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The Characteristics and Content of Thermal Water and Their Impact in Dibër Area

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***Abstract*:** *One of the objectives of this study has been the analyzing and defining of the content and the characteristics of thermal water in Diber, Albania, and their impact in the area. This study has been organized during years 2013-2015. The indicators measured and evaluated the water quality have been: salt content (electrical conductivity), cations and anions (Ca, Mg, Na, bi-carbonates, sulfate, chlorides), the nutrient elements (nitrogen azote, ammonium nitrogen, phosphate, potassium) and other factors (acidity and dry remnant), as well as use of the thermal water in irrigation in 3 communities of Diber area. The study is based in the samples of waters taken 2 times per year during 3 years mentioned above. They are analyzed near the Centre for Transfer of Technology located in Fushë Krujë. The data produced from analyzes, compared with the level of the element for the water for irrigation, show that the content of Ca, bicarbonates and sulphates is over the level of standard norms. Bicarbonates are about 3 times more than the optimal level of content.*
The use of this water for irrigation is one of the main activities in Diber. 450 hectares use them in different agriculture productions. Their use is also significant in medical treatments too. Management of their negative impacts will contribute to the integrated sustainable development and use of local potentials/resources.

Keywords: *agriculture production, impact, local resources, quality of water, sustainable development*

1. Introduction

Dibra is a region in north-east of Albania. It is a mountain area. The agriculture, forestry, pastures, dairy and tourism are the main resources of the area. Dibra is far away from Tirana and the area is developed in slow steps. But there are many special resources in the Dibra territory. Thermal water is one of the greatest resources that are used for many years. Actually it as a touristic, economic and agriculture used resource, not only by Diber citizens, but for visitors too.The thermal waters sources are found in the eastern part of the city, down Bellovë village, at a distance about 1.5 km from the city center. [1]

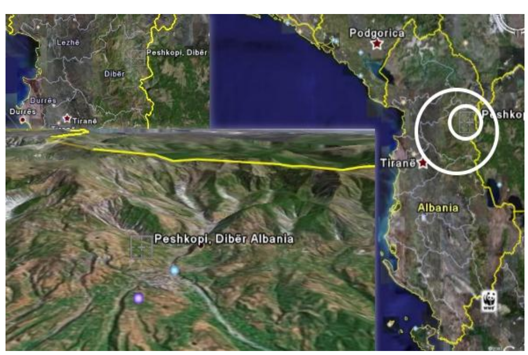

Fig. 1: Thermal water location

During the years, the primary use of thermal water was for curative purposes, however, thermal water flow to the stream and mix with other water sources coming down from the river of Bellove village and then used for irrigation. Thermal waters are used as an activity that has generated income primarily for the municipality, but also for families residing in the neighborhood near by Thermal Bath area. There are very few studies on these waters, and those existing do not provide any in-depth evaluation on the impact of thermal water at various aspects such as to the soil, plants, environment, or health.

The water has color gray in blue. Their temperature in the source is around 42 grades. Because of that, their evaporation creates the smell of spoiled egg which feels around 1 km far from the source.

Fig 2. Normal water for irrigation

Fig 3. Thermal water

Due to the content of sulfur and its temperature, thermal waters are not recommended to be used during hot months of the year. Their use during these months could cause increased risks of negative effect from the heat. Meanwhile, even during the months of low temperatures, the use of such water decreases because the exposure in outside after bathing into the hot water of Thermal Baths increases the risk of causing a variety of illnesses related to exposure to cold and changing the person's temperature immediately in very quick term.

All chronic rheumatic diseases, degenerative rheumatism, arthrosis, chronic peripheral neurite, situations of post traumatic fractures, plegia, hemiplegia, tetraplegia, essential arterial hypertension without cardiac insufficiency, some diseases of the digestive apparatus such as gastritis, colitis, chronic infections urinary apparatus, urolithiasis, colitis, some gynecological diseases such as hypoplasia, uteri, uterus chronic infections, primary and secondary sterility, certain skin diseases such as eczema and skin mycoses. [2]

The geographical location of the water source and closed terrain in the form of the valley, makes water vapor concentrate in large quantities. From the discussions with the area inhabitants, it results that the effect of the evaporated sulfur is very negative. It is noted prominently in household equipment and furniture which, if made of metal become subject of scratch and rust. The life of these devices in this city neighborhood is much shorter than areas of the Peshkopi town situated far from the thermal waters. [3]

Volatile sulfur also creates problems for human health. This especially for staff that provides services and manages patients and clients using thermal waters during the year. However, no studies have been carried out with focus on this aspect. Bathing at the bathing rooms for a time over 15 minutes, causes burning of the eyes and dizziness sometimes up to unconsciousness of the person. Years ago, to reduce the negative effects of vapors, for the personnel of the Thermal Baths was provided additional healthy food in order to prevent and reduce the negative effects of the vapors in their health. This necessary measure is not respected anymore, therefor creating serious problems in time for personnel and surrounding area residents who live very close to thermal water source.

There is no thermal water treatment method or process when using it for curative purposes or in agriculture. Before using the water for curative treatment, it gets collected in ponds and during this process a part of salt and minerals precipitate and creating a mass of mud. The mud is used for massaging patients, and as such adding the range of services to the clients. [4]

2. Materials and Methods

The research was based and supported with data from analyzes in 3 years of the studies. Information from staff that serves to the clients and people that live near to the source of thermal water is used and analyzed.

The sampling was conducted according to **APHA 2005** and **EPA 2001** methodology, according to which water samples were taken at intervals of 3 hours, were kept in sterilized bottles of 0.5 liters capacity. There were received 4 samplings a month in June 2013 and February 2014. Water was stored at 4 ° C before being sent to laboratory. The analysis of samplings was done at ATTC laboratory in Fushë Krujë.

Water samples were taken at two different periods of time, in June and in February of the following year. The average level of indicators and results were compared to the ordinary water content (used for washing and irrigation) based on Standards defined in the State Standards Catalogue 2011.

Various data related to the impact of these waters in human health are also used in order to better realize the research, the ways of use of these waters at Community level, statistical data used to evaluate the extent of curative / relaxing values, as well as problems with furniture at houses near the thermal water source. All collected data have undergone an evaluation process of analytical comparison. This research will help the other researches in the future to complete the impact of thermal water in local level in all aspects. [5]

3. Results and Discussion

Based on the results from the analysis of water samples during the three years of the study and other additional information, it results that the existence of the mineral elements in the thermal waters is quite high.

The results have demonstrated values of CE in limits 2.99 µs/m - 3.77 µs/m, Ca^{2+} is from 405 mg/l - 666.4 mg / l , Mg^{2+} content is in limits 11.84 mg / l - 24.96 mg/l, Na^+ is 279.8 mg / l - 320 mg/l, HCO_3^- is in limits 397.7 mg/l- 780.8 mg / l, SO_4^{2-} is 1609 mg / l - 1.651 mg/l, and Cl^- goes 426 mg / l - 518.3 mg/l. Thermal waters have also nutrients in them. Nitric nitrogen level is 9.9 mg/l - 13.9 mg/l, nitrogen ammoniac NH_4 is 5.8 mg/l - 8.6 mg / l, phosphates were 0.033 mg/l - 0.258 mg / l and potassium 36.4 mg/l - 49.5 mg / l.

The values of pH in the analyzed water has resulted to be in the limits that have moved from 6.7 to 7, while dry residues are 1.69 g/l till 2.06 gr / l.(TABLE 1).

In regards to the interchangeable cations and anions, the analysis show that some of them are above the allowed norms for the water to be used for irrigation. Ca^{2+} varies from 20.21 mek/l to 33.25 mek/l, while the allowed limits are in between 0-20 mek/l. Mg^{2+} varies from 2.05 mek/l to 9.73 mek/l while the allowed norms are 0-5 mek/l. [6]

The content of Na^+ is within the standard norm. From the analysis results, it is noticed that its values vary from 12.11 mek/l to 13.89 mek/l, while the normal values vary from 0 to 40 mek/l. The content of bicarbonates is in high values compared to the allowed ones. The analysis results show their values in the range between 7.93mek/l to 64.8 mek/l, while the normal allowed values vary from 0 to 10 mek/l.

Furthermore, also the content of SO_4^{2-} is above the normal values. The analysis show that their value varies from 33.46 mek/l to 34.34 mek/l, while the norms are 0-30 mek/l (TABLE 2).

The high content of cations and anions as well as their values above the allowed rate for irrigation water, shows that thermal waters are not suitable to be used for agriculture purposes, such as irrigation of crops. A way to make it suitable is water treatment to reduce the content of salt. The high rate of salt content impacts the quality of soil to which thermal water is used for irrigation. As well, there are no studies so far on the impact of thermal water on the soil quality. The same applies to the impact that the characteristics of these waters have on different agricultural crops. Continuous usage of thermal water with such lack of information may affect not only the production yield per crop, but also the health of plants and animals, since they are grazed with these products irrigated using thermal waters. Given that the surface irrigated using thermal water is about 450 ha, the negative impact is substantial. [7]

Their high temperature and high minerals content may be the factors that affect the length of the vegetation period for the plant. This issue has been studied for maize crop. However, the degree of impact will be measured based on statistical processing of the results obtained from the analysis. The results of this analysis will have a positive impact for the agriculture development in the area, since the length of the vegetation period may not allow plants to reach maturation within the set deadlines. Considering Diber area atmospheric conditions, such delay in crops harvesting could coincide with the arrival of low temperatures of autumn, thus negatively affecting the entire production. This is especially the case for hybrids with later harvesting cycle. [8]

From the observations in the field, it is noted that the use of thermal water for irrigation in the form of rainfall, has reduced the spots with dodders at alfalfa. Similar results are observed also in the process of the elimination of slugs, as one of the most common damaging pests in vegetables. Based on what provided above, the use of Peshkopi thermal water for combating diseases and control of pests in agriculture may be another topic of the study.

TABLE I: The results of Water Content

No	**The indicators**	**Year 1**	**Year 2**	**Year 3**
		2013	**2014**	**2015**
	Content of Minerals			
1	Conduction Electric (ECW)	3.75 μs/m	3.77 μs/m	2.99 μs/m
	Cations and Anions			
2	Calcium (Ca^{2+})	424 mg / l	405 mg / l	666.4 mg / l
3	Magnesium (Mg^{2+})	24.96 mg / l	22.5 mg / l	11.84 mg / l
4	Natrium (Na^{+})	320 mg / l	309 mg / l	279.8 mg / l
5	Bicarbonate (HCO^{3-})	397.7 mg / l	732 mg / l	780.8 mg / l
6	Sulfate ($SO4^{2-}$)	1651 mg / l	1609 mg / l	1609 mg / l
7	Chlorides (K^{+})	518,3 mg / l	489 mg / l	426 mg / l
	Nourishing elements			
8	Nitric Azote ($N–NO^{3-}$)	13.9 mg/l	9.9 mg/l	12.04 mg/l
9	Ammoniacal Azote ($N–NH^{4+}$)	8.6 mg/l	5.8 mg/l	6.1 mg/l
10	Phosphates ($PO4^{3-}$)	0.258 mg/l	0.033 mg/l	-
11	Potassium (K^{+})	49.5 mg/l	39.2 mg/l	36.4 mg/l
	Different factors			
12	acidity (pH)	6.7 log [H+]	6.9 log [H+]	7 log [H+]
13	Dry residues	2.06 g/l	2.39 g/l	1.69 g/l

TABLE II: Content of interchangeable Cations and Anions

No	Analyzed indicators	Norms of water for irrigation	Year 1	Year II	Year III
			2013	2014	2015
	Cations and Anions	mek/l	mek/l	mek/l	mek/l
1	Calcium	0-20	**21.15**	**25.21**	**33.25**
2	Magnesium	0-5	2.05	2.61	**9.73**
3	Natrium	0-40	13.89	12.11	12.14
4	Bicarbonate	0-10	**64.8**	**47.93**	**62.72**
5	Sulfate	0-30	**34.34**	**33.46**	**33.46**
6	Chlorides	0-20	14.61	13.79	12.01

4. Conclusion

Results have demonstrated the high value of calcium, bicarbonates, magnesium and sodium in the content of thermal waters compared with normal water content for irrigation in Peshkopi. There are no differences in content of natrium and potassium in 3 years of studies.

Part of this study is assessment of thermal water in soil characteristics and maize production quality. The data produced from the analyzes are in the processing and interpretation for more conclusion on impact of thermal water. [9]

Based in the information collected from the communities, this water has of course its impact in health of people living in the area near the thermal water. We suggest this impact must be measured to assess the affects in the human health (on families and the staff that works in this activity).

Part of the management of this water should be reduction of content of H2S in the air. The municipality should explore opportunities and models existing in the other countries in the similar situations.

Use of this water for irrigation should be managed also. Saline reduction should be in focus on the coming time. [10]

5. Acknowledgements

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