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Determine the Physical-Chemical, Bacteriology Properties and Heavy Metals in Tap Water vs. Bottle Water in Duhok Governorate

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ABSTRACT

Background: The development and spread of tap water systems over the past century have transformed the world by making clean water available to billions of people who would otherwise have continued to suffer all the health and development problems caused by clean water scarcity of centuries past. Bottled water is defined by the United States Food and Drug Administration (FDA) as "water that is intended for human consumption and sealed in bottles or other containers with no added ingredients, except that it may contain a safe and suitable antimicrobial agent as well as limited levels of fluoride."

Objective

-To determine the physical-chemical, bacteriology properties and heavy metals in tap water vs. bottle water.

-To find relationship between physical, chemical, heavy metals and bacteriological properties in tap water vs. bottle water.

Methods: A descriptive and analytic study for (200) random sample divide two part (100) sample from Tap water distributed in different regions and (100) sample from ten factories products. The study included test for temperature, pH, physical, and chemical tests, heavy metal, and bacteriology.

Conclusion: The temperature, pH, physical, chemical, bacteriology tests, and heavy metal, on samples taken from their place and production factories must be in conformity with international standards, and this is due to the importance of water in life.

Recommendation: The study recommended that health education can be conveyed through the mass media by television, documentaries, brochures, posters, and educational programs which aim to raise awareness of people in all religion s of d Duhok Governorate.

Results: The chemical examination for the all parameter for the tap water, it has shown in table -1. The heavy metal examination for the all parameter for the tap water, it has shown in table -2. The bacteriological examination for the all sample of the tap water, it has shown in table -3. The chemical examination for the all parameter for the bottled water, it has shown in table -4. The heavy metal examination for the all parameter for the tap water, it has shown in table -5. The bacteriological examination for the all sample of the bottle water, it has shown in table -6. The chemical examination result for the all parameter between tap water vs bottle water as shown in the table 7 and figure 1. The heavy metal examination result for all parameter between tap water vs bottle water as shown in table 8 and figure 2.

Keywords: *Tap water, bottle water, physical-chemical, bacteriological, heavy metals.*

1. INTRODUCTION

Water is an essential resource and one that is of imperative use. It is needed in everyday life and affects the well-being of each individual. Most governments in the world have succeeded to or aim to provide clean and safe drinking water their its residents, and many developed countries have already provided tap water to basic drinking standards [1]. However, recent decades have witnessed a rising global consumption of bottled water, especially in developed countries where water directly from the tap is drinkable. In the United States, bottled water consumption has been doubled to an average annual per capita volume of 138.17 L in 2015; this figure in the European Union is roughly 104.1 L [2,3]. Globally, the total bottled water consumption topped 329.33 billion L in 2015, an increase of more than 1/3 in per capita terms over a span of five years [4]

Tap water may be subject to regular and stringent testing and treatment, with the addition of various substances to minimize microbiological growth and other potentially harmful contaminants, and its composition may be altered to reduce corrosion of distribution systems.

Bottled mineral water is sourced from groundwater or springs and undergoes limited treatment, whereas tap water can be derived from multiple sources, including artificial reservoirs, groundwater, lakes and rivers. [5]

Bottled water initially emerged as a large, mainstream commercial beverage category in Western Europe and later expanded remarkably in the US market. In the last few years, several Asian markets have become major bottled water markets. In fact, Asia itself became the largest regional market in 2011, edging out North America and easily outshining Europe [6]. In Asia, Singapore, Hong Kong, and Macau are places where local water authorities confidently claim the safety and drinkability of municipal tap water [7,8,9]. However, despite the availability of drinkable tap water, [10].

Convincing the public to adopt and maintain sustainable behaviors, such as drinking tap water instead of bottled water, is a challenging task despite the potential for significant environmental and social benefits [11]. Water is vital for human survival and the existence of life on earth, therefore using it is imperative; 70% of the humans' body is water, urine and sweat are the main cause of losing much of this water, hence hydration is crucial at all times. Besides, flushing bacteria out of a bladder, carrying oxygen and nutrient to the cells, aiding digestion, preventing constipation, maintaining the electrolyte balance, etc., [12]. In this study, ten different areas of Dohuk governorate were chosen to take samples of drinking water from the tap, which originally comes from the Tigris River. The government conducts all treatment processes to be ready and fit for human use. Likewise, samples of mineral water packaged in plastic and glass bottles were taken from ten distributed factories. On different regions of Dohuk Governorate and their sources of spring water. All physical, chemical and bacteriological tests were conducted on these samples in the laboratories of the Environment Department in Dohuk Governorate.

2. METHODS

Total number of 200 sample one liter tacked divided in two part, 100 sample one liter of the tap water from ten distributed different regions, and 100 sample one liter of bottles water from ten factories products distributed in different regions were collected from Duhok governorate. The gross appearance, taste, odor, temperature, pH, physical, chemical tests, heavy metal, bacteriology. districts in July 2022 and November 2022 for the wet and dry seasons, respectively. plastic bottle which was washed and soaked in 10% nitric acid for 24 h, rinsed thoroughly with double distilled water and oven-dried.

The water samples for heavy metal (Fe,Cu,CO, Cd,Ni,Al, Mn,Pb,Zn,Cr) analysis were acidified with 0.5% nitric acid (HNO3) to a pH below 2.0. Water samples were acidified to minimize the precipitation and adsorption of metals on the container's walls and to prevent microbial activity. All the samples were well labeled and stored in an ice chest at 4 °C and transported to the Duhok environmental directorate Laboratory for measured by Atomic absorption spectrometric (shimadzu AAS 7000), pH meter (calibrated by using buffer solutions of pH 4.0, 7.0, and 9.0) was used to determine the pH of water samples [15].

The electrical conductivity measured by conductivity meter (Jenway) instrumental method, total dissolved solids T.D.S measured by (Arithmetically EC*0.64), total alkalinity T.AL measured by titration H2SO4 titrimetric method, total hardness T.H and calcium Ca+2 measured by (Titration EDTA titrimetric method). Magnesium Mg+2 calculating by calculation method (T.H- Ca+2)*2*4.88), chloride Cl- measured by titration (silver nitrate titration method),potassium K+ measured by flame photometer (BWB), flame photometric method, sodium Na+ measured by flame photometer (BWB) flame emission photometric method , sulfate SO4-2 measured by spectrophotometer (CECIL9000) turbid metric method, nitrogen (Nitrate) N-NO3-1measured by spectrophotometer (CECIL9000) UV spectrophotometric method, and turbidity (Turb) measured by turbidity meter (Hanna) nephelo metric method.

3. PHYSICAL CHARACTERISTICS OF WATER

The physical properties of water have a given appearance.

Color: Pure water is colorless. Dissolved organic material from decaying vegetation (algae, and humus compounds) and certain inorganic matter for example increasing concentrations of dissolved (Fe and Mn) ions, measured in (ppm) causes color in water. The color is estimated by comparing sample color with a standard solution color (1.245 gm of chloro-platinium potassium added to 1.0 gm of crystalline cobalt chloride in one liter distilled water.

Odor: released from any water may be due to decreases in the dissolved oxygen (DO2), presence of organic pollution, and presence of phenols and hydrogen sulfide (H2S). Pure water is odorless. Quantitative determinations of odor have been developed based on the maximum degree of dilution that can be distinguished from odor-free water.

Taste: may be due to increases in the total dissolved solids (TDS), carbonate hardness decreased dissolved oxygen (DO2), and excessive bacterial activity, There are no accepted method devised for measuring tastes (Todd, 1980). All above characteristics are subjective sensation which can be defined only in terms of the experience of a human being.

Temperature (ToC): Temperature affects the geochemical and chemical reactions. It affects the acceptability of a number of other inorganic constituents and chemical contaminants that may affect taste. Temperature of groundwater is constant relatively and increases with the depth, it has effects on the hydro geochemical relatively and increases with the depth, it has effects on the hydro geochemical reactions.

Turbidity: The turbidity is the measure of suspended and colloidal matter in water such as silt, clay, organic matter and microscopic organisms, also it depend on the structural conditions like flow regime and weathering, and the total suspended solids (TSS). Measurement are often based on the length of the light path passes through the water sample till the image of a flame of a standard candle disappear, turbidity.

Hydrogen Ion Concentration (pH): pH is the negative logarithm of hydrogen ion activity and its value expresses the intensity of the activity or alkalinity condition of water under normal condition temperature (T°C) and pressure. Most reactions in gas/water/rock systems involve or are controlled by the pH of the system, it related to taste, and odor problems. PH-value in natural water is affected by the concentration of bicarbonate and carbonate ions. The pH value for all water samples is in the optimum range (6.5-8.5). According to (WHO, 2006), some water samples are described as alkaline water, and the others are close to neutral. The water in a pure state has a neutral (pH=7), while the rain has a natural acidic pH of about 5.6 because it contains CO2 and SO2. It measured by pH Electrode meter. Radioactivity: Water sources can contain radionuclides of natural and artificial origin (i.e. Human made). Water may contain radioactive substances radio.

4. RESULTS

A total of 200 samples of tap water and bottled water were collected according to their local availability. The samples were examined for all parameters to assess the quality for both type of the water in the study.

Results of the tap water.

Chemical examination;

The chemical examination for the all parameter for the tap water, it has shown in table -1 and the results show the lowest score and the highest score, respectively for all parameter in all location include in the examination. All parameter in mg/l. The turbidity (1.3-1.8), the color is clear for all sample in the all location, the pH (6.8-8.0), the EC (198.1- 427.1), the total dissolved solids (200.7 – 273.4), the total alkalinity (100.0 – 136.0), the total hardness (140.0 – 184.0), the calcium (29.3 – 43.2), the magnesium (17.4 – 19.2), the colure (16.5 – 28.0), the sulfate (38.0 – 54.0), the sodium (7.7 – 9.7), the potassium (0.8 – 1.6), the nitrogen (2.9 – 12.3), all of the results are acceptable and within the global sandwich despite the disparity between them.

Table and figure

Chemical examination of mental Tap Water

All Parameter in mg/l unless otherwise states

Table 1

Characteristics		Turbidity in (NTU)	Color	PH	EC in uS	Total dissolved solids	Total Alkalinity	Total Hardness	Ca	Mg	Cl	S	Na	K	N
Max-Permissible		5	-	6.5-8.5	-	1000	125-200	100 - 500	75-200	250	250	250	200	2-3	50
1	T1	1.8	clear	8.0	427.1	273.4	136.0	184.0	43.2	18.5	24.0	40.6	9.7	1.6	3.5
2	T2	1.7	clear	7.8	400.1	230.1	120.0	173.0	40.1	18.5	26.0	46.2	9.6	1.2	4.5
3	T3	1.4	clear	7.6	397.2	244.6	100.0	175.0	42.2	18.7	23.0	54.0	8.9	1.4	3.8
4	T4	1.9	clear	7.7	257.1	218.9	107.0	180.0	38.4	18.1	27.0	48.0	9.4	1.5	3.2
5	T5	1.3	clear	7.9	330.3	200.7	115.0	158.0	37.0	17.9	22.6	50.0	8.7	0.9	2.9
6	T6	1.6	clear	8.0	350.4	235.4	123.0	159.0	29.3	17.4	23.0	45.0	8.4	0.8	3.7
7	T7	1.5	clear	7.6	250.2	222.2	117.0	140.0	34.5	18.0	28.0	46.0	8.1	1.3	8.6
8	T8	1.8	clear	7.0	198.7	250.6	125.0	173.0	35.0	17.7	20.5	49.0	7.7	1.2	11.5
9	T9	1.4	clear	6.8	220.1	201.4	102.0	180.0	37.6	19.2	18.5	38.0	8.1	0.8	11.8

10	T10	1.3	clear	7.4	210.2	227.4	105.0	165.0	32.1	18.6	16.5	44.0	9.5	0.9	12.3
11	Mean	1.5	clear	7.58	304.14	230.41	115.0	169.7	36.94	18.2	22.9	46.08	8.8	1.1	6.58

Heavy metal examination; -

The heavy metal examination for the all parameter for the tap water, it has shown in table -2 and the results show the lowest score and the highest score, respectively for all parameter in all location include in the examination. All parameter in mg/l. The level of Cd is (0.0001 – 0.0002), the Pb is (0.00137 – 0.00161), the Co is (0.00130 – 0.00147), the Al is (0.002 – 0.1697), the Zn is (0.350 – 0.400), the Fe is (0.157 – 0.165),the Mn is (0.076 – 0.094), the Cr is (Nil – 0.002), the Ni is (0.056 – 0.062), and the Cu is(0.013 – 0.014), all of the results are acceptable and within the global sandwich despite the disparity between them.

Heavy Metal Examination of Tap Water

All Parameter in mg/l unless otherwise states

Table 2

	Max-Permissible Level	0.005	0.05	0.005	0.2	3.0	0.3	0.1	0.05	0.1	1.0
No.	Heavy metal	Cd	Pb	Co	Al	Zn	Fe	Mn	Cr	Ni	Cu
1	T1	0.0001	0.00144	0.00141	0.0031	0.392	0.163	0.091	Nil	0.058	0.013
2	T2	0.0002	0.00156	0.00143	0.003	0.384	0.165	0.094	Nil	0.056	0.014
3	T3	0.0001	0.00153	0.00147	0.0021	0.400	0.158	0.087	0.002	0.062	0.013
4	T4	0.0002	0.00148	0.00137	0.0025	0.350	0.163	0.084	0.001	0.055	0.013
5	T5	0.0002	0.00161	0.00141	0.0028	0.352	0.165	0.088	Nil	0.057	0.014
6	T6	0.000`1	0.00154	0.00136	0.0023	0.364	0.161	0.086	Nil	0.060	0.014
7	T7	0.0002	0.00142	0.00140	0.0029	0.377	0.157	0.084	Nil	0.058	0.013
8	T8	0.0001	0.00138	0.00136	0.0023	0.368	0.160	0.078	Nil	0.061	0.013
9	T9	0.0002	0.00141	0.00130	0.002	0.354	0.157	0.076	Nil	0.056	0.014
10	T10	0.0002	0.00137	0.00140	0.0021	0.361	0.161	0.080	Nil	0.060	0.014
11	Mean	0.00016	0.00147	0.0138	0.1697	0.370	0.160	0.084	0.0003	0.058	0.013

Bacteriological Analysis .

The bacteriological examination for the all sample of the tap water, it has shown in table -3 and all parameter in mg/l. Results for the residual free chlorine and E-Coli is Nil (-) and the results for the presumptive total coliform, confirmatory total coliform and confirmatory faucal coliform is ($\leq$ 2.2) . These results are acceptable and within the global international and within the WHO.

Bacteriological Analysis of Tap Water

Table 3

No.	Location	Sources ml	Residual Free Chlorine mg/1	MPN per/100ml			
				Presumptive Total Coliform	Confirmatory Total Coliform	Confirmatory Faucal Coliform	E. Coli

1	T1	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
2	T2	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
3	T3	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
4	T4	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
5	T5	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
6	T6	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
7	T7	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
8	T8	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
9	T9	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
10	T10	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-

5. RESULTS OF THE BOTTLED WATER

Chemical examination;

The chemical examination for the all parameter for the bottled water, it has shown in table -4 and the results show the lowest score and the highest score, respectively for all parameter in all location include in the examination. All parameter in mg/l. The turbidity (0.3 – 0.5), the color is clear for all sample in the all location, the pH (6.5-7.3), the EC (174.3 – 200.7), the total dissolved solids (118.4 – 144-6), the total alkalinity (45.3 – 91.3), the total hardness (79.4 – 102.0), the calcium (20.8 – 27.6), the magnesium (10.2 – 14.7), the colure (6.8 – 14.0), the sulfate (18.0 – 46.0), the sodium (1.4 -9.5), the potassium (0.3 – 0.8), the nitrogen (0.2 – 12.5), all of the results are acceptable and within the global sandwich despite the disparity between them.

Chemical examination of mental Bootel Water

All Parameter in mg/l unless otherwise states

Table 4

Characteristics		Turbidity in (NTU)	Color	PH	EC in uS	Total dissolved solids	Total Alkalinity	Total Hardness	Ca	Mg	Cl	S	Na	K	N
Max-Permissible		5	-	6.5 - 8.5	-	1000	125-200	100-500	75-200	250	250	250	200	2-3	50
1	F1	0.4	clear	6.8	196.1	136.2	45.3	102.0	23.0	12.0	9.0	40.0	1.4	0.4	0.6
2	F2	0.5	clear	7.0	188.2	130.5	84.1	101.0	21.0	11.5	9.6	18.0	1.6	0.6	0.8
3	F3	0.4	clear	6.7	174.3	127.4	63.0	98.4	24.0	10.2	8.7	27.4	1.9	0.5	0.2
4	F4	0.3	clear	6.5	189.5	125.9	47.0	89.5	20.8	13.5	10.0	46.0	3.6	0.3	3.5
5	F5	0.6	clear	7.1	190.1	118.4	89.4	100.3	23.0	12.4	6.8	33.3	1.7	0.8	10.0
6	F6	0.5	clear	6.8	175.3	135.7	91.3	95.1	24.0	10.7	10.2	25.4	2.5	0.4	0.2
7	F7	0.4	clear	7.1	186.3	142.4	86.7	94.8	25.0	14.7	11.3	12.8	4.4	0.3	9.5
8	F8	0.3	clear	6.6	200.5	144.6	94.4	86.3	27.6	11.6	14.0	14.5	3.2	0.7	4.8

9	F9	0.3	clear	6.8	197.8	134.4	76.3	79.4	18.5	11.0	12.0	37.2	21.0	0.5	7.8
10	F10	0.5	clear	7.3	200.7	128.5	85.3	97.5	26.1	13.2	9.5	44.1	9.5	0.6	12.5
11	Mean	0.4	clear	6.8	189.0	132.0	76.3	94.4	22.3	11.9	10.1	29.8	5.08	0.5	4.99

Heavy metal examination; -

The heavy metal examination for the all parameter for the tap water, it has shown in table -5 and the results show the lowest score and the highest score, respectively for all parameter in all location include in the examination. All parameter in mg/l. The level of Cd is (Nil – 0.0001), the Pb is (Nil – 0.0003), the Co is (0.00100 – 0.00124), the Al is (0.0711 – 0.1600), the Zn is (0.211 – 0.311), the Fe is (Nil – 0.0080),the Mn is (0.031 – 0.061), the Cr is (Nil – 0.001), the Ni is (0.0020 – 0.0025), and the Cu is(0.004 – 0.027), all of the results are beter than in the tap water and all acceptable within the global sandwich despite the disparity between them.

Heavy Metal Examination of Boottle Water

All Parameter in mg/l unless otherwise states

Table 5

	Max-Permissible Level	0.005	0.05	0.005	0.2	3.0	0.3	0.1	0.05	0.1	1.0
No.	Heavy metal	Cd	Pb	Co	Al	Zn	Fe	Mn	Cr	Ni	Cu
1	F1	Nil	Nil	0.00111	0.0841	0.211	Nil	0.041	Nil	0.0025	0.004
2	F2	0.0001	Nil	0.00100	0.0711	0.242	0.0081	0.031	Nil	0.003	0.006
3	F3	0.0001	0.0001	0.00120	0.0833	0.311	0.0078	0.051	Nil	0.0025	0.005
4	F4	0.0001	0.0002	0.00124	0.0766	0.282	0.0072	0.061	Nil	0.0022	0.007
5	F5	Nil	Nil	0.00101	0.1233	0.277	Nil	0.052	0.001	0.0023	0.005
6	F6	0.0001	0.0003	0.00110	0.01121	0.300	0.0080	0.033	0.001	0.0020	0.004
7	F7	0.0001	0.0001	0.00120	0.0894	0.295	Nil	0.045	0.001	0.0023	0.012
8	F8	Nil	0.0001	0.00110	0.0773	0.244	0.0079	0.060	Nil	0.0020	0.027
9	F9	Nil	0.0002	0.00111	0.0800	0.311	0.0076	0.042	Nil	0.0021	0.008
10	F10	0.0001	0.0001	0.00120	0.1600	0.292	0.0071	0.055	Nil	0.0025	0.004
11	Mean	0.00006	0.0001	0.00112	0.0856	0.252	0.0053	0.0471	0.0003	0.0024	0.0185

Bacteriological Analysis.

The bacteriological examination for the all sample of the bottle water, it has shown in table -6 and all parameter in mg/l. Results for the residual free chlorine and E-Coli is Nil (-) and the results for the presumptive total coliform, confirmatory total coliform and confirmatory faucal coliform is ($\leq$ 2.2). These results are acceptable and within the global international and within the WHO. There is no different in the bacteriological analysis shown between the tap water and bottle water in our study.

Bacteriological Analysis of Botell Water

Table 6

				MPN per/100ml

No.	Location	Sources ml	Residual Free Chlorine mg/1	Presumptive Total Coliform	Confirmatory Total Coliform	Confirmatory Faucal Coliform	E. Coli
1	F1	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
2	F2	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
3	F3	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
4	F4	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
5	F5	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
6	F6	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
7	F7	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
8	F8	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
9	F9	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-
10	F10	100	-	≤ 2.2	≤ 2.2	≤ 2.2	-

Chemical examination of the tap water vs bootel water.

The chemical examination result for the all parameter between tap water vs bootel water as shown in the table 7 and figuer 1, the mean, standard deviation and p-value, they are respectively for all parameter in all location between and include in the examination. All parameter in mg/l. The turbidity (1.57 – 0.42), (0.22 – 0.10),(p< 0.001), is the color is clear for all sample in the all location, the pH (7,58 – 6,87),(0,41 – 0,25),(p< 0.001), the EC (304.14 – 189.88),(86.88 – 9.44), (p< 0.001), the total dissolved solids (230.47 – 132.40),(22.15 – 7.89), (p< 0.001), the total alkalinity (115 – 76.28),(11.51 – 18.17), (p< 0.001), the total hardness (168.70 – 94.43),(13.38 – 7.28), (p< 0.001), the calcium (36.94 – 23.30),(4.36 – 2.69), (p< 0.001), the magnesium (18.26 – 12.08),(0.54 – 1.39), (p< 0.001), the colure (22.91 – 10.11),(3.65 – 1.97), (p< 0.001), the sulfate (46.08 – 29.87), (p< 0.002), the sodium (8.81 – 5.08),(0.72 – 0.08), (p< 0.085), the potassium (1.16 – 0.51), (p< 001), the nitrogen (6.58 – 4.99),(3.99 – 4.65), (p< 0.423),all of these results are significant accept the sodium, potassium and nitrogen.

Table 7. Chemical examination of the tap water vs bootel water.

	Tab water		Bottle water		
	Mean	Standard Deviation	Mean	Standard Deviation	*P* value (t-test)
Turbidity	1.57	0.22	0.42	0.10	< 0.001
PH	7.58	0.41	6.87	0.25	< 0.001
EC	304.14	86.88	189.88	9.44	0.002
Dissolved	230.47	22.15	132.40	7.89	< 0.001
Alkalinity	115.00	11.51	76.28	18.17	< 0.001
Hardness	168.70	13.38	94.43	7.28	< 0.001
Ca	36.94	4.36	23.30	2.69	< 0.001
Mg	18.26	0.54	12.08	1.39	< 0.001
Cl	22.91	3.65	10.11	1.97	< 0.001
S	46.08	4.61	29.87	12.14	0.002
Na	8.81	0.72	5.08	6.08	0.085
K	1.16	0.30	0.51	0.17	< 0.001
N	6.58	3.99	4.99	4.65	0.423

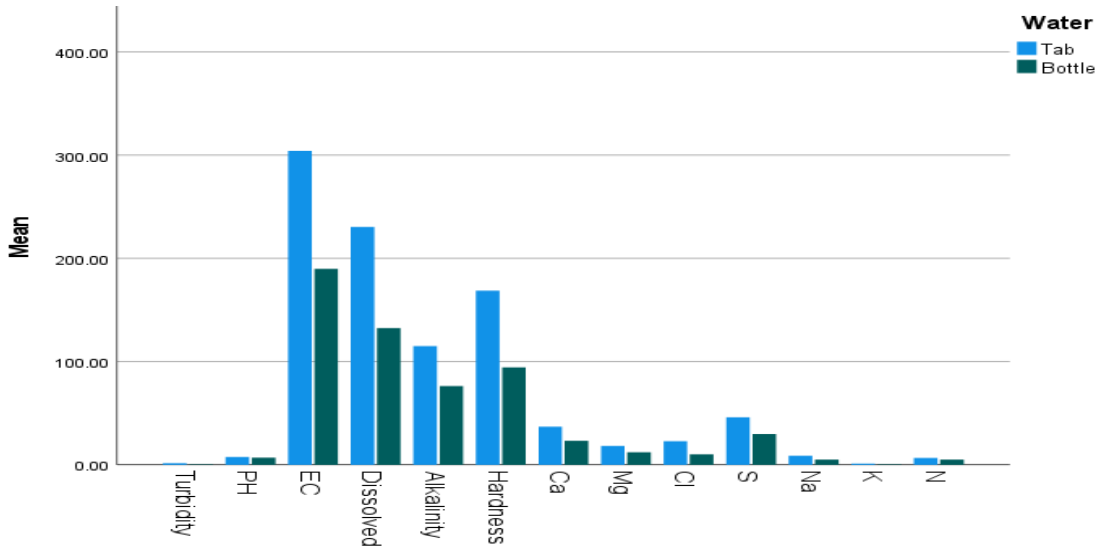

Figure 1. Chemical examination of tap water compared to bottle water

Heavy metal examination of the tap water vs bootel water.

The heavy metal examination result for all parameter between tap water vs bootel water as shown in table 8 and figure 2 the mean, standard deviation and p-value, they are respectively for all parameter in all location between and include in the examination. All parameter in mg/l. The Cd (0.00016 – 0.00006),(0.00005 -0.00005),(p< 0.001) the Pb is (0.00147 – 0.00011),(0.00008 – 0.00010),(p< 0.001) the Co (0.00139 – 0.00113),(p< 0.001),( ), the Al (0.00251 – 0.08563),(0.00041 – 0.03787),(p< 0.001), the Zn (0.37020 – 0.27650),(0.01742 – 0.03347),(p< 0.001) the Fe (0.16100 – 0.00537),(0.00302 – 0.00372),(p< 0.001), the Mn (0.08480 - 0.04710),(0.00565 – 0.01047), (p< 0.001), the Cr (0.00030 – 0.00030), (0.00067 – 0.00048),(p< 1.0), the Ni (0.05730 – 0.00234),(0.00236 – 0.00030),(p< 0.001), and the Cu (0.01350 – 0.00820), (0.00053 – 0.00705),(p< 0.042). all of these results are significant accept Cr.

Table 8. Heavy metals examination of the tap water vs bootel water.

	Tab water		Bottle water		
	Mean	Standard Deviation	Mean	Standard Deviation	*P* value (t-test)
Cd	0.00016	0.00005	0.00006	0.00005	< 0.001
Pb	0.00147	0.00008	0.00011	0.00010	< 0.001
Co	0.00139	0.00005	0.00113	0.00008	< 0.001
Al	0.00251	0.00041	0.08563	0.03787	< 0.001
Zn	0.37020	0.01742	0.27650	00.03347	< 0.001
Fe	0.16100	0.00302	0.00537	0.00372	< 0.001
Mn	0.08480	0.00565	0.04710	0.01047	< 0.001
Cr	0.00030	0.00067	0.00030	0.00048	1.0
Ni	0.05830	0.00236	0.00234	0.00030	< 0.001
Cu	0.01350	0.00053	0.00820	0.00705	0.042

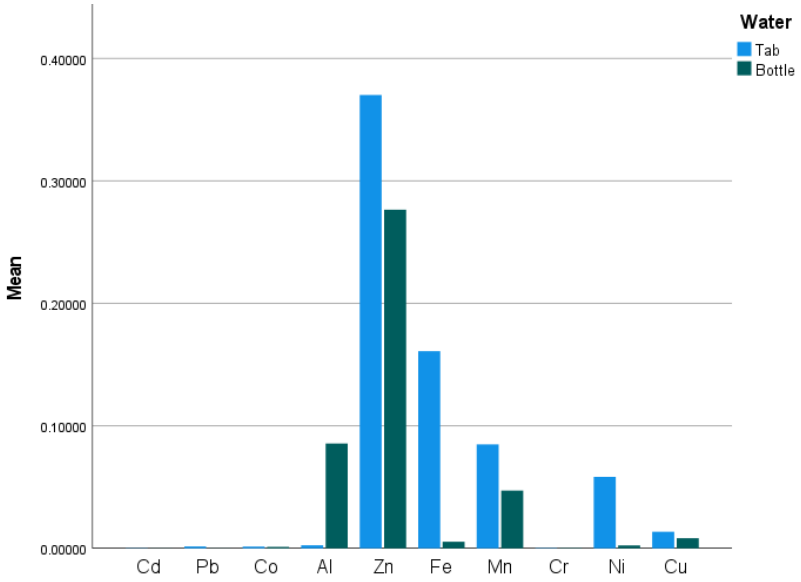

Figure 2. Heavy metal concentration in tap water vs bottle water

Statistical analysis .

The general information of the tap water and bottle water was presented in mean and Sta. deviation or number and presenter. Gross appearance, taste, odor, temperature, pH, physical, and chemical tests, heavy metal, and bacteriology will be started.

the comparisons between tap water and bottle water were examined in an independent t-test.

The significant level of difference was determined by a p-value of less than 0.05. The statistical calculations were performed in JMP pro 14.3.0.

What are the differences between bottle and tap water?

The differences between bottle and tap water include the cost, degree of environmental impact, and regulatory differences. The price differential between bottle and tap water is an important consideration. Compared to tap water, bottle water is on average approximately 3,000% more expensive per gallon. Compared to tap water, bottle water has a higher environmental footprint in most usage scenarios. For example, to, an estimated 28 million barrels of oil are required annually to meet America's demand for mineral water is contributes to the use of fossil fuels and hence global warming.

Comparing bottle water and tap water.

The decision regarding the pros and cons of bottle vs. tap water is highly situational, with each water source having its benefits and drawbacks. Bottle water is almost always healthy and safe, and one of its major pros is being able to provide safe drinking water to developing countries that lack access to safe drinking water such as in Sub-Saharan Africa, developing Asia, and developing Latin America. The ability to provide safe water in emergency situations, convenience on the go, and a range of tastes and sources to meet consumer preferences are further benefits. However, the major drawbacks of bottle water are its environmental impact and high cost.

Municipal tap water in developed countries is usually just as safe and healthy as bottle water. The major pros of tap water are its low cost and smaller environmental footprint. The cons include a higher possibility of contamination from external sources, the high cost to governments of establishing and maintaining the necessary infrastructure, and the lack of well-functioning and safe tap water systems in the developing world.

6. DISCUSSION

The chemical examination for the all parameter for the tap water, it has shown in table -1. The heavy metal examination for the all parameter for the tap water, it has shown in table -2. The bacteriological examination for the all sample of the tap water, it has shown in table -3. The chemical examination for the all parameter for the bottled water, it has shown in table -4. The heavy metal examination for the all parameter for the tap water, it has shown in table -5. The bacteriological examination for the all sample of the bottle water, it has shown in table -6. The chemical examination result for the all parameter between tap water vs bottle water as shown in the table 7 and figure 1. The heavy metal examination result for all parameter between tap water vs bottle water as shown in table 8 and figure 2

It has been shown from this comprehensive study on the condition and cleanliness of the water used in Duhok Governorate,

and through studding the physical characterizing , chemical tests, estimating the degree of heavy metals, and bacteriological tests, shown in the tables and figure , that the condition of the water in both type of tap water and bottles water filled with plastic , glass bottles within the study is very good and is within the international standard and WHO knowing that the water of the bottle water much better than tap water. To know the condition of good water for drinking and for daily uses, you must review and follow the points listed below and keep and maintain the cleanliness of water sources because of the importance to general human health , especially women, children and pregnant women, because water pollutants have risks to public health. The chemical potability analysis can be performed when trying to identify a strange taste or taint in drinking water which can be caused by higher metal levels. It can also show the scaling or corrosive tendencies of the water. This may be useful where a household or business is trying to identify the reason for corrosion or scale in the pipework be this for drinking water or process water. The analysis can identify galvanic corrosion, for example, an excess of manganese could be the cause of copper corrosion or corrosive water rusting a heating cylinder could be the reason for brown water (iron). Excessive levels of Iron, Manganese or Copper can cause staining of fixtures, basins & pools. High Nitrite and Sulphide levels can be toxic and may be indicative of fertiliser or sewage contamination. An eggy smell in water could mean the presence be sulphate reducing bacteria which can be identified by the presence of high levels of sulphide and sulphate Our analysis will come with a written interpretation of our findings giving you an explanation as to whether any issues you have informed us of could be caused by out of spec parameters with a comparison against the Drinking Water Inspectorate limits. Be aware this analysis is for observation purposes only as the lab isn't UKAS accredited for drinking water. The chemical potability analysis can be performed when trying to identify a strange taste or taint in drinking water which can be caused by higher metal levels. It can also show the scaling or corrosive tendencies of the water. This may be useful where a household or business is trying to identify the reason for corrosion or scale in the pipework be this for drinking water or process water. The analysis can identify galvanic corrosion, for example, an excess of manganese could be the cause of copper corrosion or corrosive water rusting a heating cylinder could be the reason for brown water (iron). Excessive levels of Iron, Manganese or Copper can cause staining of fixtures, basins & pools. High Nitrite and Sulphide levels can be toxic and may be indicative of fertiliser or sewage contamination. An eggy smell in water could mean the presence be sulphate reducing bacteria which can be identified by the presence of high levels of sulphide and sulphate Our analysis will come with a written interpretation of our findings giving you an explanation as to whether any issues you have informed us of could be caused by out of spec parameters with a comparison against the Drinking Water Inspectorate limits. Be aware this analysis is for observation purposes only as the lab isn't UKAS accredited for drinking water. The heavy metals enter the body from different ways including drinking water, air, food, or

occasionally dermal exposure. Following absorption, heavy metals are retained and they accumulate in the human body. There is a need that the drinking water of the areas should be filtered by the quality control agencies. The water cannot be used for drinking purposes unless it is passed through special water treatment human body. There is a need that the drinking water of the areas should be filtered by the quality control agencies. The water cannot be used for drinking purposes unless it is passed through

his study provides guidance to assist water supply utilities in collaboration with public health authorities and toxicologists, to identify those chemicals that are likely to be present in an individual water supply, and may represent a potential public health risk from long-term exposure. Appropriate monitoring

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special water treatment human body. There is a need that the drinking water of the areas should be filtered by the quality control agencies. The water cannot be used for drinking purposes unless it is passed through special water treatment. People may suffer through disease on drinking water with higher concentration of heavy metals resulting in physiological effects on kidney, digestive system, circulatory system, nervous system etc. Heavy metals disrupt cellular events including growth, proliferation, differentiation, damage-repairing processes and apoptosis, epigenetic alterations which can influence gene expression. Some toxic metals including Cr, Cd and As cause genomic instability. Several removal techniques have been developed and applied for the treatment of these wastes to remove the toxic metal ions. Hence, it is the need of the hour to keenly watch the pot ability of drinking water supplied in any region and then supply to the communities which would reduce the harmful effects and save live.

One of the important reasons of decline of quality of drinking water may be attributed to the growth of microbes, sub-lethally recognized as pathogenic to humans. Hence, an understanding of microbiological quality and safety of drinking water has been become important. Present study has been designed to examine the microbiological quality of drinking water available in our ears locality. The aim of this study is to analyze the microbiological quality of the available drinking water collected directly from various sources, supply outlets, as well as drinking water kept stored in various containers or storage pots, in order to;

a) Check the quality of drinking water being supplied;

b) To assess the awareness among the people for maintaining cleanness and hygiene conditions for storage of drinking water.

This study provides to notify the local government with public health department, to identify those chemicals that are likely to be present in an individual water supply, and may represent a potential public health risk from long-term exposure. Appropriate monitoring programs should be established to ensure that the chemical quality of drinking water remains within acceptable national standards and to maintain water safety for public use. Reduction of metals which have cumulative toxic hazards in drinking water is a necessity.

7. CONCLUSION

Water could have percolated down from the surface to the ground and as such the difference in concentration of trace elements in premonsoon and postmonsoon seasons could be noticeable. After assessing the trace elements, it has been found that the trace elements detected in the bottled water were within the permissible limit of IBWA guidelines. There are many trace elements, which are not taken into consideration especially by Department of Food Technology and Quality Control (DFTQC), IBWA, Food and Drug Administration (FDA), and World Health Association (WHO). Taking into account the following paragraphs. Tap water is drinking water that we can get from the tap or directly from the plumbing system of the house while bottled water is drinking water that we have to buy from the store. . Bottled water is packaged in plastic or glass bottles while tap water is not. Bottled water is expensive while tap water is cheaper. Tap water is regulated by the government and undergoes strict testing for bacteria and contamination while bottled water is not strictly regulated. Bottled water can either contain minerals or not while tap water certainly do contain minerals.

Recommendation

In view of the importance of water in public life alike if it is to allow residential neighborhoods to pass through the tap water or through factories and companies filing water in plastic or glass bottles , these two sources of water must be kept away from all kinds of toxins and pollutants, natural and unnatural, as well as urging citizens to stay away from these sites, as well the government must be firm and not lenient with workers in field in terms of cleaning water, adding sterilizers and following up on the stages of filtration and sterilization ,as well as following up on water delivery pipes periodic inspection of tanks and operations of transporting and preserving water in its good stores.

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