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Physico-Chemical quality analysis of drinking water samples in Darbandikhan region, Iraq

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Abstract

From all natural resources in the earth, water is the most important for all living organisms. The aim of this study was to overview the quality of drinking water in a certain part of Darbandikhan, Iraq to secure the safe and clean of drinking water for protecting public health and conservation. In this study, we measure the physio-chemical properties and investigate drinking water for human utilization. Physio-chemical analysis encompass a number of parameters, such as color, odor, taste, temperature, PH, electro conductivity (EC), total dissolved solids (TDS), total chlorine, Alkalinity, Calcium, nitrate, potassium, and iron. These data were collected from 4 July 2018 – 9 Oct 2018. The attained rate of each of the parameters was compared with the standard values of the World Health Organization (WHO) and National Drinking Water Quality Standard (NDWQS). The water took from the locations was found to be safe and clean as a drinking water. The results demonstrated that the drinking water was assembled from different places in Darbandikhan region.

Keyword: Water, physio-chemical analysis, WHO, TDS, human utilization, public health.

I- Introduction

Water is the greatest part of material after air for living things. A large expand of human survival depend on water. It is important for many purposes; such as drinking, hygiene, as well as felicity. Insofar as the drinking water if crucial for health, the society inadequacy of a good quality of this commodity will be baffled with many issues which should contrarily be dodged [1]. Today, the chemical aspect of drinking water is degraded noticeably due to the existence of

many toxic elements and heavy materials, even a small amount may cause the hazards for human health [2]. Today, fresh water is diagnosed as an essential for survival of human life. About 780 million people in the world do not secure water and the approximately 2.5 billion people also do not have a good cleanliness. Correspondingly, every year over 6-8 million people die because of the impurities and calamities of water [3].

The main difference between organic chemicals and inorganic chemicals in drinking water is the inorganic chemicals dominate an accumulated fraction as impurities [4]. Heavy metals are the part of inorganic minerals. Most of heavy metals contribute to assemblance in the parts of the human body and nervous regulation and inhibits with their typical role. Latterly, heavy metals like cadmium (Cd), lead (Pb), Mercury (Hg), copper (Cu), and nickel (Ni) have gained important attention by reason of being many problems of human health [5]. Furthermore, epidemiological studies demonstrate that the kidney disease, heart problems, neurocognitive disorder, and as long as cancer are related to the trace and heavy metals in drinking water such as mercury, chromium, and cadmium [6].

Water ought to be free from any life forms. In any case, tragically water isn't constantly discovered unadulterated. The tainting of normal water with fecal material, local and manufuctural sewage and rural and field keep running off may result in an expanded danger of sickness transmission to people [2].

Approach to secure drinking water is vital to continual improvement and crucial to food management, quality wellbeing and contraction of poverty. Securing drinking water is basic to our life and a gratifying safe supply should be made accessible to users [7]. Water is subsequently enhancing into an essential factor for improvement and the personal satisfaction in various nations. In individual bone-dry regions it has even turned into a survival factor [8]. In this way, water calculated for human utilization must not contain unsafe synthetics or microorganism germs; since water polluted with pathogens is the reason for contagious [9]. That is great drinking water may not be a comfort, but a standout amongst the most basic necessities of life itself [10]. In any case, in some countries, have experienced an absence of access to safe drinking water from enhanced sources and to sufficient sanitation administrations [11]. The WHO [12] uncovered that 75% percent of all infections in developing countries emerge from corrupted and contaminated drinking water.

In this study, the physico-chemical analysis about drinking water may have been inspected toward Darbandikhan city, Iraq. The purpose of this analysis is to pass on out various physicochemical parameters of samples of water assembled from various areas of Darbandikhan city and to propose those in the event that it will be drinkable or not. The major water traits of parameters for analyzing drinking water in this research are temperature, PH, Total dissolved salts (TDS), alkalinity Furthermore total hardness.

II- Material details and methods

The current research tested hundred samples of water in five different sources in the Darbandikhan distinct region, Sulaimani governorate, Iraq. The sources included well water, filter water, Serwan river water, project water, and

headspring water. In the present research the testing was finished all along morning hours and all water specimens were assembled in the polyethylene bottle one Liter size. For well and Sirwan river water the samples assembled dipped in the river and well depth of 0.5 to 1.0 meters. All samples were collected from several different distinct points in Darbandikhan region. From the times between the sample collection and certain analysis, numerous physical and chemical responses changed the nature of water specimen consequently to limit this change the specimen were protected in the near future after the accumulation. All samples of water were saved in dark, dry, and cool place between (15-25) ℃. Before analysing all parameters, all instruments were arranged and marked in accordance with producer's suggestions. The TDS, PH, EC and temperature were examined and determined quickly at the same spot after the accumulation, and they were analyzed by (Portable waterproof pH/EC/TDS Meter- HI991300). Although the analysis of other residual parameters were done in the laboratory. The investigation was conveyed for a time of two months. The gathered water tests were transferred to the lab and appropriate examination and determination was executed. Turbidity was calculated by turbidity meter model ISO Compliant. Colour was analyzed by water portable photometer, Model HI96727. The temperature was determined by using a thermometer, Potassium, calcium, and chlorine were analyzed by flame photometer (AE-FP82), Iron was estimated by using Atomic absorption spectroscopy. Nitrate, and nitrite were analyzed by using standard laboratory methods.

III- Result and discussion

The results attained from the overall of the physical and chemical analysis of different water sources that shown in table 1,2, and 3. Exept the taste and odour of Sirwan river that is is not accordance with the standard data, all physical parameters such as colour, temperature, taste and odour, and turbidity was acceptable in processing and urban water because as it's shown in table 1 there are no big differences between the temperatures (the greatest temperature that allowed of standard water should not be more than 25 ℃ as supported WHO (2004)), colours, taste and odor, and turbidity, (WHO (2004) was settled that the turbidity of fresh water should not be more than 5 Nephelometric Turbidity Unit (NTU), if the turbidity is more than 5 that means the water is unhealthy, in this research the turbidity of Sirwan and project water are slightly higher than others which means that the other sources are more preferred.

Source	Temperature (C°)	Colour (Unit)	Taste and odour	Turbidity (NTU)
Well water	23.8	< 1.5	Agreeable	0.4
Water filter	25.3	< 1.0	Agreeable	0.3
Sirwan river	20.6	< 2	Disagreeable	0.6
Project	20.8	< 2	Agreeable	0.6
Headspring	23.4	< 1.5	Agreeable	0.5

Table 1. Results of overall physical parameter analysis of different samples from five various sources of water in Darbandikhan city.

The mean value of all chemical parameters for different kinds of water sample is shown in table 2, PH is the measurement of the concentration of hydrogen ion in water. PH of acid water is recommended below 6, and the alkaline water with a PH above 8.5. In the current study the values of PH range is not very amplitude compared with each other; The noticed value was between 7.09 to 7.94. WHO has approved that the highest acceptable PH for fresh water is from 6.5 to 8.5, although, there is a significant association between PH values, the highest PH was found in headspring water (7.94± 0.26), and the lowest PH was recorded in water filter (7.09± 0.48), the statical value is (f = 21.72, p = 0).

Electrical conductivity (EC) of water is highly influenced by ions and dangling impurities that has presence in it, more ions and suspending impurities cause to increase EC. WHO was recommended that the normal range of freshwater streams is proper between 0 to 1500 microsiemens per centimeter (µs/cm), table 2 demonstrates that the EC of well water is higher than others, because the inorganic ions in well water is more than others. Mean value of EC was significantly high in well water (695.67±304.21) and lowest in water filter (44.27± 59.66), therefore the statical value is (f = 25.75, p = 0).

Total dissolved solids (TDS) include the inorganic and little organic matters that have presented in the act of solution in water, it is frequently affected by the density of main ions such as; chloride, calcium, and bicarbonate, it is also approximately associated with the EC, furthermore, it can be also taken as a marker of water feature. The desirable limit range of TDS is 500 mg/L, according to this study the range of TDS ranged from 44.27 mg/L to 347.32 mg/L as presented in table 2. Well water has the greatest amount of TDS, otherwise the water filter has the smallest because well water has a considerable amount of matter compared with other sources and it is mostly separated to refine the ions. The mean value of TDS is essentially high in well water (347.32± 149.12) and quite low in water filter (44.27± 59.66), from that case the statical value is (f = 23.40, p = 0) (table 2).

Chlorine is a chemical matter that is utilized for cleaning water. For a typical household use leftover chlorine levels of water ought to be somewhere range between 0.2 to 0.5 mg/L. In this study, the amount of chlorine ranged from (0.01-0.28), and the mean value is necessarily important between each source, for example the highest value is attributed for well water and it is (0.28± 0.51), and the minimum is for water filter, therefore the statical value is (f = 25.75, p = 0) (table 2).

Water alkalinity traits assess the quantity of water to neutralize acid balance, Alkalinity relief to prohibit the abrupt change of the acidity level of water. The normal range for calcium carbonate ($CACO_3$) alkalinity for fresh water is (20-200) mg/L as demonstrated in table 2. In the present study, the total measure of alkalinity CaCO3 is from 39 to 230 mg/L and the means for alkalinity was significantly high in well and headspring water are (230.64± 88.75) and (227.50± 137.89), so, the statical value is (f = 11.60, p = 0).

The normal range for nitrate ion in fresh water is 20-45 mg/L. In this research the range of nitrate ion was investigated between (17.28 - 1.31) mg/L. Mean values for nitrate ion in project water is higher among them (17.28± 28.68), as well the lowest is attributed for water filter (1.31+ 2.47), so the statical value is (f = 10.7, p = 0).

Source		PH	E.C µs/cm	TDS (mg/L)	Total chlorine (mg/L)	Alkalinity $CaCO_3$ (mg/L)	Calcium Ca^{+2} (mg/L)	Nitrate NO_3^- (mg/L)	potassium (mg/L)	Iron (mg/L)
Well water	Mean ± Std.	7.59± 0.32	695.67± 304.21	347.32± 149.12	0.28± 0.51	230.64± 88.75	171.34± 69.01	4.77± 3.92	1.87± 1.31	0.31± 1.26
Water filter	Mean ± Std.	7.09± 0.48	92.70± 120.16	44.27± 59.66	0.01± 0.02	39.00± 58.20	163.33± 109.20	1.31+ 2.47	1.39± 0.33	1.56± 3.08
Sirwan river	Mean ± Std.	7.89± 0.21	402.40± 104.44	215.55± 135.94	0.18± 0.39	188.66± 64.21	121.23± 82.74	1.51± 2.18	1.47± 0.41	0.10± 0.15
Project	Mean ± Std.	7.91± 0.21	511.25± 150.66	249.16± 76.13	0.21± 0.33	198.33± 81.45	152.33± 15.37	17.28± 28.68	2.23± 0.25	0.01± 0.01
headspring	Mean ± Std.	7.94± 0.26	422.50± 253.71	220.72± 116.95	0.05± 0.03	227.50± 137.89	87.50± 51.23	2.20± 3.12	1.20± 0.27	0.03± 0.04
Total	Mean ± Std.	7.61± 0.40	552.57± 328.98	277.53± 167.70	0.15± 0.34	201.85± 100.63	157.63± 76.98	9.40± 52.86	1.73± 1.09	0.38± 1.45
f.		21.72	25.75	23.40	0.45	11.60	2.44	10.67	1.16	1.84
sig.		0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.34	0.13

Table 2. Average concentration (Mean± Std.) results of overall chemical parameters of different samples in particular places in Darbandikhan city

According to table 3, There was a significant negative correlation of water temperatures with PH and alkalinity. Water temperature decreased with the high PH level and alkalinity concentration (R= -0.332, P= 0.000), (R= -0.301, P= 0.003).

PH level also significantly negative correlated with the level of calcium and Iron. PH level has decreased with the high level of calcium and Iron, as shown in table 3 respectively (R= -0.428, P= 0.000), (R= -0.248, P= 0.017).

There was a significant correlation of EC of the water with the TDS, alkalinity, calcium, nitrate, and potassium concentration. (R= 0.926, P= 0.000), (R= 0.645, P= 0.000), (R= 0.268, P= 0.009), (R= 0.267, P= 0.011), (R= 0.230, P= 0.006).

Similarly, a significant positive correlation of water TDS was found with the alkalinity, calcium, nitrate, and potassium concentration, as illustrated in table 3 respectively (R= 0.575, P= 0.000), (R= 0.278, P= 0.007), (R= 0.284, P= 0.007), (R= 0.245, P= 0.019).

Alkalinity had a positive significant correlation with the nitrate concentration, (R= 0.249, P= 0.018)

Calcium and nitrate had a significant concentration with the potassium concentration, (R= 0.203, P= 0.049)

Parameters		PH	E.C µs/cm	TDS (mg/L)	Total chlorine (mg/L)	Alkalinity $CaCO_3$ (mg/L)	Calcium (mg/L)	Nitrate (mg/L)	Potassium (mg/L)	Iron (mg/L)
Temperature (C°)	Correlation Coefficient	-0.332	0.012	0.068	-0.094	-0.301	0.142	-0.041	-0.077	0.009
	Sig. (2-tailed)	0.000	0.883	0.393	0.719	0.003	0.164	0.696	0.460	0.930
PH	Correlation Coefficient		-0.015	-0.040	0.013	-0.040	-0.428	-0.176	-0.009	-0.248
	Sig. (2-tailed)		0.851	0.616	0.960	0.706	0.000	0.094	0.934	0.017
E.C µs/cm	Correlation Coefficient			0.926	0.095	0.645	0.268	0.267	0.230	0.026
	Sig. (2-tailed)			0.000	0.716	0.000	0.009	0.011	0.006	0.811
TDS (mg/L)	Correlation Coefficient				-0.204	0.575	0.278	0.284	0.245	-0.004
	Sig. (2-tailed)				0.432	0.000	0.007	0.007	0.019	0.970
total chlorine (mg/L)	Correlation Coefficient					0.177	-0.436	-0.132	-0.188	0.309
	Sig. (2-tailed)					0.583	0.080	0.698	0.471	0.328
Alkalinity $CaCO_3$ (mg/L)	Correlation Coefficient						0.105	0.249	0.128	0.022
	Sig. (2-tailed)						0.320	0.018	0.233	0.835
Calcium Ca^{+2} (mg/L)	Correlation Coefficient							0.184	0.203	0.065
	Sig. (2-tailed)							0.084	0.049	0.542

Nitrate (NO_3^-) (mg/L)	**Correlation Coefficient**								0.075	-0.043
	Sig. (2-tailed)								0.491	0.690
Nitrite (NO_2^-) (mg/L)	**Correlation Coefficient**								0.538	-0.284
	Sig. (2-tailed)								0.047	0.324
potassium (mg/L)	**Correlation Coefficient**									0.117
	Sig. (2-tailed)									0.274

There was also a significant relation between Nitrite with the potassium ion as demonstrated in table 3, (R= 0.538, P= 0.047)

Table 3. Correlation coefficient between chemical parameters.

IV- Conclusion

In this research the estimations of water quality parameters, like PH, E.C, TDS, Total chlorine, Alkalinity, Calcium, Nitrate, potassium and Iron, from all samples were collected in different area of Darbandikhan. The results were revealed that all measured parameters are standard by WHO, but the concentration of all calcium, potassium, and Iron in all sampling a little higher than the standard value of WHO. In general, the investigation found in all parameters didn't at the level of pollution and not cause the risky for the consumer.

V- References

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