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## Evaluation of Spring's Sweiber and Thouban Water Quality at AL-Diss Ashrqiya, Hadhramout, Yemen and Its Suitability for Use in Drinking and Irrigation

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**Abstract:** This study was performed for one year (during the period 2018-2019) to investigate Sweiber and Thouban springs water quality of which are located in AL-Diss Ashrqiya-Hadhramout, Yemen. The results showed that the values of the electrical conductivity, total dissolved solids, total hardness, calcium hardness, magnesium hardness, sulphate, fluoride, manganese, calcium, potassium and water temperature are not within the permissible levels of Yemeni and World Health Organization (WHO) standards, therefore, the water of Sweiber and Thouban can be classified as undrinkable water. In comparison with the classifications adopted in this study, it can be concluded that the water of Sweiber and Thouban springs are not suitable for irrigation purposes, as it is water with acute problems.

**Keywords:** Hadhramout; Hot Spring; Sweiber; Thouban; Water quality

### 1. Introduction

The continuous flow and renewal of groundwater beneath the Earth's surface is attributed to the constant replenishment it receives from rainwater when it falls, or through rivers and lakes that seep into the soil to reach the groundwater basin. Groundwater may not be renewable, and its level may gradually decrease as it is consumed. This water, due to its lack of direct connection to renewable sources, has accumulated in the Earth's interior over centuries and rainy periods, and it is distinguished by characteristics different from other groundwater due to its presence in the Earth's interior for long periods. These characteristics include its high temperature derived from the high temperature of the Earth's interior or its proximity to places with volcanic activity. Among its characteristics that led to its name as mineral and sulfurous water is its high content of salts, gases, and sulfur. This water may erupt in the form of springs and fountains [1], and therefore,

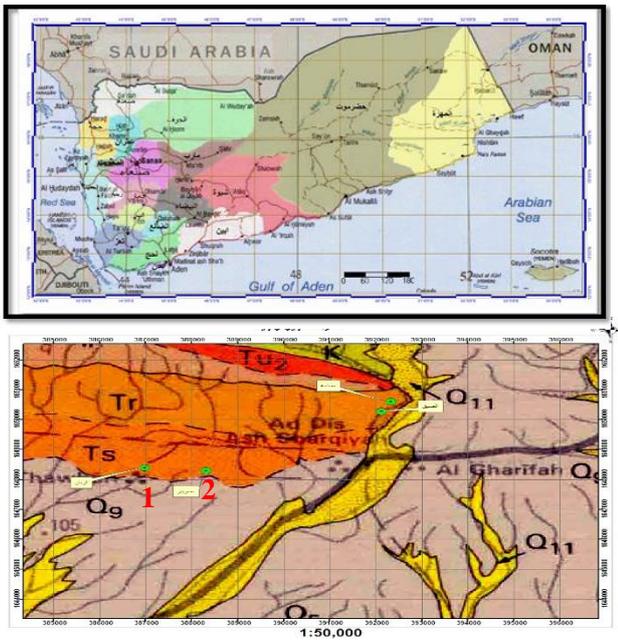
sometimes this groundwater Aquifer does not need to be drilled for wells to appear, as its emergence is a result of increased pressure on it or the pressure of the Earth's crust in this place, causing it to flow in the form of a fountain or the flowing water flows on the surface of the Earth in irrigation canals that carve and split it. [2]

Natural environment in Yemen, such as sea shores, narrow valleys, or between mountains, are often host hot springs [3-6]. Their waters flow through cracks and fissures in areas where rocks meet. In Hadhramout Governorate, which is located at the east of the Republic of Yemen and is the largest governorate in the republic [7], there are number of springs along its coasts from which mineral and sulfurous waters flow. These springs are locally called "Maayeen" (singular: Ma`yan), and they are also called mineral springs because the water from these springs comes from the depths of the earth to its surface and carries with it many minerals and gases. These springs are often associated with the

presence of faults parallel to the Red Sea fault (north-south), and the phenomenon of mineral water flowing is one of the distinctive phenomena in Hadhramout.[8]

In a natural way, this water collects in special water reservoirs that prevent it from mixing with surface water. From one location to another, the amount of this water changes according to the conditions of its formation and the type of layers in which it is stored. Mineral water is also distinguished by its stable chemical composition and its lack of change [2]. The water of many springs is used for medical treatments, where its role in medical tourism becomes prominent. These springs are often frequented by residents of the area or tourists for the purpose of healing from skin diseases and rheumatic diseases. [8,9]

Recent scientific literature indicates that mineral-rich aqueous environments can influence biological systems, as mineral constituents are known to affect physiological processes in plants and other organisms. This is consistent with findings on the impact of nanomaterials on plant morphology, physiology, and productivity, where mineral-based particulate matter alters nutrient uptake and stress responses [10].



**Figure 1.** Map of the Republic of Yemen and a geological map of the AL-Diss Ashrqiya, Hadhramout showing the locations of Thouban spring (1) and Sweiber spring (2). (Source of map: Geological Survey and Mineral Resources Board -Hadhramout Branch for their contribution to identifying and drawing geological map.

All previous studies conducted by a number of researchers during the past three decades (1976-2000) have resulted in the identification of 34 hot springs in the Republic of Yemen, with the highest water temperature reaching about 71°C. In AL-Diss Ashrqiya area, which is about 110 km east of the city of Mukalla, the capital of Hadhramout Governorate (Fig. 1) at coordinates (14.910°N 49.992°E), there is a group of hot springs, the most famous of which are Thouban Spring, Sweiber Spring, Assaiq and

Senah Spring [11]. Thouban Spring and Sweiber Spring are the focus of this study. Thouban and Sweiber are two small villages located west of the AL-Diss Ashrqiya area, where two springs flow with hot sulfurous mineral water, and they are located at about five kilometers to the west of the city center.

This study was conducted during the period 2018-2019. It aims to determine the physical and chemical properties of Thouban and Sweiber spring to compare laboratory results with local and international standards in order to assess the quality of such water in terms of its relevance and use for drinking and agricultural purposes, and to develop recommendations resulting from this study on mechanisms for developing and utilizing these springs for medical tourism.

## 2. Materials and Methods

A field visit was conducted to Thouban and Sweiber springs, which flow year-round in the AL-Diss Ashrqiya area. These two springs were selected due to the continuous flow of their water throughout the year. The coordinates of each spring were taken to determine its geographical location using a Global Positioning System (GPS) device. Samples were collected over different time periods for a period of one year. Sterilized glass bottles with a capacity of 1 liter were used to collect and store the samples. A set of laboratory measurements were performed to study the physical and chemical properties of the water. All analyses were conducted in the central laboratory of the Local Water and Sanitation Corporation in Hadhramout Governorate, Yemen .

The study included temperature measurement T, solids concentration (TDS), electrical conductivity (EC), and pH. The presence of chloride ion (Cl<sup>-</sup>), fluoride F<sup>-</sup>), sodium (Na<sup>+</sup>), potassium (K<sup>+</sup>), calcium (Ca<sup>+2</sup>), magnesium (Mg<sup>+2</sup>), nitrate ion (NO<sup>-3</sup>) and Total Hardness (TH). To measure the color and determine the concentrations of sulfate, fluoride, nitrate, iron and manganese, spectrophotometer DR/2010 was used. The Hanna pH Meter is used to measure pH, and the Conductance Bridge Griffin is used to measure electrical conductivity. The presence of sodium and potassium ion is estimated by the spectral flame lamps. (Flame Photometers) To calculate the risk of both sodium and calcium ions and salinity in water and to identify the quality of water used for agricultural purposes, the following mathematical relationships were used: -

Sodium Adsorption Ratio (SAR), calculated according to the following formula:

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{+2} + Mg^{+2}}{2}}} \quad (1)$$

The Residual Sodium Carbonate (RSC) was measured also with the following relationship:

$$RSC = (CO_3 + HCO_3^-) - (Ca^{++} + Mg^{++}) \quad (2)$$

Total alkalinity, total hardness, calcium and chloride measurement were measured using the calibration method. The quantity of dissolved solids (TDS) has also been calculated by the following formula:

$$TDS = E.C * 0.64 \quad (3)$$

Magnesium hardness has also been defined according to the formula as follows:

Measurement of magnesium hardness = total hardness – calcium hardness [12]

### 3. Results and Discussion

Based on our study of hot spring sites in the AL-Diss Ashrqiya area (Thouban and Sweiber), the locations of the two springs were precisely determined using the GPS. Sweiber Spring is located at the coordinates (N 14° 54' 28.448" and E 49°56' 57.304"), while Thouban Spring is located at the coordinates (N 14° 54' 24.997" and E 49°57' 42.239").

By measuring the flow rate of the spring water throughout the year, it was found that the average flow rate of Thouban Spring exceeded that of Sweiber Spring by about 14 times. The average flow rates of Thouban and Sweiber Springs are 2.69 and 0.21 liters per second, respectively.

Figure 2a shows a recent image of Thouban Spring, which rises 84 meters above sea level. Fig. 2b provides an image of Sweiber Spring, which rises 69 meters above sea level.

The results of measuring the water temperatures of the springs revealed that the temperature varies depending on the sampling point, being higher closer to the water source and lower on the surface of the water collection area. Accordingly, the average temperature readings of the water flowing from Thouban Spring are 40°C, while the average water temperature of Sweiber Spring is 35°C.

Drinking water specifications typically include being colorless, odorless, and tasteless. Since there is no device to measure taste and odor, the sense of taste and smell were used to assess the potability of the water, as well as the strength or weakness of the odor of hydrogen sulfide gas (H<sub>2</sub>S). Water containing hydrogen sulfide has a rotten egg odor, and swamp water has a distinctive swampy odor. The presence of organic matter and microorganisms in water imparts a characteristic odor.



**Figure 2.** Picture of the (a) Thouban Spring and (b) Sweiber Spring in the Eastern Dees region of Yemen.

The presence of certain inorganic compounds can alter the taste of water. For instance, high concentrations of chlorides and sulfates impart a salty taste, while a significant amount of organically derived nitrogenous compounds can

give water a sweet taste. Freshwater is typically colorless, odorless, and tasteless [13].

Visitors to Thouban and Sweiber Springs can easily detect the odor of rotten eggs, indicating the emission of hydrogen sulfide gas. This odor is more pronounced in Thouban Spring water compared to Sweiber Spring water. Upon tasting the water from both springs, it becomes evident that it has a bitter taste and is less salty, making it drinkable. However, this does not necessarily imply its suitability for drinking purposes.

**Table 1.** Physical Properties of Thouban and Sweiber Spring Waters in the AL-Diss Ashrqiya Area.

| Laboratory Tests                           | Thouban Spring | Sweiber Spring | Permissible Limits for Yemeni Standard Specifications [16] for drinking | Permissible Limits for WHO Standards [17,18] For drinking |
|--|----------------|----------------|---|---|
| Flow Rate (l/sec)                          | 2.69           | 0.21           | -   | -   |
| Temperature (°C)                           | 40             | 35             | 8 – 25  | 0 – 25  |
| Color Measurement (Units)                  | 103            | 69             | 15  | -   |
| Turbidity Measurement (NTU)                | 56.80          | 41.50          | 5   | -   |
| pH Measurement                             | 6.19           | 6.15           | 6.5 - 9.0   | 6.5 - 9.0   |
| Electrical Conductivity at 25°C (µmhos/cm) | 3470           | 3480           | 2500  | 1000 - 2500   |
| Total Dissolved Solids (TDS) (mg/l)        | 2221           | 2227           | 1500  | 500 - 1500  |

Table 1 presents the study findings regarding the physical properties of (Thouban and Sweiber) Spring waters. Presence of hydrogen ion value, which indicates whether the water solution is acidic or alkaline, is used to express the concentration of hydrogen ions in the solution [14,15]. The Presence of hydrogen values for Thouban and Sweiber Springs ranged from 6.19 to 6.15, suggesting the acidic nature of the spring waters. Turbidity in water is measured by its ability to scatter or absorb light and is caused by suspended particles such as clay, colloidal matter, and some microscopic organisms. The turbidity results for the spring waters revealed that the turbidity values for Thouban and Sweiber Springs were (56.80 NTU) and (41.50 NTU), respectively. Additionally, the color values for Thouban and

Sweiber Springs were (103 units) and (69 units), respectively.

**Table 2.** Comparing the Chemical properties in Thouban and Sweiber Spring Waters with Yemeni and WHO Drinking Water Quality standards/ guidelines

| Chemical Compound (mg/l)        | Thouban Spring Water | Sweiber Spring Water | Yemeni Standard Specifications [16] | WHO Drinking Water Quality Guidelines [17, 18] |
|---------------------------------|----------------------|----------------------|-------------------------------------|--|
| Total Alkalinity                | 610                  | 712                  | 120                                 | 120 – 350                                      |
| Total Hardness                  | 1570                 | 1640                 | 500                                 | 100 – 500                                      |
| Calcium Hardness                | 980                  | 1080                 | 200                                 | 75 – 200                                       |
| Magnesium Hardness              | 590                  | 560                  | 150                                 | 30 – 150                                       |
| Chloride (Cl)                   | 350                  | 360                  | 600                                 | 200 – 600                                      |
| Fluoride (F)                    | 2.40                 | 2.61                 | 1.5                                 | 1-1.5  |
| Iron (Fe)                       | 0                    | 0                    | 1.0                                 | 0.3-1  |
| Manganese (Mn)                  | 0.6                  | 0.6                  | 0.2                                 | -  |
| Calcium (Ca)                    | 392                  | 432                  | 200                                 | 75 – 200                                       |
| Magnesium (Mg)                  | 141.60               | 134.40               | 150                                 | 10 – 100                                       |
| Potassium (K)                   | 41                   | 42                   | 12                                  | -  |
| Sodium (Na)                     | 241                  | 173                  | 400                                 | 0 - 220  |
| Carbonate (CO <sub>3</sub> )    | 0                    | 0                    | 120                                 | -  |
| Bicarbonate (HCO <sub>3</sub> ) | 744.20               | 868.64               | 500                                 | 150 - 500                                      |
| Sulfate (SO <sub>4</sub> )      | 880                  | 1160                 | 400                                 | 200 - 400                                      |
| Nitrate (NO <sub>3</sub> )      | 3                    | 2.8                  | 50                                  | -  |

Electrical conductivity (EC) measures the ability of an aqueous solution to conduct electrical current [15,19]. The degree of electrical conductivity provides an estimate of the total salinity in water [20]. Chemically, pure water has low electrical conductivity and is considered a good insulator, with values typically below (250 µmhos/cm). Water is considered suspicious or unsuitable for use if its electrical conductivity exceeds (2000 µmhos/cm) or more [21]. Thouban Spring water has an electrical conductivity of 3470 µmhos/cm, while Sweiber Spring water has an electrical conductivity of 3480 µmhos/cm. The electrical conductivity of aqueous solutions to electric current serves as an indicator of the amount of dissolved salts present. There is a direct relationship between electrical conductivity and the conc Total dissolved solids (TDS) comprise a group of inorganic salts, including potassium, calcium, sodium, magnesium, bicarbonates, chlorides, and sulfates, in conjunction with minute quantities of dissolved organic matter in water. The concentration of TDS in water

varies significantly across different geological regions due to variations in mineral dissolution rates and salt formation. Thouban Spring water exhibited a TDS concentration of 2221 mg/l, while Sweiber Spring water yielded a value of 2227 mg/l (Table I). These values exceed the permissible limits for drinking water established by Yemeni and WHO standards. entration of dissolved salts.

Considering that increased total hardness (TH) in drinking water can lead to a higher risk of cardiovascular diseases, hypertension, salt deposition in the body, and hardening of the arteries [22], it was crucial to investigate the total hardness of the studied springs. Measuring total hardness involves quantifying the levels of iron, calcium, tin, magnesium and aluminum salts [23,24]. The salts are forming soap scum (palmitates and calcium stearates) that hinder the formation of foam necessary for cleanliness. Total hardness can be defined as the inability of water to form foam with soap [22,23]. Magnesium and calcium salts are the primary sources of natural water hardness, as they are essential components of human cells, bones, and teeth [25]. Calculations of total hardness revealed values of 1570 mg/l and 1640 mg/l for Thouban Spring and Sweiber Spring waters, respectively, classifying both springs as having extremely hard water [23, 31].

Table 2 presents the concentrations of elements such as chloride, iron, sodium, magnesium, calcium, potassium, fluoride, manganese, and in Thouban and Sweiber Spring waters, comparing them to the permissible limits set by Yemeni and WHO standards. Calcium is essential for human growth and development, playing a crucial role in prenatal, gestational, and lactational stages, as well as in bone and tooth formation, blood clotting, and nervous system function [26]. Magnesium, next to calcium, is one of the most important positively charged ions present in groundwater [19, 26].

**Table 3.** Water classification by electrical conductivity value, dissolved salts ratio and sodium damp ratio according to American salinity plant [29-33].

| Class | Electrical Conductivity (µS/cm) | Dissolved Salts (mg/L) | Description        |
|-------|---------------------------------|------------------------|--------------------|
| C1    | 0-250                           | 160-0                  | Low Salinity       |
| C2    | 250-750                         | 480-160                | Medium Salinity    |
| C3    | 750-2250                        | 1440-480               | High Salinity      |
| C4    | 2250-5000                       | 3200-1440              | Very High Salinity |
| Class | (%Sodium incidence SAR)         |                        | Alkalinity Damage  |
| S1    | 10-0                            |                        | Low                |
| S2    | 18-10                           |                        | Medium             |
| S3    | 26-18                           |                        | High               |
| S4    | 30-26                           |                        | Very High          |

Fluoride is a common ion in nature [25] and is present in groundwater in small amounts [19, 20]. If fluoride levels exceed the natural range (0.7-1.2 ppm), elevated fluoride in

water can cause tooth staining, erosion, and bone softening diseases, especially in children. Conversely, if fluoride levels fall below (0.5 ppm), tooth decay can occur [27]. Sodium, the sixth most abundant mineral, is found in most natural waters and is present in high concentrations in saline waters and waters treated with sodium chloride solution [28].

Nitrates (NO<sub>3</sub>), sulfates (SO<sub>4</sub>), carbonates (CO<sub>3</sub>), and bicarbonates (HCO<sub>3</sub>) are among the chemical compounds whose concentrations in water must be determined. The presence of these compounds in water in excess of permissible limits poses risks for both drinking and agricultural purposes.

Upon analyzing the chemical properties of Thouban and Sweiber Spring waters and comparing the concentrations of elements and chemical compounds in the study area's waters, it was found that the levels of most of the studied elements and chemical compounds did not comply with Yemeni and WHO standards. The study also revealed that the concentrations of chloride and sodium fell within the permissible limits set by Yemeni and WHO standards. Additionally, the study showed that magnesium and nitrate levels were below the Yemeni standard limits, and Thouban and Sweiber Spring waters were free of iron. According to the study of the suitability of Thouban and Sweiber Spring waters for irrigation and agricultural purposes, global classifications such as the U.S. Salinity Laboratory scale [29-33] were used. Table III shows the water classes according to the U.S. Salinity Laboratory classification, which is one of the most widely used classifications in the world and consists of four grades.

**Table 4.** Chemical and physical analysis of Thouban and Sweiber water and comparison with FAO standards for irrigation.

| Laboratory Test Characteristics   | Thouban Spring | Sweiber Spring | Allowable limits of FAO standards [37, 38] |
|-----------------------------------|----------------|----------------|--|
| pH                                | 6.19           | 6.15           | 8.3 – 6.0                                  |
| (EC at 25°C) $\mu$ mhos/cm        | 3470           | 3480           | 3000 – 700                                 |
| TDS mg/l                          | 2221           | 2227           | 2000-450                                   |
| HCO <sub>3</sub> mg/l             | 744.20         | 868.64         | 0-610                                      |
| CO <sub>3</sub> mg/l              | 0              | 0              | 120 – 0                                    |
| Cl <sup>-</sup> mg/l              | 350            | 360            | 1065 – 0                                   |
| SO <sub>4</sub> <sup>-</sup> mg/l | 880            | 1160           | 960 – 0                                    |
| NO <sub>3</sub> meq/l             | 0.05           | 0.04           |  |
| Ca mg/l                           | 392            | 432            | 400 – 0                                    |
| Mg mg/l                           | 141.60         | 134.40         | 60 – 0                                     |
| Na + K mg/l                       | 282            | 215            | 47 – 0                                     |
| (SAR)%                            | 2.66           | 1.87           | 15 – 0                                     |

The U.S. Salinity Laboratory classification is based on the salinity level and the measured electrical conductivity value of the water and the sodium adsorption ratio. Based on the measured electrical conductivity values of the hot springs (Thouban and Sweiber) ranging from 3470 to 3480  $\mu$ S/cm, which fall within the fourth classification (C4) of the

U.S. Salinity Laboratory divisions, Thouban and Sweiber Spring waters are considered to be very high salinity waters. Consequently, we anticipate a significant potential for problems arising from the use of this type of water. These waters are suitable for irrigating only the most salinity-tolerant crops, such as date palms, and should only be used on well-drained soils with excessive amounts of water to remove accumulated salts from previous irrigations [34]. Furthermore, the results in Table IV indicate that the sodium adsorption ratio (SAR) values for the study waters ranged from 1.87 to 2.66%, which falls within the range of 0-10, corresponding to class S1, representing a low alkalinity impact category. Therefore, we expect the alkalinity-related damage to be minimal [35]. Upon comparing the results of the study area's water tests (Table IV) with Eaton's classification [36], which is based on the relationship between electrical conductivity in  $\mu$ S/cm and residual sodium carbonate (RSC) in meq/L, it was found that the hot spring water samples in the AL-Diss Ashrqiya area ranged from 3470 to 3480  $\mu$ S/cm. According to this scale, this exceeds 3000  $\mu$ S/cm and therefore falls into the category of unsuitable for irrigation. Additionally, the results showed that the residual sodium carbonate (RSC) values for all study area waters ranged from -13.91 to -19.02 meq/L, which is less than 1.25 and therefore falls into the category of suitable for irrigation.

According to the guidelines established by the Food and Agriculture Organization (FAO) [37, 38], the electrical conductivity (EC) values of the hot spring waters in the AL-Diss Ashrqiya area ranged from 3.470 to 3.480 (mS/cm). This indicates a very high salinity level, and we anticipate potential problems arising from the use of this water [11, 39].

The results also indicated that the sodium adsorption ratio (SAR) values for the hot springs in the AL-Diss Ashrqiya area were less than 3. Therefore, we anticipate no issues arising from sodium adsorption in the soil due to the use of this water [40]. The results further showed that the chloride (Cl<sup>-</sup>) concentration in the hot springs in the AL-Diss Ashrqiya area ranged from 8.40 to 10.08 meq/L. Consequently, upon using this water, we expect an increase in chloride-related problems for both soil and plants. The nitrate (NO<sub>3</sub>) concentration in the hot springs in the AL-Diss Ashrqiya area was less than 5 meq/L. Therefore, we do not anticipate any nitrate toxicity issues arising from the use of this water.

It was also found that the pH values for all hot spring waters in the study area fall within the suitable range for irrigation water. Additionally, the results showed that the bicarbonate (HCO<sub>3</sub>) concentration in Thouban and Sweiber Spring waters was 13.90 and 11.91 meq/L, respectively. Therefore, we anticipate problems arising from the presence of bicarbonates in Thouban and Sweiber Spring waters.

Through our study of spring waters in the AL-Diss Ashrqiya area, we found that Thouban and Sweiber Spring waters flow year-round. The average temperature of these spring waters ranges from 35 to 40°C, and the temperature increases with depth. The presence of calcium, magnesium, and sodium ions in the spring waters indicates that the chemical properties of these waters are influenced by rock type. Therefore, the waters of these two springs can be used

for therapeutic purposes for treating skin and rheumatic diseases. Thouban and Sweiber Spring waters in AL-Diss Ashrqiya area are not suitable for drinking purposes because many of their chemical and physical properties exceed the limits allowed by Yemeni standards and World Health Organization (WHO) drinking water standards.

#### 4. Conclusion

Through our study of spring waters in the AL-Diss Ashrqiya area, we found that Thouban and Sweiber Spring waters flow year-round. The average temperature of these spring waters ranges from 35 to 40°C, and the temperature increases with depth. The presence of calcium, magnesium, and sodium ions in the spring waters indicates that the chemical properties of these waters are influenced by rock type. Therefore, the waters of these two springs can be used for therapeutic purposes for treating skin and rheumatic diseases. Thouban and Sweiber Spring waters in AL-Diss Ashrqiya area are not suitable for drinking purposes because many of their chemical and physical properties exceed the limits allowed by Yemeni standards and World Health Organization (WHO) drinking water standards.

According to the U.S. Salinity Laboratory classification scale, the hot spring waters in AL-Diss Ashrqiya area are classified as very high salinity and low sodium (C4 - S1) waters. According to a study of the conformity of the two spring waters with FAO specifications, these waters can be used to irrigate the most salt-tolerant crops, such as date palms, especially in well-drained soils.

#### Recommendations

Based on what has been presented in this study, we can make the following recommendations:

- 1-conducting studies of the hot springs, which was not covered by any studies in the Republic of Yemen.
- 2-Various sectors such as agriculture, commerce and health are cooperating to enhance the mechanisms of utilizing these hot springs.
- 3-Establish a body to monitor the state of the hot springs water periodically to ensure its optimal exploitation.
- 4-Publicize the importance of hot springs and preserve them from pollution by encouraging the community through the awareness or facilities of the municipality, and prepare brochures on hot springs to encourage medical tourism in AL-Diss Ashrqiya area

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## تقييم جودة مياه نبعي صويير وثوبان في منطقة الديس الشرقية، حضرموت - اليمن، وملاءمتها للاستخدام في الشرب والري

**المخلص:** أجريت هذه الدراسة على مدى عام كامل (خلال الفترة 2018-2019) بهدف تقييم جودة مياه نبعي صويير وثوبان الواقعين في منطقة الديس الشرقية بمحافظة حضرموت، اليمن. وأظهرت النتائج أن قيم التوصيلية الكهربائية، والمواد الصلبة الذائبة الكلية، والعسر الكلي، وعسر الكالسيوم، وعسر المغنيسيوم، إلى جانب تركيزات كل من الكبريتات والفلوريد والمنغنيز والكالسيوم والبوتاسيوم، إضافة إلى درجة حرارة المياه، جميعها تتجاوز الحدود المسموح بها وفق المعايير اليمنية ومعايير منظمة الصحة العالمية (WHO). وبناءً على ذلك، تُصنّف مياه نبعي صويير وثوبان على أنها غير صالحة للشرب. كما تُشير مقارنة نتائج هذه الدراسة مع تصنيفات مياه الري المعتمدة إلى أن مياه النبعين غير مناسبة لأغراض الري، لما تتصف به من مشكلات حادة في الجودة تجعل استخدامها الزراعي محفوفاً بالمخاطر.