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**RESEARCH ARTICLE**

# Analysis of Physico-Chemical Properties of water from Markanday Spring in Hamirpur District of Himachal Pradesh A Novel Report

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**ABSTRACT**

Physico-chemical properties and bacteriological examination of spring water was done from from Markanday region of Hamirpur District in Himachal Pradesh. Physico-chemical properties such as Total Dissolved solids (TDS), Dissolved oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Alkalinity, Hardness, Chloride and pH were determined and compared with World Health Organization (WHO) standard. Bacteriological examination was done by isolation of microorganism from water and identification by serotyping. It was found that water was potable and free of pathogenic strain.

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## INTRODUCTION

Water pollution is a major global problem which requires ongoing evaluation and revision of water resource policy at all levels (international down to individual aquifers and wells). It has been suggested that it is the leading worldwide cause of deaths and diseases (Pink and Daniel, 2006; West, 2006) and that it accounts for the deaths of more than 14,000 people daily (West, 2006). It has also been suggested that eighty per cent of all illnesses in India and one-third of deaths can be attributed to water-borne disease (Puttick, 2008). According to WHO organization, about 80% of all the diseases in human beings are caused by water. Once the groundwater is contaminated, its quality cannot be restored back easily and to device ways and means to protect it (Maniyar, 1990; Mise, 1988; Shivasharanappa, 1988). Water quality characteristic of aquatic environment arise from a multitude of physical, chemical and biological interactions (Deeu, 1989). The provision of potable water to the rural and urban population is necessary to prevent health hazards (Nikoladze and Akastal, 1989; Lemo, 2002). Before water can be described as potable, it has to comply with certain physical, chemical and microbiological standards, which are designed to ensure that the water is palatable and safe for drinking (Tebutt, 1983). Water can be obtained from a number of sources, among which are streams, lakes, rivers, ponds, rain, springs and wells (Kolade, 1982). Unfortunately, clean, pure and safe water only exists briefly in nature and is immediately polluted by prevailing environmental factors and human activities. Water from most sources is therefore unfit for immediate consumption without some sort of treatment (Raymond, 1992). The consequences of waterborne bacteria and virus infection; polio, hepatitis, cholera, typhoid, diarrhea, stomach cramps, etc, have been well established but nitrate contamination is just as deadly. Consequent to the realization of the potential health hazards that may result from contaminated drinking water, contamination of drinking water from any source is therefore of primary importance because of the danger and risk of water borne diseases (Edema *et al*., 2001; Fapetu, 2000). The lack of safe drinking water and adequate sanitation measures lead to a number of diseases such as cholera, dysentery, salmonellosis and typhoid, and every year millions of lives are claimed in developing countries. Diarrhoea is the major cause for the death of more than 2 million people per year world-wide, mostly children under the age of five. It is a symptom of infection or the result of a combination of a variety of enteric pathogens (Anon, 2000). Bacteria are a large domain of prokaryotic microorganisms. Bacteria have a wide range of shapes, ranging from spheres to rods and spirals. Bacteria are present in most habitats on Earth, growing in soil, acidic hot springs, radioactive waste (Fredrickson, 2004). There are approximately five nonillion ($5\times10^{30}$) bacteria on Earth (Whitman WB, 1998). *Escherichia coli* is a Gram-negative, rod-shaped bacterium that is commonly found in the lower intestine of warm-blooded organisms (endotherms). Most *E. coli* strains are harmless, but some serotypes can cause serious food poisoning in humans, and are occasionally responsible for product recalls due to food contamination (Vogt, 2005). The harmless strains are part of the normal flora of the gut, and can benefit their hosts by producing vitamin $K_2$ (Bentley, 1989) and by preventing the establishment of pathogenic bacteria within the intestine (Hudault, 2001). Varanasi, a city of one million people in India that many pilgrims visit to take a "holy dip" in the Ganges, releases around 200 million litres of untreated human sewage into the river each day, leading to large concentrations of faecal coliform bacteria (Abraham, 2011). Present work was done on Markanday spring Himachal Pradesh. It is located in Distt. Hamirpur 6 km away the Dera Parol on the bank of Kunal Khad in the place of the Markanday Rishi. According to Purans it is there that the idol of Rishi Markanday was installed. A natural spring is there on which present research was done.

## MATERIALS AND METHODS

Water sample was collected in a clean plastic bucket from Markanday Region in Hamirpur District in Himachal Pradesh. Preservation and

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transportation of the water sample to the laboratory was as per standard methods (APHA, 1998). Total Dissolved solids (TDS), Dissolved oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Alkalinity, Hardness, Chloride and pH were determined. Total dissolved solid (TDS) was determined gravimetrically by evaporating a known volume of water to dryness in a pre-weighed crucible on a steam bath. Dissolved oxygen (DO) was measured by Winkler's titration. Biochemical Oxygen Demand (BOD) was determined by dilution method in which water sample was incubated in laboratory for three days at $27^0$C. Chemical Oxygen Demand (COD) of water was determined by titration with Potassium dichromate solution method. Alkalinity was determined by titrating a known volume of water sample with 0.1N Sodium thiosulphate. Hardness of water was determined by titrating with EDTA using Eriochrome black T as indicator. Chloride in water was dermined by titrating known volume with 0.025N Standard silver nitrate solution. pH of water was determined by pH paper method. Bacteriological examination of water by multiple tube fermentation test which include: presumptive test, coliform test, confirmed coliform test. Biochemical test performed for identification of bacteria in water sample include: Indole Test, Methyl Red Test, Citrate Utilization Test and Glucose fermentation Test. Serotyping of isolated bacteria was done for pathogenic strain identification.

## RESULTS AND DISCUSSION

The experimental value for Total Dissolved Solids (TDS) of water sample was found to be 66.66 mg/lt. Dissolved Oxygen (DO) was 1.48 mg/lt (Table No. 2, Fig. 1). Biological oxygen demand increases due to biodegradation of organic materials which exerts oxygen tension in a water body (Abida, 2008). The value for BOD was found to be 0.43 mg/lt. (Table No. 3). The values for alkalinity and COD were found to be 100 mg/lt and 0.035 mg/lt (Table No. 4 and 5). The hardness of natural waters depends mainly on the presence of dissolved calcium and magnesium salts (Ikomi and Emuh, 2000). The value for hardness was found to be 102 mg/lt (Table No. 6, Fig. 5). The experimental value for chloride was 63.9 mg/lt. (Table No. 7 and Fig. 6). pH value was found to be 7. All parameters were compared with WHO standard (http://www.who.int/water_ sanitation_health/ dwq/ gdwq0506.pdf) as shown in Table No. 1. Presumptive, confirmed and completed coliform test was found to be positive (Fig. 2, 3 and 4). Biochemical tests were given in Table No. 8. Polyvalent sera test was found to be positive so determination test for O group was performed using monovalent sera, which showed positive results. Monovalent sera test was found to be positive which showed that O group of tested strain was present. *E. coli* O158 strain was found which is non pathogenic. So considering both aspects of WHO standard as well as bacteriological examination, it was concluded that water was potable and free of pathogenic strain of *E.coli.*

**Table 1. Comparative estimation of experimental values with WHO standard**

| S. No. | Physico-chemical Properties | Experimental Values | WHO Standard | Inference |
|---|---|---|---|---|
| 1. | Total Dissolved solids | 66.66 mg/lt | 500 mg/lt | Potable |
| 2. | Dissolved oxygen | 1.48 mg/lt | 7 mg/lt | Potable |
| 3. | Biochemical Oxygen Demand | 0.43 mg/lt | 30 mg/lt | Potable |
| 4. | Chemical Oxygen Demand | 0.035 mg/lt | 250 mg/lt | Potable |
| 5. | Alkalinity | 100 mg/lt | 200 mg/lt | Potable |
| 6. | Hardness | 102 mg/lt | 300 mg/lt | Potable |
| 7. | Chloride | 63.9 mg/lt | 250 mg/lt | Potable |
| 8. | pH | 7 | 6.5 - 8.5 | Potable |

**Table 2. Determination of Dissolved oxygen (DO) of water**

| S. No. | Initial reading | Final reading | Volume used |
|---|---|---|---|
| 1. | 0.0 | 0.5 | 0.5 |
| 2. | 0.5 | 0.8 | 0.3 |
| 3. | 0.8 | 1.1 | 0.3 |

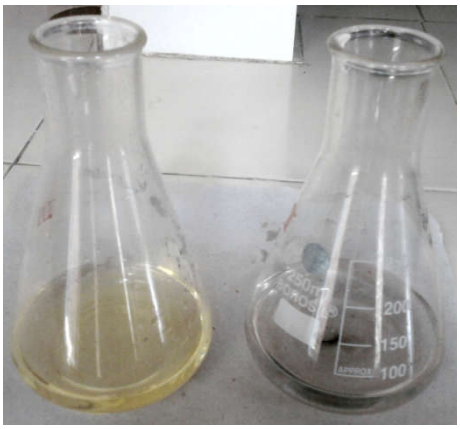

**Fig. 1. Biochemical Oxygen Demand of water sample**

**Table 3. Biochemical Oxygen Demand (BOD) of water**

| S. No. | $D_1$ (at time zero) | $D_2$ (after incubation) |
|---|---|---|
| 1. | 1.3 | 1.0 |
| 2. | 1.2 | 0.8 |
| 3. | 1.3 | 0.7 |
| Total | 3.8 | 2.5 |

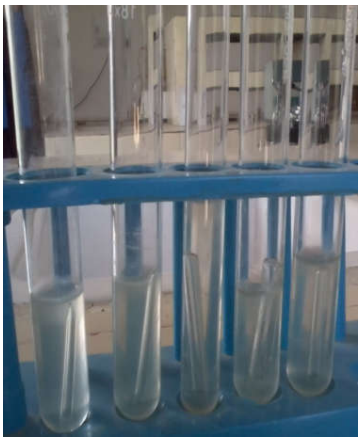

**Fig. 2. Presumptive Coliform Test**

**Fig. 3: Confirmed Coliform Test**

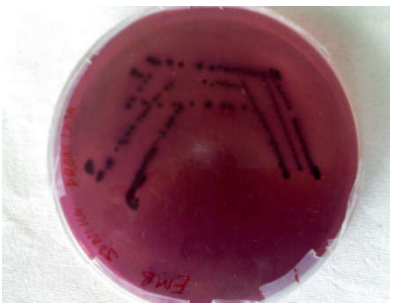

**Fig. 4. Completed Coliform Test**

**Table 4. Determination of alkalinity of water**

| Sample used | Burette reading Phenolphthalein indicator | | Volume of acid used ($V_1$) | Burette reading methyl orange indicator | | Volume of acid used ($V_2$) |
|---|---|---|---|---|---|---|
| | Initial | Final | | Initial | Final | |
| | 0 | 3.3 | 3.3 | 1.9 | 4.9 | 3.0 |
| | 1 | 1.9 | 0.9 | 3.3 | 10.9 | 7.6 |
| 50ml | 14.2 | 16.5 | 2.3 | 2.3 | 20.9 | 4.4 |

**Table 5. Determination of Chemical Oxygen Demand (COD) of water**

| S. No. | Volume of Titrant used For Blank A | For Blank B |
|---|---|---|
| 1. | 2.3 | 15.6 |
| 2. | 6.2 | 10.7 |
| Total | 8.5 | 26.3 |

**Table 6. Hardness of water**

| Total Volume of sample | Burette reading Initial | Final | Volume of EDTA |
|---|---|---|---|
| | 0.0 | 5.4 | 5.4 |
| | 5.4 | 5.0 | 5.0 |
| 50 ml | 10.4 | 15.3 | 4.9 |

**Table 7. Determination of Chloride in water**

| S. No. | Volume of Sample (ml) | Burette reading Initial | Final | Volume of Silver Nitrate (ml) |
|---|---|---|---|---|
| 1. | 50 ml | 0.0 | 5.0 | 5.0 |
| 2. | 50 ml | 5.0 | 8.0 | 3.0 |
| 3. | 50 ml | 8.0 | 11.0 | 3.0 |

**Table 8. Biochemical Tests of Bacterial Isolate**

| S. No. | Biochemical Tests | Results |
|---|---|---|
| 1. | Indole Test | +ve |
| 2. | Methyl Red Test | +ve |
| 3. | Citrate Utilization Test | -ve |
| 4. | Glucose Fermentation Test | Acid Gas |

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