated.

As sources of good quality drinking water diminish at an alarming rate, there is an urgent need to protect the still usable sources from degredation and to discover new underground resources. Where water quality has dropped below acceptable levels, water treatment will be needed, and in rural areas this can only be done on sustainable basis if existing appropriate technology is used and new technologies are developed.

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