*International Research Journal of Environment Sciences*_____ ISSN 2319–1414
Vol. **2(8),** 28-31, August **(2013)** *Int. Res. J. Environment Sci.*

To study the Physico-Chemical properties and Bacteriological examination of Hot Spring water from Vashisht region in Distt. Kullu of HP, India

Kumar Naresh[1], Singh Ankusha[2] and Sharma Priya[2]
[1]Department of Biotechnology, Chaudhary Devi Lal University, Sirsa - 125055 Haryana, INDIA
[2]Department of Microbiology, Abhilashi Institute of Life Sciences, Tanda, Distt Mandi – 175008, Himachal Pradesh, INDIA

Available online at: www.isca.in
Received 25th June 2013, revised 14th July 2013, accepted 11th August 2013

Abstract

Hot springs are those places where the temperature of water lies significantly above the mean of annual air temperature of that region. In this paper, physico-chemical properties such as total dissolved solid (TDS), fixed residue, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), alkalinity, hardness, chloride, pH, temperature and bacteriological examination of hot spring water from Vashisht region in Distt. Kullu of Himachal Pradesh, India was studied. Physico-chemical results were compared with WHO potability parameters and it was found that water was potable. Further results of bacteriological examination by multiple tube fermentation test showed that coliforms were absent and hence water was potable.

Keywords: Springs, Coliforms and WHO

Introduction

Water is vital resource of our planet and is being deteriorated by environmental pollution. In India about 70% of the available water is polluted. According to a WHO estimate most of water pollution in developing countries such as India is caused by domestic wastes. Pollution parameters have been classified as physical, chemical and biological on the basis of analytical tests. Physical parameters include temperature, turbidity, colour, suspended and floating matter etc. Chemical parameters include organic and inorganic dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), nitrogen in various forms, pH, alkalinity, chlorides, pesticides etc. Biological parameters include coliform bacteria, pathogens, bioassay, and species diversity etc[1]. Physico-Chemical analysis of water by Total dissolved soilds (TDS), Dissolved oxygen (DO), Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), Alkalinity, Hardness, Chloride and pH from Markanday Spring in Hamirpur District of Himachal Pradesh were also done to check potability of water[2]. Physico-chemical properties such as pH, turbidity, chlorine, sulphate, nitrate, nitrate, ammonia, bicarbonate and sodium ions were studied from some Euthopian hot springs and risk to the health of the community[3]. Physico-chemical analysis of hot water springs of Sikkim-Polok Tatopani, Borong Tatopani and Reshi Tatopani were also reported[4]. Physico-chemical characteristics of thermal water and soil of Tarabalo and Attri geothermal province, Orrisa, India was also studied[5].

Spring are concentrated discharge of groundwater that appears at the surface as a current of flowing water[6]. Springs that discharge water which has a temperature above that of the normal local groundwater are called thermal springs[6]. Most of springs are the result of long cracks in sedimentary rock. Hot springs contained the life even long before they reach the surface, and the warm water of the springs allows an abundant of algae and bacteria to survive which are called as thermophilic microorganisms. The thermophiles may among the first living things on the earth, developing and evolving during the primordial days of earth when surface temperatures were quite hot, and thus been called the "Universal Ancestor"[7]. The physico-chemical characteristics as well as floristic and faunistic life of the seven thermal springs and one cold spring of Bakreswar, West Bengal have been studied[8].

Temperature is one of the most important factors that govern species abundance and distribution. High temperatures in soil and/or water exert pressure on microbial species leading to the selection of specific flora capable of tolerating and surviving heat stress. Some species can survive at the elevated temperatures of hot springs, or in various other adverse environments. The defense mechanism cells utilize when confronted with high temperatures in their local environment is known as the heat shock response. This response has been described extensively in both eukaryotes and prokaryotes[9]. The systematic of various Indian hot springs have been studied[10,11] , their ecological study has been rather neglected. Among the predominant forms of cyanobacteria common to all hot water springs in India are *Chroococcus yellowstonesis, Synchococcus elongatus.* Var. *amphigranulatus, Oscillatoria jasorvensis, O. tenus, O. filiforms, Phormidium laminosus, Lyngbya nigra* and *Mastigocladus laminosus*[11].

Figure-1
Vashisht hot water spring

Himachal Pradesh has various hot water springs in Kullu, Mandi and Kinnaur district. Vashisht is such hot spring which is located in the Manali region of Kullu district. The place is named after the Vashisht Rishi of Lord Rama's era. The water 'kunds' are present in the centre of the village. The temperature of the water in the kunds is about 110 degree Fahrenheit. So considering the extreme nature of this hot spring, physico-chemical analysis and bacteriological examination was done.

Material and Methods

Water sample was collected from Vashisht spring of Kullu district on 10th March, 2013 in sterile bottles and brought into laboratories at Abhilashi Institute of Life Sciences, Tanda, Distt. Mandi, Himachal Pradesh. Temperature was measured by using mercury bulb thermometer in situ. Following physico-chemical properties were studied. Total dissolved solid (TDS) of water and fixed residue was measured by evaporation method[12]. Dissolved oxygen (DO) and biochemical oxygen demand (BOD) of water was measured by sodium thiosulphate titration method[12]. Chemical oxygen demand (COD) was measured by titration of potassium dichromate and sodium thiosulphate[12]. Alkalinity of water is measured by titration method[13]. Hardness of water was measured by titration with EDTA solution[14]. Chloride in water and pH was measured by method of FAO[15]. Bacteriological examination of water was done by multiple tube fermentation test which consists of: presumptive coliform test, confirmed coliform test and completed coliform test[12]. Biochemical tests were performed on isolated microorganisms such as: Indole, Methyl red, Citrate utilization and Glucose fermentation[12].

Results and Discussion

As per WHO, water containing more than 500 mg/l of TDS is not considered desirable for drinking water. The experimental value for TDS of water sample was found to be 400 mg/lt which is less than WHO standard, so this water is potable. Fixed residue denotes mainly the various kinds of minerals present in water sample. They do not contain any gaseous or colloidal fraction. They can be measured as residue left over after evaporation of filter sample. The experimental value for fixed residue was found to be 200 mg/lt. The experimental value for dissolved oxygen was 2.52 mg/lt which is less than WHO standard that is 7 mg/lt. This indicated the potability of water.

Biological oxygen demand increased due to biodegradation of organic materials which exerts oxygen tension in a water body[16]. The value for BOD was found to be 4.8 mg/lt. According to WHO the value of BOD should not exceed 30 mg/lt. As per WHO, the values for COD and alkalinity should be 250 mg/lt and 200 mg/lt, respectively, the experimental values for COD and alkalinity were found to be 0.048 and 196 mg/lt, which seems to be lesser than WHO standard, hence the water was potable.

The hardness of water depends mainly on the presence of dissolved calcium and magnesium salts[17]. The experimental value for hardness was found to be 165.2 mg/lt which were less the WHO standard value that was 300 mg/lt, so water was safe for drinking. WHO standard value for chloride was 250 mg/lt and the experimental value for chloride was found to be 197.38 mg/lt. The value was less than WHO standard value so water was potable. pH value was found to be 7 which lie in between WHO standard value (6.5 – 8.5) which showed the potability of water. Temperature of water was 110^0C.

Among bacteriological examination, presumptive and confirmed coliform test were found to be positive due to acid and gas formation. Completed coliform test was found negative with no coliform colonies on petri plate. Biochemical tests are shown in table 1 which depict that bacteria isolate showed negative results for indole, methyl red test, citrate utilization test. Positive result for glucose fermentation test was found. These results showed that there were no coliform (*Escherichia coli)* in water sample. All parameters were compared with WHO standard as per table 2 as per URL: (http://www.who.int/water_ sanitation_health/dwq/gdwq0506.pdf). Overall it was concluded that according to all physico-chemical parameters compared with WHO, water is potable. According to biological parameters, coliforms were absent in water. So water in Vashisht hot spring is potable.

Table-1
Biochemical Tests of Bacterial Isolate

S.No.	Biochemical Test	Results
1	Indole Test	Negative
2	Methyl Red Test	Negative
3	Citrate Utilization Test	Negative
4	Glucose Fermentation Test	Positive

Table-2
Comparative estimation of experimental values with WHO standards

Physico-chemical Properties	Experimental Values	W.H.O standard	Inference
Total Dissolved solids	400 mg/lt	500 mg/lt	Potable
Fixed residue	200 mg/lt	-	Potable
Dissolved oxygen	2.52 mg/lt	7 mg/lt	Potable
Biochemical oxygen demand	4.8 mg/lt	30 mg/lt	Potable
Chemical oxygen demand	0.048 mg/lt	250 mg/lt	Potable
Alkalinity	196 mg/lt	200 mg/lt	Potable
Hardness	165.2 mg/lt	300 mg/lt	Potable
Chloride	197.38 mg/lt	250 mg/lt	Potable
pH	7	6.5 – 8.5	Potable

Conclusion

From the results of physico-chemical analysis of this study it was concluded that all the parameters lie within potabilty range of WHO. Bacteriological examination revealed that there were no coliforms in hot water. So on the basis of these, water was potable. Some more studies on exact strain of microbes present in hot water spring are requied to check pathogenicity.

References

1. Kumar A., Rawat S., Srivastava M. and Bhushan V., Physico-chemical analysis and isolation of bacteria from water sample of Maharana Pratap Sagar, Kangra district of Himachal Pradesh, *Journal of Applied Sciences in Environmental Sanitation*, **7(3),** 161-166 **(2012)**

2. Kumar N. and Nath S., Analysis of Physico-Chemical Properties of water from Markanday Spring in Hamirpur District of Himachal Pradesh A Novel Report, *International Journal of Current Research*, **5(01),** 056-058 **(2013)**

3. Haki G.D. and Gezmu T.B., Physico-chemical properties of waters from some Ethiopian hot springs and risk to the health of community, *Greener Journal of Physical Sciences*, **2(4)**, 138-140 **(2012)**

4. Sherpa M.T., Das S. and Thakur N., Physico-chemical characteristics of thermal water and soil of Tarabalo and Attri geothermal province, Orrisa, India, *Recent Research in Science and Technology*, **5(1)**, 63-67 **(2013)**

5. Shreerup G. and Pravasini P., Physico-chemical characteristics of thermal water and soil of Tarabalo and Attri geothermal province, Orrisa, India, *Journal of Ecophysiology & Occupational Health*, **8(1&2)**, 83-88 **(2013)**

6. Todd D. K., Ground Hydrology (2^{nd} edn.), Wiley, New York **(1980)**

7. Sen K.S., Mohapatra K.S., Satpathy S. and Rao T.V.G., Characterization of hot water spring source isolated clones of bacteria and their industrial applicability, *International Journal of Chemical Research*, **2(1),** 01-07 **(2010)**

8. Jana, B.B., The Thermal springs of Bakreswar, India – physico-chemical conditions, flora and fauna, *Hydobiologia*, **41 (3)**, 291-307 **(1979)**

9. Carlos A.J., The heat shock response in meso- and thermoacidophilic chemolithotrophic bacteria, *FEMS Microbiology Letter*, **56**, 289-294 **(1988)**

10. Prasad B.N. and Srivastava P.N., Thermal alga from Himalayan hot springs, *Proc. Natl. Inst. Sci., India*, **31B**, 45-53 **(1965)**

11. Vasishta P.C., Thermal Cyanophyceae of India-1, *Phycos*, **7**, 198-241 **(1968)**

12. Aneja K.R., Experiments in Microbiology, Plant pathology and Biotechnology. New age International publisher, Fourth edition **(2003)**

13. Yadav S.S. and Kumar R., Monitoring water quality of Kosi river in Rampur district, Uttar Pradesh, India. *Advances in Applied Science Research*, **2(2),** 197-201 **(2011)**

14. Kumar, R. and Yadav, S.S., Correlation analysis of ground water quality in and around Shahzad Nagar block of Rampur district, Uttar Pradesh, India. *Int. J. Chem. Sci.*, **9(1),** 440-447 **(2011)**

15. Food and Agriculture Organization (FAO), Chemical analysis manual for food and water, 5th Ed. FAO ROME, **1,** 20-26 **(1997)**

16. Abida B. and Harikrishna, Study on the Quality of Water in some streams of Cauvery River, *Journal of Chemistry*, **5(2),** 377-384 **(2008)**

17. Ikomi R.B. and Emuth C.T., The status of the physico-chemical Hydrology of Upper Warri River Nigeria, *Journal of Science and Environment,* **2**, 75-86 **(2000)**