

REVIEW / ARTÍCULO DE REVISIÓN

Composition, hydrology, and health benefits of Zamzam water

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Abstract: Since before, many religions have used Zamzam water because they used it for treatment and other spiritual activities. This study reviews the composition, hydrology, and the effect of Zamzam water on human health. Zamzam water differs from regular water. Mineral deposits show it is alkaline and biologically has no biotic growth, and does not show toxicity signs. Zamzam is well-focused based on the expenditure of Makah hill. Zamzam well has been used for about 4000 years. Zamzam water is used for the treatment of many diseases. The data on Zamzam water composition, hydrology, and health benefits have been narratively reviewed. Future research is needed to investigate the other benefits and uses of Zamzam water on human health as antioxidants, antimicrobial, and its effects on cancer patients.

Key words: Zamzam water, antioxidants, antimicrobial, spiritual activities.

Introduction

Water is secured for human society from either surface water or groundwater surface water includes all forms of water bodies above the earth's surface; such as streams, rivers, lakes, wetlands, and oceans, while groundwater refers to water that seeps through the layers of the earth consisting of gravel, sand, or crushed rocks such as limestone, which contain materials with pores and spaces between their grains that make them permeable, and the speed at which groundwater flows depends on the size of the voids and pores in the earth layers¹. All living organisms need water to survive, starting from simple organisms to more complex organisms such as humans, as water is used as a carrier and solvent, as it works to dissolve all the vitamins and essential nutrients from food and transfer them to cells. These organisms vary in how much they need water to survive, as bacteria, for example, need smaller amounts of water to survive compared to other organisms, and no organism can survive without getting water. Humans can live with no food for 30 days, but they can live with no water for only seven days. Water is a suitable medium for mixing organic compounds, and water is one of the main factors that helped form the first life forms on earth; in addition, water is also necessary for protecting the earth from sunlight. Water is used to keep plants alive, such as those found in gardens and parks. Water is necessary for the production of various crops, and it is also necessary for the manufacture of many products. Zamzam water is natural alkaline water that contains many essential mineral salts for the body, supporting the body with energy; it also helps to neutralize its pH, which protects it from disease and makes it a potent antioxidant agent². Zamzam well is located in the Kingdom of Saudi Arabia, in the holy city of Makkah. It is filtered by micro-filters and sterilized by ultraviolet light before it is disseminated to the

consumers. Microbiological investigations set that there were no signs of microbial progress in the water gained from the Zamzam well³.

Background

Many religions have used Zamzam water since before that belief was used for treatment and other spiritual activities. Many Muslims considered that Zamzam water is delightfully deified and can fulfill together starvation and thirstiness, at the same time to treat illness. Pilgrims sort a durable activity to take this water throughout their hajj, besides individuals alive neighboring, might take the water regularly². Zamzam water has special optical measures that differ from bottled drinking and distilled water, and it differs from standard water in minerals qualities⁴. Many or even millions of pilgrims drink it annually during the Hajj season and take it to their countries. Many Muslims and pilgrims drink Zamzam water for medicinal or religious use².

Source of Zamzam water

Zamzam water was found in Makkah AlMukarramah, kingdom of Saudi Arabia (KSA). The well of Zamzam (Figure 1) was hand excavated, and it has a depth of about 30.5 meters and a diameter from 1.08 to 2.66 meters⁵. The Arab historians said Zamzam was well used for about 4000 years. Allah's mercy sent Gabriel to rub off the earth to make the spring when Hajar

Prophet Abraham's wife and her son Ismail went after a water search with dying thirst. When he found the spring, Hajar surrounded it with stones and sand as it ran out⁶. Zamzam water would have been a stream flowing on the surface of the earth (Sahih Bukhari). Muslims contemplate that the Zamzam water well seemed to Hagar, mother of Ismail Son of Abraham.

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Figure 1. Historic Zamzam well mouthpiece.

As she was pointed with gloom for water for her infant and other Muslim historians say Ismail rub the earth with his heel, and after that, Zamzam water sprang up².

Location and hydrogeology of the Zamzam well

In hydrogeological expression, the well located in Ibrahim hill, which surrounds Makkah and pipes groundwater of the hill silt to a much lower range and from the undeveloped fresh bedrock 13.5 m of the upper well dig in the sandy build-up of the Ibrahim valley and the lower 17 m in the underlying diorite bedrock. There is a thinner layer (0.5 m) of porous weathered rock between sandy alluvium and diorite bedrock. The silt part of the wall stuff with rock structure, except for the topmost 1.0 m, has a fortified solid hoop. The weathered stone part is filled with stone and supply the main water entree into the well⁷.

The Zamzam well was drilled manually long ago, to a depth of 30.5 meters and a diameter ranging from 1.08 to 2.66 meters. Hydrogeological, the well is located inside Wadi Ibrahim, which passes through the holy city of Makkah and extracts water from it. The well of Zamzam is located in a room in the basement, and the well is surrounded by glass panels that allow it to be seen.

They used ropes and buckets to draw water from inside the well in the past, but now electric pumps are used. Visitors are not allowed to pass into the well room. Cold Zamzam water fountains and drinking bottles are provided in the service area outside the room. Upon the recent expansion of the Haram, this area was covered and is no longer available to pilgrims. Instead, cold Zamzam fountains and distribution vessels are now located in the vicinity of the Tawaf area⁸.

Quality parameters of water compared to Zamzam water

Physical parameters

Zamzam water has many characteristics that make it unique and different from other wells, as the Zamzam well has not been contaminated throughout history. However, it still supplies everyone who visits the Holy Mosque in Mecca with water. It is abundant enough for all visitors; the follow-ups have shown that on the seventh of Dhu al-Hijjah for several consecutive years, approximately ten thousand cubic meters per hour are withdrawn from it. One of its characteristics is the ability to drink it over time and with different visitors' domiciles. There was no complaint from any visitor that his health was affected after drinking it, and no biological growth was proven in the well, such as algae, compared with other wells². Comparing Zamzam water with other water, numerous scientific studies have proven that, Zamzam water has chemical properties that distinguish it from others, where the percentage of mineral salts in it reaches 2000 mg/liter, while the treated mineral water ranges from 150 to 350 mg/liter. Its percentage is 200 mg/liter. It is also considered digestive soft water as it contains 366 mg of bicarbonate per liter, and the normal water is carbonated if it includes more than 357 mg, and it should be noted that mineral water helps treat many diseases⁹.

The properties of magnetized water are close to the properties of Zamzam water, and this concludes that Zamzam water may have been magnetized in origin, which acquired these unique properties, and this may be due to the nature of the strong rocky stones surrounding the well of Zamzam, on the other side, as is common the majority of the physical and chemical

properties of the two water molecules are responsible for the covalent bonds between the two atoms. Therefore, this arrangement of hydrogen and oxygen atoms, where they form angle magnitudes 104° angle in the two molecules of Zamzam water in a particular form that differs entirely from what is found in normal water, which makes Zamzam water consistently superior in physical properties to the rest of the magnetized models of water. The most important conclusion is that Zamzam water has important optical properties that it cannot characterize, even if it is magnetized. This means that Zamzam water can be used as an optical fluid and has optical properties⁹.

The scientist Emoto, M.¹⁰ showed that Zamzam water has unique scientific properties not found in normal water through many studies and analyses conducted on the water. He used his nanotechnology research; he found that it could not change Zamzam's water properties. The world was also surprised at adding one drop of Zamzam water to a thousand drops of regular water makes the latter acquire the blessed Zamzam water characteristics. Emoto¹⁰ explained that Zamzam water is unique. Its crystals do not resemble any water in the world, regardless of its source, the resulting crystals after refining give beautiful shapes, and when water crystals were exposed to Basmala (In the name of God, the Most Gracious, the Most Merciful) through reading, it made a tremendous effect on it and formed stunning crystals in the formation of water. When the Holy Qur'an was recited on the water, its crystals formed with a symbolic design, in serenity and purity. That might be due to the different geometric shapes in which the water crystals are formed on which the Qur'an or supplication was recited form vibrations resulting from reading in the form of a picture of energy, indicating that the memory of water is a form of the potential energy that enables it to hear, see and feel and emotion and storing information, transmitting it and being affected by it. In addition to its effect on strengthening human immunity and possibly treating organic and psychological diseases as well. Emoto¹⁰ also reported that every word uttered at any point of Zamzam water makes it take a particular shape when it is frozen at high speed when it turns into frozen water crystals under magnification.

Emoto¹⁰ captured the expression of water and developed a technique for photographing the newly formed crystals from frozen water samples using a mighty microscope in a cold room. He indicated that controlling the interaction of the molecules involved in the reaction and directing these molecules through the production of a specific substance, this type of response is known as molecular fabrication and placing the atoms during the reaction in their right or appropriate place¹¹.

Zamzam water bears the name water, while it differs radically from the water compounds, as all waters are acidic while Zamzam water is alkaline. Drinking it frequently gives the human body a strong immunity against viruses because it does not live in an alkaline environment. That is why pilgrims used to drink Zamzam water as much as they could to keep not being infected with the pilgrims' transmitted diseases. Many chemical analyses were performed to find out that Zamzam water contains high amounts of Ca, Mg, and other minerals. Also, other waters contain between 130-160 mg/liter of mineral salts; in contrast, the total mineral salts in Zamzam water are 2000 mg/liters, and for this reason, Zamzam water refreshes exhausted pilgrims².

Chemical parameters

Shomar² examined thirty Zamzam water samples using four tools IC, ICP-OES, ICPMS, and the HGAAS. The results in-

dicated that the water quality did not change for 24 months; the results showed that Zamzam water was alkaline (average pH was 8), the average NO_3 concentrations showed values three times higher than the standards of the World Health Organization.

While the mean calcium and potassium were 95 and 50 mg L⁻¹, respectively. A progressive study of multi-elemental and hydrochemical study of Zamzam water was carried out by (5), who used inductive couple plasma and other available traditional methods. The concentration of thirty-four elements reported, including Ca, Mg, Na, and Cl, was higher in Zamzam water than in natural water. The concentrations of Sb, Be, Bi, Br, Co, I, and Mo in Zamzam water were more minor than 0.01ppm. There were a bit of Cr, Mn, and Ti noticed in Zamzam water.

Arsenic, cadmium, lead, and selenium, as harmful elements, were found below the risk level for human drinking water⁵.

Biological parameters

Zamzam water demand has always been universal, as it does not change the color, taste, smell, as usually occurs in other waters. That makes water stodgy due to the expansion of moss for most alterations in taste and odor. However, many studies reported no mark of microbial growth in Zamzam water and never been chemically conserved or chlorinated, as in normal water⁵. Average growth and flora are usually present in most water resources. Nanotechnology was used to investigate Zamzam water; the study revealed that when mixing one drop of Zamzam water with 1000 drops of normal water, the average water will have the quality of Zamzam water^{5,12}. Mas-hat stated that Zamzam water has no signs of biotic growth. Results showed that *E. coli* had not polluted Zamzam water, and the entire settlement sums fall within the accepted parameters for all samples¹³. Muslims attend the Zamzam well, from all their ethnic backgrounds, drink, search for restoration, do their ablution, and clean. This means that a lot of this water goes to the sewage system. As a result, this enormous amount of water needs to be invested in farming, as some plants can be planted either as nutrient crops or as valuable street trees, especially in holy places such as Arafat and Mina place¹⁴. A study done by Alsokari¹⁵ investigated the impact of Zamzam water on growth and biochemical parameters in Lentils compared to tap water (as control). The study revealed that the irrigation of lentil seedlings with various quantities of Zamzam water significantly increased the germination level and augmented the content of protein and RNA. In general, Zamzam water has beneficial impacts on plant irrigation near Makkah lands due to the form of nutrient in the water and the proportion of this nutrient that has served as synergistic agents for useful nutrients or as antagonistic agents for harmful elements to postpone their harmful effects.

Antioxidants activity

Many diseases in animal and human bodies are related to oxidative stress, so antioxidants are essential for animals and human health¹⁶. The antioxidant capacity of animal bodies was reinforced by water¹⁷. Alkaline water is considered to be with high antioxidant activity, which is due to it is alkalinity¹⁸, the anti-radiation effect of Zamzam water on mice bone marrow after being subjected to gamma radiation was investigated by (18) and resulted that, Zamzam as alkaline water reduced the clastogenic and cytotoxic effects, this attributable to the previous believes that the natural antioxidant activity of the natural radioprotectors has less toxicity and no side effects than the chemical.

(19) conducted his study on the effect of Zamzam water on diabetic type 2 patients, according to their oxidant-antioxidant status, glycaemic control, and lipid profile; his results revealed that drinking Zamzam water effectively increased antioxidant efficiency and improved wellness. Zamzam as alkaline water was investigated by (20) in terms of antioxidant mechanisms; the experiment was conducted on two groups the first contains normal rats as control and the second group was subjected to a high dose of gentamicin then Zamzam water was given to both for 21 days and demonstrated that Zamzam water does not show any sign of toxicity in normal rats and total antioxidant in rats stressed with gentamicin overdose. Investigation of Zamzam water as a potential antioxidant agent was conducted by (21) in terms of decreasing rats' liver toxicity caused by carbon tetrachloride and the results indicated that Zamzam water has a potential protective effect against carbon tetrachloride liver toxicity in rats.

Antimicrobial activity

Microorganisms are the most well-known reason for irresistible infections in humans. Diversity of bacterial pathogens, such as *Escherichia coli* and *Salmonella*, leads to soft-viscer mortality in many humans, which is a problem in such diseases²². Also, fundamental fungal diseases caused by *Candida albicans* have risen as significant reasons for bleakness and mortality. Zamzam water is water consumed by a lot of Muslims worldwide. It contains neither microscopic organisms nor molds that cause changes in smell and taste. Many studies reported it as free from any microorganism growth and confirmed it is suitable for drinking purposes. The Prophet Mohamed of Islam (peace and blessings of Allah be upon him) said: "The best water in the world is the water of Zamzam; it is a piece of food and source of healing from disease²²."

Zamzam water has a superior composition that makes it beneficial and contains a large amount of calcium and magnesium elements compared to the other types of water. It also contains fluorides that have germicidal effects, which makes the growth of algae so challenging to produce changes in taste and odor. All these criteria give Zamzam water characteristics of no growth of bacteria and make it an antioxidant to fight against so many diseases and their complications^{5,7}.

Anticancer effect of Zamzam water

As Zamzam water is alkaline and contains many minerals, it is considered an effective anticancer agent. (23) investigated the cytotoxic effects of Zamzam water on human lung cancer (A549) cell lines, and they compared it with human skin fibroblasts (HSF). The study showed that Zamzam water treatments reported a reduction in the cell viability of A549 cells, and they assured the effectiveness of using Zamzam water in treating lung tumors. (7) investigated an experimental mouse fed with 500 ml Zamzam water once a day for 30 days for treating colon cancer. Their results revealed that a decrease in the tumor mass was detected significantly. The probable cause for the loss of cancer is the natural composition of Zamzam water. Zamzam water contains 34 different components. The concentrations of sodium (Na), calcium (Ca), chloride (Cl), and magnesium (Mg) are higher than normal water. Rare traces of chromium (Cr), manganese (Mn), and titanium (Ti) exist in Zamzam water. Likewise, the quantity of toxic 34 estimates of the probable anticancer activity of Zamzam Water in human colon cancer cell Line components including, cadmium, lead, arsenic and selenium, is below the level of danger of human consumption.

Additionally, Zamzam water has a higher pH value (7.9–8.0) than the pH value of normal water (pH 6.5–7.0)⁸. Earlier studies confirmed that specific doses of some toxic minerals such as selenium, arsenic, and lithium inhibited the proliferation of cancer cells lymphocytes in the colon and were directed by Zamzam water. Cancer origin is affected by a definite immune mechanism, causing a reduction of cancer mass. In the same manner, (24) studied the effect of Zamzam water as colon anticancer; their results showed that Zamzam water treatments reduced the cell viability of cancer cells, they concluded that the death of cells happened through the cell death pathway in the two treatment situations. The early cell death was (3.0%, 3.5%), and 2.8% in control, respectively. The late phase of cell death was significant (4.2%) after one day of cure with Zamzam water. (25) studied the effect of Zamzam water on breast and ovarian tumor cell lines; their results revealed that using Zamzam water as a treatment raises cell production compared to drinking water. The chemotherapeutic agent diminishes and drops the sustainability of the cell by Zamzam water. Treatment with Zamzam water inhibited the influence of chemotherapy-induced reduction of CRAF, MEK1/2, ERK1/2, and P38 phosphorylation in breast and ovarian tumor cell lines. Equally, their results revealed that the silencing of ERK1/2 raises the chemotherapy-influence cell death in breast and bowel tumors. These data recommend that MAPK proteins primarily activated ERK1/2 showed a role in Zamzam water refereed defeat of chemotherapy- influence cell death.

Zamzam water, diabetes, and hypertension

Using Zamzam water as a treatment for hypertensive patients exaggerated excellent and bad cholesterol levels as verified significantly between intervention groups ($p < 0.05$)²⁶. These authors showed that the hypothesis testing using paired T-test revealed significant prior and afterward cured with Zamzam water ($p < 0.05$). While the study that was conducted by (27) showed that drinking Zamzam water leads to a significant rise in systolic pressure, diastolic pressure, heart rates, and the average pressure in patient arteries during one cardiac cycle within a few times after consumption. Also, they reported that drinking Zamzam water leads to a substantial rise in parasympathetic activity but does not affect cardiac sympathetic activity. Compared to carbonated water, Zamzam water has no significant influence on parasympathetic and sympathetic activity. In their distinguished study on the effect of drinking Zamzam water on the level of insulin and cholesterol in experimental rats, (28) fed them a diet with a tap or Zamzam water as the only source of fluids. Ten weeks later, these researchers measured fasting blood glucose, serum insulin, insulin resistance, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, super-dismutase, and lipid oxidation. Their study concluded that consuming Zamzam water for ten weeks reduces fasting blood sugar, blood insulin, and insulin resistance. However, Zamzam water does not affect lipids, redox homeostasis, and body composition. A study was conducted by (19) who studied the impact of drinking Zamzam water for non-insulin-dependent diabetes mellitus patients. His result showed that the group of patients who drink Zamzam water has great significance in the antioxidant capacity, superoxide dismutase, and glutathione concentration. This author emphasized that a diabetic patient who drinks Zamzam water has a significantly a lower glycated haemoglobin but not in fasting plasma glucose. Both glycated haemoglobin and fasting plasma glucose were not change significantly in the control group.

Other health benefits of Zamzam water

A study was conducted by (29) on patients with inflammatory bowel disease (IBD), they found that there was extreme simple guidance regarding the usage of complementary and alternative medicine (CAM) by their families (66%) and (62%) used honey, (54%) Zamzam water and physical exercise (32%). The most common of patients prefer the use of complementary and alternative medicine when they have a severe complaint.

In a comparative study between Zamzam water and other water sources and their effect on the prevalence and severity of tooth decay among school girls, by dividing the children into two groups, the first group of mixed dentition and the second group of permanent dentition, the results of the clinical examination indicated that there were no statistically significant differences in the first group, while the mean decayed missing filled teeth (DMFT) score is the lowest among all children in all the children used Zamzam water. A possible justification for that is the high level of fluorides in Zamzam water. Many studies have referred to the role of fluoride in preventing tooth decay, as they mentioned that, there is an inverse relationship between the spread of tooth decay and drinking water according to the percentage of fluoride in it, as it was found that 1.0 part per million of fluoride in drinking water reduces the experience of caries by 50%, this confirms the importance of adding a certain percentage of fluoride to drinking water and that it has beneficial effects⁶.

Conclusions

This review clarified much important information about the chemical composition of Zamzam water, and it became clear that there are many benefits of drinking Zamzam water compared to regular tap water. Perhaps this is because Zamzam has many benefits water is alkaline. This study summarized the results of many studies about the great benefits of this water on humans and animals. But also, on plants, as studies conducted on many experimental rats have shown, the resistance or reduction of various human diseases and reduce cancerous growth by Zamzam water. This mini-review study confirmed the mineral and nutritional balance in the composition of Zamzam water.

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