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PHYSICO CHEMICAL ANALYSIS OF UNDERGROUND WATER QUALITY IN DIFFERENT AREAS OF TRIPOLI CITY

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ABSTRACT
Underground water is an important source of water supply and the dependency of people on such water has increased lately. Thus, regular monitoring of the underground water quality is essential. The present study was performed to assess the quality of underground water in different areas of Tripoli city. All the samples were analyzed for the major physicochemical parameters including: pH, temperature, Total Hardness (TH), Total Dissolved Solids (TDS), Chloride (Cl^-), Nitrate (NO_3^-), Sulphate (SO_4^{--}), Carbonate (CO_3), Bicarbonate (HCO_3) and ammonia (NH_3) by using standard analytical methods. The results were analyzed and compared with the Libyan Standard No. 82 for Drinking Water and WHO Water Quality Guidelines. All samples were also evaluated for a possible microbial contamination. The obtained results indicated that the water was found to vary from place to place. The results revealed that the underground water was not suitable for drinking as well as for domestic purposes due to significant variation of most of the physicochemical data from the standard limit which was high in water samples collected from Tajoura areas. It means the ground water of this area needs a considerable degree of purification treatment before use. The results obtained from this study revealed that the Cl value ranging between (106-798 mg/L), SO_4 (28-335 mg/L), NH_3 (0.05-0.98 mg/L) are also lower than that of the WHO and Libyan Standards. Overall, it has been stated that a combined Physico chemical and microbial aspects become an effective method of monitoring drinking water. Such investigation is needed to know possible sources of contamination such as storage tanks and pipeline to ensure the reach of safe drinking water to the users.

KEYWORDS: Underground Water, Water Quality, Physicochemical Parameters, Bacterial Characteristic.

1. INTRODUCTION
Underground water is one of the most important sources of water supply for drinking and for domestic purposes in Libya. The quality and purity of such water has direct effect on human life. The problem of underground water quality is essential since shortage of drinking water worldwide is becoming very acute nowadays.[1,2] About 2.5% of earth's water is fresh and clean for human use and it has been assumed that the underground water represents 13% of this water. Underground water has been used for drinking for a long time due to its purity and has made it very important source of clean water widely.[3] It is considered as the only source of water supply for drinking, agricultural and other purposes. Approximately 90% of water supply comes from underground water while the 10% comes from other sources.[4] It has been believed that underground water is pure and safer than surface water. Although the presence of more than 200 chemical constituents has been documented in it, the source of these chemicals are both naturally or anthropogenic.[5] Underground water quality can also be contaminated with different bacteria including pathogens which make water unsafe for use.[6,7] Once the water becomes polluted at site, it may remain unusable or even hazardous for decades of centuries. In Libya, underground water represents one of the main sources of fresh water. Its availability and quality is susceptible to climate changes. Unavailability and depletion of underground water as a result of overuse in agricultural developments cause salinity and sea-water penetration into the coastal aquifers are the major concerns in Libya. Thus, assessment of the physico chemical parameter of water quality is crucial; a previous study by Elhamili et al was conducted to evaluate the chemical property of underground water in Tripoli city using atomic absorption spectrometry.[8] The aim of this study is directed toward evaluating the physico-chemical properties of underground water in different regions of Tripoli city including Ain Zara, Tajoura, Arada, Alhadba, Alkala and Janzour with a special focus on investigating, pH, temperature, Total Hardness (TH), Total Dissolved Solids (TDS), Chloride (Cl^-), Nitrate (NO_3^-), Sulphate (SO_4^{--}), Carbonate (CO_3), Bicarbonate (HCO_3) and ammonia (NH_3) by using standard analytical

methods. Moreover, all collected samples were evaluated for a possible microbial contamination.

2. MATERIALS AND METHODS

The sampling was carried out in six different locations of Tripoli city; the underground water from these wells represented a source of drinking wells as well as for domestic purposes. The area tested include (GA: Ain Zara, GT: Tajoura, GR: Arada, GH: Alhadba, GK: Alkala and GZ: Janzour). Three sets of the sample were collected from each location. The plan with the sampling was to test whether the city location in some way contributes to the rise of contamination, thus, the samples were chosen to be taken from different site of the city. Each set contained three (500 mL) bottles, before sampling, the bottles were first rinsed with sample water three times and then filled. The collected samples were then transported to laboratory, upon arrival at laboratory the samples were analyzed within 48 hr. When not in use, the samples were kept refrigerated at + 4 C^0. Temperature and total dissolved solids were measured immediately on site after sampling using Hanna auto ranging microprocessor while the pH of the water samples was measured using the pH meter**.** Nitrate concentration was determined by spectrophotometer. The other Physico-chemical parameters were analyzed in the laboratory using the standard analytical methods.[9] For Microbial test, the water samples were collected in sterile bottle, the bottles were sterilized by passing flame on them, after that the water samples were collected. The method used for the Microbial Test was most Probable Number (MPN), the media used was MacConkey broth, which contain bromocresol purple as indicator + peptone + lactose + bile salt + NaCl + distilled water using the Durham tube. The sample to be tested was prepared in 10-fold dilution series and then the samples of each dilution were inoculated into triplicate broth culture tubes for incubation. The concentration of samples that were inoculated into triple tube was (10 mL, 1 mL, 0.1mL). Following incubation, all tubes were examined for media color change and presence of gas bubble in Durham tube, the pattern of growth in the tubes was scored against table of such values.

3. RESULTS AND DISCUSSION

The collected data revealed that there were considerable variations in physicochemical properties of examined samples from the different locations. The quality of the collected water samples was first tested by measuring the pH, temperature and Total dissolved solids (TDS). Temperature of water samples was almost the same about 18°C. pH influences significantly the taste and odour of a substance, especially when it controls the equilibrium concentration of the neutral and ionized forms of a substance in solution. Additionally, the pH value of drinking water is an important index of acidity or alkalinity and greatly influenced by geology of catchments area and buffering capacity of water.[10] The obtained pH value for the all tested water samples were ranging from 7.13 to 8.19 which lie within the recommended range as stated by the Libyan standard 1992 and the WHO standards (2000) for drinking water quality which should be within (6.5 to maximum 8.5)[11,12] as it can be seen in Table 1. Total dissolved solids (TDS) are one of the main characteristics that decide the quality of drinking water. High levels of TDS might be due to contamination of ground water as result of discharge of waste waters into pits and pods.[13] Moreover, TDS comprise of organic matter and inorganic salts, which may originate from natural bicarbonates, chlorides, sulphate, nitrate, sodium, potassium, calcium and magnesium. TDS is related to other water quality parameters like hardness, which may occur if the high TDS content is due to the presence of carbonates.[13] Total dissolved solids (TDS) of the tested water samples were ranging between (348 - 1488 ppm) which revealed a large variation. The lowest value was found in water samples of Ain Zara whereas the highest value obtained in Tajoura samples as it can be seen in Table 2. The recommended limit set by WHO and Libyan standard was (500-1000 ppm). These results were also consistent with the results by previous studies in other country.[14,15] Chloride occurs in groundwater as a result of sewage discharge, irrigation water being drained. The chloride content of all water samples was varying from 106.5 – 514.7 ppm. These values were lay within the standard limit of WHO and Libyan standards (200-250 ppm) for drinking water. The exception was observed for Salah Aldin and Alhadba sample with 514.7 ppm and 798.7 ppm respectively. High chloride value in ground water gives salt tastes to water and possibly due to minerals like apatite and mica or might be from liquid inclusions in the igneous rocks.[16] These results were agreed with the results reported by.[15] Total hardness is an important parameter of water quality to be used for any purpose. It had been reported that water hardness in most ground water is naturally occurring from sedimentary rock and calcium bearing minerals or as a result of an application of lime to the soils in agricultural areas.[14] Hardness is the resistance of water in forming lather with soap. The principal ions causing hardness are calcium and magnesium. When the anion is carbonate, it can be removed by boiling, unlike when the anions are sulfates, chlorides and nitrates. Groundwater is often harder than surface water. The normal range is (200-500 ppm), the obtained results showed high concentration for almost all location except for Ain Zara samples. Nitrates and nitrites are considered together because conversion from one form to the other occurs in the environment and the health effects of nitrates are generally as a consequence of its ready conversion to nitrites in the body. The results show that nitrate concentration in water samples were ranged between 1.86 – 31.7 ppm, the recommended permissible limit for nitrate is up to 45 ppm. Thus, all tested water samples were within the limit. Nitrate is highly soluble element and had an anionic form. Therefore it can be easily leached into the water table. The most sources of nitrate contamination in ground water are atmospheric fallout, organic and sewage pollution and agriculture activities.[17] The concentrations of sulphate (SO_4^{--}) were also evaluated in all collected underground water samples, the normal range is (200-400 ppm) and it can be seen in Table 2 all tested samples were below the limit expect for Arada water sample. The carbonate and bicarbonate level were also estimated. Alkalinity is an index of the buffering capacity of water produced anions of weak acids, like hydroxides, bicarbonates and carbonates. An increase in alkalinity causes a loss of colour, which is directly proportional to the alkalinity of the water sample and is usually close to its hardness value. Slight increasing of alkalinity values is not harmful to human beings health.[18,19,20] Ammonia level (NH_3) in tested water samples were ranged between 0 – 0.98 ppm. The permitted level is < 0.5 ppm. Additionally, the microbial evaluation of water sample using MPN test was also conducted. The accepted results mean that the bacterial count should not exceed 3 per 100 mL (0.03 per 1 mL). After incubation according to the MPN the results is shown in Table 3. It appear high in all areas, the highest value was in GT followed by GA, whereas it is much less but still high compared to the limit in GR, GK, GH and GS respectively. The RSD value was based on triplicate runs.

Table 1: Guideline values for the recommended level of studied physicochemical parameters (ppm) according to WHO and the Libyan standard of drinking water 1992.

Parameter	Concentration according to WHO	Concentration according to the Libyan standard (ppm)	
		Minimum	Maximum
pH	6.5-9.5	6.5	8.5
TDS	0.003	500	1000
Cl^-	250	200	250
CO_3	-	-	-
HCO_3	-	-	-
TH	0.003	200	500
NH_3	2	-	<0.5
NO_3^-	-	-	45
SO_4^{--}	-	200	400

Table 2: The obtained results for the studied physicochemical parameters of water samples.

Parameter Tested	Area tested					
	GA	GT	GR	GH	GK	GZ
pH	7.18	7.49	7.13	7.62	8.14	8.19
Temp	18.2	18.1	18.0	18.0	18.0	18.0
TDS	348	1488	683	1076	828	610
Cl^-	142.0	205.9	106.5	798.7	514.7	248.5
CO_3	264.0	300.0	180.0	1680	120.0	72.0
HCO_3	292.0	109.8	122.0	292.8	193.0	244.0
TH	252.3	1733.7	800.8	920.9	720.7	476.4
NH_3	0	0. 98	0.70	0.79	0.35	0.05
NO_3^-	7.89	4.23	1.56	27.7	18.87	31.7
SO_4^{--}	28.0	132.0	335.0	155.0	118.0	104.0

Table 3: The obtained results using (MPN) test.

Sample	10 mL	1 mL	0.1 mL	Statistic
GA	3	2	2	210/mL
GT	3	3	1	500/mL
GR	3	1	0	40/mL
GH	0	0	0	<3/mL
GK	0	1	0	3/mL
GZ	0	0	0	<3/mL

4. CONCLUSIONS

The present study was directed toward evaluating the suitability of underground water in different areas of Tripoli city for drinking, on the basis of physico-chemical analysis of collected water samples (pH, temperature, TDS, Cl, CO_3, HCO_3, TH, NH_3, NO_3 and SO_3) in addition to microbial test. Monitoring of the water quality of ground water is done by collecting representative water samples and analysis of physicochemical characteristics of water samples at different locations of Tripoli City. According to the obtained results, the underground water quality varies from place to place. High values of some chemical elements were observed in some places compared to the other; these high values of some chemical parameters are considered signs of the deterioration of the water quality.

The results show high concentrations of TDS, Cl^-, Ca^{++}, NH_3^-, CO_3 and HCO_3 at certain locations which indicate that the underground water of these specific locations is not suitable for drinking and needed primary treatment. For the TDS, high value was observed in GT area followed by GH with a value of 1488 and 1076 respectively, whereas low value than the limit was obtained in GA area. Cl is within the limit in GT and and GZ area and lower than the limit in GA and GR whereas it is higher than the limit in GH and GK area. TH, is high in all areas except in GA and GZ within the limit. NH_3, NO_3, lower than the limit for all areas. SO_4, lower than the limit for all tested areas except GR is within the limit. According to the result, all water samples are free from bacterial contamination and their pH is within the needed range. Additionally the concentration of heavy metal in all samples are within the WHO and Libyan requirement. thus through the present investigation, by discussing some properties of drinking water that used by the public of Tripoli city and finding that all water sample is accepted and suitable for public health except the Fe concentration which show low concentration level than the accepted range according to Libyan standard except in sample (WB) which is within the range. This low concentration could be personal or instrumental error. Consequently, for further investigation use the inductive coupled plasma with increasing the number of tested samples are required and highly recommended.

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