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EVALUATION OF PHYSICO-CHEMICAL PARAMETERS OF BOTTLED WATER MARKETED IN BABEL GOVERNORATE: IRAQ

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Abstract

Consume bottled water has been expanded consistently over the last years, even in the countries with good quality of tap water. This study included the tested some physical and chemical properties of locally and most distribution bottled water in Babel city. The study included ten samples of local bottled water from different manufacturing (L_1 to L_{10}) and one sample of imported bottled water (F). The physical and chemicals properties such as(pH, TDS, TH, Cl, Na^+, K^+, Ca^{+2}, Mg^{+2}, NO_3, and SO_4) were tested according to the standard method, the result showed that the values of characteristics (pH, TDS, TH, and Cl) were less than the maximum allowable limits in Iraqi and IBWA standard. While the concentration of Ca^{+2} and Mg^{+2} were less than the allowable limits in Iraqi standard and there is no pacify value for these parameters in IBWA standard. And the nitrate and sulphate concentration not more than the maximum allowable limits for both standard, and the Na^+ concentration limited to no more than 100 mg/l. also the potassium concentration in all sample were very low except the sample (L_2 & L_{10}). Also the result shows there was difference in the physical and chemicals properties of two samples of product and there was difference between the standard of packaging and the result of samples tested.

Key words : Bottled water, locally and imported bottled water, physical and chemical parameters, water quality.

Introduction

Water is beneficial resource for domestic, industrial and agricultural purposes and rich in nature occupying 71% of the earth surface (Peter, 2006). Drinking water is chief for existence, and biological and chemical contamination is a serious matter that may have serious health effects. The available drinking water would need sequence of treatments before it could be harmless or right for drinking, Bottled water is only dependable healthy drinking water in any parts of the globe (Catherine, 2013). It is usually accepted as drinkable and thereby free from physical, chemical and microbial contaminants that could initiate hostile health effects in humans when consumed therefore, Bottled waters are becoming increasingly popular worldwide. packaged drinking water is any water that is in a closed plastic and dispersed or offered for sale and is intended for human drinking. As a protective measure, consumption of packaged drinking water has increased in recent years in developing countries. The sale and consumption of packaged drinking water stays to raise rapidly in most of the developing countries of the world. In order to protection public health it is vital that the available packaged water is of the highest quality. There is a worldwide be anxious over the quality of water from tap, due to pollution, biological contamination, and the related taste and odor (Saleh *et al.*, 2001); therefore, people turned to bottled water for safity and quality features in order that, the bottled water in a giant global market was rising continuously to meet the rise in demand and the examiner for good quality drinking water (Mahajan *et al.*, 2006). Water quality is recognized as the most significant subject, not only related to users and their supplies, but also to the safety of the water resources and the environment (Benedini and Tsakiris, 2013). The assessment of water quality is a hard duty due to the many factors involved in its characterization. This difficulty was recognized and led to offers for accepting simplified approaches, such as the water quality indices (Tyagi *et al.*, 2013). The global use of bottled water was set from 130,956 million liters in 2002 to 188,777 million liters in 2007. Thus, the average annual global drinking rate is 28.8 liters per capita in 2007 (BMC, 2008).

However, bottled water is not essentially harmless than tap water, and over the years, concerns have been elevated about the quality of bottled water marketed worldwide. Also, the commercialization of treated tap water, authorized by many countries, may entice unscrupulous producers toward unlawful activities such as bottling tap water and export it as mineral water. Literature shown that the levels of some water elements in bottled water may be in damage of action ranks for several parameters (Karamanis, 2006).

Materials and Methods

Collection of samples

Ten samples of local bottled water and one of imported were collected during a period of six month beginning from November 2018 to April 2019. These samples collected from the market in Babil city. The samples named (L) for local one and (F) for imported one without naming the company of manufacturing and then the samples were transferred to the laboratory and Measure for Physical and chemical parameters ((pH, TDS, TH, Cl, Na+, K+, Ca^{+2}, Mg^{+2}, NO_3, and SO_4) were tested according to the standard method (Karamanis, 2006).

Results and Discussion

Table 2 shows the average values of physical and chemical measurements of successive types of both locally and imported varieties, respectively, which will discuss each variable with three sides. The first steps compared to the specifications adopted in this study were shown in table 1, while the second step was to compare two samples of the same product and the third step compared to the specifications of the manufacturer that was printed on the packaging.

Table 1: Limits of study variables in accordance with the standards approved in the study.

IBWA specifications*	Iraqi specifications	Parameter*
6.5 – 8.5	6.5 – 8.5	pH
500	625**	TDS
-	-	Na
-	75	Ca
-	30	Mg
250	250	Cl
250	250	So_4
10	45	No_3

) * IBWA) (International Bottled Water Association (

* All values of the variables are calculated in mg/l (mg/l) except pH

** The Iraqi standard did not specify the value of the soluble salts and the value mentioned in the table calculated from the value of electrical conductivity (Ec = 1000 ìs / cm)

Discussion

Bottled water is filled Plastic or glass containers. People simply trust packaged water bottled for drinking uses. More elements like dissolved ions and complexes, suspended, colloids ions and solid sediments are present in different water bodies. Depending on the biological activities, Potential oxidation, The strength of ionic bonds, hydrogen ion concentration, activities of organic and inorganic compounds as well as cleaning processes lead to increase in the concentrations of ions in the water (Dawood, 2014). The monitoring Programme-2017 Updates which is based According to World health organization show that was 71% of the population in the all world uses a safely managed drinking water services (WHO and UNICEF, 2017). Whereas two billion people worldwide are using drinking-water source pullulated with feces from this reason, a bottled drinking-water has become more safety option than tap water for many people as they believe that it contains less pollutants. However, some threats can appear during the manufacturing process, storage, so we made this study for some chemical and physical characteristics of bottled water in Iraq.

Hydrogen ion concentration pH

The pH values of the study samples were illustrated in Fig. 1 and noted that pH values in the study samples ranged between (6.6 - 7.6), while the Iraqi and IBWA specifications set the pH value between (6.5 - 8.5) which was meaning that all 11 samples within the Iraqi and IBWA specifications. The percentage of difference between the two samples of the same product ranged between 4 from 11 samples at a rate of 36%. This difference may be acceptable if we know that the water sources for most of these companies is the network and the quality of the water network is following the water quality of the river and the latter varies by seasons. The differences between the specifications of the packaging and the results of the examination of samples ranged from 6 samples out of 11 to 54%.

Total dissolved salts TDS

Fig. 2 shows the results of the total dissolved salts testing. The total dissolved salt concentration values ranged between (57 - 175 mg/l), which makes this variable and all the samples tested less than the maximum allowable limit in the Iraqi standard (625 mg/l) and IBWA (500 mg /l). One of the main objectives of bottled water companies is to reduce the percentage of total dissolved salts. The percentage difference between the two samples of the same product was 72%, indicating the variation quality of the produced water. While the

Table 2: Values of the average of the physical and chemical measurements of each class.

Sodium	Potassium	Nitrate	Magnesium	Calcium	Sulphate	Total hardness	Chloride	T.D.S	PH	Sampling No.
Nil	Nil	0.84	3.8	15	50	56	25	126	6.82	L1
7	Nil	1.104	8.5	16	69	75	18	138	6.7	L2
Nil	40.2	0.977	4.1	32	74	97	58	160	7.2	L3
Nil	Nil	0.34	19	26	51	80	16	110	7.3	L5
Nil	Nil	5.4	7.2	32	75	110	58	175	7.6	L6
Nil	Nil	2.1	7.7	16	61	72	40	135	6.75	L7
Nil	Nil	0.31	4.3	20	86	68	18	105	7.3	L8
Nil	Nil	1	8.5	12	18	65	20	57	7.3	L9
0.6	43.9	0.5	1.4	24	14	66	11.5	85	7.2	L10
Nil	Nil	0.05	2.9	16	36	52	3.6	85	6.8	F

difference between the specifications mentioned in the package and sample examination 7 samples of 11 samples and 77% is not identical between the contents of the bottle and the specifications mentioned.

Chloride Cl

From Fig. 6 test results for the studying samples show that: The chloride concentration values in the study samples ranged between (36 - 76 mg/l). The difference between the results varied. The percentage of difference between the packaging specification and the results of the examination ranged between 5 out of 9 samples at a rate of 55%, which is a large difference between the type of product and the specifications of the production company. The specifications of water drinking purposes according to public requirements are showing that the chloride level not to exceed 250 mg/l and also high-level chlorides have harmful effects on the fishes and aquatic life. The severity of the signs and symptoms caused by chlorine vary according to amount, the direction and period of exposure (Lei, 2016). In view of the common use of chlorine in the process of water disinfection, several studies have been conducted to determine its effect on humans and found that increased concentration causes abdominal pain in addition to the combination with organic compounds in the water causing chlorinated organic compounds which may be caused cancer (Guideline for drinking water quality, 2004).

Calcium Ca& Magnesium mg

Calcium and Magnesium ions are the main cause of calcification and water hardness. Calcium and Magnesium salts are considered the most important The sources of water hardness are carbonate and sulphate Calcium and Magnesium of The salts can be deposited when heated and adversely affect water quality in different uses On the other hand, they have effects on human health (WHO, 1998). Calcium concentration values for the study samples were shown in Fig. 4 and the following are observed. The mean values of the calcium concentration in the study samples ranged from (12 - 32 mg/l), which is less than the maximum permissible limit in the Iraqi standard (75 mg/l) While IBWA did not specify a value for the calcium concentration. The percentage of difference between the results of the examination of the two samples of the product ranged between 5 out of 11 samples at a rate of 45%, which is a good ratio when compared to other variables. While the difference between the standard of the packaging and the results of the examination of samples ranged from 7 out of 11 and at a rate of 63%, which is a big difference.

From Fig. 5 illustrates the results of the magnesium concentration examination of the study samples and notes from the figure include: The concentration of magnesium concentration in the samples tested ranged between (1.1 - 19 mg/l), which is lower than the maximum limit allowed in the Iraqi standard (30 mg/l), while the IBWA specification did not specify the value of the concentration of magnesium. The percentage of difference between the results of the examination of the two samples of the product ranged between 10 out of 11 samples at a rate of 90%, which indicates a clear contrast in the quality of the product. The difference between the standard of the packaging and the results of the sample examination ranged from 7 out of 11 samples at a rate of 63%, and this remains a significant difference between the type of product and its specifications.

Sulphate (So_4)

The concentration of sulphates in the study samples was illustrated in Fig. 7. The sulphate concentration values in the study samples ranged between (14 - 86 mg/l), which in all samples are below the maximum allowable limit in both Iraqi and IBWA (250 mg/l). While the percentage of difference between the results of the examination of the two samples of the same product at a rate of 100%, which indicates a clearly difference in the quality of one

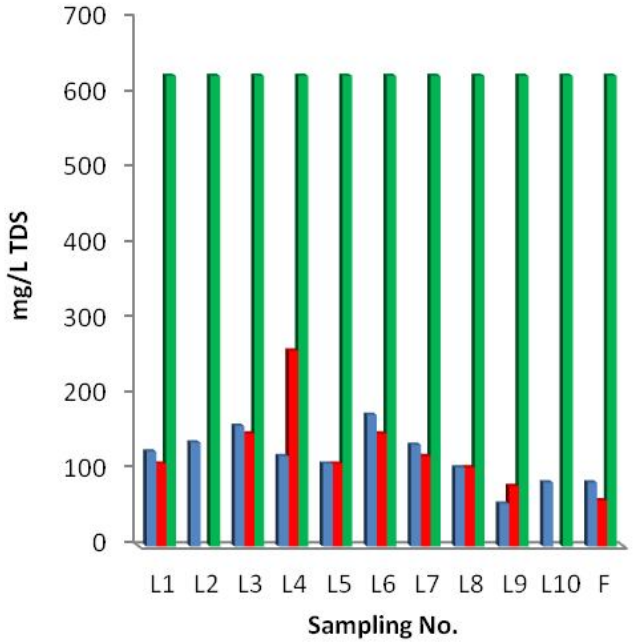

Fig. 1: pH value.

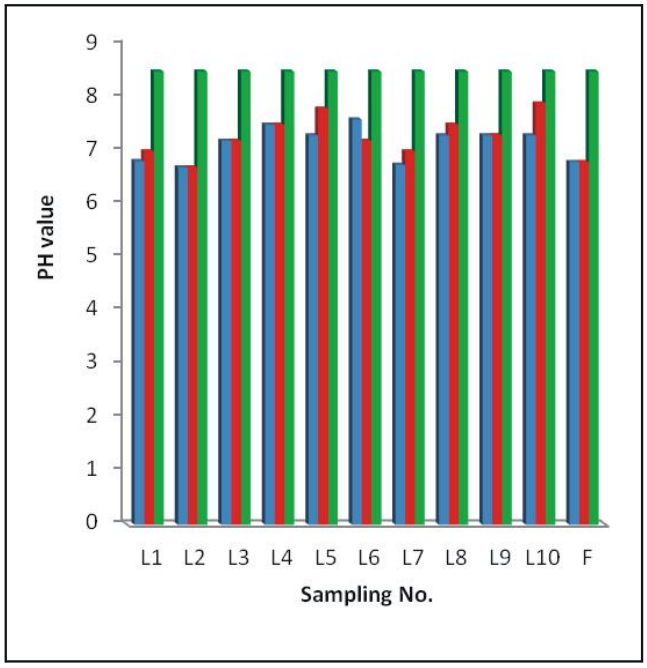

Fig. 2: Total dissolved solids value.

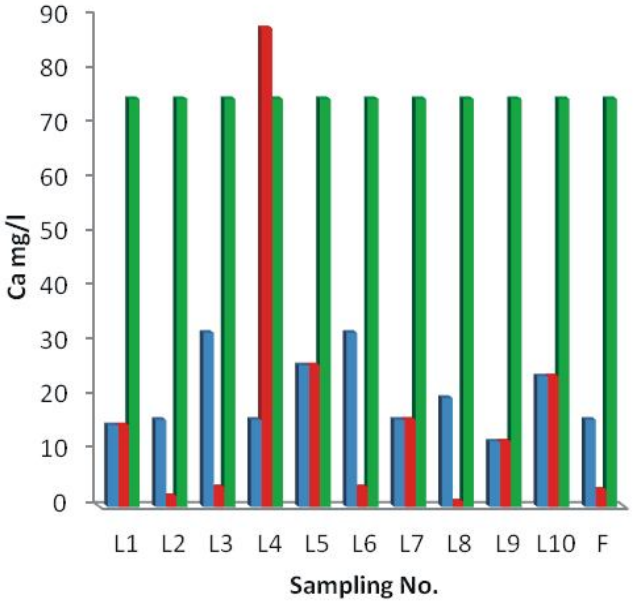

Fig. 3 : Value of sodium concentrations.

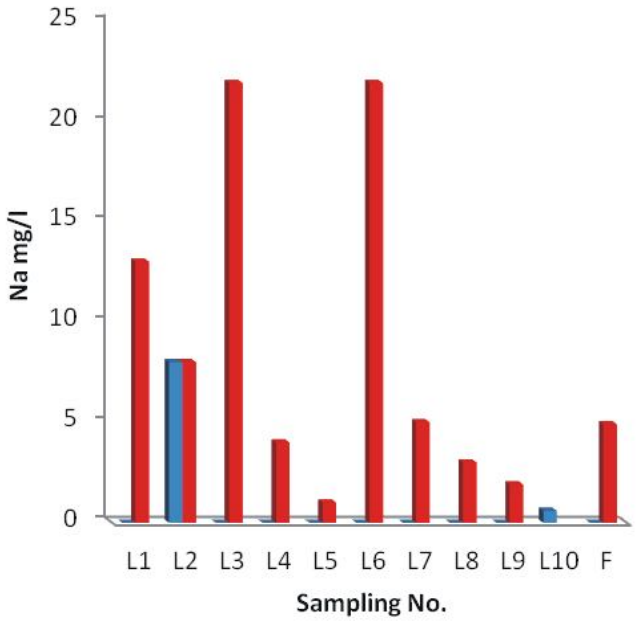

Fig. 4 : Value of Calcium concentrations.

product, and the percentage of difference between the standard of the packaging and the results of the examination of samples ranged between 5 out of 9 varieties at a rate of 55% and the difference is clear between the product and the specification of the company on the package of the same sample. The main source of sulfate in water is the falling rainwater, which is concentrated from (1-3) mg /l. the high concentration of sulphate causes diarrhea, as well as undesirable taste and sewage erosion (Judeh, 2004).

Nitrate NO_3

Fig. (8) shows the concentration of nitrates in the study samples and concludes from the figure that: Nitrate concentrations in the study samples ranged between (0.05 - 5.4 mg/l). These values are well below the maximum limit allowed in the Iraqi standard (45 mg/l) and IBWA (10 mg/l). The percentage of difference between the results of the examination of the two samples of the product at a rate of 100%, which indicates a clearly difference in the quality of the same product. The

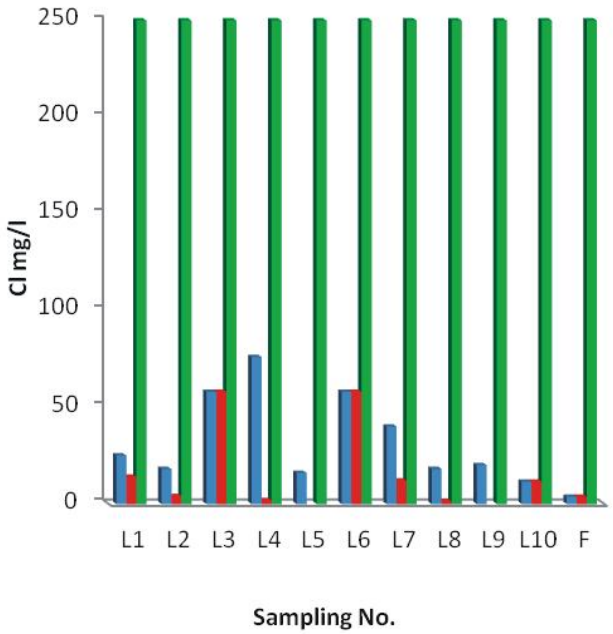

Fig. 5: Value of Magnesium concentrations.

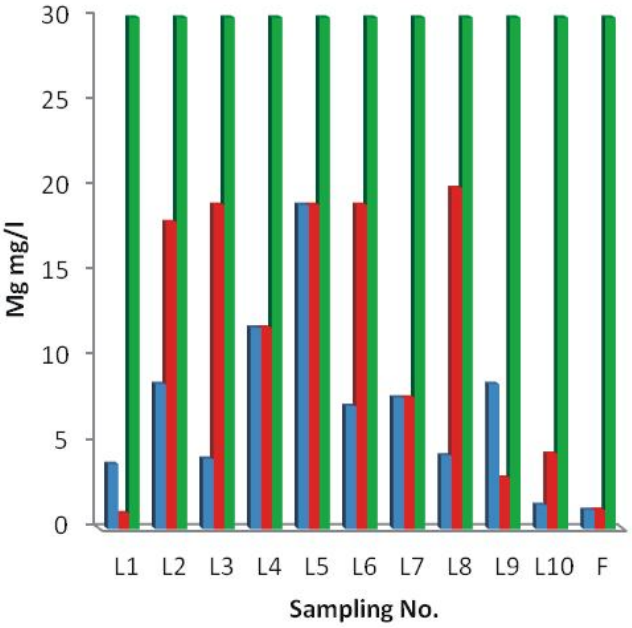

Fig. 6: Value of Chloride concentrations.

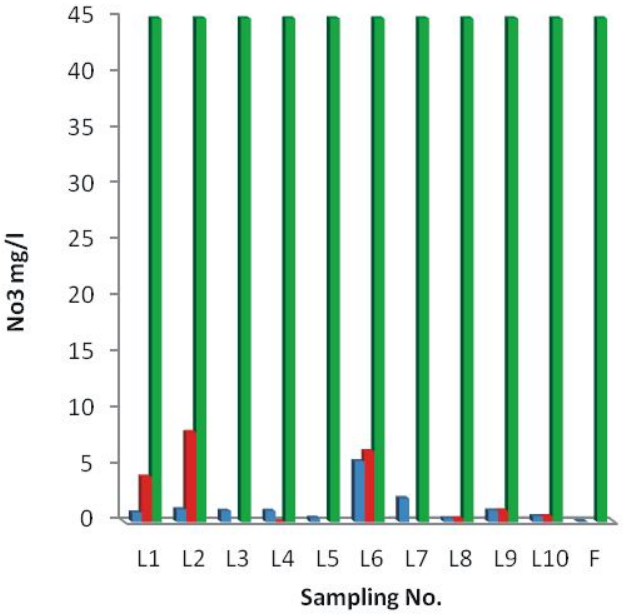

Fig. 7: Value of Sulphate concentrations.

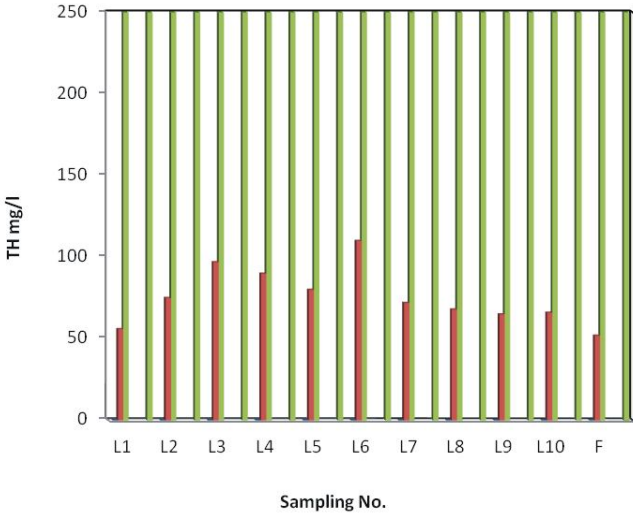

Fig. 8: Value of Nitrate concentrations.

percentage of difference between the packaging specification and the results of the sampling examination ranged between 4 out of 7 varieties and at a rate of 57%, which is a large difference. The presence of nitrates in the water at relatively high concentrations is undesirable, because of its effects on the health of the public health; which caused the disease of children's blueness (Methaemogloinaema) and some cancer diseases such as stomach cancer, colon and thyroid cancer (Central Organization for Standardization and Quality Control, 2006).

Sodium Na

Fig. 3 shows the results of sampling samples for sodium concentration and notes the following: The sodium concentration values in the study samples ranged between (0 – 7) mg/l. It is evident that there is a significant variation in the value of this variable from one product to another. There are no limits for sodium concentration in both Iraqi and IBWA, The concentration of sodium was limited to no more than (200 mg/l). It is clear that all the samples of the study did not exceed this limit, but are much lower.

Total hardness TH

The total hardness of water depends on the Calcium and Magnesium concentration of and other elements

colloids. Hard water is not a risk on the health; in fact, the National Research Council (National Academy of Sciences) states that hard water Participates a small amount toward total Magnesium and Calcium human dietary needs. From Fig. 10 show that the values of total hardness of all sampling concentration not exceed the acceptable limits.

Potassium k

In most of the studied samples, table 1 shows the lack of concentration of potassium except the sample (L_2 & L_{10}) despite the importance of this element, as it is not a toxic element, and the increase in concentrations leads to imbalance in heart rate and renal failure, so avoid exposure to high concentrations of it.

Where:

: is the sampling Numbers

: is the Company specifications

: is the Iraqi specifications

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