Evaluation of the Physio-Chemical Quantities for Groundwater in some Industrial and Residential Locations of AjdabiyaCity, Libya

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Abstract: The present study was conducted for chemical analysis of some parameters and the concentrations of the major ions in groundwater samples. Thirty-six groundwater samples were collected from February to April in19 from different sources in Ajdabiya City, Libya. The study relied on using standard methods to obtain accurate results for assessing the pH and the concentrations of alkalinity, sulphate, chloride, total dissolved solids (TDS), total hardness (TH), and the percentage of sodium (Na%). Results show that the pH of water in all the samples has no remarkable variation from 6.7-8.9. The mean TDS values were 1.00 - 988 mg/L, where the highest TDS permissible level is 1000 mg/L. and the mean EC values were 222 and 3980µs/cm. The content of Ca^{+2}, Mg^{+2}, and SO_4^{2-} were found to be less than the permissible limit. Therefore, this study showed that all analyzed samples are within acceptable limits. The analyzed water samples may be classified as safe for drinking compared with WHO, BIS, and ICMR standards results.

Keywords: Ajdabiya City; Groundwater; Physico-chemical parameter.

1. Introduction:

Nowadays,a critical problem is the contamination of groundwater, which is due to industrial activities and humans (Kumari, 2020). Water is nature's most great, abundant, and valuable compound and it is the basis of all lives–ecological supplies for the flora and fauna of our earth and a necessity for all lives. (Tatawat & Chandel, 2008). Libya has long depended on groundwater reserves for drinking and irrigation, where Libya is an arid nation, mostly desert, in which freshwater is perpetually scarce. As increasing the pollution, many coastal groundwater aquifers have become salty with an influx of seawater (Das & Datta, 2001).

There are several studies in various Libyan cities and villages on the quality of drinking water and the estimation of physicochemical properties such as pH, alkalinity, and dissolved oxygen. For example, in 2011, Hasanand co-authors.,studied the physicochemical parameters such as conductivity, pH, TDS, chloride content, total hardness, and dissolved oxygen to monitor the groundwater quality of public water supply in Al-Khums city (Hasan et al., 2011). Al-Farrah and co-authors have studied the main cations and anions for water samples collected from the Jifarah Plain and analyzed samples of water from 134 wells.These samples indicate that change in the chemistry of groundwater is done by cation exchange reactions through the mixing up process between seawater and freshwater. Where the groundwater samples show 80% seawater intrusion to freshwater (Al Farrah et al., 2011).

Water chemical quality including water salinity studies by Ibeda in the Murzuq-Sabha fossil aquifer has studied the grade of its anthropogenic pollution (Ibeda et al., 2013). Mansour A. In 2013,Salem analyzedthe characteristics of groundwater of 51 holes for drinking water in the Alshati region measured for its convenience for drinking by several Physico-chemical parameters (Mansour A. Salem, 2013). Al-sbaihy& Ban evaluated the drinking water quality in 21 drinking water sources categories in three levels in Tukrah town (Al-sbaihy & Bumadian, 2016).AbdouKh. A., and others assessed the hygienic quality of groundwater

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sources intended for animal and human drinking and studied the pollution sources in six regions in Tripoli, Zliten, and Zawia cities in Libya and Beni-Suef, Ismailia, and Matrouh in Egypt, over a ten-month from January to October 2014 (Abdou Kh. A.,et al., 2016). Hafez assessed the quality of groundwater for human consumption in the rural and urban areas of the Al Kufra area, were used the black wells and old water wells as sewage drains (Hafez et al., 2019). Shaloland others studied the physio-chemical parameters like pH, salinity, TDS, cations, and anions constituents of produced water in the Sarir oil field, where produced water contains different compounds that can have a negative impact on the environment and economic problems associated with oil and gas production, accordingly for this studies these parameters show a wide variation from well to another (Shahlol et al., 2019).

In 2020, Abeishand others studied the characterization of water sources located in the Assabaa region to understand the characterization of the physical and chemical parameters of some water wells in this area (Abeish & Said, 2020). Nuraand co-authors. evaluated the physical, chemical, heavy metals, and microbiological properties in Al-Abyar Reign. where she studied the quality of groundwater and determinate (Nura N. M., et al., 2020).In Zliten, Libya Ighwela studied the effect of war on the water of Ain Kaam (spring) and Wadi Kaam (dam), and determine the relationships between each other in physiochemical properties, the water sources anywhere have been affected in Libya since the beginning of the revolution in February 2011 (Ighwela, 2020). Alradiny performed the physical, chemical, and biological analysis of the twelve samples of groundwater that were carried out belong four locations within the area of Almarqab (Alradiny, 2021).

Bukhzamstudied the assessment of groundwater in Sug al Juma'a area in Tripoli. Where determined the parameters such as EC, salinity, SAR, permeability index (PI) for drinking and irrigation water.According to the value of the water quality index (WQI), more than 60% of the samples are not suitable for drinking purposes but groundwater in the study was found to be varied in suitability for irrigation purposes (Bukhzam, 2021).

Several studies were conducted to estimate the quality of groundwater in Ajdabiya, where many tests were conducted to reveal the nature of this water in terms of its chemical and biological composition and study the geological layers of the region, and which it is used for human and agricultural use and to detect the percentage of pollution. In August 2016, Al Kassah and others chose random sites and collected samples from 61 underground wells, these wells include sites that lack sanitary services and sometimes use old water wells as drains for sewage. in this study, they found the EC values within Libyan Standard Specifications, also the values of TDS, pH, TH of water, chloride, sulfate and sodium and potassium ions were included within the allowable limits. (Al Kassah, F.et. al., 2017).

In September 2018, Shaltami and others, study the quality of drinking water and sanitation, they collected the water samples from two major water sources: the reservoirs and household wells. Where they found the water of the Ajdabiya reservoirs is less polluted than household wells. Because it contains the lowest concentrations of Cl^- and Na^+ ions.(Shaltami et al., 2020).

Saleh A. Emhanna and co-authors determined the causes of the rising water table, where collecting the groundwater samples from 22 wells. The measurements were performed from December 1, 2010, to January 31, 2012. Results showed that the pH value of samples varies from 6.6 to 7.55. The EC varies from 1320 to 10670 mS/cm. the concentration of Cl- ranged between 165 and 1775 mg/L. (Emhanna et al., 2021).

The main aim of this study is to determine the characteristics of groundwater by studying the chemical and physical properties and using the standard methods to determine the groundwater quality in Ajdabiya City, Libya

2. Material and methods:

2.1 The geographical location of the experimental site:

Ajdabiya city is situated between latitude: 30.75, longitude: 20.22 30° 45′ 20″ north, 20° 13′ 31″ east, and 12 m (39 ft) above sea level. Where figure -1 indicates a map of Libya and the study area. Sampling sites were collected from five different sub-regions. The first group of samples was collected from different locations near the mosque of Khalid Bin-Walid. The second set was collected around the AL-Tanam Mosque. The third collection is from jungle street. The fourth set of samples was collected from the near western zone. Finally, the fifth groupwas collected from different locations that are for the Industrial district.

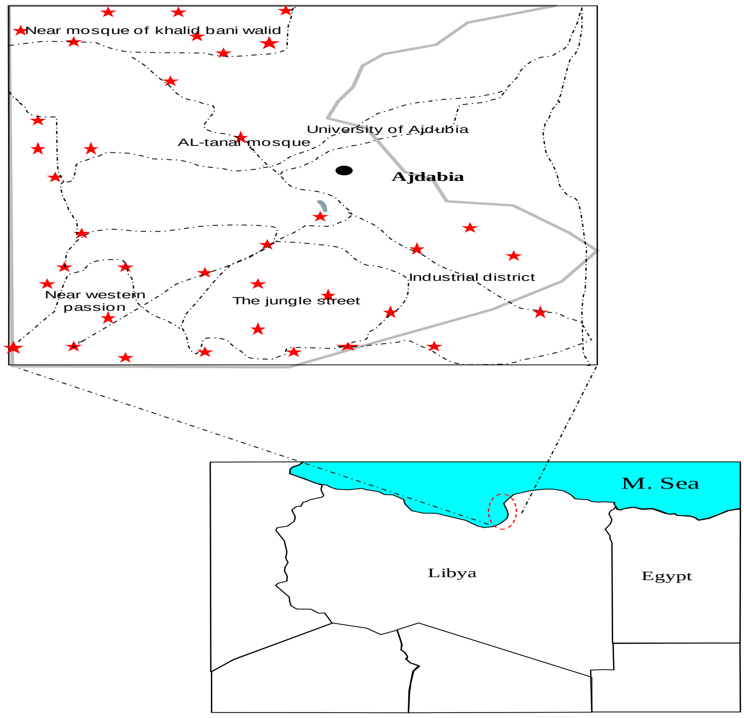

Figure 1: Location map of Ajdabiya city, Libya and sampling points.

2.2 Water samples collection:

Thirty-six groundwater samples were collected fromFebruary to April 2019 (Figure-1). Samples were collected in good quality polyethylene bottles of three replicates each one-liter capacity. Sampling has been carried out without adding any additivesto well-rinsed bottles. High pure chemicals and distilled water were used for preparing the analysis solutions.

2.3 Physicochemical analysis:

All samples were collected and placed in the laboratory before physical and chemical analysis. Analysis was carried out for various water quality parameters such as pH, TDS, and EC. Sodium and potassium were estimated by flame photometer at Sirte oil company at Al-Briaga City. Calcium, magnesium, soluble chlorides, carbonate, bicarbonates, and total hardness were determined using titrating standard methods (Federation & Association, 2005; Harvey, 2000).Sulphate was determined spectrophotometrically(Apha, 1998; Sawyer et al., 2003). The sodium adsorption ratio (SAR) values of each water sample were calculated by using the Richard equation (Ahmad et al., 1977), and the sodium percentage (Na%) values were determined using the equations of Todd (Todd, 1980).

3 Results and Discussion:

The difference in physio-chemical descriptions of water sampleshas been reviewed in tables (1), and (2).

3.1 Acidity pH:

During the present investigation, the pH of samples ranges between 6.7-and 8.9. The maximum value of pH. Table-1 indicates the alkalinity of water might be due to the high temperature that lowered the solubility of CO_2. However, these values are within the limits prescribed by the Bureau Indian standard (BIS) (BIS, 1991), Indian Council of Medical Research (ICMR)(Research, 1,962) and WHO (Organization, 2003).

3.2 Electrical conductivity (EC):

Conductivity is the degree of the conductance of an electric current in the water. The electrical conductivity of the groundwater samples is varying from 222 to 3980 µs/cm, wherein drinking water's maximum value of EC =1400µs/cm (Organization, 2003).

3.3 Total Dissolved Solid (TDS):

The total dissolved solids in water samples ranged from 1.00 to 988 mg/L. The total dissolved solids in water are constituted mostly of chloride, phosphate, carbonate, bicarbonate, and nitrate of calcium, magnesium, sodium, potassium and manganese, organic matter, salts,and other particles, as prescribed by WHO (500 mg/l) (Organization, 2003). and ICMR (600 mg/L) (Research, 1962).

3.4 Total Hardness (TH):

The total hardness (TH) of the studied samples is varying from 0.56 to 4.4 mg/L. These values are within the permissible limit prescribed by BIS, ICMR, and WHO. TH depends on the concentration of total precipitate of calcium/magnesium carbonate.

Table-1: Physical-chemical parameters of groundwater of Ajdabiya City.

Sample No.,	pH	EC, µs/cm	TDS mg/L	TH mg/L	SAR%	Na %
1	8.7	468	240	0.56	7.3	99.1
2	7.9	1614	7.99	2.83	39.8	99.7
3	7.8	390	2.04	1.5	39.5	99.8
4	8.8	971	488	0.6	17.4	99.42
5	7.9	1755	887	1.3	31.1	99.52
6	7.7	222	111	1.56	30.1	99.3
7	8.1	335	1.94	1.5	43.2	99.73
8	7.5	672	338	0.68	14.9	99.3
9	8.3	1558	814	1.1	29.7	99.52
10	7.7	1053	831	4.4	22.3	97.83
11	7.0	303	4.69	2.74	26.5	98.5
12	7.7	304	1.23	1.98	26.5	98.9
13	7.3	241	1.20	2.0	26.9	98.92
14	7.2	242	1.40	1.8	25.5	99.6
15	7.7	240	1.24	2.2	29.4	99.1
16	7.5	302	1.00	1.3	28.7	99.5
17	7.6	2900	1.48	3.2	25.7	97.96
18	7.8	1297	612	0.56	22.8	99.8
19	7.0	3880	1.96	1.3	49.3	99.6
20	7.2	1749	833	1.1	23.4	99.7

21	6.8	2350	1.20	1.2	31.8	99.73
22	6.9	1796	865	0.97	25.3	99.51
23	6.7	457	2.22	2.3	40.6	99.4
24	7.3	1171	600	1.2	21.9	99.00
25	7.1	3980	893	1.2	32.4	99.74
26	8.6	2690	851	1.3	24.7	99.6
27	8.9	2680	1.33	2.4	29.03	99.1
28	7.2	1747	848	1.3	27.83	99.64
29	7.4	2870	1.43	1.8	28.81	99.4
30	7.0	3320	1.65	2.5	37.04	99.3
31	7.4	2130	1.04	1.4	31.62	99.64
32	7.9	1600	1.27	2.6	37.6	99.7
33	8.2	2300	1.53	4.1	32.42	99.2
34	8.8	2500	1.48	3.4	36.5	99.6
35	8.1	1570	988	2.2	27.6	99.6
36	8.9	1297	1.08	2.8	38.3	99.7
Average	70.54	15260.5	2970.6	10.9	280.9	960.8
max	8.9	3980	988	4.4	49.3	99.8
min	6.7	222	1.0	0.56	7.3	97.8
SD	0.63	1090.2	379.61	0.95	8.2	0.47

3.5 Sodium Absorption Ratio (SAR)

SAR is an important parameter for the determination of the suitability of irrigation water. The sodium hazard is typically expressed as the sodium adsorption ratio (SAR). The adsorption of sodium adsorption into water is one of the main indicators on which water classification is based which is known as classification (Richard, 1954), which is calculated from the following equation for studied water samplesfollowing equation: -

$$SAR = (Na^{+}meq/L) / \sqrt{}\ [(Ca^{2+}meq/L) + (Mg^{2+}meq/L)/2$$

SAR in the studied area for all samples was found close in ranges between 7.3-49.3%. This variable is essential for determining the quality of water used for irrigation, otherwise, it willcause dispersion of soil concentration (Al Farrah et al., 2011).

3.6 Sodium Percentage (Na%)

Groundwater is classified according to the modified Todd's method. If all the ions are converted from mg/l to meq/l and then converted to a meq (%), the sodium percentage was calculated by (Kontis & Gaganis, 2012):

$$Na\ \% = (Na + K)\ 100 / (Ca + Mg + Na + K)$$

The concentration of sodium is important in the classification of groundwater for irrigation purposes because it reacts with the soil, and the ratio has been returned (60%) as maximum within the permissible limits (Ackah et al., 2011). The sodium percentage in the study area for all samples was close in ranges between 97.8 to 99.8 %. The category is Unsuitable according to the classification of irrigation water. The Na% values reflected that the water was under the category of 'good' (20-40 Na %), permissible (40-60 Na%) and 'doubtful' (60-80 Na%) class according to Todd(Todd, 1980; Wilcox, 1966).

3.7 Alkalinity:

Alkalinity in water is caused by carbonate and bicarbonate concentration, where the strength of water determines to resist change in pH upon the addition of acid.The alkalinity of samples water was varying from 97.6 to 640 mg/L and 10.6 to 108.6 mg/L forthe carbonate and bicarbonate respectively.

3.8 Chloride

Table 2, shows the concentrations of varying chloride content, the content was between 146.7 - 2463.7 mg/L. Some samples that have exceeded the limit by WHO are smaller than 250 mg/L, and the remaining samples are within the permissible limits by ICMR standards. Unusual concentration may indicate pollution by organic waste, whereas chloride increases with a higher amount of pollution.

Chloride salts over 100 mg/L give a salty taste to water. When combined with calcium and magnesium, it may increase the corrosive activity of water. It is recommended that chloride content should not exceed 250 mg/L (Tatawat & Chandel, 2008).

3.9 Sodium

Table- 2,also shows the variation in the sodium content of samples water which it ranged from a minimum of 40 mg/L to a maximum of 1280 mg/L. The high rate of mineralization in the sediment, increases sodium in the nutrient pool, thereby making more sodium solubility. Water should not be used for drinking when containing more than 200 mg/L, where a maximum drinking standard of 100mg/L has been proposed for the general public (Water & Behera, 2010).

3.10 Potassium

Variation in potassium contents ranged from 10 to 100 mg/L are presented in table 2. Potassium is one of the lowest metals of sodium and is distinguished in the potassium element. It is difficult to dissolve in water because it has a lower sodium content and a natural concentration of less than 20mg/L.

3.11 Calcium:

Calcium and magnesium are the main contributors to water hardness. When water is heated, calcium breaks down and precipitates out of the solution, forming a scale. Maximum limits have not been established for calcium. Calcium concentrations are varying from 0.5 to 6.9 mg/L all samples are less than the permissible limit prescribed by ICMR, BIS, and WHO.

3.12 Magnesium:

Magnesium concentration varies from 0.1 to 2.5 mg/L and these values are less than permissible limits prescribed by BIS, ICMR and WHO. Magnesium concentrations greater than 125 mg/l may have a laxative effect on some people. Calcium treatment is softening (tank media) and reverse osmosis. Magnesium levels can be controlled through distillation.

3.13 Sulphates:

Sulphate concentration is varying from 3.2 to 23.5 mg/L and these values are lower than permissible limits prescribed by BIS, ICMR and WHO. Water containing high levels of sulphates, particularly magnesium sulphate (Epson salts) and sodium sulphates (Glauber's salt) may have a laxative effect on people unaccustomed to the water. These effects vary among individuals and appear to last only until they become accustomed to using the water. High sulphate content also affects the taste of water and forms a hard scale in boilers and heat exchangers. The upper limit recommended for sulphates is 250 mg/L. Treatment includes reverse osmosis.

Table-2: Major ion concentration of groundwater samples of Ajdabiya City.

Sample No.,	Ions (mg/L)							
	Ca^{2+}	Mg^{2+}	K^{+}	Na^{+}	CO_3^{2-}	HCO_3^{-}	Cl^{-}	SO_4^{2-}
1	0.5	0.1	20.0	40.0	380.8	11.4	151.5	21.0
2	1.1	1.7	40.0	830.0	409.6	26.0	1746.6	21.7
3	1.1	0.4	40.0	820.0	217.6	12.2	1412.9	3.2
4	0.8	0.2	10.0	160.0	246.4	30.1	347.9	11.0
5	2.0	0.8	50.0	530.0	363.2	13.0	208.8	13.7
6	2.7	1.1	40.0	490.0	180.0	34.2	2463.7	16.4
7	2.1	0.7	50.0	980.0	121.6	10.6	355.0	16.9
8	0.8	0.1	10.0	120.0	268.0	25.2	208.3	12.0
9	1.8	0.7	30.0	470.0	125.6	22.0	158.6	23.5
10	6.9	2.5	100.0	325.0	296.0	43.9	1900.4	17.8
11	4.5	1.8	30.0	380.0	577.6	24.4	350.3	17.0
12	3.3	1.3	30.0	380.0	322.4	17.9	178.3	23.3
13	3.3	1.3	30.0	390.0	278.4	11.4	203.5	15.5
14	1.6	0.1	40.0	360.0	195.2	21.1	224.8	12.8
15	3.3	1.1	30.0	460.0	390.4	21.1	183.0	16.1
16	1.8	0.6	30.0	440.0	519.2	24.4	243.8	22.5
17	5.4	2.2	20.0	350.0	160.8	22.0	284.0	17.2
18	0.5	0.1	10.0	270.0	117.6	15.5	146.7	22.5
19	1.6	0.3	70.0	1280.0	192.0	34.2	674.5	20.2
20	0.9	0.1	30.0	300.0	97.6	19.5	267.4	20.6
21	1.4	0.2	60.0	560.0	185.6	24.4	267.8	16.6
22	1.4	0.4	20.0	340.0	212.0	52.1	175.1	23.3
23	4.0	1.5	50.0	870.0	210.4	24.4	662.7	17.9
24	2.0	0.8	20.0	260.0	116.8	24.4	1121.8	21.3
25	1.5	0.2	60.0	580.0	336.0	108.6	179.9	19.0
26	1.4	0.1	40.0	340.0	396.0	37.8	781.0	18.5
27	3.8	1.4	80.0	490.0	316.0	12.2	258.0	17.2
28	1.6	0.2	60.0	440.0	356.8	48.8	227.2	16.6
29	2.5	0.6	50.0	460.0	339.2	16.3	198.8	20.3
30	4.2	1.7	70.0	750.0	376.0	27.7	229.6	18.5
31	1.9	0.5	80.0	570.0	391.2	32.9	236.7	15.4
32	1.6	1.0	70.0	770.0	336.0	56.1	260.3	17.8
33	4.8	0.7	60.0	580.0	391.2	74.4	423.6	18.7
34	3.2	0.2	60.0	720.0	320.8	19.5	602.9	13.4
35	1.7	0.5	70.0	440.0	640.0	14.6	210.6	14.6
36	2.3	0.6	40.0	770.0	552.0	24.4	345.5	13.5

Discussion:

Statisticalstandard analysis procedures, as powerful tools, can provide such knowledge and assist the interpretation of environmental data statistical summaries for all measured species in water samples are presented in Table-3. The average total concentration, minimum, maximum, and standard deviation for each element is shown. Standard deviations listed in this table are high for most of the measured metals. Such high standard deviations are expected for data and do not denote poor analysis or sampling. These observed variations are due to the large variability of the concentrations, variations in physical and chemical transformations in the groundwater and also nature of the sampling site, nature and type of anthropogenic sources, and the variations in the source strengths (Nriagu, 1988).

Table-3: Statistical summary for measured ions in water samples (mg/L)

Ions	**Concentration (mg/L)**			
	Average	**SD**	**Min**	**Max**
Ca^{2+}	2.3687	1.5	0.5	6.9
Mg^{2+}	0.77	1.0	0.1	2.5
K^{+}	44.4	22.1	10	100
Na^{+}	.75508	254.4	40	1280
CO_3^{2-}	305.4	135.4	97.6	640
HCO_3^{-}	28.5	19.6	10.6	84.6
Cl^{-}	6335.5	35026.5	146.7	2463.7
SO_4^{2-}	16.7	4.9	3.2	23.5

Previous studies(Al Kassah, F.et al, 2017; Emhanna et al., 2021; Shaltami et al., 2020) confirmed that the groundwater has been affected by diverse contamination sources such as intrusion of saltwater, domestic and industrial waste discharges, weathering, and leaching of sedimentary rocks and soils, water must be treated to remove the contaminations. As shows in table- 4 A and B, summaries for all measured species in water samples in previous studies and this study comparing with the Libyan Standard measurements*. (Al Kassah, F. et al., 2017). A higher concentration of chloride in the water is usually taken as an index of pollution and considered a tracer from groundwater contamination.

Table-4 A: Summaries physical-chemical parameters of groundwater in different studies:

References	pH	EC (mS/cm)	TDS, (mg/L)	TH, (mg/L)
Libyan* Standard	6.5- 8.5	1500	1000	500
This study	6.7-8.9	222-3980	1-988	0.56-44
(Al Kassah, F, 2017)	7.1-8.3	1107-8500	731-5610	100-1900
(Shaltami, 2020)	6.81-7.99	924-2240	-	-
(Emhanna 2021)	6.6-7.55	1320-10670	-	0.072-0.880

Table-4 A: Summaries major ion concentration of groundwater in different studies:

References	(mg/L)					
	Cl^{-}	Na^{+}	K^{+}	Ca^{+2}	Mg^{+2}	SO_4^{-2}
Libyan* Standard	250	200	40	200	150	250
This study	146.9- 2463.7	40-1280	10-100	0.5-6.9	0.1-2.5	3.2-23.5
(Al Kassah, F, 2017)	110-1100	50-580	18-43	68-400	8-408	100-1070
(Shaltami, 2020)	144-880	126-485	20-50	-	-	-
(Emhanna 2021)	165-1775	-	-	-	-	-

4 Conclusion:

Water wells in Ajdabiya city are classified as low density, from the chemical analysis, we find that the water is fresh and suitable for human drinking following WHO recommendations. Some samples contain high chlorine and sodium contents. The water is considered valid for most industries taking into account the high concentration of chlorine.

On the other hand, all the sampling stations are also suitable for irrigation uses according to TDS taking into account the high concentration of sodium for some samples.

5 Recommendation:

We recommend more studies should be carried out on the determination of the amount of main metal, heavy metal, phosphate, nitrate ions and organic pollutants in groundwater.

التقدير الكمي لبعض الخواص الفيزوكيميائية للمياه الجوفية المجمعة من مواقع صناعية وسكنية في مدينة اجدابيا، ليبيا

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الملخص: أجريت هذه الدراسة للفحص الكيميائي لعينات المياه الجوفية لتقدير الأيونات الرئيسية وبعض الخواص الفيزوكيميائية الأخرى. حيث تم تجميع 36 عينة من المياه الجوفية خلال الفترة من فبراير إلى ابريل لعام 2019 من مصادر مختلفة من مدينة اجدابيا، ليبيا. هذه الدراسة اعتمدت على استخدام الطرق الإحصائية للحصول على نتائج دقيقة لتقدير كلا من الاس الهيدروجيني، تركيزات القلوية، تراكيز ايونات الكبريتات والكلوريد والمواد الصلبة الذائبة الكلية وأيضا عسرة المياه، والنسبة المئويةللصوديوم. أظهرت النتائج أن الأس الهيدروجيني في جميع عينات المياه لا يوجد فيها أي اختلاف ملحوظ وتراوحت قيمته ما بين 6.7-8.9. ومتوسط قيم المواد الصلبة الذائبة الكلية ما بين 1.00-988ملجم/لتر بالمقارنة مع القيمة المسموح بها 1000 ملجم/لتر، كانت قيم التوصيلية الكهربية 222-3980 ميكروسيمنز/سم، محتوى تراكيز ايونات الكالسيوم، الماغنيسيوم، والكبريتات لعينات المياه تحت الدراسة وجدت أنها من ضمن الحدود المقبولة، وبذلك يمكن تصنيف عينات المياه التي تم تحليلها على أنها آمنة للشرب مقارنة بنتائج معايير منظمة الصحة العالمية(BIS, ICMR, WHO).

References:

Abdou Kh. A., Walaa A. Moselhy, Asmaa N. Mohammed, Abulgassm M.A., K. I. A. (2016). Monitoring the hygienic quality of underground water in different localities in Egypt and Libya. *Journal of Veterinary Medical Research*, *23*(2), 249–258. https://doi.org/10.21608/jvmr.2016.43248

Abeish, A. M., & Said, O. A. (2020). *Assessment of Groundwater Quality of Assabaa Region , Libya*. *December*, 1–9.

Ackah, M., Agyemang, O., Anim, A. K., Osei, J., Bentil, N. O., Kpattah, L., Gyamfi, E. T., & Hanson, J. E. K. (2011). Assessment of groundwater quality for drinking and irrigation: the case study of Teiman-Oyarifa Community, Ga East Municipality, Ghana. *Proceedings of the International Academy of Ecology and Environmental Sciences*, *1*(3–4), 186.

Ahmad, S., Middlebrooks, E. J., & Al-Layla, M. A. H. (1977). *Water Supply Engineering Design*. Ann Arbor Science.

Al-sbaihy, Y. M., & Bumadian, M. M. (2016). *Assessment of bacteriological quality of drinking water from various sources in Tukarh , Libya* [M.Sc., Benghazi]. http:repository.uob.edu.ly/handle/123456789/165

Al Farrah, N., Martens, K., & Walraevens, K. (2011). Hydrochemistry of the upper miocene-pliocenequaternary aquifer complex of Jifarah plain, NW-Libya. *Geologica Belgica*, *14*(3–4), 159–174.

Al Kassah, F., Abdulhafeed, A., Al Kassah, F., Amhanaa, S., Deeh, A., and Sheikhy, S. (2017). Hydrochemical study of some groundwater wells in Ajdabiya, Libya. *Hydrochemical*

Study of Some Groundwater Wells in Ajdabiya, Libya., *February 2016*, 839–856.

Alradiny, I. M. A. A. A. (2021). Assessment of Validity of Ground Water for Drinking Purposes in the Almarqab Region in Libya. *Muthanna Journal for Agricultural Sciences*, *8*(2). https://doi.org/10.52113/mjas04/8.2/22

Apha, W. E. F. (1998). AWWA, 1995. Standard methods for the examination of water and wastewater. *Amer. Pub. Heal. Assoc. Washingt. DC*.

BIS, I. S. (1991). 10500 Indian Standard Drinking Water–Specification, first revision. *Bureau of Indian Standards, New Delhi, India*.

Bukhzam, A. (2021). *Ground Water in Sug al Juma ' a area in Tripoli , Libya*. *10*(1), 42–48.

Das, A., & Datta, B. (2001). Simulation of seawater intrusion in coastal aquifers: Some typical responses. *Sadhana*, *26*(4), 317–352.

Emhanna, S. A., Musa, N. S. Ben, & Mostafa F. Mostafa. (2021). Causes and Impacts of Rising Water Table in Ajdabiya City , NE Libya. *International Journal of Environment & Water*, *10*(2), 127–140.

Federation, W. E., & Association, A. P. H. (2005). Standard methods for the examination of water and wastewater. *American Public Health Association (APHA): Washington, DC, USA*.

Hafez, S. S., Mohamed, G. E.-M., Noha, S. D., & Frhat, , M. S. Bo Aiad. (2019). Assessment of Some Bacteriological and Physicochemical Properties of Groundwater in Al Kufra Area, Libya. *Journal of Environmental Science*, *46*(3), 1–23. https://doi.org/10.21608/jes.2019.129955

Harvey, D. (2000). *Modern analytical chemistry* (Vol. 1). McGraw-Hill New York.

Hasan, S. K., Usmani, F., Zaiad, G. M., & Edra, S. (2011). *Physicochemical Analysis of Municipal Water in Al-Khums City, Libya*. *1*(1), 2010–2012.

Ibeda, A., Abosith, M. F., Alemad, A., Elkharrim, K., & Belghyti, D. (2013). Physicochemical quality of Murzuq groundwater Sabha, Libya. *WIT Transactions on Ecology and the Environment*, *178*, 225–239. https://doi.org/10.2495/WS130191

Ighwela, K. (2020). *Relationships between Physiochemical Properties in Water of Ain Kaam and Wadi Kaam in Zliten Libya* . 26–31. https://doi.org/10.5281/zenodo.3938806

Kontis, E. E., & Gaganis, P. (2012). Hydrochemical characteristics and groundwater quality in the Island of Lesvos, Greece. *Global Nest Journal*, *14*(4), 422–430.

Kumari, S. (2020). *Physicochemical properties of Groundwater around Municipal waste disposal sites : a Review*. *10*(8), 12–21.

Mansour A. Salem, M. A. S. (2013). Physico-chemical Evaluation of Drinking Water Quality in Alshati District of Libya. *IOSR Journal of Environmental Science, Toxicology and Food Technology*, *4*(1), 46–51. https://doi.org/10.9790/2402-0414651

Nriagu, J. O. (1988). A silent epidemic of environmental metal poisoning? *Environmental Pollution*, *50*(1–2), 139–161.

Nura N. M., Mohammed M. A. A., Mohamed A. A., Talaat A. H., M. A. M. E. (2020). Evaluation of Groundwater Quality along AL-Abyar Area, Northeast Libya. *Himalayan Journal of Agriculture*, *1*, 6–16. https://www.himjournals.com/article/articleID=40

Organization, W. H. (2003). *The World health report: 2003: shaping the future*. World Health Organization.

Research, I. C. of M. (1962). *Manual of standards of quality for drinking water supplies*.

Richard, L. A. (1954). Diagnosis and improvement of saline and Alkali soils agric Handbook 60, USDA and IBH PUB. *Coy Ltd*, 98–99.

Sawyer, C. N., McCarty, P. L., & Parkin, G. F. (2003). *Chemistry for environmental engineering and science* (Vol. 5). McGraw-Hill New York.

Shahlol, O. M. A., Isawi, H., El-Malky, M. G., Al-Aassar, A. E.-H. M., & Elzwi, A. (2019). Assessment of the Physico-Chemical Properties of Produced Water From Sarir Oil Field in Sirt Basin, Libya. *Journal of Environmental Science*, *47*(2), 1–19. https://doi.org/10.21608/jes.2019.108113

Shaltami, O. R., Fares, F. F., El-Shari, S. M., Farag, M. E. O., Salloum, F. M., Favaloro, R. R., Alshelmani, N., Al-Maqrif, A., & Moftah, S. A. (2020). Assessment of drinking water quality and sanitation in Ajdabiya City, ne Libya. *Iraqi Geological Journal*, *53*(1), 102–107. https://doi.org/10.46717/igj.53.1b.7rz-2020-03.03

Tatawat, R. K., & Chandel, C. P. S. (2008). Quality of ground water of Jaipur-city, Rajasthan, (India) and its suitability for domestic and irrigation purpose. *Applied Ecology and Environmental Research*, *6*(2), 79–88. https://doi.org/10.15666/aeer/0602_079088

Todd, D. K. (1980). Ground Water hydrology John Wiley and Sons, Inc. *New York*, *535*.

Water, S., & Behera, N. R. (2010). *Physico-Chemical Analysis of Surface and Ground Water of Bargarh District , Orissa , India*. *2*(March), 284–295.

Wilcox, L. V. (1966). *VS Salinity Laboratory*. Mimo.