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Microbial quality and some physicochemical properties evaluating of drinking water in some residential neighborhoods in Baghdad city-Iraq

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Abstract: Physical, chemical and a biological measurments were carried out and drinking water samples were collected from four areas Abu ghraib, Dora, Ghazaliya and Saydiya for period extended from February 2016 to September 2016, through the residential sites at different areas situated with various distances from the supplying source, three samples were taken monthly. Water temperature at sampling time was varied from 17.4°C to 30.8°C, for temperature at sampling time also. The results of pH values were within the allowable limits, ranging from 6.5 in winter to 8.2 in summer. The highest value of turbidity recorded for drinking water was in spring with 21 NTU and the lowest value was in summer with 0 NTU. The study showed that the results of TDS values ware ranged from 520 mg/L in winter to 200mg/L in spring. The highest value of residual chlorine was recorded in winter with 2.01 mg/L; the lowest value was 0.1 mg/L in spring . The current results showed an increased in the number of autotrophic bacteria, total coliform, and *E. coli* during winter season in most study locations as compared to those of the other seasons for drinking water . The Total plat count results of drinking water were exceed 100 cell/ml, the allowable limit for drinking water, for some samples in some sites. On the other hand, the TC, and *E. coli* exceeded zero cell/100ml, the allowable limits for drinking water, in some drinking water samples for some sites.

Keywords : Microbial quality , physicochemical properties , drinking water , Baghdad .

Introduction

Drinking water is defined as having acceptable quality in terms of physical, chemical, and biological parameters so that it can be safely used for drinking, cooking and other domestic applications (1).

Drinking water is a major source of microbial pathogens in developing regions, although poor sanitation and food sources are integral to enteric pathogen exposure (2). The lack of safe drinking water and adequate sanitation measures lead to a number of diseases such as cholera, dysentery, salmonellosis and typhoid and every year millions of lives are claimed in the developing countries (3). Comprehensive evaluations of microbial quality of water require survey of all the pathogens that have potential for human infections (4).Drinking water is essential in ensuring the health and well-being of populations and plays an important role in the development process. All drinking water and sewerage systems are subject, to a greater or lesser degree, to natural disasters such as earthquakes, floods and droughts. The impacts of a natural disaster can cause contamination of water, break in pipelines, damage to structures, watershortages, and collapse of the entire system. In this situation, the main public health priority is usually to provide a basic water supply to the affected population (5,6) .

The aim of this search is study the procedure a preliminary survey operations for a water drinking areas Karkh District of Baghdad , which includes the physical and chemical properties and the water does Biological investigating the efficacy and validity of drinking water.

Compared validity water drinking in the center of Baghdad / Karkh areas with the outskirts of Baghdad areas. The properties was including the TPC, TC, FC, *E.coli* and FS bacteria and acidity of water (pH) and its effect on water quality, temperature, TDS, concentration of residual chlorine, and study the turbidity of water because. The study includes both physical and chemical tests carried out in the central environmental laboratory.

Material and methods

(Sampling) Water samples for physical, chemical and biological variables were performed from number of residential areas fed by these water treatment plant, Karkh District of Baghdad during period extended from the February 2016 and ended in September 2016. Water samples were collected

for physiochemical analysis using pre-washed polyethylene bottle by water sample twice before filling (7). Water sample for biological analysis was collected in closed glass bottles, contained 0.2 ml of a sodium thiosulfate solution concentration of 10% to offset the effect of residual chlorine sterilized by the autoclave at temperature of 121 C^{o} for 30 minutes at 15 Par. then kept in cool box till carrying to a laboratory for examination (8).

Methods

Water sample for physic-chemical parameters include water temperature (by using thermometer), hydrogen ion concentration (by using pH-meter), turbidity level (by using turbidity-meter) and residual chlorine (by using addition methods) and TDS were measured according to APHA (7).Water sample for biological analysis (total coliform, fecal coliform and fecal streptococcus) used multiple fermentation tube or most probable number (MPN) technique are commonly used for enumeration of the bacteria (8), while total bacterial count (TBC) was carried out using the pour plate technique according to described by APHA (8).

Results and Discussion

Physical-chemical properties

The distribution and monthly variation of the physical-chemical qualities in the drinking water from four sites are shown in the Figure 1,2,3,4&5 ,respectively. water temperature is an important factor in any aquatic environments affecting on biological processes, The obtained results showed that the water temperature values were varied from highest value (30.8°C) in summer at site Saydiya and showed mean temperature values (30.53°C) to lowest value (17.4°C) in winter at sites Ghazaliya and showed mean temperature values (18°C) This result was similar to previous studies done by (Al-Helaly and Al-Mayah (9,10). In this study, the results of pH for drinking water samples from different sites showed that the highest value (8.2) during summer at Dora site ,and showed that the mean of pH values was (7.96) and the lowest pH water content (6.5) was found in winter at Dora site showed mean of pH values reached to 6.53 this result agreed with (11), they reported that Iraqi inland water is regarded to be on the alkaline side of neutrality, reflecting geological formations of the area and the results are agree with the finding that recorded by Al-Lami and Al-Obaidi (12,13). In this study the maximum turbidity level for drinking water sample recorded in spring 21 NTU for Saydiya site, which its turbidity mean value recorded 20.67 NTU, whereas, the minimum level recorded in summer was zero NTU for all sites. Water turbidity is caused by increasing of rainfall proportion and rising water levels with all the drifting of these rains that are ended in river water as well as discharge water which leads to increase the level of organic materials and other materials that increase turbidity (14)(15).

For free residual chlorine of drinking water, the highest value showed 2.01 mg/l which was recorded in site of Saydiya in winter. Mean of free residual chlorine was 1.94 mg/l while the lowest value 0.10 mg/l was recorded in site of Ghazaliya in spring. Mean of free residual chlorine was 0.336 mg/L .Also the results showed high percentages of free residual chlorine in drinking water in March despite with high temperatures, which directly affect the concentration of chlorine causing its volatilization and the reason is that most of the water purification plants add largest doses of chlorine to the water in March than in December because of increased pollution due to low water levels in March (16, 17). The results were in agreement with results of Barakat and AL-Hashimi (18,19).Current results revealed that the maximum value was 520 mg/l of TDS of drinking water which was recorded in winter for Abu ghraib site, and TDS mean value 513.33 mg/l, and the minimum value reached to 200mg/L that was recorded in spring for site of Abu ghraib, and TDS mean value was 210 mg/l

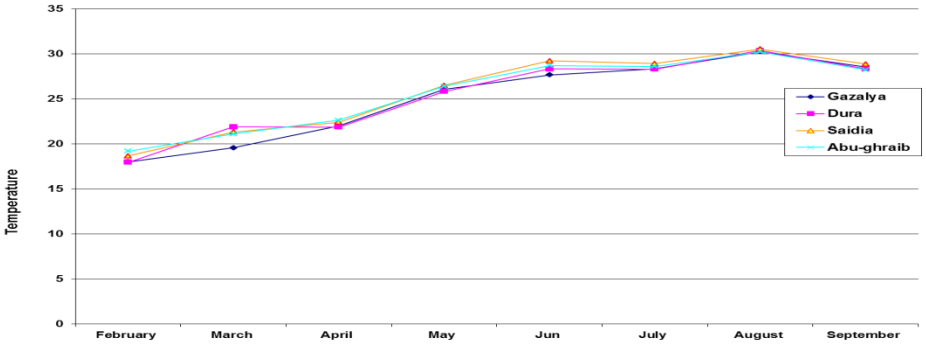


Figure 1. Mean water temperature values of drinking water samples during study period

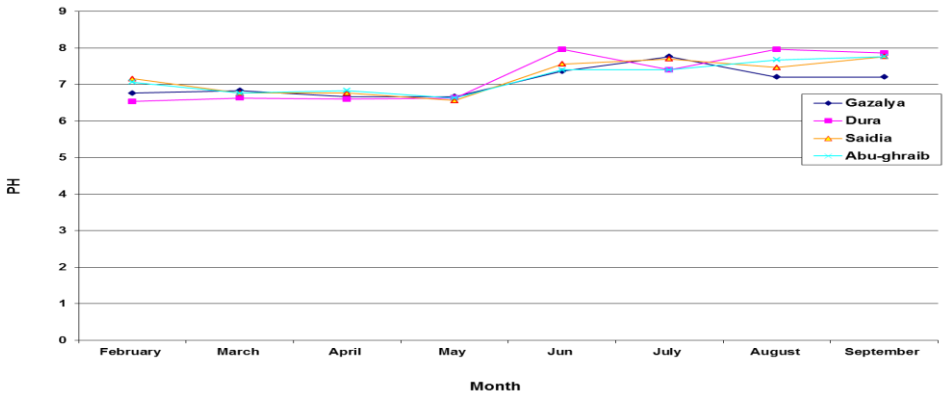
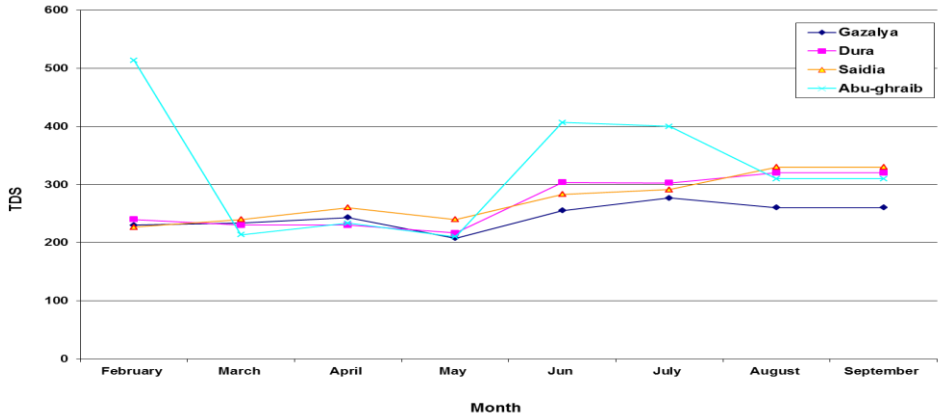


Figure 2. Mean PH values of drinking water samples during study period



Fig(3):Mean TDS values of drinking water samples during study period from feb-sep 2016

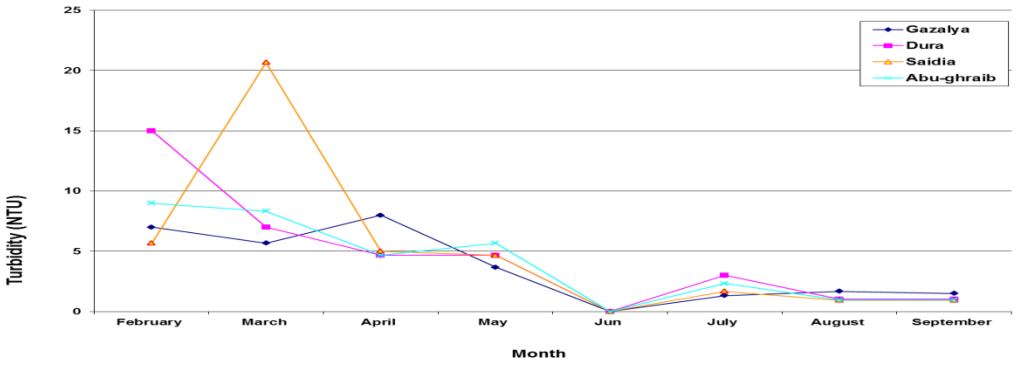
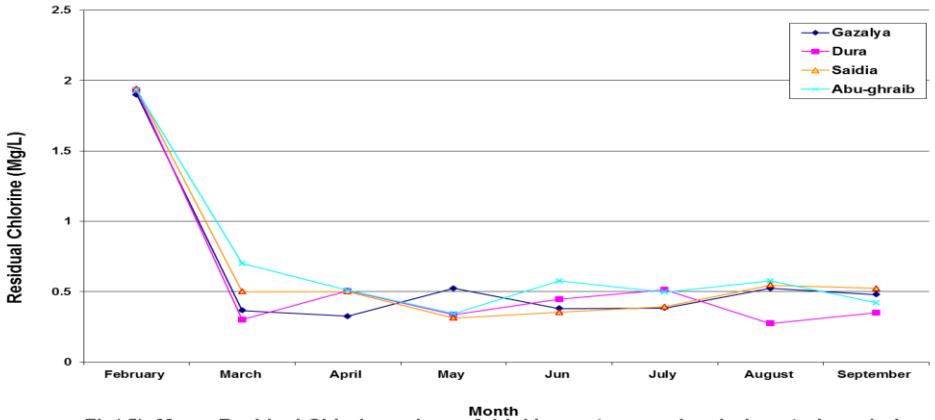


Figure 4. Mean Turbidity values of drinking water samples during study period



Fig(5): Mean Residual Chlorine values of drinking water samples during study period from feb-sep2016

Microbial properties

Figures (6,7,8,9&10) showed distribution and monthly variation for numbers of the bacteria species from four areas Abu ghraib, Dora, Ghazaliya and Saydiya.

Regarding TPC, the current results have found examined drinking water samples from different sites, the highest TPC number was 240 CFU/ml and was recorded in water samples collected from site of Dora, during summer, while the lowest TPC number was zero CFU/ml and was detected in several examined sites in all seasons (Fig. 6) .

Differences between these data were found to be significant at ($P \leq 0.05$) in terms of seasons for all sites and drinking water. The rise in TPC values may due to repeat fractures and defects afflicting distribution network pipeline, which increased the amount of exudes and leaked water from the surrounding environment of the pipe leading to the contamination especially in the case of scarcity and use pumps to draw water directly from the network and then increase the likelihood of pollution as a result of the low pressure and enter the sewage or contaminated groundwater. Increased turbidity level which works to reduce the rate of inhibition by disinfectants and providing protection and shelter for the bacteria and facilitate their passage through the distribution network, also lack of quality of filtration process because the filters are contaminated, the poor maintenance, and lack of regularity of washing filters .The pollution of water reservoirs was attributed to the presence of high levels of organic materials and particles deposited in the bottom of reservoirs that help the growth of bacteria in the largest (20). The values obtained are exceed the permissible limit for both Iraqi standard for drinking water (2001) and WHO standards drinking water (2004),(Table, 1). APC values recorded in the present work are coincided with findings of Barakat et al. (21).In this study, the results of TC for drinking water sampled from different sites showed that the highest TC was 33 cell/100ml and was recorded in water samples collected from site of ghazaliya, during spring, mean of TC value was 24.67 and the lowest value of TC of water was zero cell/100ml and was detected in water samples of several examined sites in all seasons (Fig.7).

From the study results it has be observed that high coliform numbers were found during the spring months and decreased numbers were detected in the hot summer months. This may be due to appropriate environmental conditions for the growth of these bacteria in the cold months has led to increasing numbers in the water, as the increase in rainfall and turbidity during the winter months which contributes to an increase in the number of coliform. The presence of coliform in drinking water may be attributed to inadequate chlorination, insufficient contact time, and poor maintenance of service reservoirs and may be because re growing of bacteria in the distribution system(22).

The values obtained are exceed the permissible limit for both Iraqi standard for drinking water (2001) and WHO standards drinking water (2004),(table, 1). This results are agree with the finding that recorded by (23,24).

Current results revealed that the maximum value and minimum values of FC of drinking water he recorded with 0 cell/100ml in all sites and seasons (Fig.8)**.**NO Differences between these data were found significant ($P \leq 0.05$) in terms of drinking water sites and seasons .The abscent of Fecal coliform in drinking water is an evidence of no fecal contamination and an indicator that water was clean within the distribution system(25)

The values of *E. coli* of drinking water ranged from lowest value of 0/100ml which recorded in all seasons, to the highest value of 16 cell/100ml which found in spring . (Fig.9). the drinking water examination showed high value also in spring with 16 cell/100ml for ghazaliya, and the lowest value recorded in all seasons zero cell/100ml

In this study, the Current results revealed that the maximum values and minimum values of (FS) drinking water were recorded zero cell/100ml in all sites and seasons (Fig.10).The abscent of bacteria in drinking water of the examined sites, evidence to the clean drinking water . These values obtained are exceed the permissible limit for both Iraqi standards for drinking water.

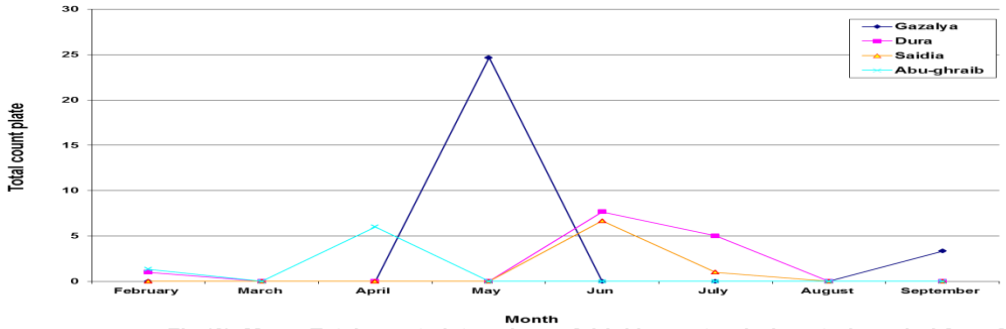


Fig (6). Mean Total count plate values of drinking water during study period from feb-sep2016

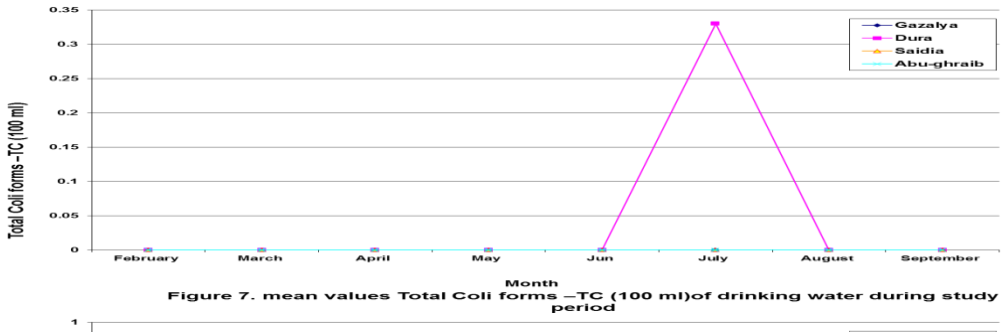


Figure 7. mean values Total Coli forms –TC (100 ml)of drinking water during study period

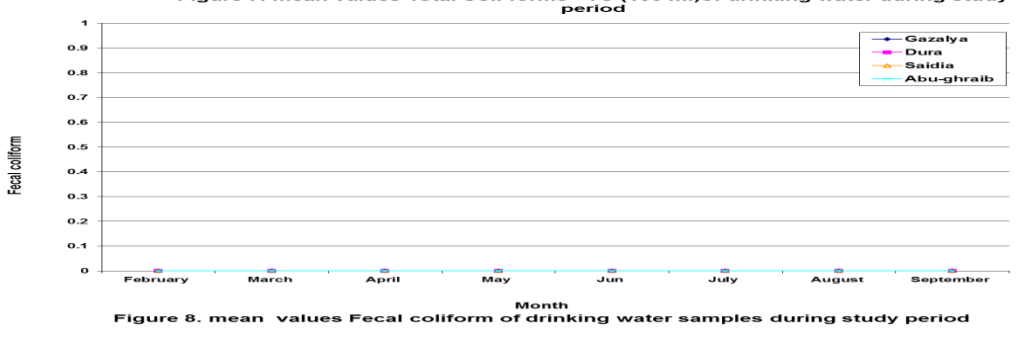


Figure 8. mean values Fecal coliform of drinking water samples during study period

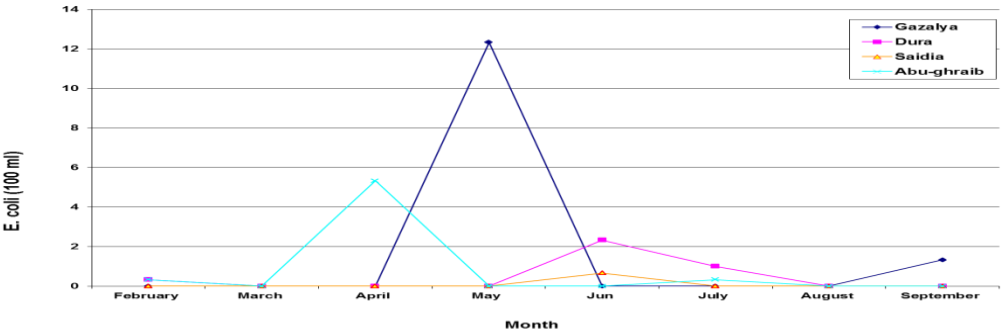


Figure 9. mean values E. coli (100 ml)of drinking water samples during study period

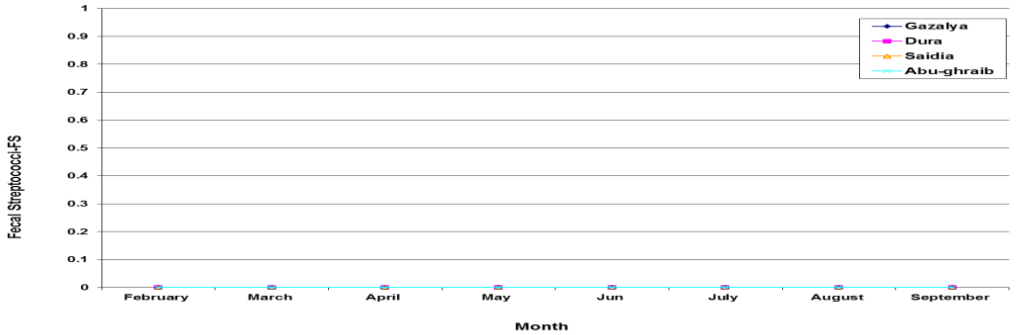


Figure 10. mean values Fecal Streptococci-FS of drinking water samples during study period

Table (1): Comparison between some water quality parameters of drinking water treatment plant with the Iraqi and international standards

Parameter	WHO standards for drinking water in 2004	Iraqi standard for drinking water	Present Study Minimum&Maximum
pH	6.5- 8.5	6.5 - 8.5	6.5 - 8.2
Turbidity NTU	0-50	0 - 5	0-21
Residual Chlorine mg/L	----	0.3 – 2-5	0.1-2
Heterotrophic CFU/100ml	100 cell / ml	10 cell / ml	0-240
Total Coliform CFU/1ml	Absent	Absent	33
Fecal Coliform CFU/1ml	Absent	Absent	Absent
Fecal Streptococci CFU/1ml	Absent	Absent	Absent
***E. coli* CFU/1ml**	Absent	Absent	0-16

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تقييم النوعية الميكروبية وبعض المؤشرات الفيزيوكيميائية لمياه الشرب في بعض الاحياء السكنية في مدينة بغداد – العراق

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الخلاصة

تم اجراء فحوصات فيزيائية وكيميائية وإحيائية لمياه الشرب في اربعه مناطق من بغداد الكرخ،(الغزالية وابو غريب والسيديه والدورة) شهريا للمدة من شباط 2016 الى شهر أيلول 2016 ، في المنازل التي تقع على مسافات مختلفة عن مصدر التجهيز وبواقع ثلاثة نماذج من كل موقع.حيث تراوحت قيم درجة حرارة الماء وقت النمذجة من 17.4°م الى 30.8 °م طيلة مدة الدراسة ، اما قيم الاس الهيدروجيني فقد كانت ضمن الحد المسموح به وتراوحت مابين6.5 في الشتاء الى 8.2 في الصيف ، و كانت اعلى قيمة للعكارة سجلت للمياه الشرب فقد سجلت اعلى قيمة لها وكانت 21 وحدة عكارة في فصل الربيع واقل قيمة كانت 0 وحدة عكارة في فصل الصيف.كما أظهرت الدراسة بأن نتائج قيم المواد الصلبة الذائبة الكلية التي تراوحت من 200 ملغم التر في الربيع الى 520 ملغم\التر في الشتاء. أعلى قيمة للكلور الحر المتبقي سجلت في الشتاءوكانت 2.01 ملغم التر. وقد أظهرت الفحوصات البكتريولوجية ارتفاع قيم كل من العد الطبقي للبكتريا الهوائية، البكتريا القولونية الكلية، ، الاشريشية القولونية في فصل الشتاء في عدد من مواقع الدراسة مقارنة بالفصول الاخرى من السنة لمياه الشرب في كل المواقع . إن نتائج العد الطبقي للبكتريا الهوائية لمياه الشرب تعدت الـ (100 خليةامل) وهو الحد الأقصى المسموح به لمياه الشرب في بعض المواقع، من جانب آخر فقد تجاوزت قيم البكتريا القولونية الكلية والإشريشية القولونية الحد المسموح به وهو (صفر خلية\100مل) في عدد قليل عينات مياه الشرب.