

Physico-Chemical Analysis of Aripal Spring in Kashmir Valley, India

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ABSTRACT

The present study was conducted for the time period of 5 months (August, 2019-December, 2019) with an aim to find out the physico-chemical nature of water of Aripal spring, a fresh water body located in Tral tehsil of Pulwama district. Water samples were collected on monthly basis and were tested following standard methods. The physico-chemical parameters like temperature, pH, Electrical conductivity, DO, free CO₂, Chloride, TDS, Total alkalinity, Total hardness, Magnesium hardness, Calcium hardness, Turbidity, Nitrate and ortho-phosphorus showed distinct variation. The physico-chemical characteristics of water revealed that the values for electrical conductivity, dissolved oxygen, total hardness and calcium hardness showed a decreasing trend from August to December. During the study period it was also observed that there existed an inverse relationship between water temperature and dissolved oxygen.

Key words: Physico-Chemical, Aripal Spring, Water, Analysis

1. INTRODUCTION

Water is the most critical and precious natural resource. It is one of the most essential requirements for all kinds of life. Most animals and plants contain more than 60 percent water by volume. Water could not be replaced by any other known natural or man-made compound. The health of our water is the principal measure of how we live on the land. After air, portable water is second essential need for existence of human life on the planet earth. Clean water is essential for healthy environment to support life systems on this planet. However due to increasing anti-environmental human activities and some natural processes coupled with increasing human population, the quality of water is deteriorating continuously and is posing a great threat to all living organisms. Consuming contaminated water is the major cause for the spread of many water borne diseases like diarrhea, jaundice, cholera, typhoid etc. [1]. Safe

drinking water is a basic need for good human health without which life is not possible in any region of the globe. Fresh water is already a limiting resource in many parts of the world. In the next century, it will become even more limiting due to increased population, urbanization and climate change [2]. Therefore conservation and management of freshwater is necessary because freshwater is becoming increasingly scarce and expensive like all commodities. Climate change is affecting the spatial and temporal availability of water resources throughout the world whatever is left is either dirty or not fit for human consumption [3]. The state of Jammu and Kashmir has ample water resources present in the form of lakes (Dal, Walur, Manasbal, Mansar, and Pangong etc.), rivers (Indus, Jhelum, Chenab, Beas etc.) and glaciers besides nice reserves of ground water. The quality of these water bodies is deteriorating day by day and the water as a resource is becoming scarce due to anthropogenic pressure. The fresh water bodies of state are under huge anthropogenic pressure due to various man-made events and processes like urbanization, catchment degradation and contamination through sewage and sewerage that have build up enough pressure on the fresh water bodies of the valley resulting in mass degradation of these ecosystems [4].

2. STUDY AREA

The present study was carried out to assess the water quality of Aripal spring (Aripal Nag) of Tral wild life sanctuary situated in district Pulwama of Kashmir valley located about 22kms from the Pulwama and 40 kms from the summer capital Srinagar. Tral is a bowl shaped valley surrounded on all sides by lush green forests. It is situated at an average altitude of 1662 meters above the sea level with geographical coordinates of 33° 56' N and 75° 1' E and is spread over an average area of 110 Kms. There are more than 50 springs present in tral especially Aripal spring (Aripal Nag) and Dilnag spring (Dil Nag) and number of fresh water streams flow from these springs. Unfortunately agriculture and horticulture activities have degraded the water

quality of these fresh water streams and springs. Aripal spring is located in Aripal village and lies at an altitude of 1670 m above sea level with the geographical coordinates of 34° 0' N and 75° 4' E. Being a tourist destination people of Kashmir valley visit this site especially during summer

season. It originates from the bottom of a mountain with crystal clear water. The bottom sediments present within the spring were sand, small and large sized pebbles. The fishes present in the spring were Schizothorax, Nemachiehus and Trout species.



Fig.1: Photograph of Aripal Spring.

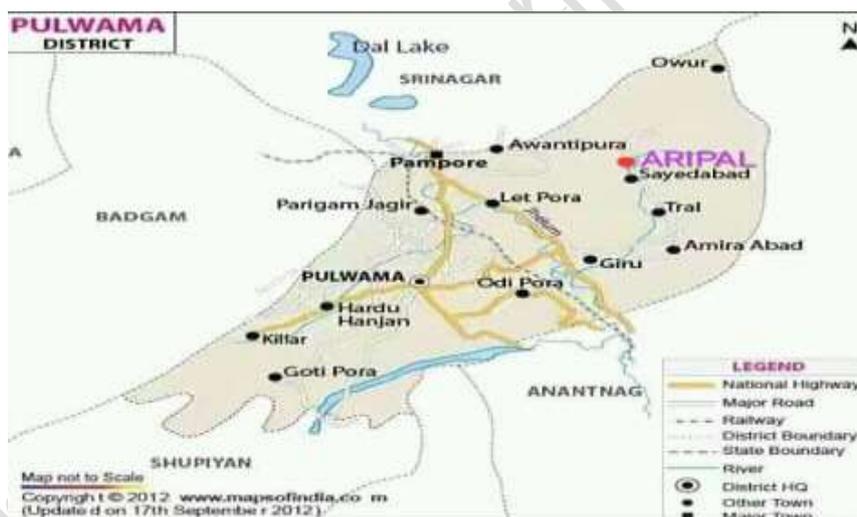


Fig.2: Map of study area. Source: www.mapsofindia.com

3. METHODOLOGY

For the purpose of the present study water samples were collected on monthly basis from August, 2019 to December, 2019. The water samples were collected in cleaned plastic bottles of 1 liter capacity which were rinsed thoroughly with distilled water. Temperature, pH and Electrical conductivity of the samples were measured using portable thermometer (°C), digital pH meter and conductivity meter. Dissolved oxygen was analyzed by modified Winkler method. Free CO₂, Chloride, Total dissolved Solids, Total alkalinity, Total hardness, Magnesium hardness, Calcium

hardness, and Ortho-phosphorous were determined by the methods given by APHA, 2005. [5]. Turbidity was estimated by turbidity meter (Nephelometer). Nitrate was estimated by Phenol disulphonic acid method.

4. RESULTS AND DISCUSSION

4.1. Temperature

Various Physico-Chemical characteristics of water of Aripal Spring along with minimum, maximum, mean and standard error have been given in (Table I). Water temperature is a factor indicating the quality of water and trend of biochemical and

biological activities in water body. It influences aquatic life and concentration of dissolved gases like oxygen and carbon dioxide. For the present study the temperature ranged from 12°C to 15°C with lowest value of 12°C in the month of August against 15°C in the month of December with mean of 13.2 ± 1.30 °C. This could be due to the fact that water has a higher heat capacity, so it takes longer to heat up and longer to cool down, so relatively it is hotter in winter and colder in summer. The minimum water temperature during summer could also be due to shading effect of trees along its periphery [6]. Similar observations were recorded by [7], while carrying out the study on physico-chemical properties of groundwater in Uttarakhand, India.

4.2. pH

The pH in natural water is the carbonate which comprises CO_2 and HCO_3 . It is a measure of the intensity of acidity or alkalinity. The pH of water controls the chemical state of many nutrients including phosphates, ammonia, CO_2 and trace elements [8]. The pH value ranged from 7.32 to 7.65 with lowest value of 7.32 in the month of August against 7.65 in the month of December with mean value of 7.43 ± 0.12 . The lowest value may be attributed to lower rates of photosynthesis [9], [10]. These results resemble with the observations of [11].

4.3. Electrical Conductivity

Electrical conductivity (EC) is a measure of water capacity to convey electric current. Conductivity becomes an indicator of dissolved salts present in any water supply, which is measure of salinity that affects the taste of portable water. The values of electrical conductivity ranged from $450 \mu\text{s}/\text{cm}$ to $580 \mu\text{s}/\text{cm}$ with lowest value of $450 \mu\text{s}/\text{cm}$ in the month of December against highest values of $580 \mu\text{s}/\text{cm}$ in the month of August with mean of $517 \pm 49.44 \mu\text{s}/\text{cm}$. The high values might be due to increased concentration of dissolved solids [12].

4.4. Dissolved Oxygen

Dissolved oxygen is an important index of water quality. The solubility of oxygen in water depends upon water temperature, the partial pressure of oxygen in the atmosphere and the salt content of the water. The results obtained for Dissolved Oxygen ranged from 4 mg/L to 6 mg/L with lowest value of 4 mg/L in the month of December against 6 mg/L in the month of August with an average value of 4.88 ± 0.76 mg/L. Concentration of Dissolved Oxygen showed an inverse relationship with temperature. The cold water contains more oxygen as compared to warm water as DO is inversely proportional to temperature [13]. Rani et

al also reported lower values of DO in summer due to higher rate of decomposition of organic matter and limited flow of water in low holding environment due to high temperature [14].

4.5. Free Carbon Dioxide

Free carbon dioxide exists naturally in water as it is produced by respiratory process in water and sediments and can also enter water from the atmosphere. Carbon Dioxide and its ionization product bicarbonate ion and carbonate ion have an extremely important influence upon the chemistry of water. Concentration of free carbon dioxide ranged from 10 mg/L to 16 mg/L with lowest value of 10 mg/L in the month of August against 16 mg/L in the month of December with an average value of 12.4 ± 2.60 mg/L. The lower value in August is attributed to photosynthetic activity by aquatic flora and fauna [15]. Carbon Dioxide in natural waters is required for the photosynthetic production of biomass by algae and in some cases is a limiting factor. High levels of CO_2 produced by the degradation of organic matter in water can cause excessive algal growth and productivity.

4.6. Chloride

Chlorine in the form of chloride ion is one of the major anion in water and waste waters. The salty taste produced by chloride concentrations is variable and dependent on chemical composition of water. The value of Chloride ranged from 15.96 mg/L to 22.96 mg/L with lowest value of 15.96 mg/L in the month of December against 22.96 in the month of August with an average value of 18.96 ± 2.70 mg/L. The high chloride levels in August (summer) have been attributed to organic pollution of animal origin [16], [17]. Jana observed that higher concentration of chloride in summer could be due to sewage mixing, increased temperature and higher runoff from catchment [15], [1].

4.7. Total Dissolved Solids

Total dissolved solids (TDS) are made up of inorganic salts (mainly sodium chloride, calcium, magnesium, and potassium) and small amounts of organic matter that are dissolved in water. TDS ranged between 170 mg/L to 246 mg/L in the months of December and September respectively with mean value of 203 ± 30.67 mg/L. It may be due to suspended substances from the catchment area [18], [19].

4.8. Total Alkalinity

The alkalinity is mainly constituted by the bicarbonate ion which represents the main carbon source for assimilation during photosynthesis [20]. Total alkalinity ranged from 56.5 mg/L to 60 mg/L with lowest value of 56.5 mg/L in the month of

August against 60 mg/L in the month of November with an average value of 57.82 ± 1.58 mg/L. A decline during summer (August) may be due to increase in the volume of water by monsoon rains [21]. Similar observations of seasonal fluctuation were observed by [1] while studying the physico-chemical parameters of pond.

4.9. Total Hardness

The presence of total hardness of water is almost entirely due to the presence of Calcium and Magnesium. These salts add to water when it percolates through deposits of limestone and chalk which are largely made up of Calcium and Magnesium carbonates. The values for total hardness ranged from 110 mg/L to 140 mg/L with lowest value of 110 mg/L in the month of December against the highest value of 140 mg/L in the month of August with an average value of 123.2 ± 11.54 mg/L. The low hardness during the months of November/December may be probably due to high dilution during wet season [22]. The higher values of hardness being attributed to the inflow of rainwater carrying good amount of suspended salts [23]. Calcium and magnesium are the most abundant divalent cationic elements in the fresh water of Kashmir with calcium generally the dominant one which is related to the presence of lime rich rocks in the catchment area of these water bodies [24], [17].

4.10. Magnesium Hardness

Hardness caused by magnesium is called as magnesium hardness. The values for magnesium hardness ranged between 46.7 mg/L to 53.9 mg/L with lowest value of 46.7 mg/L in the month of November against the highest value of 53.9 mg/L in the month of August with an average value of 49.28 ± 2.95 mg/L. The increase in magnesium hardness during the month of August may be due to evaporation of surface water and lowering down the hardness due to heavy rains in monsoon [25].

4.11. Calcium Hardness

Calcium is directly related to hardness and is essential for various metabolic processes in all living organisms including man. In the present study the results ranged from 63 mg/L to 86.1 mg/L with lowest value of 63 mg/L in the month of December against 86.1 mg/L in the month of August with an average value of 73.92 ± 8.70

mg/L. The increase in calcium hardness during August (summer) may be due to evaporation of surface water and lowering down the hardness due to heavy rains in monsoon [17]. The concentration of calcium hardness was found more than that of magnesium hardness during present study. The reason for this is the dominance of calcium in fresh waters of Kashmir which is related to the presence of lime rich rocks in the catchment areas of these water bodies [24].

4.12. Turbidity

Turbidity in waters is caused by suspended matter like clay, silt, organic matter, phytoplankton and microscopic organisms. The values for turbidity were in between 2 NTU to 2.9 NTU with the minimum value in the month of November and the maximum in September with mean of 2.32 ± 0.37 NTU. The higher value in September may be attributed to high run off in the catchment area due to high precipitation [26], [27].

4.13. Nitrate

Nitrates are essential plant nutrients, but in excess amounts they can cause significant water quality problems. The concentration of nitrate ranged between 20 mg/L to 27 mg/L with lowest value of 20 mg/L in the month of December against the highest value of 27 mg/L in the month of September with an average value of 22 ± 3.08 mg/L. High concentration of nitrate in September could be agricultural runoff containing nitrate fertilizers [28]. Bhattacharya et al reported similar findings in the upper Gangetic West Bengal [29].

4.14. Ortho-Phosphorous

Phosphorus may be found in different forms in water and wastewater including dissolved form (orthophosphate). The values ranged from 230 μ g/L to 420 μ g/L with lowest value of 230 μ g/L in the month of December against 420 μ g/L in the month of September with an average of 322 ± 73.95 μ g/L. Phosphorus may be found in different forms in water and wastewater including dissolved form (orthophosphate). The lower values are attributed to decrease in decomposition rate in winters. The higher values in summer may be either due to regeneration of phosphate from the decaying of plants and animal remains or increased temperature resulting due to death and decomposition of living biota [30], [31].

Table I. Physico-Chemical Characteristics of Aripal Spring, Tral, Kashmir during August 2019 to December 2019.

S. No	Parameters	Min	Max	Mean \pm SD
1	Water Temperature ($^{\circ}$ C)	7	13	10.6 \pm 2.50
2	Ph	7.32	7.65	7.43 \pm 0.12
3	Electrical Conductivity (μ s/cm)	450	580	517 \pm 49.44
4	Dissolved Oxygen (mg/L)	4	6	4.88 \pm 0.76
5	Free CO ₂ (mg/L)	10	16	12.4 \pm 2.60
6	Chloride (mg/L)	15.96	22.9	18.66 \pm 2.70
7	Total Alkalinity (mg/L)	56.5	60	57.82 \pm 1.58
8	Total Hardness (mg/L)	110	140	123.2 \pm 11.54
9	Magnesium Hardness (mg/L)	46.7	53.9	49.28 \pm 2.95
10	Calcium Hardness (mg/L)	63	86.1	73.92 \pm 8.70
11	Ortho-Phosphorous (μ g/L)	230	420	322 \pm 73.95
12	Nitrate (mg/L)	20	27	22 \pm 3.08
13	Total Dissolved Salts (mg/L)	170	246	203.2 \pm 30.67
14	Turbidity (NTU)	2	2.9	2.32 \pm 0.37

Conclusion

The physico-chemical characteristics of water revealed that the values for electrical conductivity, dissolved oxygen, total hardness and calcium hardness showed a decreasing trend from August to December. During the study period it was also observed that there existed an inverse relationship between water temperature and dissolved oxygen. The values for turbidity were high during September because at that time the catchment area receives maximum rainfall due to this the runoff directly enters the water body. The study revealed that all the parameters were within permissible limits as recommended by WHO, 2008 [32] and IS, 2012 [33]. Thus it may be concluded that the water of Aripal spring is safe for drinking, domestic purposes and irrigational use. It is also recommended that the water of Aripal spring should be properly utilized for various purposes and also some measures should be taken for maintaining the future health of the fresh water spring.

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