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Pollution of Wells' Water with Some Elements, Fe, Mn, Zn, Cu, Co, Pb, Cd, and Nickel in Al-Jadriah District, Baghdad Government

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Abstract

Ninety six water samples were collected from eight wells in Al-jadriah district—Baghdad, from June 2010 to May 2011, and analyzed for presence of Fe, Mn, Zn, Cu, Co, Pb, Cd, and Nickel, using Atomic absorption method. Results revealed presence of only scanty amount of iron, Mn and Co, ranged from 0.09 - 0.29 ppm for iron and 0.016 - 0.339 ppm for Mn, and 0.01 - 0.732 ppm for Zn. Concentrations of other elements (Cu, Co, Pb, Cd, and Ni) were nil. All values were below the safe limit of water suitability for human uses, according to safe limits laid down by WHO (2011), Iraqi Measurement and Quality Control System and Iraqi Ministry of Environment. Wells' water can be used under special management in Water management units.

Keywords

Wells' Water, Trace Element, Heavy Element

1. Introduction

Al-Jadriya province is considered high fertile loam soils. It represents the eastern side of the shoulder of the Tigris River and stretching from the eastern section of the province of Baghdad through the park Abu Nawas until the Jadiriya Bridge, and Baghdad University camp to the southern Dora district which is an extension of the plain Iraqi sedimentary [1]. The Tigris River is the only source of irrigation in Jadriya, for homes, small orchards and farmland. However, the reduction in level of Tigris River in recent years pushed those to dig wells to get water for irrigation in the lands and to avoid dependence on the central pipelines network, taking advantage

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of rich groundwater in the province of Baghdad, especially Jadriya and Karrada district.

Water quality means different things to different people depending on the objectives and purposes of water use. Good quality water should have several specifications and standards as drinking water requires high specifications and standards, and irrigation water requires less specification, while animals breeding (cattle, sheep, poultry, fish), require specifications and standards approaching the drinking water standards for humans.

WHO standards and determinants for drinking water [2] are followed by different countries in the world and each country has its own guide. In Iraq, specifications and standards for drinking water were identified by Central Agency for Standardization and Quality Control and by Ministry of the Environment [3].

It is important to estimate the concentration of trace elements in water to determine the quality of water and their effect on plant growth and production, growth of Microorganisms and human health, but when they exceed safe limits they will be potentially harmful and toxic [4]-[6].

As part of national survey of geological and water quality assessment program in the United States, concentration of Trace Elements (Boron, Iron, Lead, Molybdenum, Cadmium, Lithium, Zinc and others) were measured on samples of ground water collected from 1992 to 2003. Results revealed differences and diversity in the concentration of trace elements that have been studied due to the diversity of geological crust in USA, and reported an increase in the solubility of trace elements in groundwater with pH less than 7.0, except for Molybdenum which dissolve in alkaline pH [7].

Schauss (2012) noted that water mixed homogeneously with many materials, more than any other solvent and considered an optimum medium for transfer of nutrients, and through geological mixing with components of earth's crust it equips all minerals required for our bodies' health [8].

This study was conducted to determine the chemical composition of groundwater in Al-Jadiriyah, Baghdad province to assess trace and heavy elements (Iron, Manganese, Zinc, Copper, Cobalt, Lead and Cadmium and Nickel) present in the ground water in wells Al-Jadriya.

2. Materials and Methods

Samples: Water samples were collected from eight wells, in Al-Jadriya, at area lies between Al-Mualak bridge and AL-Jadiriya bridge parallel to the path of the Tigris River (at depth from 15 to 20 meters), monthly for one year from June 2010 to May 2011, **Figure 1**.

Figure 1. Google Map shows Well sites between Al-Mualak bridge and AL-Jadria bridge across Abu Nuwas street and University Camp.

Preparation of Sample Solutions: Sterile plastic bottles (5000 cm^3), were used for collection of water. Samples were stored at 4˚C through the analytical stages for keeping it from evaporation.

100 ml of water samples were taken, to which 20 ml concentrate (65%) Nitric acid was added; transferred to plastic vessel (beaker), heated in a lab-guide microwave oven at low-medium power for 10 - 15 minutes. Cooled and transferred to a volumetric flask, then rediluted to 100 ml final volume.

Trace elements (Fe, Zn, Mn, Cu) and heavy metals (Pb, Co, Ni, Cd) were measured.

Instrument: Buck Model 210/211 AAS furnished with; Air flame (for Fe and Cu) and Furnace (for Pb and Fe). The wavelengths for each element. Described in (**Table 1**).

Calibration: A linear, 2-point Calibration was made using the appropriate Matrix Blank for the Flame or Furnace and the Standards set within the CAL MAX range for each metal [9].

3. Results and Discussion

The average quarterly results of the trace elements that have been assessed in 96 water samples from eight wells in this study for the period from June 2010 to May 2011 are:

Iron: analysis revealed concentration range (0.12 to 0.29) ppm in most water samples (**Tables 2-5**). This range is less than limited values specified by WHO (0.3 ppm). Iron is an important RBC component, and its deficiency causes anemia, but its presence in the water in excess of the allowable limit (0.3 - 1.0 ppm) causes toxicity and poor taste water [10]. Manganese: trace amount range was (16.00 - 443 ppb) (**Tables 2-5**), this level is within the proper focus of this element according to the WHO guide (500 ppb) (WHO, 2011). Zinc concentrations ranged (0.13 ppm - 0.71 ppm), (**Tables 2-5**), it is less than limitations of the WHO (3.0 ppm). Zinc is essential for plant growth and human and added as soil fertilizer and as medical creams to address the shortage in patients who suffer from skin infections [10].

Results revealed absence of Copper, Cobalt, Lead, Cadmium and Nickel: in water samples, (**Tables 2-5**), so wells' water is not-polluted.

The low concentration or absence of trace and heavy elements in wells' water is related to type of soil, the Sedimentary soil in Mesopetenium region, resulting from flood plain deposit which is poor with this elements [11], and the absence of excess of fertilizers, insecticides and industrial pollution. This gives pure well's water free from pollutions [12].

Trace elements and heavy metals concentrations that included in our study did not exceed the concentrations allowed for drinking water set by the Central Organization for Standardization and Quality Control [3].

Table 1. Shows the elements and wavelengths that have been taught at the measurement (BUCK, 2006).

Element	Fe	Mn	Zn	Cu	Co	Pb	Cd	Ni
Wavelengths nanometer (ηm)	245.3	279	213.9	324.8	240.7	217	228.9	232

Table 2. Average concentration of trace elements and heavy water samples wells Jadiriya months of June July and August 2011 for eight wells.

Limited values WHO ppm	Tiger water	Well No. 8	Well No. 7	Well No. 6	Well No. 5	Well No. 4	Well No. 3	Well No. 2	Well No. 1	Unit	Element
0.3	Nil	0.29	0.25	0.17	Nil	0.18	Nil	0.12	Nil	ppm	Fe
0.5	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	16.00	ppb	Mn
3.0	Nil	0.32	0.25	0.13	0.22	0.24	0.15	0.25	0.23	ppm	Zn
2.0	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Cu
-	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Co
0.01	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Pb
0.003	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Cd
0.02	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Ni

ppm = part per million, ppb = part per million, 1 ppm = 1000 ppb.

Table 3. Average concentration of trace elements and heavy water samples wells Jadiriya months of Sept October and November 2011 for eight wells.

Limited values WHO (ppm)	Tiger water	Well No. 8	Well No. 7	Well No. 6	Well No. 5	Well No. 4	Well No. 3	Well No. 2	Well No. 1	Unit	Element
0.3	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Fe
0.5	Nil	Nil	Nil	Nil	Nil	Nil	Nil	40.00	58.00	ppb	Mn
3.0	Nil	30.00	10.00	33.00	25.00	19.00	12.00	23.00	41.00	ppb	Zn
2.0	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Cu
-	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Co
0.01	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Pb
0.003	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Cd
0.02	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Ni

Table 4. Average concentration of trace elements and heavy water samples wells Jadiriya months of December January and February 2011 for eight wells.

Limited values WHO (ppm)	Tiger water	Well No. 8	Well No. 7	Well No. 6	Well No. 5	Well No. 4	Well No. 3	Well No. 2	Well No. 1	Unit	Element
0.3	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Fe
0.5	Nil	Nil	Nil	33	15	70	62	33	104	ppb	Mn
3.0	Nil	100	24	20	15	10	56	40	580	ppb	Zn
2.0	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Cu
-	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Co
0.01	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Pb
0.003	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Cd
0.02	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Ni

Table 5. Average concentration of trace elements and heavy water samples wells Jadiriya months of March April and May 2011 for eight wells.

Limited values WHO (ppm)	Tiger water	Well No. 8	Well No. 7	Well No. 6	Well No. 5	Well No. 4	Well No. 3	Well No. 2	Well No. 1	Unit	Element
0.3	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Fe
0.5	Nil	Nil	Nil	361	153	92	443	84	60	ppb	Mn
3.0	Nil	150	30	20	30	50	110	50	710	ppb	Zn
2.0	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Cu
-	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Co
0.01	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Pb
0.003	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Cd
0.02	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	ppb	Ni

From above results, we can conclude that wells water can be used under special management if no other problems are presented.

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