African Journal of Advanced Pure and Applied Sciences (AJAPAS)
Online ISSN: 2957-644X
Volume 4, Issue 4, 2025
Page No: 208-217
Website: https://aaasjournals.com/index.php/ajapas/index
ISI 2025: 1.126 SJIFactor 2024: 6.752 معامل التأثير العربي: 1.62

A study of the physical properties of drinking water in some areas of western Libya

Munera Mustafa Aonyas [1*], Ebtihal Fathy Tarish [2],
Umaima Nour El-Din Ghita [3], Maha Fawzy El-Abbasi [4]
[1] Department of Chemistry, Faculty of sciences, Sabratha University, Raqdalin, Libya
[2,3,4] Department of Chemistry Graduates, Faculty of sciences, Sabratha University, Raqdalin, Libya

دراسة الخصائص الفيزيائية لمياه الشرب في بعض مناطق غرب ليبيا

منيرة مصطفى اونيس [1*]، ابتهال فتحي طريش [2]، اميمة نورالدين غيطة [3]، مها فوزي العباسي [4]
[1] قسم الكيمياء ، كلية العلوم ، جامعة صبراتة، رقدالين ، ليبيا
[2،3،4] خريجات قسم الكيمياء ، كلية العلوم ، جامعة صبراتة، رقدالين ، ليبيا

*Corresponding author: muneramustafa020@gmail.com

Received: August 11, 2025	Accepted: October 13, 2025	Published: October 20, 2025

Abstract:
This study aims to evaluate the quality of drinking water in some areas of the western region by comparing the physical properties of ten desalinated water samples and eight groundwater (well) samples. Laboratory analyses were conducted for a number of important parameters, including pH, electrical conductivity, total dissolved solids (TDS), turbidity and the obtained results were compared with the Libyan national standards and those of the World Health Organization (WHO).).

The results showed that the pH of desalinated water ranged from 7.7 to 8.9. Most samples were within the permissible limit, except for samples A1, A2, and A4, which recorded values of 8.9, 8.6, and 8.6 respectively—slightly above the maximum allowed limit. As for well water, pH values ranged between 7.1 and 8.3, and all were within acceptable limits.

The electrical conductivity of desalinated water was relatively low, ranging from 84.6 to 466.6 µS/cm, and all values were within the recommended limits. In contrast, well water samples ranged from 109.4 to 6027 µS/cm, indicating a clear exceedance in several samples (B2, B4, B6, B7) of the permissible limits, suggesting high salinity. These samples recorded values of 3465, 4249, 6027 and 3364 µS/cm respectively.

All TDS values in desalinated water were within permissible limits. As for well water, it was observed that four samples (B2, B4, B6, B7) recorded values of 2247, 2761, 3918, and 2186 mg/L, respectively exceeding the acceptable limits.

Turbidity levels in all desalinated and well water samples were within acceptable limits, except for two well water samples (B6 and B9), which recorded values of 3.04 and 2.38 NTU, respectively. These exceeded the ideal limit but remained below the maximum allowable limit.

Keywords: pH, electrical conductivity, total dissolved solids, turbidity.

الملخص
يهدف هذا البحث لتقييم جودة مياه الشرب في بعض مناطق المنطقة الغربية وذلك من خلال مقارنة الخصائص الفيزيائية لعشر عينات من مياه التحلية ثمانية عينات من الآبار وتم إجراء التحاليل المعملية لمجموعة من المعايير المهمة شملت الأس الهيدروجيني والموصلية الكهربائية والأملاح الذائبة الكلية والعكارة وتمت مقارنة النتائج المتحصلة عليها مع المعايير القياسية الليبية ومنظمة الصحة العالمية.
أوضحت النتائج أن الأس الهيدروجيني لمياه التحلية تراوحت بين (7.7 – 8.9) اغلبية العينات كانت ضمن الحد المسموح به باستثناء العينات (A4,A2,A1)التي سجلت القيم (8.9, 8.6 ، 8.6) على التوالي أعلى بقليل من الحد الأعلى .

المسموح به ، والأس الهيدروجيني بالنسبة لمياه الآبار تراوحت بين (8.3-7.1) فكل القيم كانت ضمن الحدود المسموح بها، وبالنسبة للموصلية الكهربائية لمياه التحلية (84.6- 466.6 ميكروسيمنزلكل سنتيمتر) وهي جميعها ضمن الحدود الموصى بها، أما الموصلية الكهربائية لعينات مياه الآبار فقد تراوحت بين (109.4-6027 ميكروسيمنزلكل سنتيمتر) مما يشير إلى تجاوز واضح في عدة عينات للحدود المسموح بها مما يدل على ملوحة عالية .
قيم الأملاح الذائبة الكلية لمياه التحلية جميعها ضمن الحدود المسموح به ، أما مياه الآبار فقد لوحظ تجاوز لأربعة عينات التي كانت القيم (2247 ، 2761 ، 3918 ، 2186) وهي أعلى من القيم المسموح بها ، (B2,B4,B6.,B7)بالنسبة للعكارة كانت جميع العينات لمياه التحلية ومياه الآبار ضمن الحدود المسموح بها ، باستثناء عينتين من مياه الآبار
(B9,B6) وكانت قيم العينتين على التوالي (NTU2.38,3.04) تجاوزت الحد المثالي لكنها بقيت تحت الحد الأعلى المسموح به.

الكلمات المفتاحية: الرقم الهيدروجيني، التوصيل الكهربائي، الأملاح الذائبة الكلية، العكارة.

Introduction

The water is considered the basic element for all living creatures. It is necessary for every cell and tissue in the living creature. It constitutes about 65% of the components of the human body, and through it all vital processes take place inside and outside the cells (Najat Al-Mabrouk Aoun *et al*., 2019, Walid bin Mohammed *et al*., 2002, Abdul Nasser Al-Bashir Omar *et al*., 2019) The water covers 71% of the Earth's surface. Despite this, we have not dealt with it properly due to the increase in population, agricultural and industrial activities near water sources and distribution networks. One of the disadvantages of this matter is human errors that led to linking the supply network to the drainage networks, and extending sewage lines near the water network lines. As a result, the concentration of many pollutants in this water has increased, so the water has become unable to get rid of these pollutants (Najat Al-Mabrouk Aoun *et al*., 2019, Walid bin Mohammed *et al*., 2002).

The population increase led to an increase in water consumption, which led to a decrease in the basic stock of fresh water and its inability to meet the necessary water needs. This led to the use of small stations to treat groundwater to make it suitable for human use (, Walid bin Mohammed *et al*., 2002, Abdul Nasser Al-Bashir Omar *et al*., 2019).

Currently, most water sources are polluted, starting from seas, oceans, rivers, groundwater, and rainwater. The pollutants that reach the human body daily in water pose a danger, whether these pollutants are biological or chemical (Najat Al-Mabrouk Aoun *et al*., 2019, Abdulrahman I. Alabdula'aly *et al*., 1999). Therefore, water quality must be monitored to raise the level of public health by constantly investigating the conditions of water quality and its suitability for drinking. The costs of this process are expensive, especially when using modern technologies in purification and filtration processes (Najat Al-Mabrouk Aoun *et al*., 2019, Shaima Al-Maamouri, 2017).

Total dissolved salts affect water properties such as taste, hardness, and the tendency to scale (Samah Hassan Abu Bakr *et al*.,2024). Low levels of these salts are not recommended for drinking. The electrical conductivity of water is a direct indication of the total concentration of total dissolved salts. The electrical conductivity values of water depend on the concentration and quality of the salts in it (Samah Hassan Abu Bakr *et al*.,2024)..

Due to the increasing problem of water pollution, we as researchers must intensify our efforts and research in order to monitor water to reach the distribution of pure water to the largest possible number of people. As a result of the importance of water and its purity, we studied some physical properties such as pH, conductivity and turbidity in different samples of drinking water using accurate analytical methods and comparing them with the permissible limits according to Libyan standards and the World Health Organization.

Previous studies

Many studies have been conducted regarding the quality of water and its suitability for drinking. A study was conducted in 2024 in the city of Ajilat in the Kweriya area, which included ten samples. The results showed that the samples were free of microbial contamination, as well as the values of pH, sodium, potassium, bicarbonate, and chloride in all samples within the permissible limits according to Libyan and international standard specifications, while the conductivity, total dissolved salts, and nitrates did not exceed the permissible limits of Libyan and international specifications (Asim Ramadan Ammar Muhammad *et al*.,2024).

A study was also conducted in the Al-Joush area in 2024, where twelve diverse samples were taken, including natural springs, domestic and agricultural groundwater wells. The analysis results, when compared with the Libyan standard specifications and the World Health Organization specifications, indicated that most of the samples did not comply with the standard conditions; as the values of electrical conductivity, total dissolved salts, magnesium ion concentration, sulfate ion, and bicarbonate ion were higher than the permissible level, while the values of hydrogen ion, potassium ion concentration, and nitrate ion concentration were within the permissible limits according to Libyan and international specifications (Samah Hassan Abu Bakr *et al*.,2024).

A study was conducted in 2025 in the city of Tarhuna on nine well waters and nine desalinated waters. The results obtained showed that the desalinated waters contain very low concentrations of dissolved salts and electrical conductivity, which makes them less than the permissible limit according to Libyan specifications, while most samples of groundwater wells exceeded the permissible limits for these characteristics. Although the pH and most heavy metals in the well waters were within the acceptable limits, the high concentration of sulfates, sodium and nitrates in some samples may pose a risk to public health (Tabara Misbah Muhammad *et al*.,2025).

Description of the study areas

The target locations for the study are the following areas: Al-Jamil, Raqdalin, and Zelten. The Al-Jamil area is located 110 km west of Tripoli. It is characterized by its flat terrain and clay and sandy soil, Agriculture in this area depends on groundwater, as there are many agricultural and drinking wells there.

The Ragdalin area is located west of the city of Al-Jamil, 115 km west of Tripoli. It is famous for its rural and pastoral atmosphere. Although many reservoirs and wells are the main sources of water, groundwater covers the majority of the population's drinking water needs. The Zelten area is located 125 km west of Tripoli, and is characterized by similar terrain, relatively limited agricultural activity, and reliance on medium-depth groundwater sources.

Figure (1) Study areas.

Sample Collection

Drinking water samples used in the study were collected from various sources in the Al-Jamil, Raqdalin, and Zelten regions for the purpose of analyzing and evaluating their contents by estimating some physical properties such as pH, conductivity, dissolved salts, and turbidity. Table (1) shows the drinking water sample collection sites.

These areas were selected due to their dependence on different water sources, including both well water and desalination plant water, in order to evaluate the quality of water in these areas and compare it with Libyan and international specifications. Eighteen samples were collected: ten desalinated water samples and nine well water samples, as follows: six samples from the Al-Jamil area (three desalinated and three wells), eight samples from Ragdalin (five desalinated samples and three well samples), and four samples from Zelten (three desalinated samples and one well sample).

The study samples were collected using clean 1-liter polyethylene plastic bottles. The sample number was recorded on each bottle. Three replicates were taken for each sample. The bottle was washed with the water to be collected to ensure it was free of any impurities or contaminants that might affect the analysis results. The samples were transported to the laboratory for the required analyses.

Table (1) shows the locations for taking drinking water samples (desalination and wells).

Sample code	Sample type	The area	the site
A1	dessert	Al-Jamil	Al-Makman near the Al-Makman Mosque
A2	dessert	Al-Jamil	Al-Makman near Omar Ibn Al-Khattab School
A3	dessert	Al-Jamil	Al Nabaa Market near Al Shamoukh School
A4	dessert	Al-Jamil	Abu Qur'a
A5	dessert	Ragdalin	Electricity Company Road
A6	dessert	Ragdalin	Hoba near the mosque
A7	dessert	Ragdalin	The Shabshoubi, Al-Assa Road
A8	dessert	Ragdalin	Sea road near the power station
A9	dessert	Ragdalin	Near Zamzam Mosque
A10	dessert	Zelten	Malit Road
B1	well	Al-Jamil	Near Al-Jamil High School
B2	well	Al-Jamil	Al-Huda Street
B3	well	Ragdalin	Al-Sabikha Road near the cemetery
B4	well	Ragdalin	Malit Road near Al-Fida School
B5	well	Ragdalin	Ras Atiya Road near Balao Mosque
B6	well	Zelten	Al-Awtad Mosque
B7	well	Zelten	Malit
B8	well	Zelten	Near Hamza bin Jarrah Mosque

Measurement methods and devices used in analysis and measurement

PH meter

The pH is one of the most important properties of drinking water. It is the negative logarithm of the hydrogen ion concentration in water. The pH meter made in Italy, type of HANNA Instruments.

Electrical conductivity

Conductivity is a good indicator of dissolved salts in water, as it is one of the important measures for measuring dissolved salts. Conductivity is a numerical expression that indicates the ability of an aqueous transformer to transmit electrical current.

The electrical conductivity of water depends on the amount of ions dissolved in the water, which carry positive and negative electrical charges. The degree of electrical conductivity increases directly with the increase in the amount of these substances. When the water contains dissolved pollutants such as salts and minerals, the electrical conductivity value increases. Therefore, its values can be used to estimate the degree of purity and contamination with dissolved substances.

Total dissolved solids (TDS)

Dissolved salts are one of the basic indicators for evaluating the quality of drinking water. Dissolved salts in drinking water constitute the majority of dissolved solids. Dissolved solids are a group of ionic compounds of a number of minerals in addition to organic compounds and free minerals.

Figure (2) Device used to measure pH, electrical conductivity, and total dissolved salts.

Turbidity

Turbidity is an expression of the quality of freshwater. It is a measure of the rate at which light passes through the water. There is no relationship between turbidity and the concentration of suspended matter in the water. Turbidity depends on the quantity, type, color, and fineness of the suspended matter. Turbidity is measured in drinking water as a quick test of the quality of treated water and the extent of its colloidal or suspended matter content. Turbidity determines the suitability of the water for drinking or for the type of water used.

Local and international bodies have recommended that water turbidity should not exceed one NTU. Water with a turbidity of more than one NTU is not suitable for drinking and must be treated to get rid of the turbidity. Turbidity testing is carried out by passing light through a water sample and then measuring the scattering or reflection that occurred in this sample (Zaid Nihad Abu Zeina, 2017). A turbidity measuring device was used, made in Italy, the manufacturer's name is (HANNA lnstrument).

Figure (3) Turbidity measuring device

Results and Disussion

In this study, samples collected from desalinated water and wells in the areas of Al-Jamil, Raqdalin and Zelten were analyzed. They numbered eighteen samples, and physical tests were performed on all samples. The results of the physical tests are shown in Table (2).

Table (2) shows the results of physical tests for drinking water samples (wells and desalination).

Sample code	PH	Conductivity (Cond) µS/cm	Turbidity NTU	Dissolved salts(TDS)
A1	8.9	177.8	0.38	115.1
A2	8.6	84.6	1.05	55.9
A3	8.4	86.92	2.23	66.09
A4	8.6	466.6	0.57	324.5
A5	8.1	246.9	0.40	160.6
A6	7.9	99.5	0.52	64.7
A7	7.7	117.3	0.37	75.9
A8	8.3	273.2	0.39	177.5
A9	8.2	87.3	0.32	56.6
A10	8.4	171.3	0.47	110.7
B1	8	247.1	0.57	160.6
B2	7.3	3456	0.53	2247
B3	7.5	604.5	0.28	392.9
B4	7.5	4249	0.32	2761
B5	7.8	1163	0.22	756
B6	7.1	6027	3.04	3918
B7	7.7	3364	0.99	2186
B8	8.2	109.4	0.37	71.1

pH concentration results

When analyzing the obtained results, we note that the pH values of most samples fall within the limits permitted by the Libyan standard specifications and the World Health Organization. In the results of the analysis of desalinated water in Figure (4), the values ranged between (7.7 and 8.9). Sample A1, which recorded a value of 8.9, and samples A4 and A2, which recorded 8.6, are considered a slight increase according to the Libyan and international specifications (6.5 - 8.5). This may be due to an increase in alkalinity in the treatment process (National Center,2008 , Asmaa Abdel Hamid Balq *et al*.,2019).

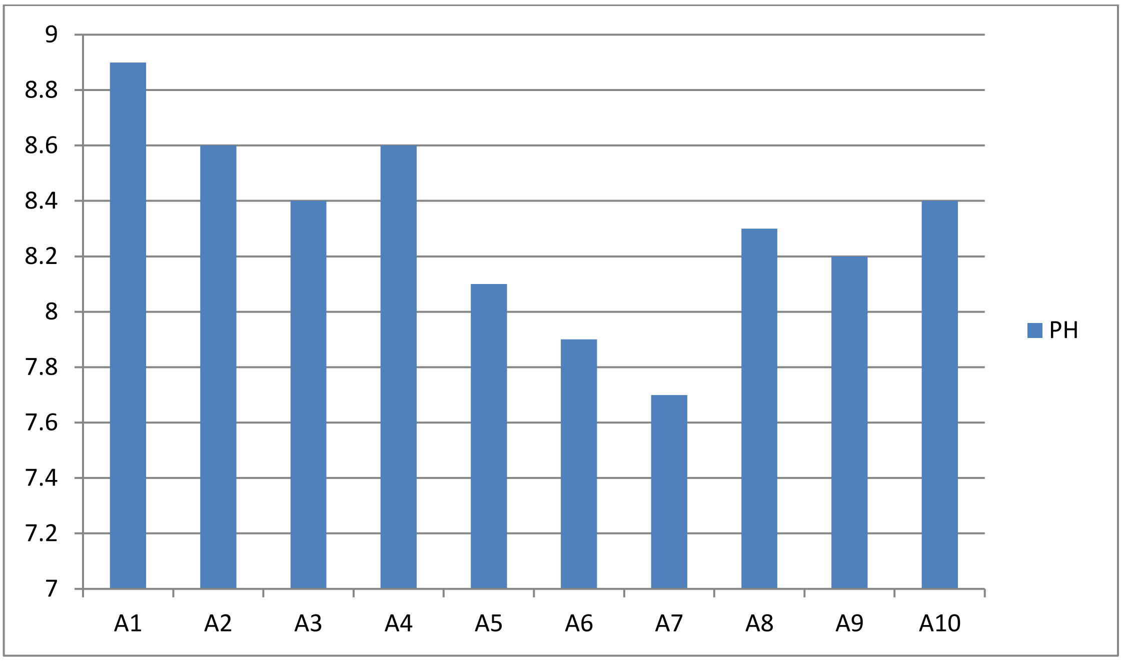

Figure (4) shows the results of the pH values of the studied desalinated water samples.

The pH results of the well water were in Figure (5) where they ranged between (7.1 and 8.2) and all of them are within the permissible limits. The sample that was closest to the permissible limit was sample B6, which recorded 7.1, which may indicate water of an acidic nature due to the interaction with organic materials or minerals in the earth's layers.

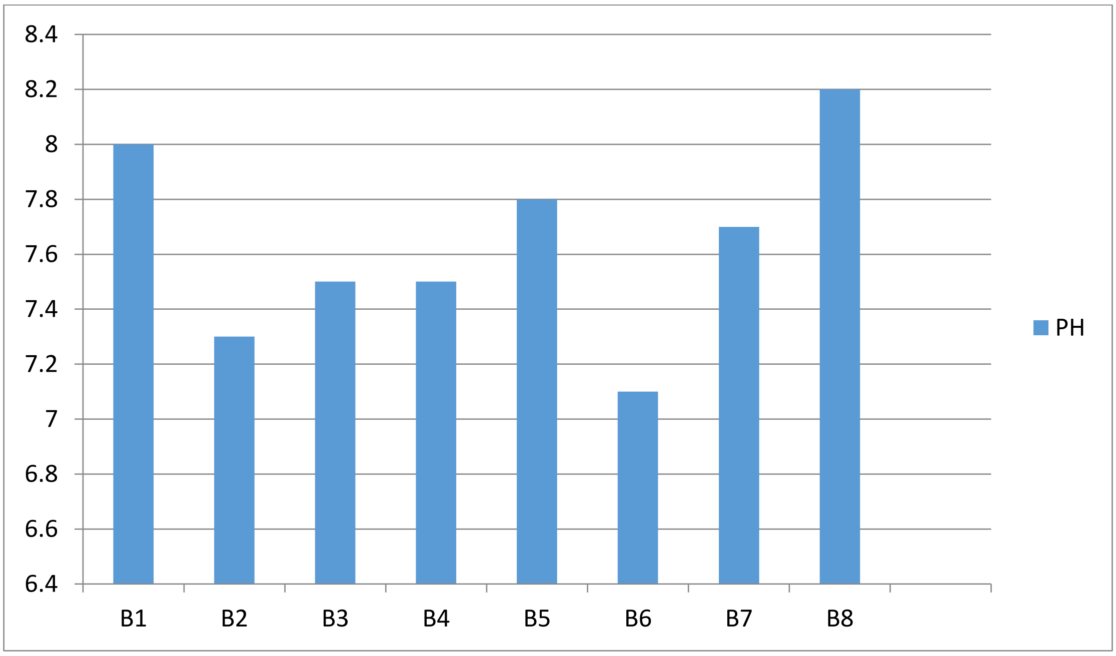

Figure (5) shows the results of the pH values of the studied well water samples.

Electrical conductivity results

According to Libyan and international standard specifications, the optimum value of electrical conductivity in drinking water should be less than 1500 µS/cm, as high conductivity indicates the presence of high concentrations of dissolved salts, which affects the taste of water and human health when the permissible limit is exceeded. The results of the electrical conductivity of desalinated water samples shown in Figure (6) showed that they were relatively low, as they ranged between 84.6 and 446.6 µS/cm, which is much less than the maximum permissible limit. This reflects the high efficiency of desalination processes in removing dissolved salts and minerals. These values are a positive indicator of the quality of the produced water, as all values fall within the permissible range for drinking water (National Center,2008 , Asmaa Abdel Hamid Balq *et al*.,2019)..

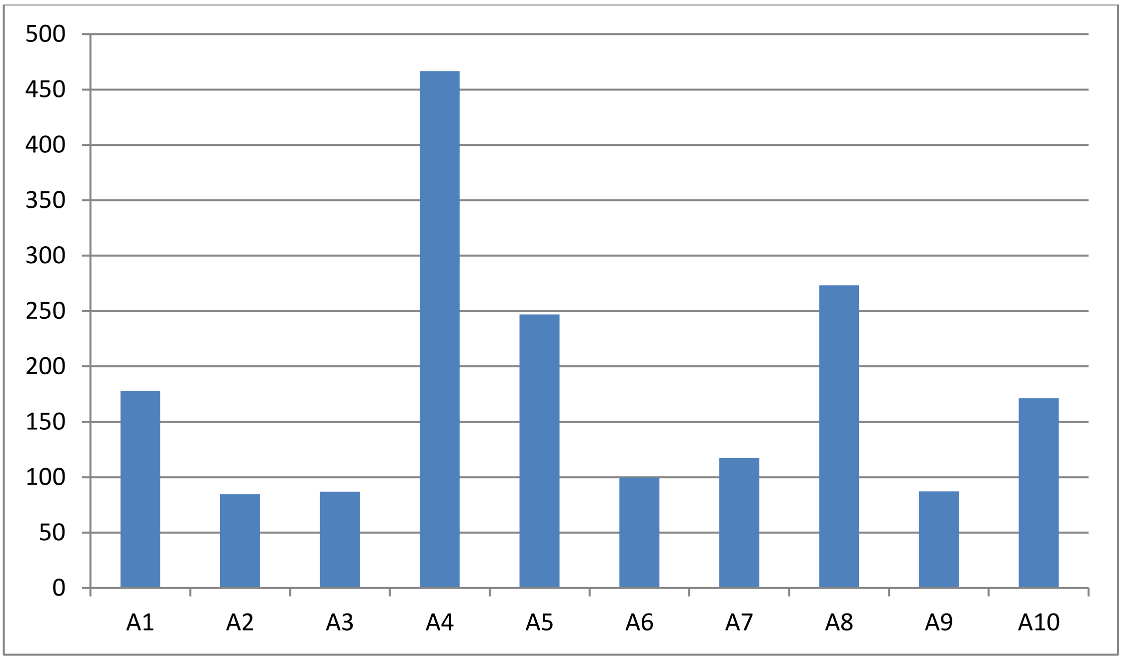

Figure (6) Conductivity results of the studied desalinated water samples.

As for the well water in Figure (7), there was a large variation in the electrical conductivity values, which ranged between 109.4 and 6027 µS/cm. Some samples gave very high values, indicating the presence of high concentrations of dissolved salts, which may make the water unfit for drinking.

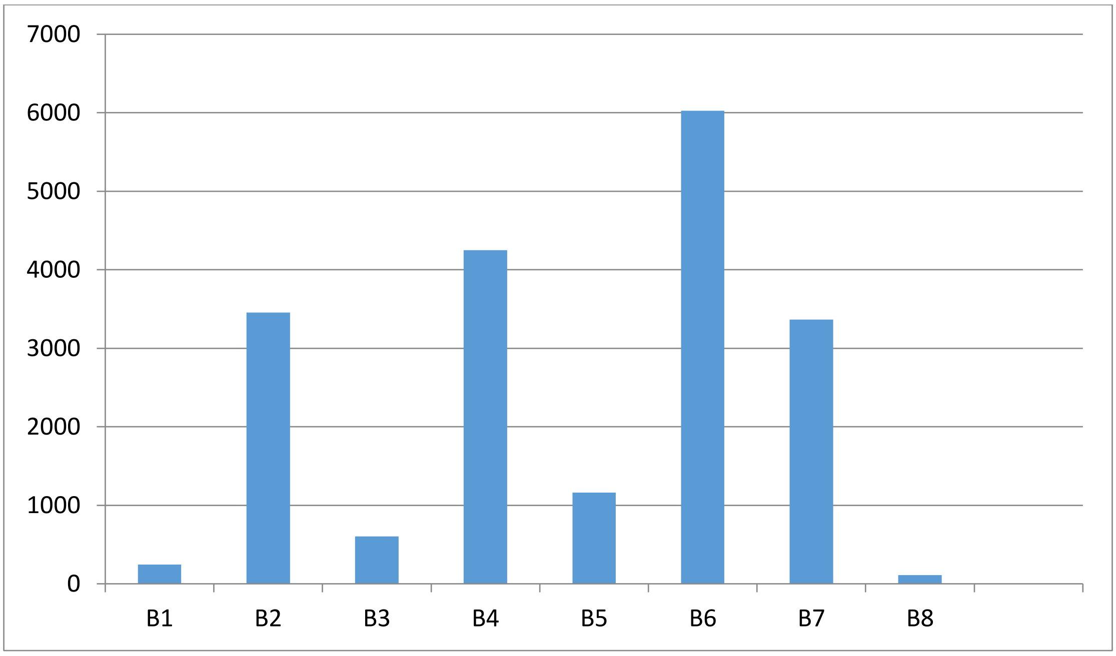

Figure (7) Conductivity results of the studied well water samples.

Comparing the conductivity results between desalinated water and well water, we see that there is a significant difference in water quality. While desalinated water shows relatively low and stable conductivity, well water suffers from significant variation and high values, reflecting differences in the quality of groundwater sources.

Total Dissolved Salts results (TDS)

Through the results of the dissolved salts shown in Figure (8), the results of the desalinated water show that most of the samples contain a low concentration of dissolved salts, as the values ranged between 55.9 to 324.5 mg/L, and they all fall within the permissible limits according to Libyan and international specifications (National Center,2008 , Asmaa Abdel Hamid Balq *et al*.,2019).

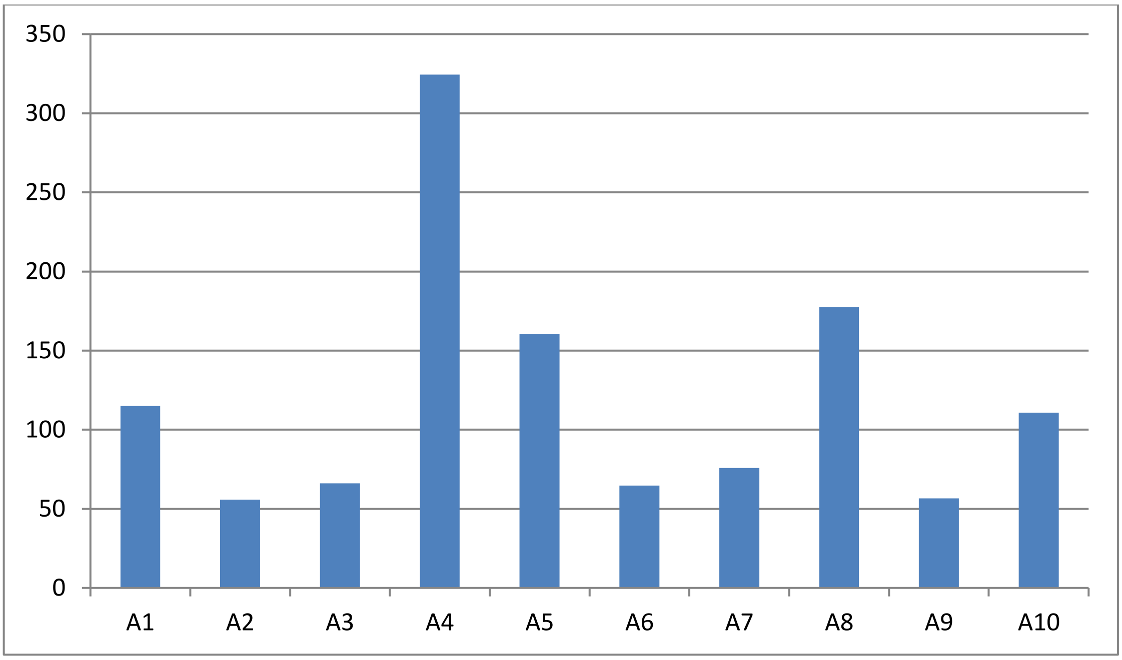

Figure (8) shows the results of the dissolved salts of the studied desalinated water samples.

The results of the concentration of dissolved salts in well water shown in Figure (9) showed a significant increase in a number of samples, while the values of other samples were low, such as 71.1 mg/L, and this indicates a significant difference in the quality of groundwater.

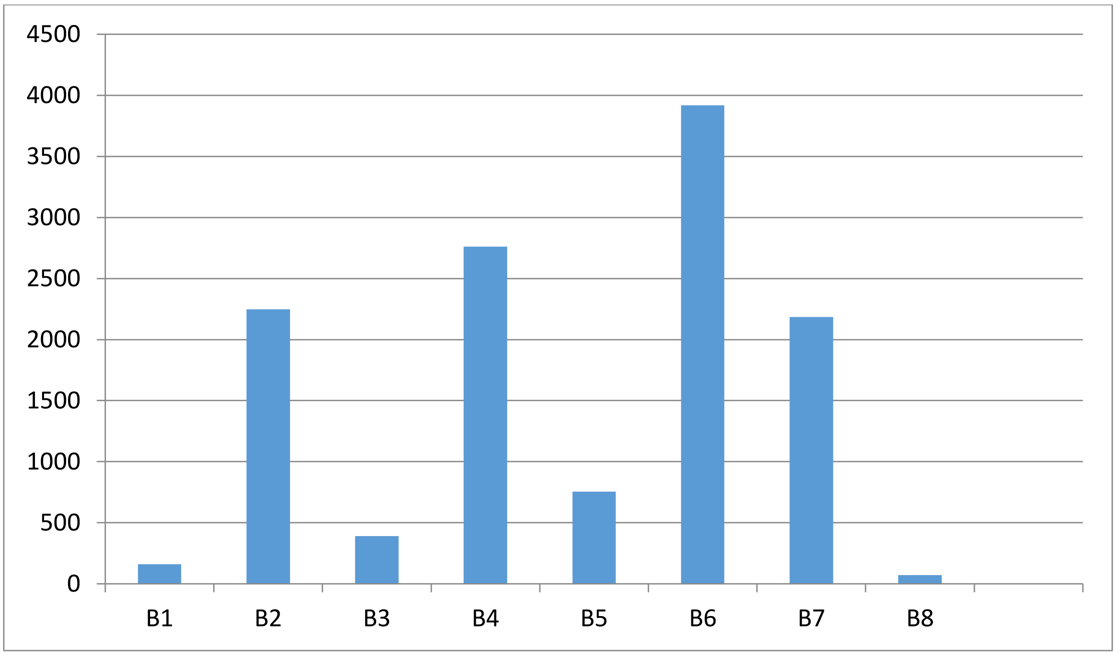

Figure (9) shows the results of the dissolved salts of the studied well water samples.

By comparing the results of desalinated water and wells, it becomes clear that desalinated water has a higher quality, as it is within the Libyan and international standard limits, while a number of well waters are considered unsuitable for direct drinking, due to exceeding the permissible values, which may cause health problems or an unacceptable taste.

Turbidity Results

It is clear from the turbidity results of the desalinated water samples in Figure (10) that all samples fall within the permissible limits according to Libyan and international standard specifications, as turbidity values ranged from 0.3 to 2.23 NTU (National Center,2008 , Asmaa Abdel Hamid Balq *et al.*,2019)..

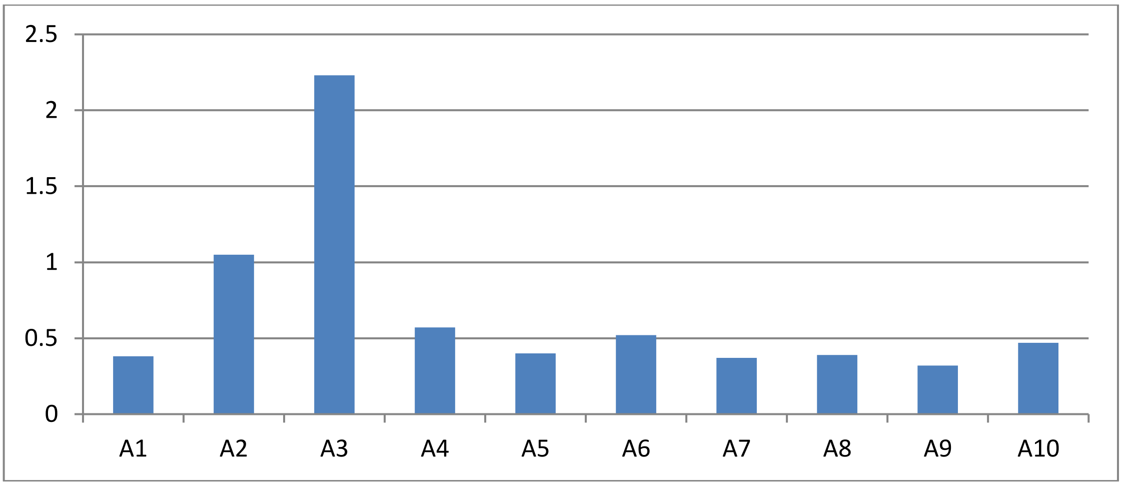

Figure (10) shows the turbidity results for the studied desalinated water samples.

Turbidity results for well water shown in Figure (11) show that the majority of samples recorded low values of less than 1 NTU, with the exception of two samples (B9, B6) whose results, respectively (3.04 and 2.38 NTU), exceeded the ideal limit but remained below the maximum permissible limit, indicating the need for periodic monitoring of the water to ensure its quality.

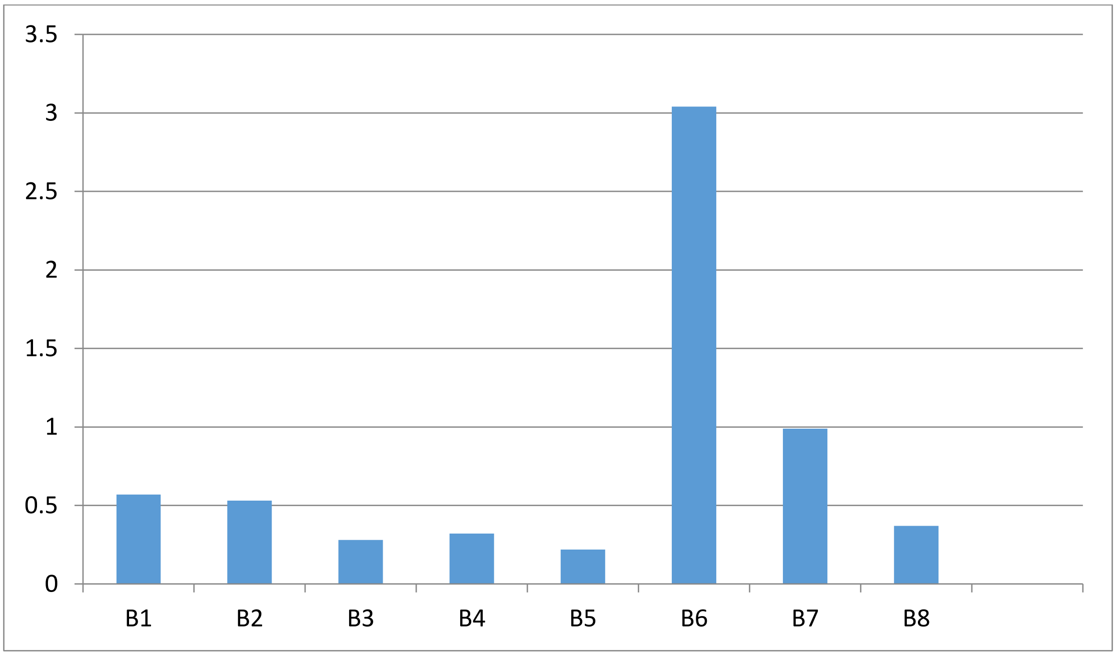

Figure (11) shows the turbidity results of the studied well water samples.

Conclusions

This study evaluated the drinking water quality of ten desalinated water samples (A1-A10) and nine well water samples (B1-B8). This was achieved by analyzing a number of basic physical and chemical properties, including pH, electrical conductivity, dissolved salts, turbidity, nitrate concentration, manganese, and free and total copper. These properties were compared to Libyan and World Health Organization (WHO) standard

specifications, as these are essential indicators of water safety and suitability for human consumption. Water samples were collected from various sources and analyzed using approved chemical analysis methods.
The results indicated that the desalinated water was generally of acceptable quality, with a slight increase in the pH value of three samples (8.9, 8.6, and 8.6). The electrical conductivity and dissolved salts were within the permissible limits, and the turbidity was low according to Libyan and World Health Organization standards.

The results of the well water samples also showed a noticeable difference in quality. The pH was within the permissible limits, while the electrical conductivity of some well water samples exceeded the permissible limit, indicating a high level of dissolved salts and the presence of excessive salinity that may negatively affect the suitability for human consumption, especially in samples (B2, B4, B6, B7), whose values were (2247, 2761, 3918, 2186), which are higher than the permissible values.
Based on these results, it can be said that desalinated water is considered safer and of higher quality than well water in the study areas, with some observations that require continuous monitoring. Well water requires additional treatment and continuous monitoring to ensure water safety.

Acknowledgements: We would like to thank the brothers working in the Chemical Analysis Laboratory of the Environmental Sanitation Department in South Tripoli for the assistance they provided us.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

References

. Abdul Nasser Al-Basheer Omar, Sanaa Ramadan Al-Jali, Salma Ziyada, Arej Antata & Hisham Saleh (2019), Estimation of the concentration of some ions in drinking water in water treatment units in Gharyan Municipality, The Third Annual Conference on Theories and Applications of Basic and Life Sciences.
. Abdulrahman I. Alabdula'aly & Mujahid A. Khan, Chemical composition of bottled water in Saudi Arabia, Environmental monitoring and assessment, (54)(1999) 173 – 189.
. Shaimaa Al-Maamouri , A study to evaluate the efficiency of the drinking water purification plant in Al-Hussein neighborhood complex, Journal of the University of Babylon, Pure and Applied Sciences, (25)(6)2017.
. Asim Ramadan Ammar Muhammad, Najah Ali Ahmed Al-Thabet & Hamid Ahmed Miftah Al-Arifi, Chemical and biological evaluation of the quality of drinking water from home purification units in the Al-Kuwayriya area in Ajilat, (2)(3) (2024)176-187.
. Asmaa Abdel Hamid Balq, Ibtisam Al-Sani Al-Akrout, Ahmed Khaled Attia, Al-Shaibani Muhammad Shaliq (2019), A study of the physical and chemical properties of bottled drinking water from the western region of Libya, Issue Twenty-One, Volume One.
. Najat Al-Mabrouk Aoun & Hamida Salem Kamuka (2019), A study of some physical and chemical properties of some types of local bottled drinking water, The Third Annual Conference on Theories and Applications of Basic and Life Sciences.
. National Center for Standards and Metrology - Libya (2008), Bottled Drinking Water, First Edition.
. Samah Hassan Abu Bakr, Nuha Ali Khalifa & Muhammad Milad Arhuma (2024), Evaluation of groundwater quality in the Al-Joush area - western Libya, Al-Qalam Al-Mubin journal ,(16) 2024 .
. Shaimaa Al-Maamouri , A study to evaluate the efficiency of the drinking water purification plant in Al-Hussein neighborhood complex, Journal of the University of Babylon, Pure and Applied Sciences, (25)(6)2017.
. Tabra Misbah Muhammad, Hanaa Al-Azoumi Abdel Salam, Suad Ali Wanis, Ahmed Muhammad Mawloud, Fadia Ammar Abdel Salam, Quality of drinking water and groundwater wells in the city of Tarhuna (3) (2) (2025) 79-91.
. Walid bin Muhammad & Kamil Zahid , Quality of local and imported bottled drinking water in the Kingdom of Saudi Arabia, King Abdulaziz University Journal of Engineering Sciences, Journal (14) (2)(2002) 81-104.
. Zaid Nihad Abu Zeina , 2017, Water Quality Testing and Monitoring Device in the Distribution Network, Palestine Polytechnic University.

