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Sacred Zamzam Water: Metallic Profile and Health Benefits

Vibha Bhardwaj*

Director Environment Laboratories, Ras Al Khaimah Municipality, United Arab Emirates

***Corresponding author:** Vibha Bhardwaj, Director Environment Laboratories, Ras Al Khaimah Municipality, Ras Al Khaimah, United Arab Emirates

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ABSTRACT

Background and Aim: Zamzam water plays a central role in the Muslim religious tradition. It has been used for over 5000 years according to Hijri calendar. Many Muslims drink Zamzam water for use either medicinally or religiously. Its safety is a public health issue, as it is consumed by thousands of Muslims. It is considered as miraculous and holy water by Muslims. Millions of pilgrims drink it and take bottles of it to their countries. The objective of this study was to draw up the mineral, metallic profile, and health benefits of Zamzam water.

Material and Methods: Samples were collected via different Zamzam taps which are distributed in the Masjid Al Haram in Mecca in Saudi Arabia. Multi-elemental analysis was done by Inductively Coupled Plasma Optical Emission spectroscopy (ICP-OES) and nutrient analysis by HACH spectrophotometer. The physicochemical parameters were determined such as pH, salinity, TDS, conductivity, nitrate, nitrite, sulphate, phosphorous, total hardness, chloride, and heavy metal concentration. The results were assessed statistically and compared with the international standards.

Results and Discussion: Zamzam water has a rich mineral composition. It has Magnesium (11±0.05 mg/L), Calcium (19.802±0.09 mg/L), Sodium (68.001±0.06 mg/L), Potassium (33.489±0.02 mg/L). Heavy metals like Lead, zinc, nickel, manganese, copper was not detected. Despite its complex metallic composition, nutrients like nitrate (15.8±0.2 mg/L), sulphate (64±0.5 mg/L), phosphorous (0.02 mg/L) were also detected. Experimental studies indicate that Zamzam water is safe and healthy to drink and does not induce hepatotoxicity or nephrotoxicity, according to the literature.

Conclusion: Minerals and metallic properties of Zamzam water give it interesting therapeutic benefits which are not fully known to date. More careful studies on Zamzam water are required to lift the veil on other potential health benefit effects of this water. In conclusion the results of the present study indicated that Zamzam water is an alkaline mineral water, unpolluted by heavy metals and is safe for consumption.

Keywords: Zamzam Water; Metallic Profile; ICP-OES Analysis; Minerals; Health Benefits

Abbreviations: SD: Standard Deviation; ZW: Zamzam Water; ND: Not Detected; ppm: Parts Per Million; ppt: Parts Per Trillion; WHO: World Health Organization; GSO: GCC Standardization Organization

Introduction

Holy water is sacred or consecrated water that plays a significant role in various religious traditions and practices. Its specific significance and use can vary among different religious denominations and cultures, but in general, holy water is believed to possess spiritual or purifying properties. Since ancient times, many religions and beliefs have used ''holy water'' for healing and other spiritual practices. The first use of holy water for baptism and spiritual cleansing is still common among a variety of religions, from Christianity to Sikhism and Hinduism (Altman, et al. [1-3]). It is used by the devotees of many religions (Shafique, et al. [4-6]).

Zamzam Water

Zamzam water holds a special place in Islam. Many Muslims believe that the water of the Zamzam well is divinely blessed, able to satisfy both hunger and thirst, as well as cure illness. According to Arab historians, the well of Zamzam first sprang 5,000 years ago (https://www.arabnews.com/node/1896976/saudi-arabia). The word Zamzam is derived from the Arabic language, "meaning the abundance of water. Zamzam has been expressed in the holy books of various religions, including the Torah / Torah, the Bible, and the Qur'an, as it was mentioned. In these scriptures, Zamzam is holy water and is described as a great gift from God (https://thepilgrim.co/how-to-drink-zamzam-water/). It is believed to be a miraculous source of water that originated from the time of the Prophet Ibrahim (Abraham) and his son Prophet Isma'il (Ishmael). It is claimed to be a branch of the holy spring in the arid desert surrounding Mecca. The well of Zamzam is situated inside the Grand Mosque near to the Kaaba in Mecca. The source of Zamzam water is in an area Mecca, which is one of the holiest cities for Muslims. This city is in the western part of Saudi Arabia, 70 km south of Jeddah on the Red Sea coast (Nashmil, et al. [6]). Many Muslims drink Zamzam water for its spiritual significance and blessings when they visit the holy city of Mecca for pilgrimage (Hajj or Umrah [7]). It is believed if a person makes a wish after drinking Zamzam water, the wish will be fulfilled (https://thepilgrim.co/how-to-drink-zamzam-water/).

During Hajj, pilgrims drink this water and use it to cleanse themselves. Millions of pilgrims drink it and those living nearby might drink the water more regularly (Careem [8]) and bring it as a gift for their relatives and friends when they return home. Zamzam water, supplied by the well of Zamzam, is available through taps and containers that are distributed in the Masjid Al Haram in Mecca. Zamzam water is also available in bottled form to facilitate air transportation for pilgrims who want to (Zamzam studies [6,9,10]) The Saudi Geological Survey has set up a Zamzam Studies and Research Centre (ZSRC), is responsible in keeping the Zamzam water both clean and plentiful. There have been some attempts to scientifically authenticate Muslim beliefs regarding the special nature of Zamzam water (Shomar [11]). The main objectives of this study were to measure concentrations of metals, nutrients, and several other water quality parameters in Zamzam water using state-of-the-art methods and laboratory facilities to ensure accuracy and to suggest future areas of study to lift the veil on other potential health benefit effects of this water.

Material and Methods

Study Area

"Zamzam" a water well in the valley of Abraham, Mecca city, Saudi Arabia, the Arabian Peninsula, Asia. Mecca city is in the western region of Saudi Arabia and is known by "Masjid al-Haram" which is the sacred Mosque of Muslims. Inside the mosque are "Kaaba" (the holiest place in Islam) and Zamzam well.

Reagents

All reagents and chemicals used in this study were of analytical grade. Ultrapure deionized water (Merck Millipore, USA) was used for preparation of reagents and dilution throughout the work. For instrument calibration and standard solutions were purchased from Analytik Jena, Germany. Chemicals used were purchased from Merck (Darmstadt, Germany) and Sigma- Aldrich (St. Louis, MO, USA). Nutrient analysis kits e.g., nitrate, nitrite, phosphorous, sulphate, total hardness, chloride was purchased from HACH, USA.

Sample Collection

Zamzam water sample was collected from the two different taps of Zamzam well which are distributed in the Masjid Al Haram. Two (2) different tap samples were collected in 1 L bottles; labelled and stored in room temperature (Figure 1).

Figure 1: Zamzam water.

Sample Preparation

After collection, each water samples were divided into two portions. The first was used for determination of pH, total dissolved salts (TDS) and levels of chloride, total hardness, sulphate, nitrate, nitrite and phosphorous. The second part was processed for heavy metal analysis. All analyses were carried out within a week of sample collection.

Physico-Chemical Analysis

Zamzam water samples were analysed for pH, salinity, Nitrate, Nitrite, Sulphate, Phosphorous and heavy metal concentration. The pH, salinity, TDS, conductivity was measured with WTW 3430 multimeter, Germany. Nitrate, Nitrite, Sulphate, Phosphorous, total hardness, chloride concentration was measured by using HACH spectrophotometer DR 3900, USA. Heavy metal concentration was analysed by using ICP-OES Plasma Quant PQ 9000 (Analytik Jena, Germany).

Quality Control Procedure

All reagents used were of analytical-reagent grade. Reference solutions used in calibration range were prepared from 1000 mg/L standard solutions (Analytik Jena, Germany). Certified Reference Material for trace metals (Analytik Jena, Germany) was used to control the quality of major trace element measurements. This reference material was analyzed at regular intervals (monthly) during sample analysis to assess the accuracy. Triplicate measurements of each sample were done. The precision of analysis was assessed by calculation of relative standard deviations (RSD). The within run and between run RSD didn't exceed 5.0% for all analyses. Recovery of the analyte from spiked samples was used to evaluate accuracy of the procedure.

Statistical Analysis

The experiments were performed in triplicates. Data are expressed as means. Pair-wise comparisons were performed. Experimental error was determined for triplicate and expressed as standard deviation (SD).

Results

This study provided valuable data concerning the assessment and awareness of quality of Zamzam well water with nutrient and metallic profile with health benefits. (Figure 2) showing the location of Zamzam well.

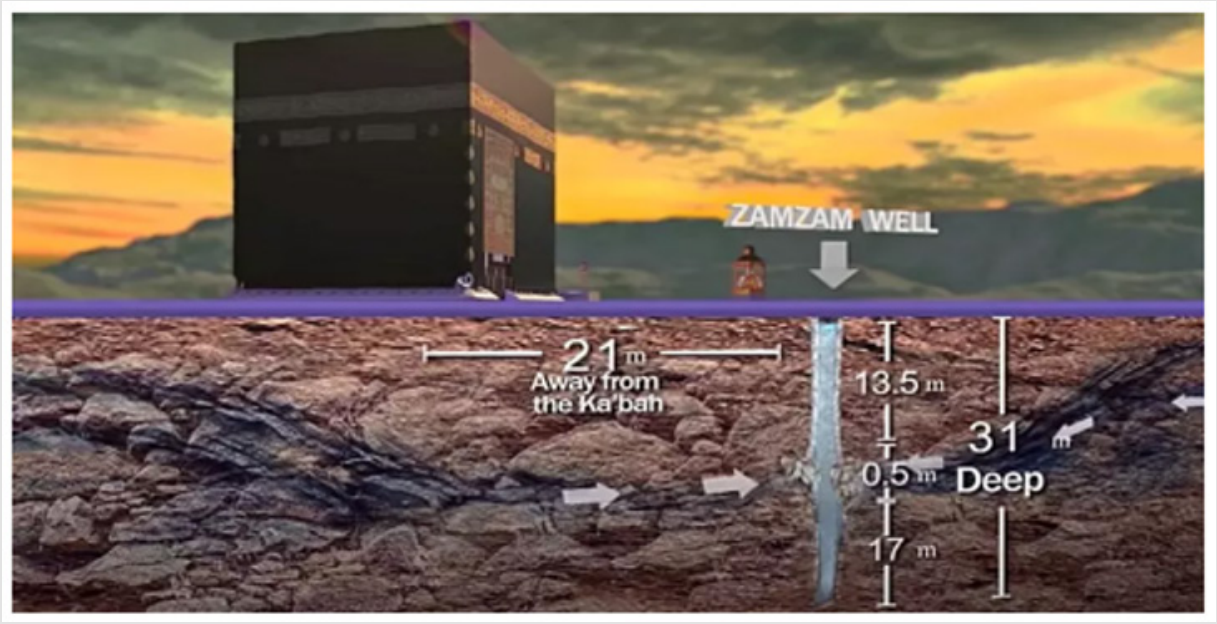

Figure 2: Location of Zamzam well (Google image) https://www.islamiclandmarks.com/makkah-haram-sharief/zamzam-well.

Metallic and Nutritional Profile of Zamzam Water

According to our research analysis, the average concentrations of all analytes (water samples) were within the permissible limits of the WHO and US EPA [12] (Table 1). It was found that Zamzam water has a rich composition in minerals, nutrients, and metals. It has Magnesium (11±0.05 mg/L), Calcium (19.802±0.09 mg/L), Sodium (68.001±0.06 mg/L), Potassium (33.489±0.02 mg/L) according to the limit value recommended by the World Health Organization (WHO) for drinking water. Heavy metals like Lead, zinc, nickel, manganese, copper was not detected. Despite its complex metallic composition, nutrients like nitrate (15.8±0.2 mg/L), sulphate (64±0.5 mg/L), phosphorous (0.02 mg/L) were also present. Some nutrients have been quantified, but the result has not been interpreted due to the lack of recommended values in drinking water.

Table 1: Summarizes the metallic and nutritional profile content in Zamzam water as well as the recommended values available according to the World Health Organization (WHO) drinking water, 4th Edition 2006, https://www.who.int/publications/i/item/9789241549950, US EPA, 2011.

Parameters	Zamzam water	Maximum allowable limit WHO Guidelines for Drinking Water; 4th Ed,2006	(US EPA, 2011)
pH	8.06	6.5-9.5	6.5-8.5
Salinity (ppt)	0.2	-	-
TDS (ppm)	489	1000	-
Conductivity (mS/cm)	0.6	Not more than 1.5 mS/cm	-
Nitrate	15.8 ± 0.2	Not more than 50 ppm	-
Nitrite	0	Not more than 3 ppm	-
Phosphorous	0.02	-	-
Sulphate	64.0± 0.5	Not more than 500 ppm	250ppm
Total hardness as CaCO3	95.4	500 ppm	-
Chloride	64	Not more than 250 ppm	Not more than 250 ppm
Boron	0.232	Not more than 2.4 ppm	-
Calcium	19.802 ± 0.9	-	-
Copper	Not detected	Not more than 2.0 ppm	Not more than 1.0 ppm
Iron	Not detected	Not more than 1.5 ppm	-
Potassium	33.489 ± 0.2	Not more than 10 ppm	-
Magnesium	11.183 ± 0.5	Not more than 30 ppm	-
Manganese	Not detected	Not more than 0.4 ppm	-
Sodium	68.001 ± 0.6	-	-
Nickel	Not detected	Not more than 0.07 ppm	-
Lead	Not detected	Not more than 0.01 ppm	-
Zinc	Not detected	Not more than 3.0 ppm	-

Discussion

The present study was conducted on Zamzam water, whose exact composition is not fully known to date despite being consumed for more than 5000 years ago (Zergui, et al. [13]). The multi-elemental analysis of Zamzam water samples was analyzed by Inductively Coupled Plasma Optical Emission spectroscopy (ICP-OES), nutrient analysis by HACH spectrophotometer DR 3900. The results of the present study pointed that chemical composition of Zamzam water is acceptable according to guidelines of WHO and US EPA for drinking water. Differences among studies could be explained by many factors such as differences in the laboratory methods used for water analysis, material used due to variable water samples, ways of collection, season, or the preservation of water in bottles and the source of the samples (Donia, et al. [14]). According to the present research work, it was found that the pH of Zamzam water is alkaline which is similar in result with (Kellas, et al. [8,15]) Zamzam water has a therapeutic effect and can neutralize the excess hydrochloric acid which is formed in the stomach and reduce heartburn. Due to alkaline pH, it might be explaining the low concentrations of Ag, Al, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn in Zamzam water. According to the Saudi Geological Survey, granite represents the major rock of the aquifer rocks in the study area (ZSRC, [16]). The alkaline nature of the Zamzam water is due to the association with granitic environments (Michard, et al. [17-21]).

In a dry climate like Saudi Arabia, evaporation is the major way in which originally low values of element concentrations may rise; this also holds for subterranean waters, because water may evaporate after it has moved upward by capillary action. The alkaline nature of the Zamzam water could explain its healing properties. Several studies have conferred on the process by which alkaline water promotes healing. For example (Kellas, et al. [15]) stated that alkaline drinking water plays an important part in getting ridding the toxins from the body. The more acidic the body is, the more it holds onto (heavy) metals. Heavy metals in turn create a high oxidative stress that acidifies the body. Subsequently, alkaline water has been used for improving bone density and healing (Wynn, et al. [22]); controlling gastric functions (Bertoni, et al. [23]); improving capacity for aerobic activities and flushing toxins and acidic waste (Whang, et al. [24,25]). According to the geographical regions the concentration of TDS may vary. The mean values of TDS of collected Zamzam water samples were 489 mg/L, respectively which is similar with the previous results of (Koh,

et al. [21]). TDS includes inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulfates) and small amounts of organic matter that are dissolved in water. Generally, TDS in drinking water comes from natural sources, sewage, urban runoff, and industrial wastewater. Concentrations of TDS in water vary according to geological regions owing to differences in the solubility of minerals.

WHO doesn't suggest a guideline value for TDS as it is not of health concern at levels found in drinking-water. Nevertheless, drinking water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/L (WHO [26]). There is a scarcity of information about the health impact of TDS but according to the World Health Organization [27], high levels may affect consumer acceptance. However, French guidelines for TDS concentration recommend different mineral water contents than WHO and GSO (French Food Safety Agency [28]), However there are no fixed reference limits for TDS concentration. (Table 1) showed that the results were significant and similar with (Shomar, [11]), for the magnesium concentration in Zamzam water. Magnesium is responsible for nerve activation, muscle contraction, building protein DNA is doubled (NIH [29]). Magnesium helps in counteract osteoporosis (Remer [30]). According to our research findings, there was no nickel detected. Maximum limits for nickel nanoparticles in water by United States Environmental Protection Agency [31] (0.02 mg/L), European Union 1998 (0.02 mg/L), World Health Organization [32] (0.02 mg/L). While many states require a lead-water test. Our research results are similar with (Shomar [11]), for calcium and potassium in Zamzam water which says the elevated Ca (60 mg/L) and K (50 mg/L) in Zamzam water for the samples of (Shomar [33]). Finally, no data have been advertised on the effects of Rare-Earth Elements (REE), Poor metals, Metalloids and Transition metals in the therapeutic qualities of Zamzam water.

More careful research work on Zamzam water is required to explore the potential health benefit effects of these elements that constitute Zamzam water.

Conclusion

The results of the present study concluded that Zamzam water has a rich mineral composition. It contains Magnesium (11±0.05 mg/L), Calcium (19.802±0.09 mg/L), Sodium (68.001±0.06 mg/L), Potassium (33.489±0.02 mg/L). Heavy metals like Lead, zinc, nickel, manganese, copper was not detected. Despite its complex metallic composition, nutrients like nitrate (15.8±0.2 mg/L), sulphate (64±0.5 mg/L), phosphorous (0.02 mg/L) are also present. Zamzam water is an alkaline mineral water, unpolluted by heavy metals and is safe for consumption. Its mineral, and nutritional properties give it interesting therapeutic virtues which are not fully known to date. All metal concentrations in the studied samples were within the acceptable limits according to the international standard of WHO and US EPA [12]. Efforts are made by the local authorities to maintain Zamzam well (Zamzam studies, [7,9,34]). The exceptional mineral composition of Zamzam water ensures several nutraceutical and functional benefits that work in synergism with other agents to impart beneficial effects, or to thwart harmful effects [35-41]. More comprehensive research is required to explore the potential health benefit effects and its unique properties and mysteries to lift the veil on the benefits of this water and to explore the relationship between Zamzam water's chemistry and its nutraceutical benefits.

Consent For Publication

Not applicable.

Availability of Data and Materials

The relevant data and materials are available in the present study.

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Declaration of Competing Interests

The authors declare that they have no competing interests. All procedures followed were in accordance with the ethical standards (institutional and national). The author declared that there is no specific conflicting financial interest or personal partnership that could have influenced the work presented in the article.

Credit Authors' Statement

Dr. Vibha Bhardwaj performed all the experiments. VB analysed the data and wrote the manuscript. Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Supervision, Data curation, writing original draft, Writing review & editing, Visualization.

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