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Comparative Limnology of Two Religiously Important Springs of Kashmir

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ABSTRACT

The present investigation deals with the physico-chemical limnology of two well known springs of Kashmir, Khir Bhawani and Pir Nag. The two springs depicted slight uniformity for conductivity, alkalinity, calcium, magnesium, chloride and ammonical nitrogen. However, marked differences were observed for pH, dissolved oxygen, carbon dioxide, iron, nitrite nitrogen, nitrate nitrogen and available phosphorus.

Key words: Springs, Limnology, Khir Bhawani, Pir Nag, Kashmir.

INTRODUCTION

If Kashmir is a garden, then the springs are the roses in it. The Vale of Kashmir is well known for its marvelous waterbodies including lakes, rivers and springs, throughout the globe. Among these, springs occupy a special importance in that most of them are associated with religious practices and are treated as sacred places to the extent that their fish is conserved and not utilized as food. Pir Nag spring has a good wealth of fish while as the Khir Bhawani spring is devoid of fish fauna.

Being home to numerous and diverse waterbodies, voluminous information is available on the limnology of Kashmir. The limnological research in Kashmir which started comprehensively from 1960s, however, pertains mostly to lakes and wetlands (Kaul and Zutshi, 1967; Zutshi and Vass, 1971; Zutshi *et al*., 1972; Kaul, 1977; Vass *et al*., 1977; Yousuf and Shah, 1988; Pandit, 1980, 84, 96, 99, 2002; Ravinder *et al*., 2004). The lotic systems have received little attention with only a few notable publications (Qadri and Yousuf, 1979; Qadri *et al*., 1981; Yousuf *et al*., 1983; Bhat and Yousuf, 2002; Pandit *et al*., 2002). The present investigation was, therefore, undertaken on two important springs of Tehsil Ganderbal to have an insight about the physical and chemical characteristics of their waters. The study should, in no way, be seen as a comparison of two religious places.

STUDY AREA

The study was carried out on two religiously important springs of Tehsil Ganderbal of District

Srinagar in the month of November, 2004. Both the springs are situated to the north-west of Srinagar city at an altitude of about 1600m (a.s.l). Khir Bhawani spring is about 25 km while as Pir Nag spring lies about 26 km away from Srinagar city. Khir Bhawani spring is accessible easily through Ganderbal, while as the Pir Nag spring is accessible through Sumbal (Sonawari). Pir Nag spring is situated to the north-east side of the Ahansar lake. Khir Bhawani spring is bound on all sides by concrete walls except for a small outlet channel. Its water flows very slowly. Its water is highly turbid and is grossly polluted. The spring is extremely important pilgrim site of Hindus and, therefore, the site is under security. The pilgrims usually through flowers, milk and khir (sugared, cooked rice) into the Khir Bhawani spring and hence the name. On the other hand, Pir Nag spring, considered sacred by Muslims, is an open waterbody without any concrete walls and it ultimately drains into Ahansar lake. Its water is transparent and the flow is comparatively faster than the Khir Bhawani spring.

MATERIAL AND METHODS

The water samples were collected in two litre polyethylene bottles by dipping them 10 cm below the water surface. While temperature was recorded on spot, other parameters were analyzed within 24 hours of sampling in accordance with the standard methods of APHA (1998), Golterman and Clymo (1969) and Mackereth (1963).

RESULTS AND DISCUSSION

The comparison of data recorded during the present investigation reveals some of the significant differences between the two springs (Table 1). The lower temperature of water (9 °C) at Khir Bhawani spring may be due to the shading effect of Chinar (*Platanus orientalis*) trees growing along its periphery and also due to slow movement of water. On the other hand, the higher temperature of water (12.5°C) in Pir Nag spring may be attributed to its faster flow and comparatively lesser residence time. The pH of both the springs was circumneutral. However, in Khir Bhawani spring it was slightly towards the acidic side of neutrality (6.62) while in Pir Nag spring it was towards the alkaline side (7.50). The low pH in Khir Bhawani spring may be due to high amount of carbon dioxide (50 mgL^{-1}) which in turn may be related to respiration of living organisms besides the leaching from the underlying limestone bedrock (Hynes, 1979). The lower pH in Khir Bhawani spring may also be due to decomposition of organic matter which releases carbon dioxide besides some acidic compounds.

Conductivity, the total ionic potential of a system, revealed higher values in both the springs, being 512 μScm^{-1} in Khir Bhawani and 520 μScm^{-1} in Pir Nag. Dissolved oxygen was extremely low (0.4 mgL^{-1}) in Khir Bhawani spring as compared to the Pir Nag spring where the value of 8.0 mgL^{-1} was recorded. The high dissolved oxygen content in Pir Nag spring may be related to the continuous mixing of atmospheric oxygen with the churning water of the spring, while in case of

Table 1. Comparison of various physicochemical parameters of the water of two religiously important springs of Kashmir

S.No.	Parameter	Khir Bhawani spring	Pir Nag spring
01.	Water Temperature (°C)	09	12.5
02.	pH	6.62	7.50
03.	Conductivity (μScm^{-1})	512	520
04.	Dissolved Oxygen (mgL^{-1})	0.4	8.0
05.	Dissolved CO_2 (mgL^{-1})	50	18
06.	Alkalinity (mgL^{-1})	256	232
07.	Calcium (mgL^{-1})	52.8	66.4
08.	Magnesium (mgL^{-1})	17.5	13.6
09.	Iron (μgL^{-1})	1190	310
10.	Chloride (mgL^{-1})	15	14
11.	NO_3-N (μgL^{-1})	4000	175
12.	NO_2-N (μgL^{-1})	05	Tr*
13.	NH_3-N (μgL^{-1})	120	100
14.	Available phosphorus (μgL^{-1})	40	80

* Traces

Khir Bhawani spring the almost stagnant water has higher concentration of CO_2. Further in Khir Bhawani spring the turbidity of water, due to the input of allochthonous materials in addition to the interception of sunlight by Chinar trees, limits the growth of phytoplankton and consequently the production of oxygen by autotrophs. The lesser quantities of dissolved oxygen in Khir Bhawani spring also seems to be due to consumption of oxygen for the decomposition of huge quantities of organic matter releasing bulk of CO_2 (Pandit *et al.*, 2002). The study gains further support from the earlier studies of Reid (1961) and Hynes (1979), who reported the low dissolved oxygen levels or even anoxic conditions in spring waters.

Total alkalinity was found solely due to bicarbonates of calcium and magnesium in both the springs. The total alkalinity of 256 mgL^{-1} was recorded for Khir Bhawani spring and 232 mgL^{-1} for Pir Nag spring. Some of the waters having high values of alkalinity have been reported to fall to the

acidic side of neutrality (Cole,1983). The same very reason explains the low pH values in Khir Bhawani spring though its alkalinity was recorded to be high. The maximum value for Ca^{2+} (66.4 mgL^{-1}) was obtained for Pir Nag spring as against the higher concentration of Mg^{2+} (17.5 mgL^{-1}) registered for Khir Bhawani spring. Both the springs were found to be calcium rich which owes its origin to the lacustrine deposits in the State (Pandit *et al.*, 2002). On the basis of Ca^{2+}, Mg^{2+} and total alkalinity, both the springs fall under "hard water" type (Reid, 1961).

The concentration of iron was much higher in Khir Bhawani spring (1190 μgL^{-1}) as compared to Pir Nag spring (310 μgL^{-1}). The higher concentration of iron in Khir Bhawani spring owes its origin to some unknown source and its accumulation because of the slow flushing of its waters. The pilgrims usually throw coins in to the spring as a mark of respect to the goddess. The chloride concentration in both the springs (15mgL^{-1} in Khir Bhawani spring and 14 mgL^{-1} in Pir Nag spring) was well within the range depicted for the Kashmir freshwaters (<20 mgL^{-1}) as reported by Yousuf (1979). However, Bhat and Yousuf (2002) have noted the chloride concentrations of 36 mgL^{-1} in Sherbagh spring. The low levels of chloride in both the springs depict the low level of pollution of animal origin (Thresh *et al.*, 1976; *c.f.* Pandit *et al.*, 2002).

Khir Bhawani spring depicted much higher concentration (4000μgL^{-1}) of NO_3-N, as against Pir Nag spring where a concentration of only 175 μgL^{-1} was recorded. The higher concentration of NO_3-N in Khir Bhawani spring may be due to the rapid nitrification of heavy loads of organic matter. These findings are in consonance with Bhat and Yousuf (2002) who also reported the NO_3-N levels to be much higher than NH_3-N levels in seven springs of Kashmir. The NO_2-N was present in lower concentrations in both the springs, being only 5 μgL^{-1} in Khir Bhawani spring and traces in Pir Nag spring. As regards NH_3-N, the concentrations of 120 μgL^{-1} and 100 μgL^{-1} were recorded for Khir Bhawani spring and Pir Nag spring respectively. Ground waters have been reported to contain NO_3-N up to the concentration of 3 mgL^{-1} and NH_3-N up to 190 μgL^{-1} (Wetzel, 1983). As per this criterion, the levels of NO_3-N in Khir Bhawani spring have crossed the limit as prescribed for ground waters. The concentration of available phosphorus was higher (80 μgL^{-1}) in Pir Nag spring as compared to Khir Bhawani spring (40 μgL^{-1}). The higher biological activity in Khir Bhawani spring may be one of the reasons for low concentrations of available phosphorus which may be locked up somewhere in the system.

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