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Study of Some Physical & Chemical Properties of Drinking Water in Some Educational Institutions in Souq Althulatha Area, Zliten

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دراسة بعض الخصائص الفيزيائية والكيميائية لمياه الشرب في بعض المؤسسات التعليمية بمنطقة سوق الثلاثاء، زليتن

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Abstract

Drinking water is one of the most natural materials consumed by individuals. Its pollution creates a real danger to the health of those who consume it. The number of students in the 40 basic and intermediate education institutions in Souq Althulatha area in Zliten is around 14,000 students during the 2021-2022 school year, most of whom use school reservoirs for drinking. So, this study aimed to identify some of the physical and chemical properties of drinking water in the targeted schools, where samples were collected from water reservoirs for 30 schools in the area, and some chemical and physical tests were conducted in the Faculty of Education laboratories at Alasmarya Islamic University and Environmental Sanitation Affairs Department in Zliten, in a time not exceeding a week from the collection process, and were analyzed in a period not exceeding 6 months. The obtained results of the tests showed that the drinking water of the targeted schools conforms to the Libyan standard specifications with an increase in some components in a limited number of school reservoirs.

Keywords: *Drinking water; Reservoir; Schools; Souq Althulatha*.

الملخص

تعتبر مياه الشرب من أكثر المواد الطبيعية التي يستهلكها الأفراد. ويشكل تلوثها خطراً حقيقياً على صحة من يستهلكها. ويبلغ عدد الطلاب في مؤسسات التعليم الأساسي والمتوسط بمنطقة سوق الثلاثة بزليتن (40) نحو 14 ألف طالب خلال العام الدراسي 2021-2022، يستخدم معظمهم خزانات المدارس للشرب. لذا هدفت هذه الدراسة إلى التعرف على بعض الخواص الفيزيائية والكيميائية لمياه الشرب في المدارس المستهدفة، حيث تم جمع عينات من خزانات المياه لعدد 30 مدرسة في المنطقة، كما أجريت بعض الاختبارات الكيميائية والفيزيائية في مختبرات كلية التربية بالجامعة الأسمرية الإسلامية وإدارة شؤون الإصحاح البيئي بزليتن، في مدة لا تتجاوز أسبوع من عملية الجمع، وتم تحليلها في مدة لا تتجاوز 6 أشهر. وأظهرت نتائج الاختبارات المتحصل عليها أن مياه الشرب للمدارس المستهدفة مطابقة للمواصفات القياسية الليبية مع زيادة في بعض مكوناتها في عدد محدود من الخزانات المدرسية.

الكلمات الدالة: مياه الشرب، خزانات المياه، المدارس، سوق الثلاثاء.

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1. Introduction

Water is of great importance in our daily life, as it is one of the most important elements in nature at all. It is an essential element needed by all living creatures. Therefore, drinking water must be safe, acceptable, and free from microorganisms and harmful pollutants. Water covers about 71% of the area earth surface, and it constitutes about 65% of the human body. Despite the fact that water is the lifeblood of life, we deal with it badly and abuse it in agriculture, industry and personal uses, and pollute it with our hands and our waste, and the remnants of our lives although we know perfectly well that all these pollutants will reach us directly or indirectly (Oon & Kamoka, 2019).

Libya is one of several countries that suffer from water scarcity, as the per capita share of renewable water resources does not exceed 108 cubic meters. The country is almost entirely dependent on groundwater, which represents 97% of the total volume of water used annually for agricultural, industrial and domestic purposes. Other resources such as rainwater, desalination and treated waste water contribute the remaining 3%. Domestic water represents 12% of the total water supply in Libya, and it has three main sources: the man-made-river (60%), municipal well fields (30%), and desalination plants (10%). By 2025, compared to 650 million cubic meters at the present time (NCDC, 2017). Not all Water is suitable for drinking or for human use. It should be pure at some level and completely free of all types of microbes, organic matter, salts and other substances dissolved in (Algryani, 2016).

Man has polluted all water sources, starting with oceans, seas, rivers and ending with groundwater and rain water. The pollutants that man consumes daily through drinking water and food has become a real threat to his health, whether because of biological or chemical pollutants. In view of the importance of water and the health risks resulting from its pollution, in this study, the quality of drinking water was highlighted in places where there are large numbers of water consumers, namely the pupils and students in Souq Althulatha, Zliten, where tests of some chemical and physical components were conducted on drinking water in schools' reservoirs located in the area. The tests included power of hydrogen PH, electrical conductivity EC, total dissolved salts TDS, total hardness TH, chloride Cl, calcium Ca and magnesium Mg (Almanhrawy & Hafez, 1997).

2. Methodology

2.1. The Study Area

Souq Althulatha is one of the areas of the city of Zliten which is located in the northwestern region of Libya on the Mediterranean coast to the east of Tripoli, a distance of about 150 km, and between latitudes 31.55^o- 32.30^o N, and longitudes 14.10^o- 14.50^o E as shown in Figure (1).

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(a) *(b)*

Figure 1. Geographical Site of Zliten Municipality *(a)* and Souq Althulatha Area *(b)*, (Google map, 2023)

2.2. Sample Collection

The samples, which amounted to 30 samples, were collected from different institution's reservoirs (secondary, preparatory, primary schools, and kindergartens) according to the APHA (1998) Standard Methods using plastic bottles with a capacity of 1.5 L. After the bottle had been washed several times with distilled water, it was filled with a water sample, then it was tightly closed. The sample was transferred directly to the laboratory and was tested as soon as it arrived.

2.3. Tests Data Analysis

A set of tests were performed on drinking water samples, including:

2.3.1. pH test:

PH was measured by electrical method using a device (STARTER 2100) with a glass electrode "selective electrode".

2.3.2. Electrical Conductivity (E.C):

The E.C was measured using the (STARTER 300) type electrical conduction device. The process of measuring the electric current is carried out at a temperature of 20^{o}C and is measured by Siemens unit.

2.3.3. Total Dissolved Salts (T.D.S):

It was measured with a TDS meter of the same type as the one used to measure E.C, and is measured in ppm.

2.3.4. Total Hardness (T.H):

The total hardness of water was determined by titrating total Mg^{+2}, Ca^{+2} with a standard solution of EDTA (ethylene diaminetetraethanoic acid) using Eriochrome Black-T indicator.

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2.3.5. Chemicals and solutions

- **0.01 M EDTA**: Dissolving 0.73 g of EDTA in 250 mL of distilled water.
- **PH 10 buffer solution**: Dissolving 8 g of NH_4Cl in distilled water, adding to it 71.25 mL of NH_3 and diluting it to 125 mL of distilled water.
- **Eriochrome Black-T indicator**: Mixing 50 mg of the indicator with 5 g of NaCl and 5 g of hydroxylamine hydrochloride.
- **Action Steps**:
  - The burette is filled with 0.01 M EDTA solution, 25 mL of the water sample to be measured is transferred into an Erlenmeyer flask and 5 mL of buffer solution pH = 10 is added with three drops of Eriochrome Black-T indicator.
  - The solution is titrated with 0.01 M EDTA until the color changes from wine red to blue. The titration is repeated three times and the volume of EDTA is taken (let it be A).
  - Calibration is calculated as follows:

$$ppm(CaCO_3) = V(A) \times 0.01 \times 100 \times 1000 \div 25mL \qquad \text{….. (1)}$$

2.3.6. Determination of Calcium Ca^{+2}

Calcium (Ca^{+2}) concentration was determined by complexometric titration method with the same steps for hardness determination, by addition of 5 ml of NaOH solution of concentration (w/v) 8% to the water sample, and murexide indicator was used instead of Eriochrome Black-T indicator (Outreach, 2022).

The volume of EDTA was taken, let it be (B), and the concentration was calculated Ca^{+2} is as follows:

$$ppm(Ca^{+2}) = V(B) \times 0.01 \times 40 \times 1000 \div 25mL \qquad \text{….. (2)}$$

3.6. Determination of Magnesium (Mg^{+2})

Calculate the magnesium concentration by calculating the volume of EDTA solution needed to estimate magnesium by subtracting the volume (B) EDTA consumed in the estimation of calcium from the volume of EDTA (A) consumed to estimate the total hardness. The concentration is calculated as follows:

$$ppm(Mg^{+2}) = V\ EDTA(A - B) \times 0.01 \times 24.3 \times 1000 \div 25mL \qquad \text{….. (3)}$$

3.7. Determination of Chloride (Cl^-)

The chloride (Cl^-) concentration was determined by the Mohr's method as following:

- The burette is filled with $AgNO_3$ (0.0141N).
- 1 mL of potassium chromate was added to the 20 mL of water sample.
- Calibration took place by adding $AgNO_3$ to the water sample until the color changes.
- Cl^- is calculated as:

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$$Cl\ (ppm) = (m_1 - m_2) \times 35.45 \times 1000 \times N \div V(mL)\ of\ sample \quad \ldots..\ (4)$$

where; m_1 is the burette reading of water sample, m_2 is the burette reading of the reference, (Note: Same steps can be repeated by using distilled water instead of the sample), 35.45 is the molecular weight of Cl, N is the normality of $AgNO_3$ which equal to 0.0141 (WHO, 2022).

3. Results and Discussion

The obtained results are presented in the Table (1).

Table (1.4): the values of PH, E.C, T.D.S, T.H, Ca^{+2}, Mg^{+2}, Cl^- of school reservoir's water samples under study.

Sample No.	pH	E.C (µs/cm)	T.D.S (ppm)	T.H (ppm)	Ca^{+2} (ppm)	Mg^{+2} (ppm)	Cl^- (ppm)
1	7.94	3630	142.1	176	36.8	20.41	53.2
2	7.39	2850	129.9	180	35.2	22.35	60.3
3	7.24	1991	76.6	152	40	12.6	14.2
4	8.60	2840	113.5	128	32	11.6	19.7
5	7.81	2490	97.4	80	30.4	0.97	46.15
6	7.72	3200	1215	1372	304	148.7	337.2
7	7.82	2200	84.4	96	35.2	1.9	35.5
8	8.06	5910	2270	184	49.6	1.5	85.2
9	7.69	1190	46.3	144	25.6	19.4	28.4
10	8.10	3580	135.9	136	35.2	11.6	56.8
11	7.74	1415	55.9	100	30.4	5.8	35.5
12	8.21	2770	115.3	156	38.4	14.5	71
13	7.85	1014	40.9	80	28.8	1.9	14.2
14	8.13	1031	49.4	72	22.4	3.8	39.05
15	7.75	4000	163.8	128	43.2	4.8	67.45
16	7.53	3040	125.7	72	14.4	8.7	71
17	8.12	7240	306	252	60.8	24.3	81.65
18	7.93	3660	172.7	152	35.2	15.5	67.45
19	7.64	2340	117.5	132	36.8	9.7	46.15
20	6.94	3710	157.9	80	14.4	10.6	81.65
21	7.18	430	28.9	52	12.8	4.86	92.3
22	8.08	3850	171.9	104	20.8	12.6	67.45
23	7.75	3940	150.0	164	36.8	17.5	46.15
24	7.38	1747	66.1	104	28.8	7.7	31.95
25	6.76	1551	80	68	14.4	7.7	49.7
26	6.66	2160	105	88	1.6	20.2	85.2
27	7.70	6570	271	112	24	12.6	120.7
28	6.63	3690	172.5	104	27.2	8.7	63.9
29	7.57	2040	95.8	100	30.3	5.8	4.85
30	7.08	5360	2150	1492	374.4	135.1	930.1
31	6.70	3930	163.6	132	30.3	13.6	63.9
32	7.96	2160	83.7	68	22.4	2.9	28.4
33	6.81	2760	1079	1144	256	122.4	234.3

4.1. pH

There is no direct adverse effect on health by the pH. But the effect appears in water taste. The higher values above of 8.5 gives alkaline taste and lower values makes the water taste sour (Hossain *et al*., 2012).

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It is noted from the results that the PH values range from 6.63 to 8.6 as shown in Figure (2), thus all the values are slightly acidic (moderate) and fall within the permissible limit according to the Libyan Standard Specifications, which ranges between 6.5 and 8.5.

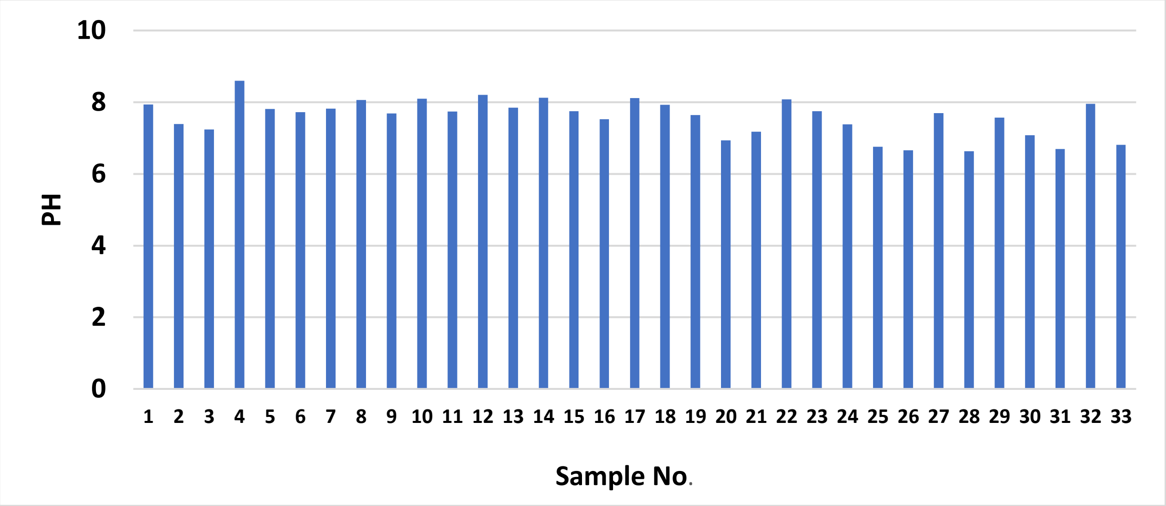

Figure 2. The pH level of water samples

4.2. Electrical conductivity (E.C)

It can be seen from Figure (3) that the E.C values in most of samples were high and exceeded the permissible limit according to the Libyan Standard Specifications, which equals 2000 µs/cm.

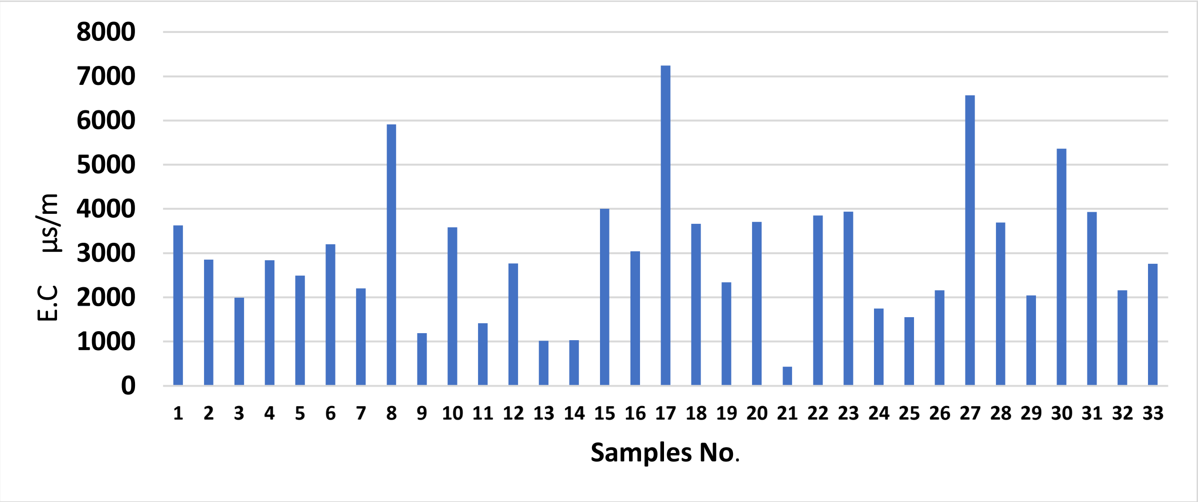

Figure 3. The level of E.C of water samples

4.3. Total Dissolved Salts (T.D.S)

It is noted from Table (1) and Figure (4) that the T.D.S values ranged from 28.9 to 2,270 ppm, and it is within the permissible limit, which is equal to (100 - 500 ppm) according to the Libyan standard specifications except for samples (6, 8, 30, and 33) respectively, whose values were

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equal to 1215, 2270, 2150 and 1079 ppm. This height may be due to the storage facilities and the type of water source.

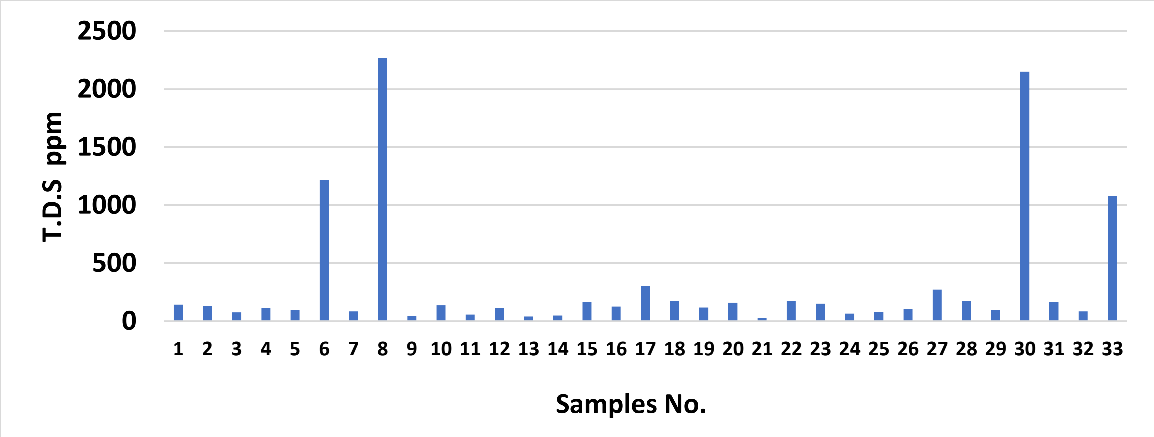

Figure 4. The level of (T.D.S) of water samples

4.4. Total Hardness (T.H)

The total hardness is a numerical expression of the water content of minerals, primarily Ca^{+2} and Mg^{+2} ions and other alkali metal ions that are present in the formation of the cement constructions. It is noted from Figure (5) that the total hardness values (T.H) in most of the studied samples are less than the permissible limit according to the Libyan standard specifications, which is equal to 200 mg/L except for samples (6, 30, and 33) which are 1,372, 1,492, and 1,144 mg/L, respectively. They are very high, and sample 17 was slightly high as it equals 252 ppm.

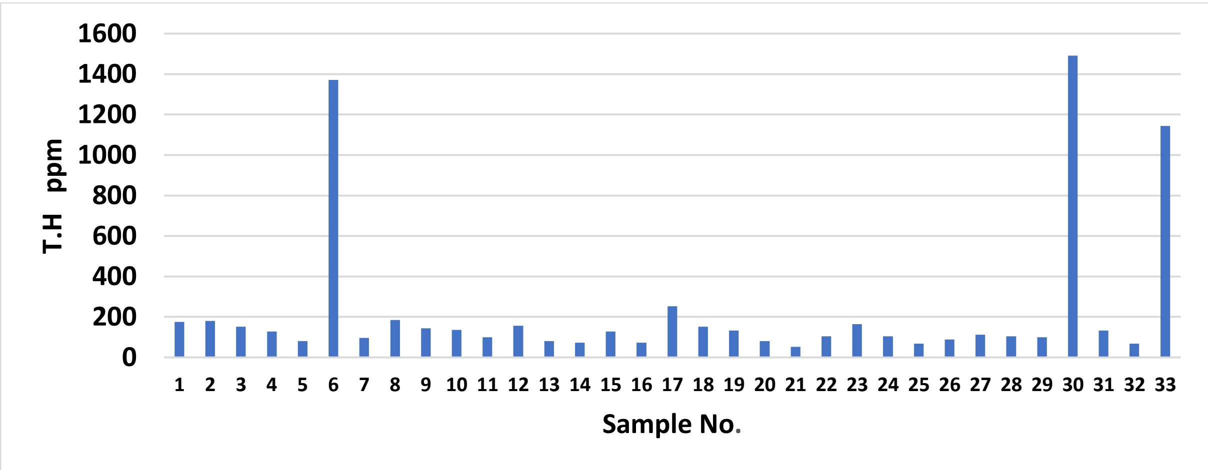

Figure 5. The level of (T.H) of water samples

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4.5. Calcium (Ca^{+2})

It is noticed from Figure (6) the values of Ca^{+2} in all samples were within the permissible limit (200 ppm) and ranged from 1.6 to 60.8 ppm except for samples (6, 9, and 30), which Ca^{+2} values appeared above the permissible limit and equal to 304, 374.4 and 256 ppm, respectively.

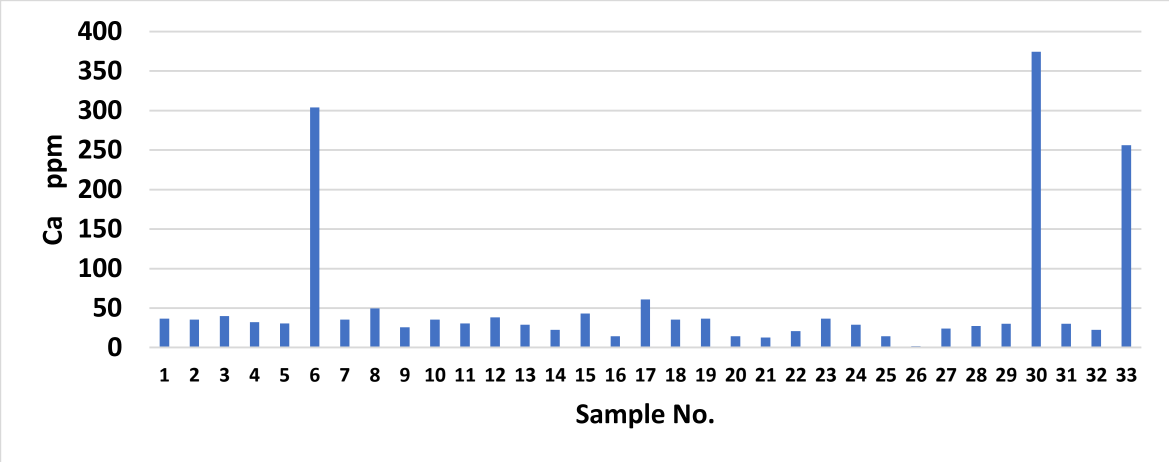

Figure 6. The level of (Ca^{+2}) of water samples

4.6. Magnesium (Mg^{+2})

It can be seen from Figure (7) that all the values of Mg^{+2} concentrations are less than the permissible limit according to the Libyan standard specifications (150 ppm). It can be noticed that a small rise (close to 150 ppm) in samples (6 and 30) whose values were 135.1and 148.7 ppm, but they are still within specification.

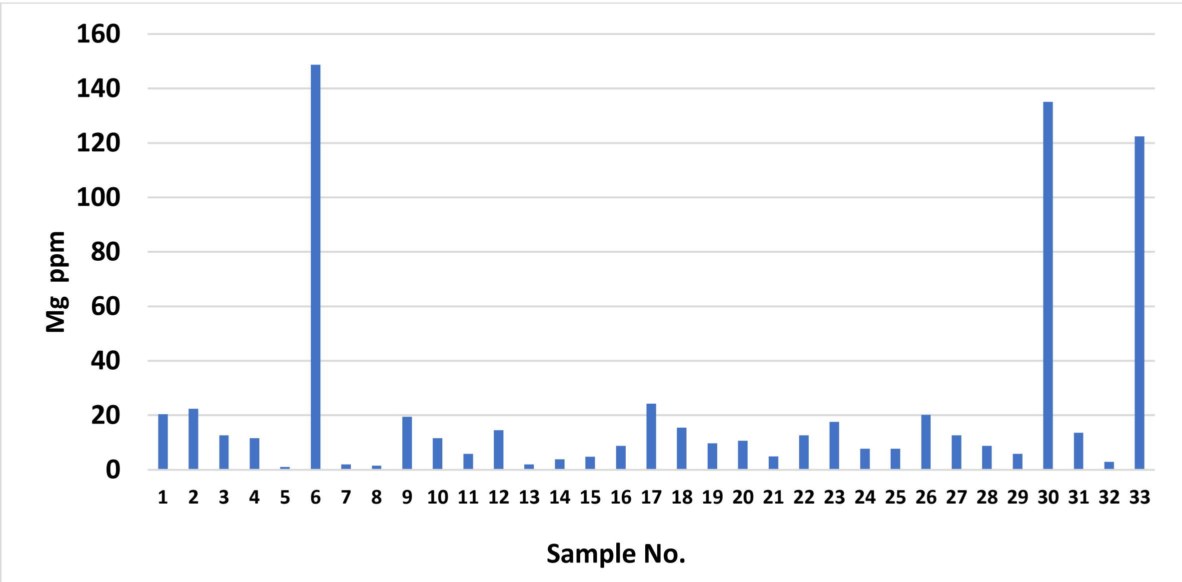

Figure 7. The level of (Mg^{+2}) of water samples

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4.7. Chloride (Cl^-)

It can be seen from Figure (8) the Cl^- values in all samples are within the permissible limit according to the Libyan Standard Specifications (250 ppm) except for samples (6) and (30).

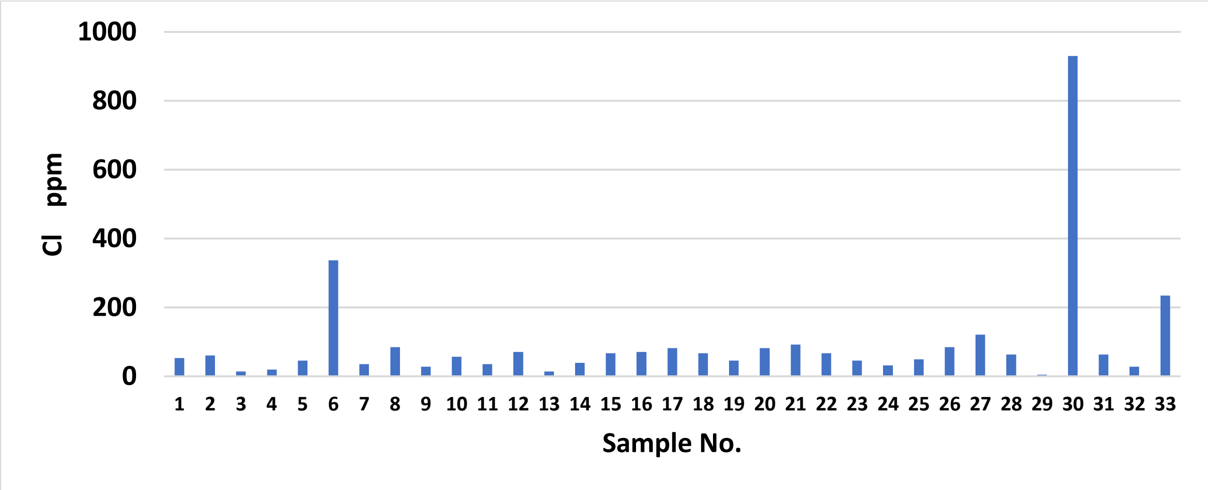

Figure 8. The level of (Cl^-) of water samples

4. Conclusion

According to this study, it can be concluded that the pH values of all samples were slightly acidic. Extremely high E.C. values in samples (6) and (30). The concentration of T.D.S, T.H, Ca^{+2}, Mg^{+2}, and Cl^- was within the permissible limit except for samples (6) and (30). The concentration of salts in drinking water is affected by the facilities of running water such as pipes, tanks, and other accessory. In general, drinking water in the targeted area is safe and satisfies the Libyan standard specifications except for three samples.

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