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Composition of minerals and trace elements at Mamasani thermal source: A possible preventive treatment for some skin diseases

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Abstract:

INTRODUCTION: Some skin diseases are incurable and modern medicine can only control them. In addition, alternative treatment remedies including balneotherapy can be effective in improving skin conditions. However, there are only a limited number of studies on particular mineral or trace elements of mineral sources that have been identified in Iran. In this respect, the amount of minerals and trace elements in Mamasani thermal source, Fars Province, Iran, was measured using electrochemical, titration, and spectrophotometric methods and evaluated.

MATERIALS AND METHODS: The amount of minerals and trace elements in Mamasani thermal source, Fars Province, Iran, was measured using electrochemical, titration, and spectrophotometric methods.

RESULTS: The concentrations of natural gases such as H₂S and NO₃ in Mamasani thermal source were measured to be 22.10 mg/L and 42.79 mg/L, respectively. The source also contained major ions such as chloride, sulfate, sodium, calcium, magnesium, potassium, and carbonate. Due to the high concentration of chloride, sulfate, and sodium ions in comparison with other major ions, the water source is also classified as sulfide water. The existing trace elements in this thermal water source are iron, zinc, copper, selenium, cobalt, chromium, boron, silisium, aluminum, magnesium, and molybdenum.

CONCLUSION: We concluded that bathing in this source could be beneficial. As nitrate concentration is close to the highest standard concentration for drinking water, it can be used in chronic dermatitis, psoriasis, burns, and allergy. Furthermore, the antibacterial and antifungal effects of sulfur-containing water in this source can be helpful in the treatment of leg ulcers, tinea versicolor, tinea corporis, and tinea capitis.

Keywords:

Fars, hydrogen sulfide, Iran, mineral source, thermal source

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Introduction

Archaeological remains show that the use of thermal mineral water sources for bathing, well-being, and religious rites, in Asia, has been around since the Bronze Age, about 5000 years ago. The Egyptians, Middle Eastern Jews, Greeks, Turks, Persians, and even the British used and developed thermal

mineral water sources.^[1] Balneotherapy, immersing the patient in mineral baths or pools, was a treatment method in the 1800s, first in Europe and then in the United States.^[2]

The therapeutic effects described by “Von Galen” and the Roman historian “Josephus” of sea water on sore skin were known

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since ancient times.^[3] For a long time, Europeans and Japanese have found that bathing in thermal sources has a significant effect on physical, mental, and emotional health. As recognized throughout the world, medical therapy is the use of natural mineral water for the prevention and treatment of diseases. Scientifically justified, balneotherapy was started to be used in the treatment of psoriatic patients at the Dead Sea in 1959. In the late 19th and 20th Century, Ferdinand Von Hebra and Louis Duhring pointed out the importance of hydration and bathing for the treatment of psoriasis, ichthyosis, and pemphigus.^[4]

Thermal balneotherapy is a natural, complementary, multifactorial, and nontoxic alternative to conventional pharmacological treatment that is used around the world in the treatment of psoriasis although it is also not accepted by some authors as a well-established treatment method.^[4-6]

The treatment of various diseases by the use of mineral water in the world in the last decades has been reevaluated.^[4] Other studies have supported the treatment of chronic skin diseases by climate and spa therapy (health resorts around the world).^[7-11] It has been shown that patients can enjoy many benefits after 3–4 weeks of balneotherapy.^[10,12-14]

The dissolved substances in the water (e.g., iodine, sulfur, magnesium, iron, carbon dioxide, carbonic acid, and radioactive substances) are absorbed through the skin and mucosa and it has been shown that trace elements

in mineral waters, which are absorbed through the skin, can be effective for modulating the immune system.^[15]

Mineral sources form under certain geological conditions, have different physical properties, without any bacteriological purity. Mineral sources have been classified by their chemical and physical properties; such as temperature, molecular concentration, chemical composition, and therapeutic effect.^[16] The waters which are mainly suitable for dermatological treatments are rich in sulfur, hydrogen sulfide, and sulfates but can have different chemical and physical properties.^[17,18]

According to the relieving effects for skin diseases observed in the local population, the present study aimed to measure the amount of minerals and trace elements of Mamasani thermal source (Abgandu) and to investigate its balneotherapeutic application in the treatment of skin diseases, and in this context, the importance of investment in this source.

Mamasani thermal source is located on 51°32'43.53" East longitude and 30°4'48.83" North latitude, West of Fars province, Iran. It is 120 km away from Shiraz, capital of Fars province. Its altitude is over 965 m above sea level. This region is located in the simply folded zone of the Zagros belt. The lithostratigraphic column of study area is shown in Figure 1. Mamasani hot water source discharges from Asmari formation (Oligocene-early Miocene) in coastal Fars. It is composed of limestone and dolomite.

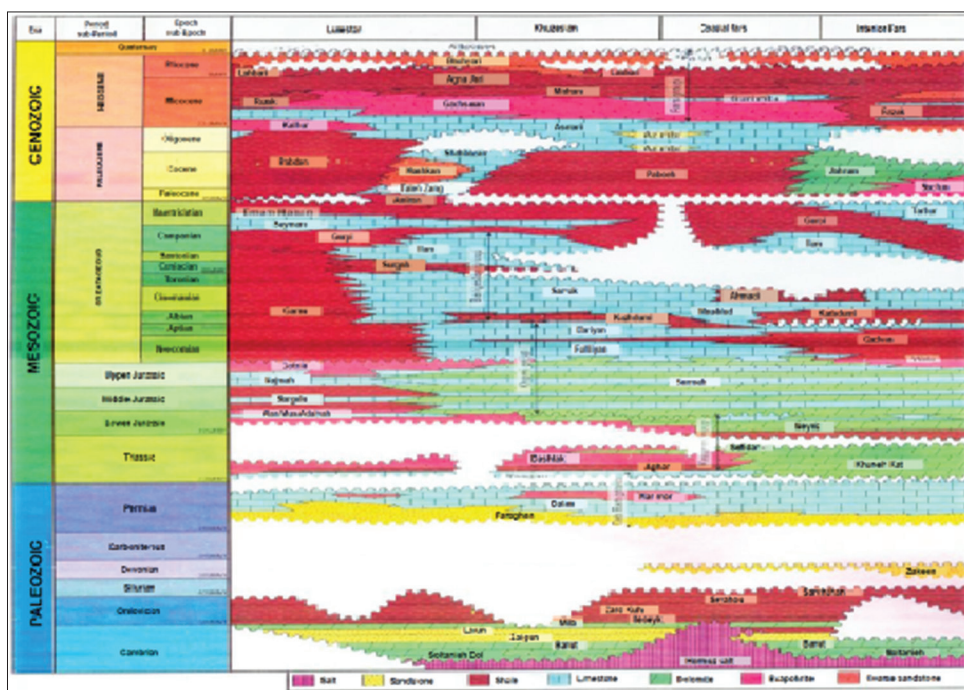


Figure 1: Simplified lithostratigraphic chart of Zagros (Ghavidel-Syooki *et al.*, 2003)

Materials and Methods

Experimental instruments

The measurement of heavy metals was performed with a GBC (Savanta, Australia) atomic absorption spectrometer equipped with graphite furnace and a hollow cathode lamp as well as a deuterium background corrector, at respective wavelengths. Atomic absorption spectrometer was used to study the main cations and anions of the water sample including Ca^{2+} , Mg^{2+} , Cl^- , HCO_3^- , and CO_3^{2-} using titrimetric method. Furthermore, the concentration of H_2S and CO_2 was measured in the field, using titrimetric method.^[19]

A (PG Instruments, England) T80 UV/Vis double beam spectrometer, utilizing quartz cells, was used for measuring absorbance of NO_3^- , NO_2^- , and SiO_2 and B of the sample.

A flame photometer (Jenway, England), model PFP7, was used to determine the concentration of Na^+ and K^+ ions.

Reagents and solutions

All analytical grade nitrate salts of metal ions and other materials were purchased from E. Merck, Darmstadt, Germany, and were used without any further purification. All solutions were prepared and diluted with double deionized water.

Results

In this study, major ions, trace elements, hydrogen sulfide, carbon dioxide, nitrate, total dissolved solids (TDSs), electrical conductivity, and acidity and source water temperature were measured [Tables 1-3]. The source water had a temperature of 32°C and a pH of 6.52. TDSs were 3962.3 mg/L. The concentrations of dissolved gases of CO_2 and H_2S in the water were 23.50 mg/L and 22.10 mg/L, respectively. The concentration of NO_3^- was 42.79 mg/L. Table 4 shows the constituents of sources where water therapy is being practiced in comparison with the sample taken from Mamasani thermal source.

Discussion

A special combination of minerals has been reported to alleviate skin conditions such as itching, irritation, eczema, and psoriasis for hundreds of years. Thousands of people with skin diseases, especially psoriasis patients from worldwide visit the shores of the Dead Sea for treatment by sea water. The major dermatological disorders, often treated by balneotherapy with a high success rate, are psoriasis^[23-26] and atopic dermatitis.^[27] Dissolved minerals in the water of the thermal sources are absorbed through the skin. Supplying of minerals through topical absorption will be more effective and

Table 1: Concentrations of heavy metals

Major ions	Concentration (mg/L)
K^+	57.72
Na^+	828
Mg^{2+}	120
Ca^{2+}	450
Cl^-	1304.63
SO_4^{2-}	900
HCO_3^-	301.95
NO_3^-	42.79
TDS	3962.30

TDS=Total dissolved solid

Table 2: Trace elements concentrations in Mamasani thermal source

Trace elements	Concentration (mg/L)
Al	0.032
As	0.0003
Ba	0.037
B	2.53
Cd	0.0001
Co	0.003
Cr	0.015
Cu	0.119
Fe	0.01
Hg	0.00001
Mo	0.0184
Mn	0.0035
Ni	7.37
Pb	0.0017
Sb	0.0002
Se	0.00005
Zn	0.0019
Si	2.75

Table 3: Dissolved gases in the sample taken from Mamasani thermal source

Gas	Concentration (mg/L)
O_2	1.63
H_2S	22.10
CO_2	23.50

less harmful in comparison with oral administration of tablets or capsules through the digestive tract.

Bromine, rubidium, calcium, and zinc in the serum of psoriatic patients after daily bathing in the Dead Sea for weeks showed a significant increase. This suggests that skin penetration of the minerals of the Dead Sea in psoriatic patients is more than penetration in healthy skin.^[28]

In vivo and *in vitro* studies have revealed the pharmacological effects of minerals from the Dead Sea water on psoriasis in human and animal skins.^[28-34] It has been shown that increased levels of minerals can play a role in cell proliferation and differentiation.^[35-37] The

Table 4: Chemical analysis of mineral waters in comparison with Mamasani thermal source

Parameter	Mamasani source	La Roche-Posay (France) ^[20]	Ipati (Greece) ^[21]	Bugok (Korea) ^[22]
pH	6.52	6.96		9.16
Temperature (°C)	32	13	33.5	76
CO ₃ (mg/L)	0	3.96	1924	29.3
Ca (mg/L)	450	140	871.7	1.99
Se (mg/L)	<0.00005	0.06		
SiO ₂ (mg/L)	2.75	30		63.5
Mg (mg/L)	120	4.9	216.2	0.24
Sr (mg/L)		0.26		0.07
Zn (mg/L)	0.0019	0.022		
Cu (mg/L)	0.119	0.005		
K (mg/L)	57.72		66	2.35
Na (mg/L)	828		1461	95
Cl (mg/L)	1304		3190	12.8
Br (mg/L)			8	
SO ₄ (mg/L)	900		21.9	123.5
H ₂ S (mg/L)	22.1		1.9	
HCO ₃ (mg/L)	301.95		1924	29.3
Fe (mg/L)	0.01			0.04
Li (mg/L)				0.06
F (mg/L)				3
TDS (mg/L)	3962.3			

TDS=Total dissolved solid

penetration of radioactive sulfur was studied in all layers of the epidermis after 8 h and a complete resorption after 24 h in the skin of healthy individuals and patients with seborrheic dermatitis, acne vulgaris, psoriasis, and other dermatoses with biopsies.^[38]

By possible interaction between sulfur and oxygen radicals in the deeper layers of the epidermis, sulfur and hydrogen sulfide is produced, which can be transformed into pantothenic acid. Antibacterial and antifungal activity of sulfur water may be due to pantothenic acid.^[39] The antibacterial and antifungal effects of sulfur water help in the treatment of leg ulcers, tinea versicolor, tinea corporis, and tinea capitis.^[6,40]

Other advantages of sulfur-rich water after penetration and oxidation of sulfur in the skin include vasodilatation in the microcirculation and an analgesic effect on pain receptors, all of which could lead to the inhibition of the immune system. Furthermore, the keratolytic effect of sulfur water is effective in many diseases, including acne.^[41,42]

In this study, minerals, trace elements, dissolved gases, temperature, and pH values were measured in the Mamasani thermal source. Based on the categorization of mineral sources, Mamasani source is classified with a variable temperature of 32.5°C and a TDS of 3.962 g/L as a thermal source (>30°C–40°C) with mild mineralized water (>2–10 g/L).^[43]

NO₃⁻ concentration in this source is close to the standard limit of NO₃⁻ concentration of drinking

water (50 mg/L).^[44] This is less than the natural limit of NO₃⁻ concentration in the ground water (45 mg/L).^[45] For this reason, the water from Mamasani source can be used therapeutically; however, it is not allowed for infants due to the risk of methemoglobinemia. Moreover, the amount of nickel is higher than all other trace elements; therefore, it is recommended that people allergic to the metal do not use this water.

Furthermore, as the concentration of H₂S is more than the normal range (>10 mg/L).^[46] Mamasani thermal source is classified as sulfide water. According to Japanese/American/Italian definitions,^[47,48] this source can also be used for balneotherapeutic purposes, because of the H₂S concentration more than 1 mg/L. Based on the effect of minerals on skin diseases, particularly psoriasis, and in view of the presence of some minerals in Mamasani thermal water, this source can be effective in the improvement or cure of acne and psoriasis. Due to the presence of sulfur, the source water can have antibacterial and antifungal effects; on the other hand, it can be effective in the treatment of leg ulcers, tinea versicolor, tinea corporis, and tinea capitis. Moreover, Mamasani thermal water contains sodium, chloride, sulfate, and sodium and can be used to treat chronic dermatitis, psoriasis diseases, burns, and allergy.^[48,49]

According to Table 4, in comparison with other thermal sources in the world that have been studied, it was found that this source has acceptable physical-chemical properties. Extensive studies and measurements of broad categories of heavy metals and other compounds

indicate that Mamasani thermal water is safe enough for bathing. This study shows that Mamasani source can be effective in the treatment and alleviation of skin diseases and it is worthwhile to invest in this source for therapeutic purposes.

Conclusion

Difficulties involved in the treatment of autoimmune diseases and the high cost of conventional treatments as well as the existence of many different types of mineral and thermal sources in various parts of Iran, convinced us to do the present study; we aimed to suggest using Mamasani thermal water as an alternative way to relieve pain in patients and to prevent the progression of diseases.

We concluded that the antibacterial and antifungal effects of the sulfur-containing water of this source can be helpful in the treatment of leg ulcers, tinea versicolor, tinea corporis, tinea capitis, and psoriasis, atopic and chronic dermatitis.

The authors suggest that further clinical research should be performed on this water source due to its benefits in the treatment of skin diseases as well as considering the feasibility of profitable investment in the Mamasani thermal water source.

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Conflicts of interest

There are no conflicts of interest.

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