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## Laboratory Evaluation of Bottled Drinking Water Collected from Basra City

Angham O. Zahei\*, Ahmed S. Al Chalabi, Entisar M. Aboud

Department of Environmental & Pollution Eng., Basra Engineering Technical College, Southern Technical University, Basra, Iraq

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### Abstract

Forty-four bottles of drinking water were collected from the local markets of Basra City and stored in the laboratory refrigerator at 4°C until the physical, chemical and biological measurements were carried out. The results showed a discrepancy in the compatibility of the specifications written on the drinking water bottle label with the sample measurements as well as the variation in the results with the Iraqi standards for bottled water. The percentage of bottled water that is not safe for drinking was 88.5% of the total samples of the study. This value is high and an indication of lack of control over marketing from the imported or produced in the local labs, so it is a danger to the health of the consumer. Results showed that the PH ranged 6.5–8 and did not exceed the values on the information sheet of the potable drinking water as well as the TDS, chloride, magnesium; nitrate and potassium which were within the permissible limits. In addition, the results showed that calcium, total hardness, fluoride and bacterial growth values exceeded the permissible limits, and there are different significations between factors in samples.

**Keywords:** Physical, Chemical, Biological factors, Water quality, Drinking water

### التقييم المختبري لمياه الشرب المعبأة والتي تم جمعها من مدينة البصرة

انغام عمير صاحي\* ، احمد صادق الجلي ، انتصار محسن عيود

قسم هندسة تقنيات البيئة والتلوث ، الكلية التقنية الهندسية - البصرة، الجامعة التقنية الجنوبية ، البصرة ، العراق.

### الخلاصة

تم جمع أربعة وأربعين عينة من مياه الشرب المعبأة من الأسواق المحلية لمدينة البصرة وتخزينها في ثلاجة المختبر في درجة حرارة 4 درجة مئوية حتى إجراء القياسات الفيزيائية والكيميائية والبيولوجية. أظهرت النتائج وجود تباين في توافق المواصفات على ملصق مياه الشرب مع قياسات العينة وكذلك تباين النتائج مع المعايير العراقية للمياه المعبأة ، ونسبة المياه المعبأة غير الصالحة للشرب 88.5 % من إجمالي عينات الدراسة ، تعد هذه القيمة عالية وهذا يدل على عدم الرقابة في تسويقها من المستورد أو المنتج في المعامل المحلية ، لذلك فهي تشكل خطراً على صحة المستهلك أظهرت النتائج أن الاس الهيدروجيني تتراوح قيمته بين 6.5-8 ولم تتجاوز القيم الموجودة في ورقة المعلومات الخاصة بمياه الشرب الصالحة للشرب بالإضافة إلى المواد الصلبة الذائبة والكلوريد والمغنيسيوم، النترات والبيوتاسيوم ضمن الحدود المسموح بها. كما أظهرت النتائج

\*Email: angham.omeer@stu.edu.iq

أن الكالسيوم والعسرة الكلية والفلورايد وقيم النمو البكتيري تجاوزت الحدود المسموح بها ، كما وظهرت النتائج وجود فروق معنوية بين العوامل في عينات الدراسة.

## 1. Introduction

Water is the basic element of life that has more than one source, which are surface water and underground water. Any person needs to drink (1-1.5 L) daily from any of the above sources [1].

Bottled water industry used many techniques such as protection and controlling the water source, reverse osmotic pressure to remove unwanted minerals, filtration, and ozone disinfection to get the water fit for human consumption.. This along with the source and the final product of any contaminant testing [2]. It identifies food and drug administration authority different kinds of bottled water on the basis of the source and its chemical composition, as well as obtained from the source: artesian water and well water[3].

The US food and drug administration defined mineral water as that water which contain more than 250 PPM of total suspended solids in the source and do not add salt to it or cannot obtained it from nature underground water [4].The quality of drinking water raises concern about human health in all developed countries To keep track of the risks, in this regard, the presence of infectious agents or toxic chemicals must be monitored and controlled. [5] .

highlight the experience gained in this regard the importance of an approach based on preventive management, which includes water from their source of supply process until people consume [6].Developing countries, where more than a billion people live in unhealthy and contaminated conditions, and the majority of their population suffers from poverty, lack basic resources, including safe drinking water supplies (WHO and UNICEF, 2000), [7], [8].

Each country in the world has a strategy and concept in managing and improving the quality of potable water, depending on the climatic and environmental conditions, and the degree of economic and technological growth[9].In countries where access to improved water sources or resources is limited, legislation, regulations and standards are likely to play a better role in facilitating access to higher levels of service, ensuring the efficient use of existing facilities, and ensuring that minimum protections are in place to avoid waterborne disease outbreaks. Improving access to improved drinking-water supply that poses minimal health risks and fulfils basic rights to a 'clean' and 'adequate' supply of water means making the best use of these goals with limited resources[10], [11].

This can be explicitly promoted by legislation, regulations and guidelines, and can be more or less cost-effective in terms of the resources needed for their implementation and the effects of their application[12].The World Health Organization is working to assist countries in developing approaches to improve drinking water in order to protect public health, and according to the economic conditions of these countries, because water quality is one of the most important problems stipulated by regulations and standards [13].

Human health is related to what one eats and drinks. Therefore, water that people use, whether for drinking or for everyday use, must be non-polluted and free from bacteria, viruses and chemicals that pose a danger to human health[14].The World Health Organization focuses on drinking water quality as it seeks to establish the highest concentration of chemicals and of certain trace elements present in drinking water, as all recent reports demonstrate the risk to human health of trace substances in drinking water[15], [3].

## 2. Material and Methods

Forty-four samples of bottled water were collected from different places of Basra City, Southern region of Iraq ; the method according to (Al-Hadethi & Al- Samerai, 1993) was used to determine microorganism's growth [16], and (Standard method, 2017) to determine physical and chemical properties [17].

**Table 1-** Identification of drinking Water According to WHO and Iraqi standards [18], [19]

No.	Material	Conc. According WHO	Conc. According IRAQ Standard	Units
1	PH	6.5 – 8.5	6.5 – 8.5	-----
2	TDS	1000	1000	mg/ L
3	Calcium	200	50	mg/ L
4	Chloride	250	250	mg/ L
5	Magnesium	150	50	mg/ L
6	Sodium	200	50	mg/ L
7	Nitrate	45	50	mg/ L
8	Potassium	45	50	mg/ L
9	Fluoride	1.5	0.5	mg/ L
10	Total hardness	500	500	mg/ L
11	Bacterial growth	No growth	No growth	-----

### 3. Results and Discussions

#### 3.1 Bacterial Growth

The results showed bacterial growth in all samples, due to poor storage and transport, inefficient sterilization using ozone, or the producing plant may not be subject to proper health and environmental conditions, in addition to lack of health control.

**Table 2-** The bacterial growth in samples

No. of Sample	Results	No. of Sample	Results	No. of Sample	Results
1	+++	16	+++	31	+++
2	++	17	++++	32	++++
3	+++++	18	++++	33	++++
4	++++	19	++++	34	++++
5	+++	20	++++	35	++++
6	++++	21	++++	36	+++
7	++++	22	+++++	37	++++
8	+++	23	+++++	38	+++
9	+++++	24	+++++	39	++++
10	+++	25	++++	40	++++
11	++++	26	+++	41	++++
12	+++	27	++++	42	+++
13	++++	28	++++	43	+++++
14	++++	29	++++	44	+++
15	+++	30	++++		

**Note:** the signal (+) Indicates the presence of more than one type of bacterial growth in the sample.

The samples were examined in the lab using the procedure mentioned above; the values of PH, TDS, chloride, magnesium, sodium, nitrate and potassium were determined. The parameters did not exceed the maximum limits according to the Iraqi specifications[18] (6.5-8.5, 1000 ppm, 250 mg/ L, 50 mg/ L, 50 mg/ L, 50 mg/ L and 50 mg/ L), respectively.

Figures (1, 2, 4, 5, 6,7 and 8) illustrate the obtained values of these parameters for the bottled drinking water . But, the values of total hardness, calcium and fluoride concentrations of each sample exceeded the maximum limits according to the Iraqi specifications[18] (50 ppm, 500 ppm and 0.5 mg/ L), respectively. Figures (9,3, and 10) illustrate these results. These maximum concentrations may increase when the plants or manufactories of bottled drinking water do not trace the environmental and health conditions. The reuse of the polymer material which the bottles are made from, effects water features and bad storage, translate and selling of water drinking bottles all of these occasions the features of water may be effected [20].

The statistical analysis shows significant differences( $p < 0.05$ ) between calcium, total hardness, fluoride and bacterial growth . The fluoride and bacterial growth have high coefficient of variance in all samples [21].

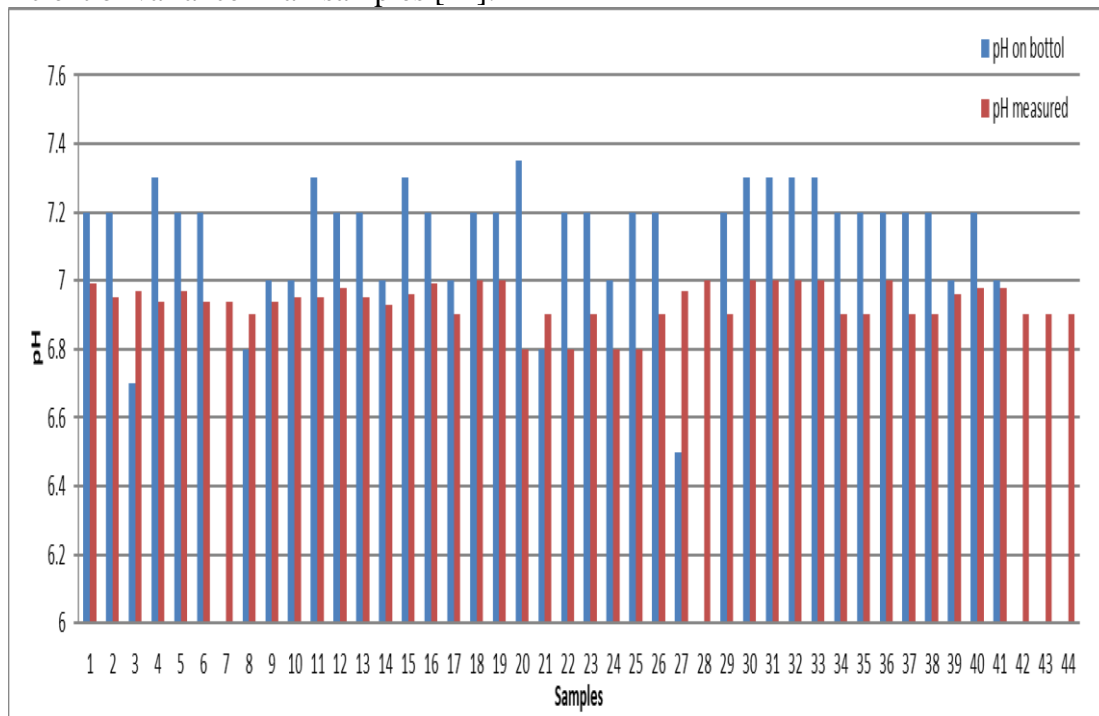


Figure 1- pH measurements

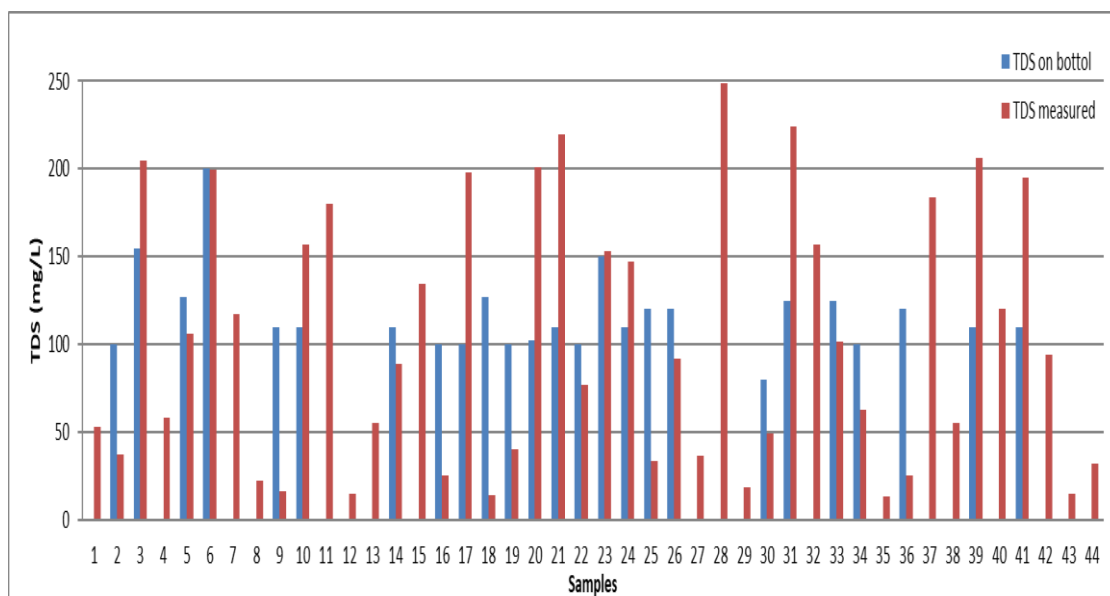


Figure 2-TDS concentrations

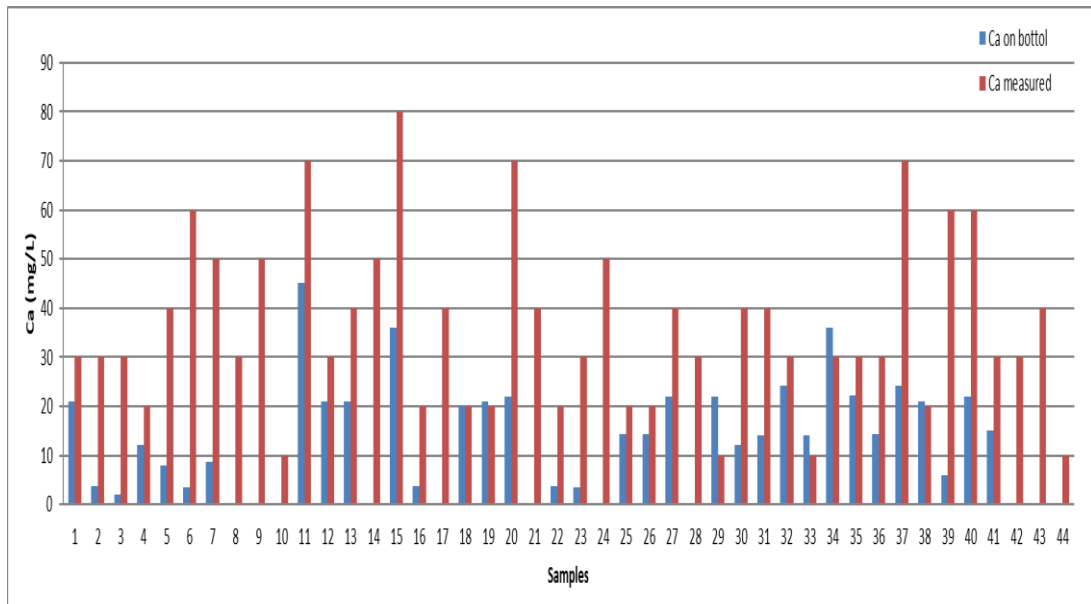


Figure 3-Calcium concentrations

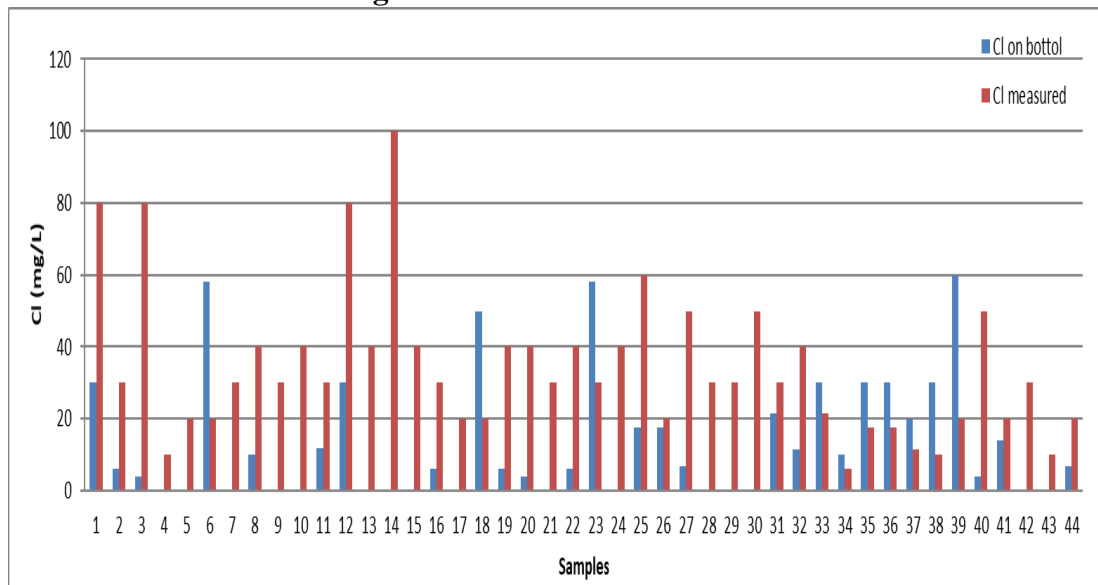


Figure 4-Chloride concentrations

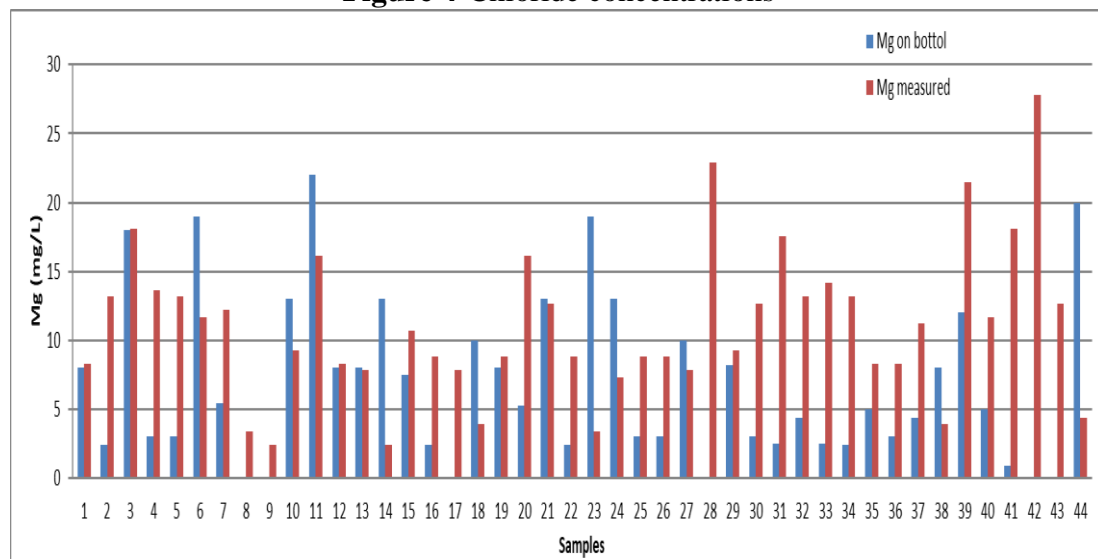


Figure 5-Magnesium concentrations

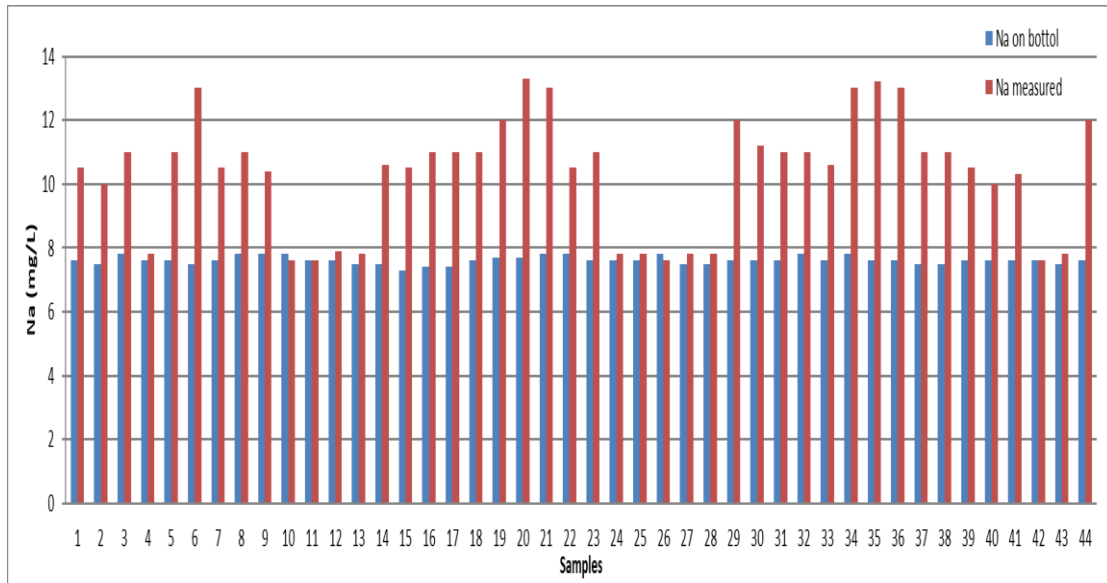


Figure 6-Sodium concentrations

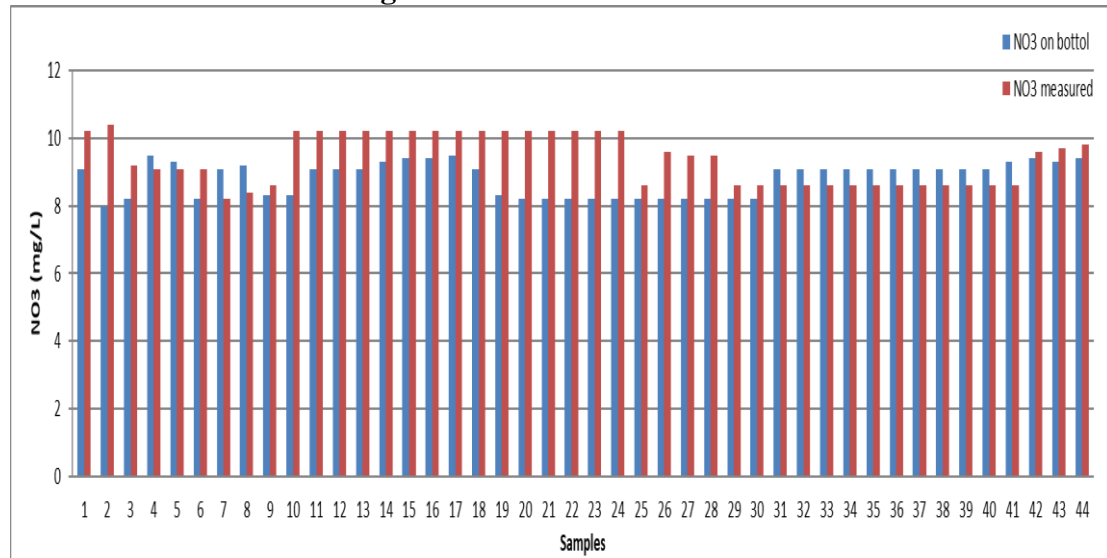


Figure 7- Concentrations

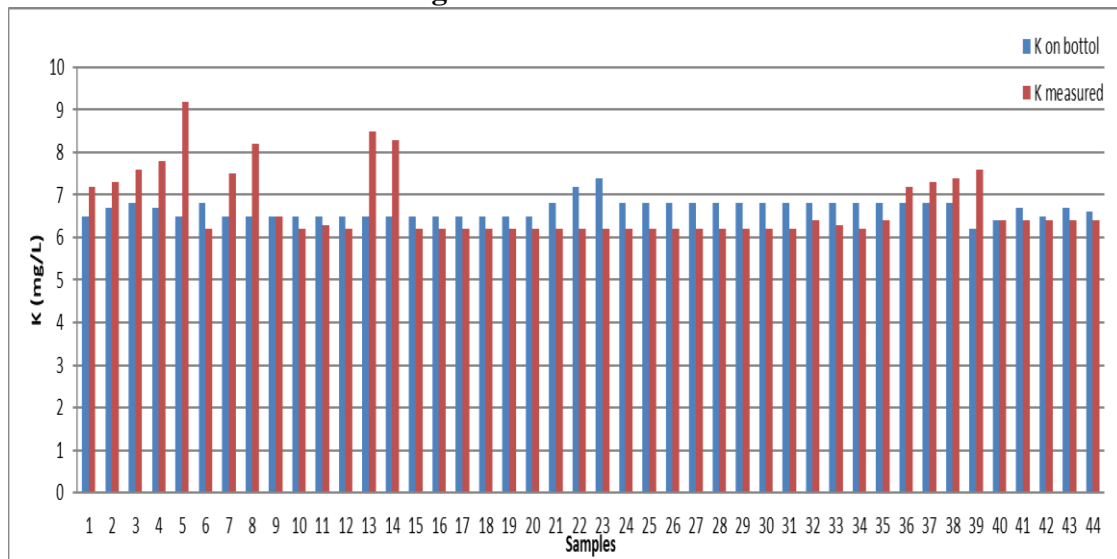
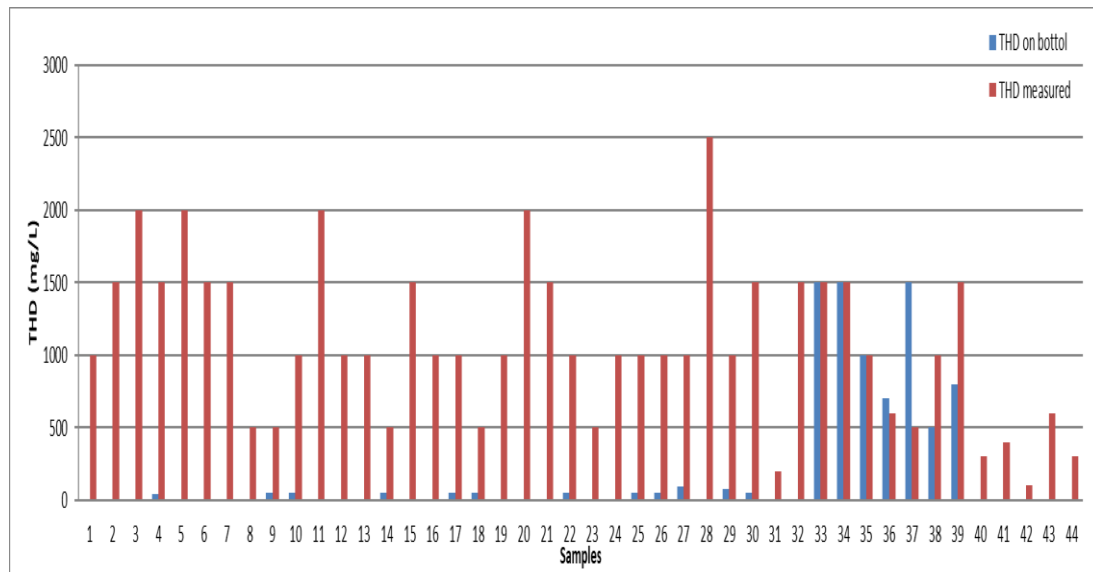
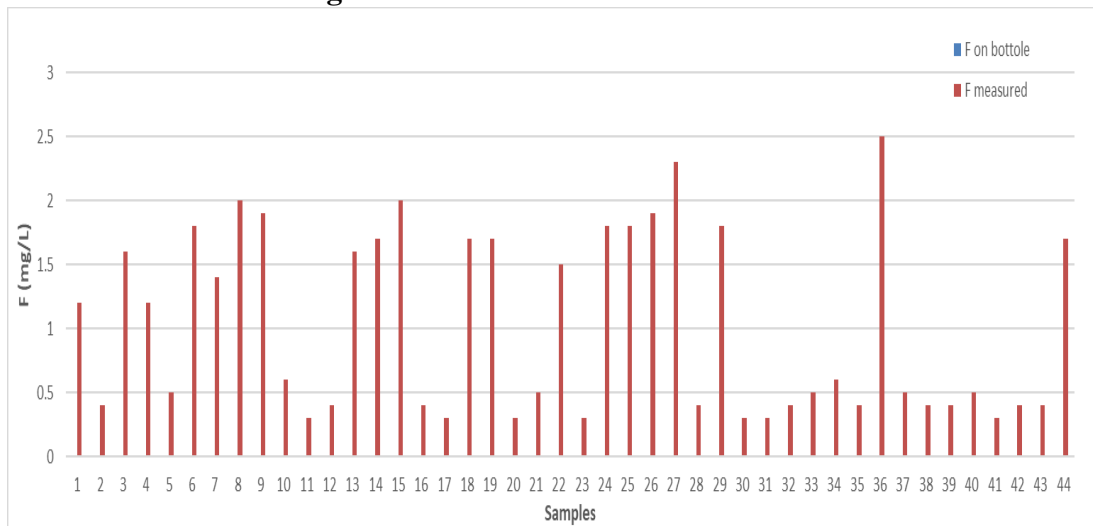


Figure 8-Potassium concentrations



**Figure 9-** Total hardness concentrations



**Figure 10-** Fluoride concentrations

#### 4. Conclusion

The results showed different effects, this led to following conclusions:

1. The biological measurement found that all samples contain bacterial contamination with more than one type of bacteria and this poses a great danger to the consumer.
2. PH and TDS values were at the limit based on Iraqi standards.
3. The concentration of total hardness showed that 77% of the samples exceeded the limit due to the increased concentration of calcium of the samples.
4. The concentration of nitrate and magnesium of the samples did not exceed the limits on Iraqi standards.
5. Concentrations of sodium, potassium and chloride of all samples were within the permissible limits of Iraqi standards.

#### 5. Recommendations

The following recommendations are presented to the central committee of the relevant ministries of the state, provided that the ministry of the interior is represented in this committee:

1. Health control on plants producing bottled water must be tightened. Unlicensed water producing plants must not be allowed.

2. Bottled water producing plants must be controlled. Legal actions must be taken against any violations from these plants concerning health and hygiene to avoid the dangers resulting from this vital subject that affects the lives of citizens.
3. A database must be built on the type of chemical and biological pollutants transported by water bottles.
4. All imported bottled drinking water must be subjected for examination by the relevant authorities to determine its compliance with the Iraqi standard specifications in order to determine its suitability for human consumption.
5. Consumers should be warned to avoid products that do not meet the standards as advertised (through video or audio) or as written on the bottles label and especially those that do not meet with the Iraqi standards.

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