Determination of Some Trace Elements in Benghazi City Drinking Water by Flame Atomic Absorption Spectrometry

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Abstract: The major sources of water supply of Benghazi city is the River Project which is represented in Talhia reservoir where water flows through pipes in the network of water distribution from Talhia reservoir to different positions in the city. In this study we divided the study area into three areas A, B and C according to the distance away from Talhia reservoir. Drinking water samples were collected from twenty six positions of Benghazi city during spring and summer seasons between March and September 2009. These samples were analysed for some trace elements Fe^{2+}, Cu^{2+}, Zn^{2+} and Mn^{2+} for aim of comparison trace elements in water of the network with Libyan and WHO drinking water standards. The trace elements Fe^{2+}, Cu^{2+}, Zn^{2+} and Mn^{2+} were determined by using a flame atomic absorption spectrometer. All trace elements of the network water samples agree well with Libyan and WHO drinking water standards. Comparison between results of spring season and results of summer season showed some differences in the majority of trace elements.

Key words: Drinking water · FAAS · Iron · Copper · Zinc · Manganese

INTRODUCTION

Water is the elixir for life. Adequate supply of potable safe water is absolutely essential and is the basic need for all human being on the earth. Trace elements are chemical elements that are needed in minute quantities for the proper growth, development and physiology of the human organism. However, all essential trace elements become toxic when their concentrations becomes excessive [1]. They are referred to heavy metals because their densities greater than $5g\backslash cm^3$. Metals are cycled through the environment and they may enter surface and ground waters through industrial processes, soils and rocks leaching and from sewage [2]. Iron is found in natural fresh waters at levels ranging from 0.5 to 50 mg/L. It may also be present in drinking water as a result of the use of iron coagulants or the corrosion of steel and cast iron pipes during water distribution [3, 4] and from mineral industries [5]. A WHO guideline value for iron in drinking water of 0.3 mg/L, is based on taste and appearance rather than on any health effect. Copper found in drinking water in range from = 0.005 to >30mg/L, primarily as a result of the corrosion of interior copper plumbing. A WHO guideline value for copper in drinking water is 2mg/L, based on protective against acute gastrointestinal effects

of copper [3]. Zinc found in surface water and groundwater in levels normally do not exceed 0.01and 0.05mg/L, respectively, concentrations in tap water can be much higher as a result of dissolution of zinc from pipes, where, zinc is used in coatings to protect iron and steel [3, 5]. However, WHO suggested that drinking water containing zinc at levels above 3mg/L may not be acceptable to consumers. Manganese ore in fresh water typically range from 1 to 200μg /L. Manganese green sands are used in some locations for potable water treatment. A WHO health-based guideline value for manganese in drinking water 0.4mg /L [3]. The aim of study comparison of our results with that obtained in the chemical analysis of drinking water of Benghazi city of a study carried out by El Hossadi, A. A& co workers in period 1982-1984 and a comparison between trace elements of the three areas A, B and C and to study if there are differences in trace elements in water of the network between spring and summer seasons.

MATERIALS AN METHODS

All chemicals and reagents used for calibration and analysis were of analytical grade. A total of fifty two drinking water samples were collected from twenty six

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Table 1: The data for all calibration curves of Fe^{2+}, Cu^{2+}, Zn^{2+} and Mn^{2+}.

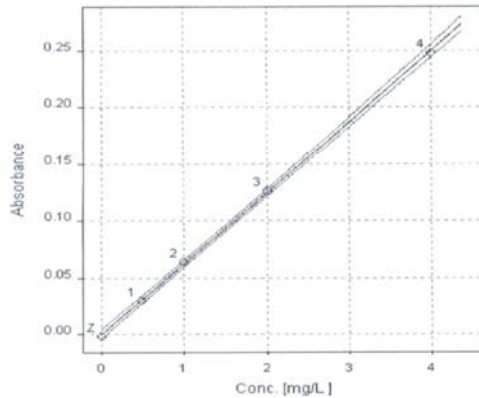| Trace element Calibration data	Fe^{2+}	Cu^{2+}	Zn^{2+}	Mn^{2+}
R^2 (adj.)	0.9996	0.9994	0.9887	0.9996
Slope	0.01461 Abs/mg/L	0.06238 Abs/mg/L	0.14947 Abs/mg/L	0.3477 Abs/mg/L
Sc0	0.02389 mg/L	0.03059 mg/L	0.03450 mg/L	0.00531 mg/L
Char. conc.	0.29837 mg/L/1%A	0.06990 mg/L/1%A	0.02917 mg/L/1%A	0.012540 mg/L/1%A

Fig. 1: The calibration curve of Cu^{2+} by FAAS
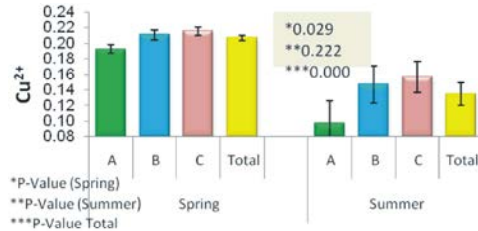

Fig. 2: Mean values of Cu^{2+} concentration of areas A, B, C and Total (The network) in spring and summer seasons
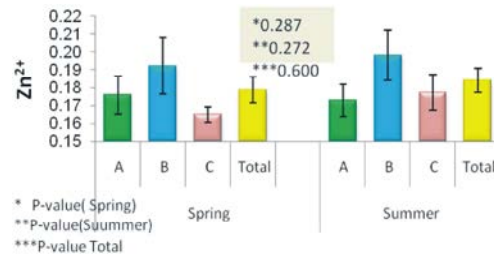

Fig. 3: Mean values of Zn^{2+} concentration of areas A, B, C and Total (The network) in spring and summer seasons
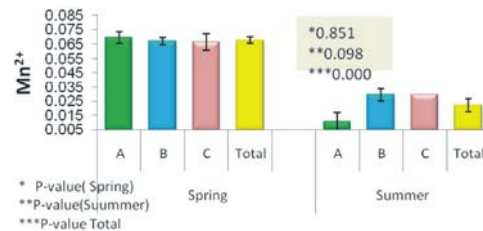

Fig. 4: Mean values of Mn^{2+} concentration of areas A, B, C and Total (The network) in spring and summer seasons

positions of Benghazi city during spring and summer seasons between March and September 2009. The number of samples collected in each season were twenty six. A 0.5 liter plastic bottles were used for collecting samples after washing with double distilled water and then soaked in 10% HNO_3 over night. A 1 ml conc. HNO_3 was added to each bottle before collecting water samples to prevent the precipitation of metals. The samples were cooled to less than 37°C in cooling bag and transported to the laboratory on the same day. The water samples were preserved and stored according to American Public Health Association [6] handling requirements. For determination of Fe^{2+} and Mn^{2+} the samples were treatment by addition calcium solution excess 200mg Ca^{2+}/L to elimination silica interference [6], KCl solution excess 1000mg K^+/L was added for control the ionisation interferences [7]. For determination of Zn^{2+} the samples were treated only with KCl solution excess 1000mg K^+/L. Analytic jena novAA 300 Atomic absorption spectrometer model was used to determine the concentration of trace elements. Table (1) illustrates the data for all calibration curves (Slop, R^2- adj., Sc0 and Char. conc.) for Fe^{2+}, Cu^{2+}, Zn^{2+} and Mn^{2+}. Figure (1) shows the calibration curve of Cu^{2+}.

RESULTS AND DISCUSSION

The range values of Cu^{2+}, Zn^{2+} and Mn^{2+} concentrations of A, B and C areas (The network system) in the spring season were illustrated in Table (2).

The range values of Cu^{2+}, Zn^{2+} and Mn^{2+} concentrations of A, B and C areas (The network system) in the summer season was illustrated in Table (3).

ANOVA tables for Cu^{2+}, Zn^{2+} and Mn^{2+} for the three areas (A, B and C) indicate that there are no significant differences (P-value □ 0.05) in the mean values of Cu^{2+}, Zn^{2+} and Mn^{2+}. All samples gave zero readings for Fe^{2+} due to the absence of this metal in these samples. In spring season there are small significant differences (P-value □ 0.05) only in the mean values of Cu^{2+} within and between groups of A, B and C areas, Although the differences in the mean values for Cu^{2+} were small through

Table 2: The average trace elements of areas A, B and C (The network system) in the spring season

Area Element (mg/L)	A	B	C	Min. value	Max. value	Average	SD	SE
Fe^{2+}	--	--	--	--	--	--	--	--
Cu^{2+}	0.192	0.210	0.215	0.192	0.215	0.206	0.0190	0.0037
Zn^{2+}	0.176	0.192	0.165	0.165	0.192	0.179	0.0365	0.0072
Mn^{2+}	0.070	0.067	0.067	0.067	0.070	0.068	0.0113	0.0022

Table 3: The average trace elements of areas A, B and C (The network system) in the summer season

Area Element (mg/L)	A	B	C	Min. value	Max. value	Average	SD	SE
Fe^{2+}	--	--	--	--	--	--	--	--
Cu^{2+}	0.097	0.147	0.157	0.097	0.157	0.135	0.0731	0.0145
Zn^{2+}	0.173	0.198	0.177	0.173	0.198	0.184	0.0854	0.0061
Mn^{2+}	0.011	0.029	0.030	0.011	0.030	0.022	0.0140	0.0044

spring and mean small values of Cu^{2+} increased toward end of the network, however, generally increase of mean values of Cu^{2+} in end of any network distribution system of drinking water may be due to leaching of metals from metal pipes and fittings within the distribution system as mentioned in the study which was accomplished on the network distribution of drinking water in Viti Levu - Fiji islands [8]. From (T-test) tables for Cu^{2+}, Zn^{2+} and Mn^{2+} values we concluded that there are significant differences (P-value $\square$ 0.05) in the mean values of Cu^{2+} and Mn^{2+} between the two seasons spring and summer, but there are not significant differences (P-value $\square$ 0.05) in the mean values of Zn^{2+}, however the mean values of Cu^{2+} and Mn^{2+} in spring were slightly higher than that in summer, generally the differences in trace elements concentrations in any network distribution system of drinking water in different periods may be due to nature of reservoirs, pipes or the source of water supply. Figure (2) shows the experimental comparison of mean values of Cu^{2+} of different areas, Figure (3) and (4) shows the mean values of Zn^{2+} and Mn^{2+} respectively.

CONCLUSION

All the trace elements of the drinking water samples agree well with Libyan and WHO drinking water standards (Less than Libyan and WHO guideline values), so drinking water of the network of water distribution of Benghazi city has high quality compared with the results obtained by El Hossadi, A. A& co workers for drinking water of Benghazi city in the period 1982-1984 where in that period Benghazi city was provided with multichannel water supply sources ranging from desalination plants to deep water wells [9]. The small increase of Cu^{2+} direction to the end of the network may be due to leaching of metals from metal pipes and fittings within the distribution system as occur in study in Suva - Fiji [8]. Additionally the values of Cu^{2+} and Mn^{2+} in spring were higher than in summer, such differences of these trace metals may be due to nature of the reservoirs, pipes or the source of water supplies (Sarir well field and Tazerbo well field). Although there are very small differences in these parameters but they did not affect the quality of the mentioned studied areas.

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