

## Medical Geology of Karstic Water Resources in the South-West of the Markazi Province

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### ABSTRACT

This article is a review of medical geology of karst water resources of South-West of the Markazi Province, with a review of mineral springs known as the control springs Chepeghly. To study the specificities of Geology this spring was carefully studied first, Geology and regional situation.

The final stage is studied geology associated with the elements and chemical compounds. Then to evaluate chemical Chpqly spring water was tested in different chemical, microbial and isotopic.

Results shows, although water rates this spring has many health and karst water to potable quality, but the amount of toxic elements and heavy water is more than the maximum allowed, such as lead, cadmium, chromium, bismuth, cobalt, and barium.

**Key words:** Spring, Medical geology, karst, Markazi Province

### INTRODUCTION

In Iran and in southwest of Markazi Province and in Shazand city, there are considerable karst water resources in the Cretaceous limes which have properties of mineral waters and of which therapeutic and drinking properties have been always considered. Among these springs, there are pleasant resort and a spring known as Chepeghli with a main opening and three side openings in 28 km of southwest of Arak city in south of Arak-Malayer-Shazand junction in adjacency to the seventh refinery of Arak and in upstream of Robat Mil Village at heart of Sefid Khani mountain range. The height from sea level in this spring is 2400 m with longitude of 49°/25' and altitude of 23°/56' and properties of its mineral water are known to all. Area of aquifer basin in Chepeghli spring is 475 hectares (figure 1).

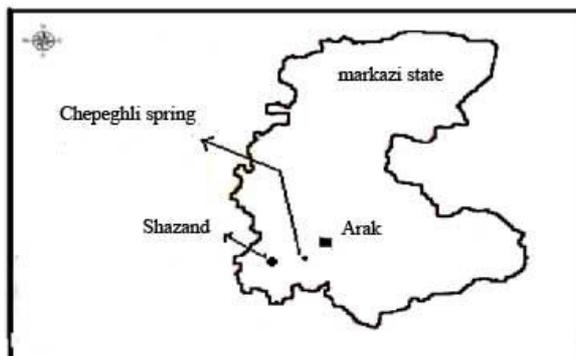


Figure 1- Position of Chepeghli spring in Markazi province.

This spring is located near some industrial contaminating manufactures called refinery, petrochemical and power plant in Shazand of Arak.

Local residents of the villages near Chepeghli spring, mountain climbers and the lovers regard this spring water as healing and call it natural kidney stone crusher and also believe that water of this spring is diuretic, pebbles and sands solve urinary ducts and prevent it from reformation. When we drink such water, blood loses considerable amount of uric acid and eating is done under better conditions. In addition that drinking such water makes urine acidity normal; it causes to increase secretion of urine and wastes of the kidney and to decrease bilious salts in blood. With regard to these specifications, this article tries to study chemical, microbial, isotopic characteristics and amount of heavy metals of this spring from the medical geological point of view.

### Geological Setting

This region is located in geological zone of Sanandaj-Sirjan of which Shemshak formation shale with Jurassic age are located below it and sequence of limestones with the Cretaceous age are located above it and their connection is of angular unconformity type (figure 2).

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This region is regarded as a metallogenic zone and lead and zinc mines of Hafteh Emarat and Iron Ore of Shams Abad are located near it and it justifies origin of elements in water of this spring.

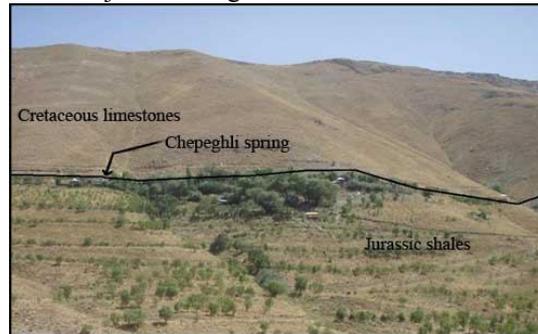


Figure 2-Geological position of Chepeghli spring.

### MATERIAL AND METHODS

In this research which was done in 12-month time period, physical, chemical, microbial and radioactivity properties of Chepeghli spring Water were determined.

Density of the related components is measured in some ways so that common methods of quantitative analysis were used in order to measure density of sulphate, chloride, nitrite, alkalinity, hardness, total soluble solid material, soluble oxygen and chlorine of which some are mentioned.

PH of spring water was measured with PHmeter with glass electrode and water conduction with conductometer. Ph and temperature of water in the spring were measured.

Zinc, manganese, iron, calcium, magnesium, lead, cadmium chrome, silver, aluminum, bismuth, cobalt, and barium were measured with atomic absorption device and fluorine was measured with selective ion electrode in Arak aluminum manufacturing plant and standard curves and tables of quantitative results are attached here.

Radioactive material was measured by Atomic Energy Organization and results of all of the above tests are included in tables 1 to 7 attached herewith and comparison has been made with specifications of drinking water in two permissible and desirable limits. It is necessary to note that the numbers included in tables have been at least 50 times of test except amount of radioactive material and natural isotopes.

Table 1- comparison of physical properties of drinking water and Chepeghli spring water

Peroperties	Unit	Desirable limit	Permissible value	Chepeghli spring water
<b>Color</b>	Platinum –cobalt	≤1	A most 20	1
<b>Odor</b>	Threshold odor number	0	At most 3 in 25 c	0
<b>Turbidity</b>	eshel silica (ssu)	5	20	1
<b>Taste</b>	-	Acceptable	Acceptable Not objected	Acceptable
<b>PH</b>	-	6.5-8.5	9.2	7.61

Table 2: comparison of the maximum amount of toxic chemical material in drinking water with Chepeghli spring water

Type of compound	Maximum permissible amount in terms of ppm of drinking water	Chepeghli spring water
<b>Lead</b>	0/05	0/2123
<b>cadmium</b>	0/01	0/0048
<b>chrome</b>	0/05	0/2474
<b>silver</b>	0/05	0/0288
<b>bismuth</b>	0/05	0/3019
<b>cobalt</b>	0/05	0/0668
<b>barium</b>	1	3/549

Table 3- comparison of the maximum permissible and desirable amount of chemicals in drinking water with Chepeghli spring water,

Type of compound	Desirable amount in terms of ppm of drinking water	Maximum permissible amount in terms of ppm of drinking water	Value obtained in water of Chepeghli spring
sodium in terms of Na	20	150	1.796
potassium in terms of K	10	12	0/0891
magnesium in terms of Mg	50	150	3/549
calcium in terms of Ca	75	200	14/18
copper in terms of Cu	1	1/5	0/0610
zinc in terms of Zn	5	15	0/0972
Manganese in terms of Mn	0/3	0/5	0/1353
Aluminum in terms of Al	< 0/05	0/2	0
iron in terms of Fe	0/5	1	0/1733
fluorine in terms of F-	0/7	1	0/1375
sulphate in terms of SO4-	200	*250	4/38
nitrite in terms of NO3-	0/2	3	0/1
hardness of total calcium carbonate	45	45	5
chloride in terms of Cl-	100-80	500	152
ammoniac n terms of nitrogen	250	600	8/7
total soluble solid material	0/002	0/05	0

\*In case that density of sulphate is more than 250 milligrams in liter, the maximum amount of magnesium should not be more than 30 milligrams in liter and if it is less than 250 milligrams in liter, the maximum amount of magnesium is 150 milligrams in liter.

Table 4- comparison of bacteriological specifications of drinking water with water of Chepeghli spring

Type of compound	Unit	Desirable limit of drinking water	water of Chepeghli spring
Total coliform	MPN/100 cm <sup>3</sup>	<2.2	0
E-coli	MPN/100 cm <sup>3</sup>	0	0

MPN=most probable number

Table 5: some of the other specifications of Chepeghli spring water

Conduction	Alkalinity of PA in terms of Calcium carbonate mg/L	Alkalinity of MA in terms of Calcium carbonate mg/L	hardness of calcium in terms of Calcium carbonate mg/L	Hardness of magnesium in terms of Calcium carbonate mg/L	Soluble oxygen DO mg/L
ms 0/287	19	115	112	26	8/5

PA=phenol phetaleic alkalinity

MA=methyl orange alkalinity

Table 6- results of radioactive and isotopic materials of Chepeghli spring water

Specification	Uranium in terms of Ug/Lit	HD <sup>16</sup> O mg/lit
Water		
Chepeghli spring water	0.005	146
Maximum permissible amount in drinking water	0.2	140-150

Table 7- comparison of specifications of some drinking waters with Chepeghli spring water (PPm or mg/Lit)

Mineral water Specification	Ploor mineral water	Wata mineral water	Damavand mineral water	Damash mineral water	Pars mineral water	Chepeghli mineral water
Calcium	06/32	8/9	4/56	28	62	14/18
Magnesium	7/61	3/2	4/15	4	10	3/549
Sodium	1	4/7	4/6	6	6	1/76
Potassium	0/1	1/9	0/6	1	0/5	0/0981
Bicarbonate	96/143	29	212	90	90	77
Fluorine	0/07	0/11	0/2	0/2	0/3	0/1733
Nitrate	6	0/7	6	6	8	7/8
sulphate	3	19	6/10	10	10	4/38
chloride	0/5	3/2	5/7	7	6	5
PH	4/7	7	3/7	3/7	7/7	7/61

## DISCUSSION

Since heavy and toxic elements even few elements have effect on health of the human being and in this research, rate of these elements have been measured and some of their values (table 2) are above the maximum permissible amount in drinking water, therefore, we have studied disadvantages of these elements on health of the human being.

For example, maximum amount of barium (Ba) in drinking water should be about 1 ppm which has been measured to be 3.549 ppm in this spring which is more than the permissible limit. Side effects of barium depend on solubility of its compounds. That group of the barium compounds which is solved in water is harmful for health of the human being. Absorption of high amount of barium solved in water causes paralysis and sometimes death. Little amount of barium in water causes respiratory problem, increase of blood pressure, pulse changes, stomachache, weakness of muscles, change of neural reaction, brain inflation and liver, kidney and heart diseases.

In spite of cobalt metal (CO) in little amount is important for health of the human being because it forms some part of B12 Vitamin and is used for curing anemia in pregnant women because cobalt stimulates production of blood cells and effects of high density of cobalt include: vomiting, nausea, vision problems, cardiac problems and damage on thyroid or bismuth which damages the kidney. Although rate of damage is low, its high dose is deadly. Ways of entrance to body are respiration, skin and eating. It causes nausea, lack of appetite and losing weight, unrest, albumin urine, diarrhea, dermal reactions, gingivitis, high fever, insomnia, depression and rheumatism and a dark line may be created due to deposition of bismuth sulfide on gingiva.

Lead metal (pb) of which measured amount in this spring water is more than the permissible limit has side effects on health of the human being. Lead in animals and human being are accumulated with calcium and strontium in bones and interfere in natural maturation in marrow and prevent from synthesis of hemoglobin in cells. During life of human being, most of the lead entering the body is accumulated in bones. With regard to age of the persons, tissues and soft organs of the body such as liver, kidneys and pancreas have different concentrations of lead but lower than bones. Different studies show that increase of lead reduces immunity of the body and interfere in activity of enzymes.

With regard to the fact that these elements especially barium and lead, bismuth of chrome and cobalt in water of the spring is more than the permissible limit and with regard to side effects of excessive amount of these elements on health of human being, these problems should be considered while drinking water of this spring.

## Conclusion

Medical geological characteristics of Karst Chepeghli spring were studied with use of chemical analysis. This spring belongs to bicarbonate group. Its electrical conduction is .0287 mili -Siemens in cm and its PH is 7.61. Alkalinity of spring water is due to bicarbonate calcium and bicarbonate magnesium. Basis of these compounds in water is solubility of dioxide carbon solubility in water which solves minerals in Cretaceous calcareous units such as calcite (CaCO<sub>3</sub>) and dolomite (MgCO<sub>3</sub>) and produces bicarbonate calcium and bicarbonate magnesium. Oxygen solved in water is one of the most effective factors of metals corrosion. Intensity of corrosion depends on density of soluble oxygen at temperature of system and PH. With regard to PH and soluble oxygen (DO), water of Chepeghli spring is not corrosive.

Alkalinity of Chepeghli spring results from bicarbonate and carbonate but amount of bicarbonate is more than carbonate.

With regard to the fact that alkalinity of phenol fetaleine is less than half of total alkalinity, therefore, this water has 2PA and alkalinity relating to T-2PA bicarbonate and this water lacks hydroxide.

Heavy and toxic elements of Chepeghli spring such as lead, cadmium, chrome, bismuth, cobalt and barium were obtained to be more than the permissible limit:

It is necessary to note that Chepeghli spring is located in metallurgic zone of Iran so that lead and zinc mines of Hafteh Emarat and Shams Abad Iron are located near it and this situation justifies origin of elements in water of the spring.

With regard to results obtained from different tests, continual consumption of Chepeghli spring water is not recommended and with regard to results of geological section, amount of water is not so high that one can use it after chemical treatment (for reduction of some of the harmful elements) for different consumptions. In addition, in spite of adjacency of two important centers causing environmental contaminants (Arak seventh refinery and petrochemistry) with this spring, one can expect that hardness and salt of this water are added gradually because H<sub>2</sub>S gas will lead to acidity of water due to these two industrial centers.

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