

Assessment of Drinking Water Quality in Some Schools in Babylon Governorate

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Abstract :

In this study, the drinking water quality of 30 school in Babylon governorate was conducted according to their location , as well as different grade level. All schools in the cities used tap water which received from treatment plant as main source of drinking water , while schools in rural area used transported water by special car.

The present study attempts to evaluate the quality of drinking water of some schools in Babylon governorate. Samples of drinking water were collected and analysis during a period of eight months, stating from January to August 2013.

Parameters for physical and chemical properties met the Iraqi standards except the turbidity and sulphate are slightly higher than the standard value.

The result showed that the heavy metals (Fe, Hg and Pb) concentration had met Iraqi standard for drinking water , except the chromium in primary schools located at Al-Hilla city in March is 0.095 mg/L higher than the standard value.

Results of school drinking water microbial detection showed that the highest unqualified rate in microbe detection is 37.5% for primary schools in Al-Mussayab city.

تقييم نوعية مياه الشرب في بعض مدارس محافظة بابل

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الخلاصة :

تم دراسة نوعية مياه الشرب لثلاثون مدرسة في محافظة بابل. تم اختيار تلك المدارس بالنسبة للموقع في المحافظة ومستوى التعليم فيها. تعتمد المدارس الواقعة في المدن على المياه الواصلة إليها من محطات معالجة مياه الشرب الواقعة في المحافظة بينما تعتمد المدارس الواقعة في المناطق الريفية على المياه المنقولة إليها بسيارات خاصة.

إن الهدف من هذه الدراسة تقييم نوعية مياه الشرب في بعض مدارس محافظة بابل، تم جمع العينات وتحليلها خلال فترة الدراسة التي امتدت ثمانية أشهر بدء من شهر كانون الثاني ولغاية آب 2013. أظهرت النتائج ان المؤشرات الفيزيائية والكيميائية لمياه الشرب كانت ضمن المواصفات العراقية ، ماعدا مؤشري العكورة وتركيز الكبريتات حيث كانت قيمها عالية وغير مطابقة للمواصفات العراقية لمياه الشرب. وقد أظهرت النتائج ايضا ان تراكيز المعادن الثقيلة (الحديد، الزئبق والرصاص) المقاسة في مياه الشرب كانت مطابقة للمحددات العراقية ماعدا الكروم حيث كان تركيزه (0.095)mg/L في شهر حزيران وهو أعلى من الحدود المسموح بها في مدرسة ابتدائية تقع في مدينة الحلة.

بينما بينت نتائج التحليل الميكروبي لعينات مياه الشرب في المدارس ان أعلى نسبة فشل في العينات كانت (37.5%) للمدارس الابتدائية في مدينة المسيب.

Study area

Babylon governorate located in the middle of Iraq, south of Baghdad as shown in Fig. (1) there are (1030) schools in the governorate and the number of students exceed (400000) (Babylon Education Directorate). Shatt Al- Hilla river represent the main water supply source for many water treatment plants in the governorate. To achieve the aim of this research to assess the quality of drinking water in schools drinking water samples were collected from different locations of Babylon governorate as shown in fig.(1).

Introduction

Water quality indicates that pollution of the water is increasing alarmingly and that it has created serious threat to human health and environment. According to the WHO, the lack of safe water supply and of adequate means of sanitation is blamed for as much as 80 % of all diseases in developing countries(Hasan &Mirani 2010).

The schools provide students with daily drinking water, which is purified from water stored in pools or water tanks. If the water sources are polluted or the water is not well treated, school drinking water quality will be a great problem(Rook 1997).

Drinking poor-quality water can cause illness from poisoning or infection. Children are in the highest-risk group and in many cases can become ill without realising that it was the water that made them sick. Illness can result from exposure to bacteria or from lead poisoning.

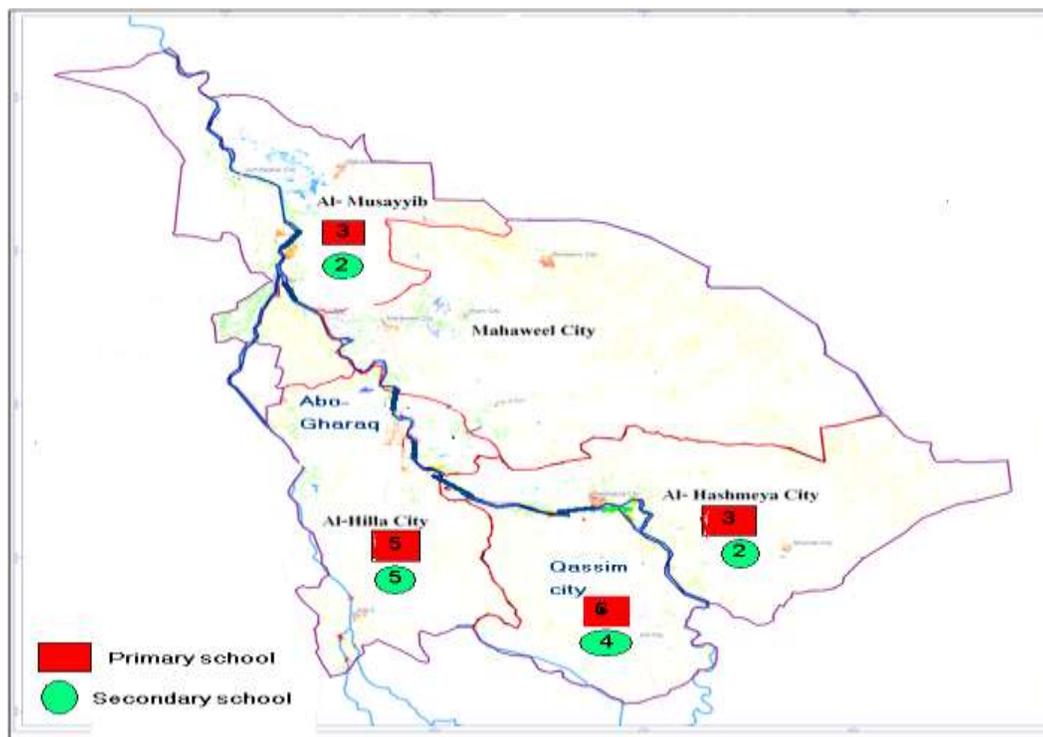


fig.(1)Sampling location and number of school selected on Babylon governorate

Materials and Methods :

Drinking water samples from 30 schools located in different locations of Babylon governorate were collected spreading over period of eight month starting from January to August 2013. Water samples were collected in clean bottles one liter. In this research, the test items for school drinking water include physical, chemical property, and microbiological detection. The test of physical and chemical property mainly cover water temperature(T), hydrogen ion concentration (pH), turbidity, electrical conductivity (EC), total dissolved solid (TDS.), nitrate (NO₃), sulphate(SO₄), calcium (Ca), potassium (K), sodium(Na), nitrate (NO₃), free available residual chlorine,. The concentrations of trace elements (Fe, Hg, Cr and Pb) tested too. Microbiological detection involves E.coli and total bacterial count. The analysis method is according to the standard method for examination of water and waste water (APHA, 1998) as shown in table (1).

Table (1): The school drinking water quality analysis item and method (APHA, 1998)

Property	Item	Method
Physical and chemical	Water temperature pH Turbidity Electrical conductivity (EC) Total dissolved solid (TDS) Sulphate(SO₄) Calcium (Ca) Potassium (K) Sodium(Na) Nitrate (NO₃)	Electrode method Electrode method Turbid meter Electrode method Electrode method Turbidimetric method Turbidimetric method Flame photometric method Flame photometric method Spectrophotometer method
Trace element	Iron (Fe) Mercury (Hg) Lead (Pb) Chromium(Cr)	Atomicabsorption technique Atomicabsorption technique Atomicabsorption technique Atomicabsorption technique

Results and discussion:

This research conducted on water quality in selected 30 schools in Babylon governorate ,12 secondary schools, and 18 primary schools (5 of them located in rural or country area). All schools in the cities used tap water as main water source, schools in

rural area used transported water and stored in stored tank. The analysis result is explained as follows:

Drinking water quality analysis :

1- Temperature :

The Temperature value of tap water in all schools throughout the study period ranged between (10-35) , the values of temperature showed there were clear differences in temperature for samples collected during separate times.

2- hydrogen ion concentration (PH) :

pH is a parameter that indicates the acidity of a water sample. The operational guideline recommended in drinking water is to maintain a pH between 6.5 and 8.5. The principal objective in controlling pH is to produce a water that is neither corrosive nor produces incrustation.

The pH values at all schools were between (7.1-8.3). The highest pH value recorded was (8.3) at primary school located in Al-Hilla city in January, while the lowest value was (7.1) in the primary school located in al-Musayyib city in May. The PH value in all schools has met the Iraqi standard (6.5-8.5).

3- Turbidity :

The result showed that values of turbidity varied from 22 to 0.16 NTU . The present study showed the values of turbidity during winter higher than the values of turbidity during summer. The highest turbidity value recorded was (22) at secondary school located in Al-Hilla city in February, while the lowest value was (0.16) in the primary school in Al-Hilla city in August. The turbidity of water samples in all schools is higher than Iraqi standard(5-10NTU) except some samples that lower than this value especially in summer season.

Turbidity in water is caused by suspended and colloidal matter, such as clay, silt, finely divided organic and inorganic matter, plankton and other microscopic organisms. (APHA, WERF, AWWA 2005).

4- Electrical conductivity (EC) :

Conductivity values throughout the period of the study at all water samples varied from (1172) $\mu\text{s}/\text{cm}$ to (682) $\mu\text{s}/\text{cm}$.

The results show clear seasonal differences in conductivity values .High values were recorded in the winter season, this due to contamination of conducting in water samples.

5- Total dissolved solid (TDS) :

TDS values throughout the period of the study at all the schools ranged between (623-162.2) (mg/l). TDS is a joint name of numerous substances, mainly including hydrogen carbonate ion, chlorine salt, calcium sulfate, inorganic salt as well as little

soluble organic synthesis(Liao & Miaw, 2008). Iraqi standard recommends that the value TDS of drinking water is 1000, water of TDS proportion lower than 1000 mg/L is acceptable, and water of TDS higher than 1200 mg/L is unacceptable. In this research the TDS value in all schools has met the Iraqi standard.

6- Sulphate (SO₄) :

The result showed that values of sulphate at water samples ranged between (230-351) mg/L . Results showed that the values of sulphate during the period of the study at all the schools higher than the allowable Iraqi standards (200) mg/L. This due to present of Sulphate in natural surface water as sulphate minerals (gypsum) or sulphide minerals (pyrite) from sedimentary rocks, industrial discharges and atmospheric precipitation(**Talk, 2004**).

7- Calcium (Ca) :

Calcium determination is usually required for portability of water.values throughout the period of the study at all samples ranged between (20- 195) (mg/l). The permissible Iraqi standard limit is 200 mg/L, the result showed that calciumvalue in all schools has met the Iraqi standard.

8- Potassium (K) :

Potassium is a naturally occurring element. Its concentration (4.1-5.6) mg/L. The excess amount of potassium present in the water sample may lead nervous and digestive disorder (**Tiwari, 2001**).

9- Sodium(Na) :

Sodium values throughout the period of the study at all the schools ranged between (83.4- 101.5) (mg/l).The maximum acceptable concentration of sodium in drinking water according to Iraqi standard is 200 mg/L, , the result showed that soduimvalue in all schools has met the Iraqi standard.

The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets (**June, 2003**).

10- Nitrate (NO₃):

The maximum acceptable concentration of nitrates in drinking water according to Iraqi standard is 20 mg/L as nitrogen.The result showed that values of nitrate in water samples ranged between (2.3-15.7) mg/L.

Nitrates are present in water (particularly ground water) as a result of decay of plant or animal material, the use of agricultural fertilizers, domestic sewage or treated wastewater contamination. Most water-related cases of

methaemoglobinaemia have been associated with the use of water containing more than 10 mg/L nitrate as nitrogen. In areas where the nitrate content of water is known to exceed the maximum acceptable concentration the public should be informed by the appropriate health authority of the potential dangers of using the water for infants (June, 2003).

11- Free available residual chlorine :

Application of chlorine is essential to insure the safety property of drinking water. When the concentration of chlorine in water is about 2–3 mg/l, people can smell an irritant odor. In consideration of the feeling of most people and the disinfection efficiency of residual dosage(Liao&Miaw 2008).

Free available residual chlorine values throughout the period of the study at all the schools ranged between (2.5-0.32) (mg/L). The permissible limit of Free available residual chlorine in drinking water according to Iraqi standard is (0.3-1) mg/L. The Free available residual chlorine in water samples at schools was lower than this value except of (2.5, 2) mg/L for primary schools located at Al-Hilla city in June and primary school located in Al-Hashimeya city in April respectively.

12- Trace element :

The concentration of four trace element (Fe, Hg, Cr and Pb) are tested in school drinking water. the concentration of (Fe, Hg and Pb) were lowest in drinking water samples and met Iraqi standard, Cr concentration in water samples at schools was lower the permissible limit of Iraqi standard (0.05mg/L) except of (0.095) mg/L for primary schools located at Al-Hilla city in March.

13- Microbe detection:

The microbiological quality of drinking water is the most important aspect of drinking water because of its association with waterborne diseases. Typhoid fever, cholera, enteroviral disease, bacillary and amoebic dysentery, and many varieties of gastrointestinal diseases, can all be transmitted by water(Hasan, Mirani, and Ismat , 2010).

Microbial quality of drinking-water includes testing for *Escherichia coli* as an indicator of faecal pollution. *E. coli* provides conclusive evidence of recent faecal pollution and should not be present in drinking-water. In practice, testing for thermotolerant coliform bacteria can be an acceptable alternative in many circumstances(WHO 2006).

In this research microbial detection covers detection of *E.coli* and total bacterial count. Results of school drinking water microbial detection are shown in table (3) .

The permissible limit of Iraqi standard for *E.coli* 1 CFU/100ml, and 50 CFU/ml for total bacterial count in water sample.

Table (3): Microbe detection content for school drinking water in Babylon governorate

The school & location		Number of samples	Number of unqualified* samples	unqualified rate (%)
Al-Hilla city	Primary	40	7	17.5
	Secondary	40	5	12.5
Al-Mussayeb city	Primary	24	9	37.5
	Secondary	16	3	18.8
Al-Hashemya	Primary	24	4	16.7
	Secondary	16	2	12.5
Qasim city	Primary	48	9	18.8
	Secondary	32	10	31.3

*The test includes E.coli and total bacterial count. Excess of either to Iraqi standards will be regarded as unqualified.

Conclusion:

From this study the following conclusions are obtained :

1. The drinking water source of schools in Babylon governorate mainly includes tap water in the cities and transported water in rural area.
2. The water quality parameters of temperature, hydrogen ion concentration (PH), Total dissolved solid (T.D.S.), calcium(Ca), sodium(Na),and Nitrate(NO₃) had met the domestic Iraqi standards.
3. The result showed that values of turbidity in water is slightly higher than standard value in winter season.
4. Results showed that the values of sulphate during the period of the study at all the schools higher than the allowable Iraqi standards.
5. Heavy metals element content conform to the domestic standard for drinking water , except the chromium in primary schools located at Al-Hilla city in March is 0.095 mg/L higher than the standard value.
6. The highest unqualified rate in microbe detection is 37.5% for primary schools in Al-Mussayab city. While the lowest value was 12.5% for secondary schools located in Hilla and Al-Hashemya city respectively.

Recommendations :

1. Inform and raise students' and teachers' awareness on issues related to drinking water protection and its impact on health.
2. Periodical testing conduct on water quality parameters (chemical and biological) in schools to ascertain the safe drinking water actually being consumed
3. Provide the schools with additional technology to clean and disinfection drinking water such as reverse osmosis (RO) system or other issues.

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