Comparative Physicochemical Study of Five main Ponds of District Bhimber Azad Jammu and Kashmir

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Summary: District Bhimber is situated at foot hills at 275- 975 meters above sea level with 1516 sq K.M area with subtropical type climate and around population 3 million. Five main ponds of district Bhimber Azad Jammu and Kashmir state were selected for the physico-chemical analysis. The samples were collected and analyzed in three seasons (summer, winter and autumn) during 2004–2005. The water samples were found within the range pH 6.56–7.54, conductivity 310–503 μS/cm, TDS 198–322 mg/L, Sulphate 20.6–91.3 mg/L, Chlorides 55–80 mg/L, Nitrite 0.02–0.155 mg/L, Nitrate 0.794–1.42 mg/L, ortho-Phosphate 0.112–0.254 mg/L, Total Phosphate 0.154–0.312 mg/L, Sodium 17.7 – 52.8 mg/L, potassium 2.15–8.83 mg/L, calcium 13.7–25.1 mg/L, magnesium 3.2–7.2 mg/L, Cd 0.068– 0.156 mg/L, Co 0.022-0.095 mg/L, Zn 0.033–0.079 mg/L, Ni 0.007–0.025 mg/L, Pb 0.009–0.057 mg/L. The results obtained were compared with WHO standards for drinking water and with each of the parameters investigated were found within the permissible limits but concentration of Pb, Cd and organic nitrogen crossed the limits. The water of five ponds is suitable for human consumption, aquatic life as well as for agricultural purposes.

Introduction

Like other parts of Azad Kashmir, several towns and villages of district Bhimber are falling shortage of drinking water. Under severe conditions, pond water provides a cost effective solution to the problem. The importance of water problem in eastern part of district Bhimber is immense and pond water is consumed by the surrounding population irrespective of its quality. Both types of ponds (artificial and perennial) are found in district Bhimber.

District Bhimber lies at longitude 74.8° and latitude 32.58° and comprises of 1516 square K. M area. It is situated at the foot hills of Azad Kashmir with population density of 0.297 million (census 1998) [1]. A large number of ponds are available in all the three sub-divisions (Bernala, Bhimber, Samahni) of district Bhimber but only 5 main ponds surrounded by medium to high population density were selected for the present study. The only source of water for these ponds is heavy rain fall during different seasons of the year. The average rainfall is 150 cm and average population density is 246 persons per square kilometer [1]. The quality of pond water is changed by the ecological and anthropogenic factors [2].

No work is reported regarding the physico-chemical analysis of pond water of district Bhimber Azad Kashmir. However Ashraf and Chaudhry reported lead contents within rock bed of Azad Kashmir [3]. The present work examines the physicochemical characteristics of water of 5 ponds within the area of District Bhimber to assess the status and seasonal and regional changes in the water quality.

Results and Discussion

The average results of physicochemical characteristics of pond water are summarized in Table-1 and reveal varying nature of the pond water. The difference in the quality of pond water may be due to some difference in the bed, human activity and different rechargeable zones [2]. Water overflows only during the heavy rainfall and remain stagnant for the large part of the year.

pH of the pond water

The pH of all the pond water was found 6.56 – 7.54. The P_2 which is surrounded by high population density, indicated pH below 7 may be because of human activity. However the ponds which were present at plains or certain elevations with thin population (P_1, P_3, P_4 and P_5) indicated pH values 7.11- 7.54. A significant change was not observed in the water pH during different seasons and it was found well within the permissible limits of 6.5-8.5 of WHO.

Electric conductivity (EC) and total dissolved solids (TDS)

Table -1 Physicochemical analysis of water samples collected from different Ponds of District Bhimber Azad Jammu & Kashmir

Parameters	P1	P2	P3	P4	P5
pH (25 °C)	7.110	6.560	7.150	6.780	7.540
Conductivity μS/cm	474.00	503.00	310.00	410.00	330.00
TDS mg/L	304.00	322.00	198.00	262.00	211.00
Salinity g/L	0.100	0.100	0.100	0.100	0.100
Bicarbonates mg/L	210.00	190.00	100.00	200.00	120.00
Hardness mg/L	200.00	180.00	95.00	195.00	110.00
Chlorides mg/L	80.00	70.00	67.00	60.00	55.00
Sulphate mg/L	21.50	22.00	21.80	20.60	91.32
Nitrite mg/L	0.155	0.031	0.020	0.029	0.021
Nitrate mg/L	1.420	1.235	0.890	0.794	0.989
T- Nitrogen mg/L	1.400	0.678	0.679	0.654	0.123
O-PO4 mg/L	0.254	0.114	0.186	0.112	0.146
Total Phosphate mg/L	0.312	0.183	0.190	0.154	0.164
DO mg/L	13.390	6.270	9.490	6.500	7.290
BOD mg/L	5.330	15.760	7.840	16.880	7.330
COD mg/L	11.000	21.000	15.000	16.000	12.000
Na mg/L	21.170	36.310	23.160	17.710	52.830
K mg/L	2.150	5.960	8.830	5.310	3.490
Ca mg/L	20.560	13.710	23.710	25.110	18.250
Mg mg/L	5.910	3.200	5.170	7.210	4.690
Fe mg/L	0.071	0.059	0.078	0.085	0.079
Cu mg/L	0.007	0.007	0.019	0.015	0.037
Zn mg/L	0.079	0.035	0.033	0.055	0.046
Ni mg/L	0.025	0.007	0.013	0.007	0.022
Pb mg/L	0.057	0.046	0.047	0.009	0.010
Cd mg/L	0.156	0.075	0.077	0.068	0.073
Co mg/L	0.038	0.026	0.029	0.095	0.022
SAR	1.550	3.258	1.683	1.331	4.030

P_1= Behmla pond Poona, Sub-division Samhani District Bhimber.
P_2= Badowal pond Sub- division Barnala, District Bhimber.
P_3= Tandar pond Sub-division Barnala, District Bhimber.
P_4= Kadhala pond Sub- division & District Bhimber.
P_5= Bandala pond Sub-division Samhani District Bhimber.

A significant change was not observed in the values of electrical conductivity (EC) and total dissolved solids (TDS) among the ponds. EC and TDS varied within the range 310-503 μS/ cm and 198-322 mg/L respectively Table-1. The ponds P_2 indicated higher values of EC and TDS may be because of thick population around the ponds. The pond P_1 than P_3, P_4 and P_5 is situated at certain elevation with thin population. The higher values of EC and TDS for pond P_1 than P_3, P_4 and P_5 may be suggested because of geological nature of the rock bed of the pond.

Bicarbonates and hardness

The bicarbonates of the pond water showed concentration within 100-210 mg/L. The hardness indicated the parallel behavior with bicarbonates in all the five ponds and showed concentration in the range 95-200 mg/L Table-1. The values of both the parameters were found within permissible limits of WHO for drinking water.

Total chlorides

The total chlorides of pond water indicated the variation within 55-80 mg/L. A little variation in chloride concentration was observed with seasons and indicated higher values in autumn, may be because less dilution in dry season.

Sulphates

All the ponds studied displayed presence of sulphate in the water. The concentration varied within 20.6-91.3 mg/L Table-1. Seasonal variation indicated parallel results as for chloride with higher values observed in autumn. The highest concentration of sulphate was observed in pond P_5 located at certain elevation with thin population may be due to geological process of the catchments area and bed rock [4].

Phosphorus

The phosphorus in the from of orthophosphate and acid hydrolysable phosphate in water may be due

to anthropogenic activity and geological reasons and indicated concentrations within the range 0.112-0.254 mg/L and 0.154-0.312 mg/L respectively Table-1. The highest concentration of orthophos-phate and acid hydrolysable phosphate was found in pond P_1 located at certain height with thin population, may be because of dissolution of the rock phosphate in water.

Nitrites, nitrates and total nitrogen

Commonly known forms of nitrogen are nitrites, nitrates, and organic nitrogen. Their presence in the water body is caused by the decomposition of proteinous compounds in waste water [5]. In natural waters, the presence of nitrogen of mineral origin is rare and presence of nitrogen compounds like nitrites, nitrates and organic nitrogen in water indicate pollution with domestic waste water. Nitrate nitrogen is the highest oxidized form of nitrogen in water and maximum permissible limit of nitrate concentration in potable water prescribed by WHO is 10mg/L. Water of all the ponds indicated nitrate concentration within the permissible limits of WHO.

Nitrite is more toxic and permissible limit of WHO for nitrite is 1.0mg/L. All the 5 ponds indicated nitrite values within the permissible limits. Total nitrogen (Kjeldahl method) in the pond P_1 with thin population crossed the limit of WHO which may be due to the decomposition material of biological origin Fig 1.

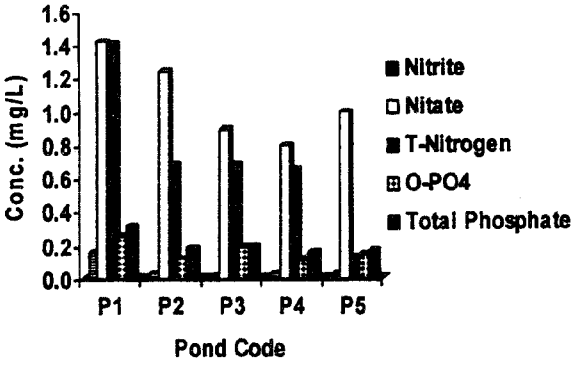

Fig. 1 : Variation in the phosphorus, nitrite, nitrate and organic nitrogen contents in the pond water

Dissolved oxygen (DO)

Dissolve oxygen (DO) in the water body is required to prevent odor and is suitable for use by aquatic plants and other life in water. The dissolved oxygen indicated the variation within 6.27-13.39 mg/L Table-1. The lowest oxygen content was observed in pond P_2, may be because of less solubility at higher temperature. The ponds with large storage capacity and low temperature indicated high DO contents Fig 2.

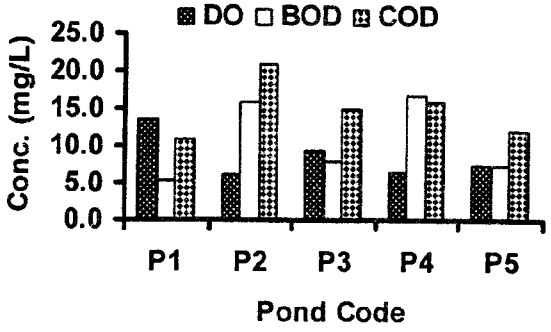

Fig. 2: Variation in the DO, BOD and COD contents in the pond water

Biological oxygen demand (BOD) and chemical oxygen demand (COD)

BOD and COD are considered essential and important parameters to estimate concentration of waste water and to decide about the quality of the drinking water. According to WHO standards, the permissible limits of COD and BOD are 50 mg/L and 20 mg/L respectively. All the pond waters were within the permissible limits. However, the water of ponds surrounded by high population indicated relatively higher values within the range 11.0-21.0 mg/L and 5.3-16.8 mg/L for COD and BOD respectively

The Cation Chemistry

The concentration of major metal contents (Na, K, Ca, and Mg) varied within the ponds and Na was dominant throughout, followed by Ca > K > Mg with the ranges Na17.7-52.8 mg/L, Ca 13.7-25.1 mg/L, K 2.2 – 8.8 mg/L and Mg 3.2- 7.2 mg/L Table-1. A clear pattern for the variation of Na, K, Ca, and Mg with population was not observed. It was noted that the concentration of major metal contents was higher in autumn as compared to summer. It may be due to less dilution of the salt contents within the catchments area of the ponds during the season of autumn in Azad Kashmir.

The minor metal contents were observed within the limits; Fe 59-85 μg/L, Zn 33- 79 μg/L, Ni

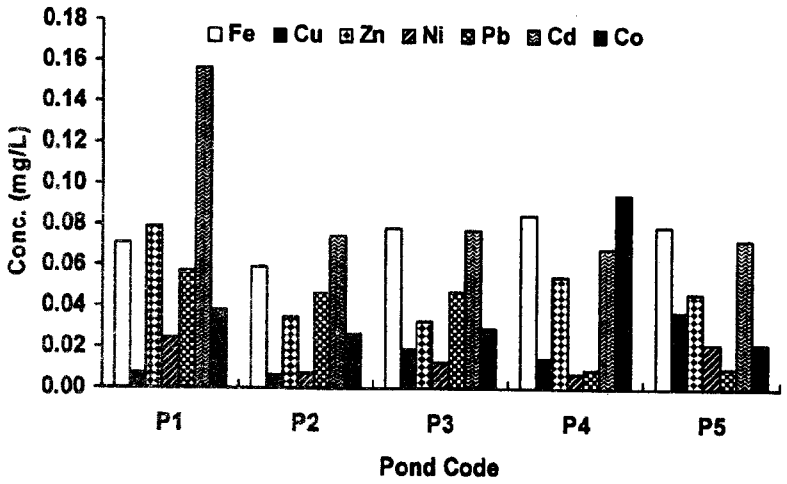

Fig. 3: Variation in the Fe, Cu, Zn, Ni, Pb, Cd and Co contents in the pond water

7-25 μg/L, Cu 7- 37 μg/L, Pb 9-57 μg/L, Cd 68- 156 μg/L and Co 22-95 μg/L. The waters indicate the following decreasing order:

$$Co > Cd > Fe > Zn > Pb > Ni > Cu$$

Five out of seven elements indicated results within the permissible limits of WHO for metal ions, However, Pb in the ponds P_1, P_2, P_3 and Cd in all five ponds (P_1, P_2 P_3, P_4 and P_5) crossed the limits of 0.01 mg/L and 0.005 mg/L respectively Table-1 Fig. 3. It may be due to geological nature of catchment's area. Seasonal variation did not affect the concentration of metal contents significantly.

Sodium adsorption ratio (SAR)

Sodium adsorption ratio was calculated and the results obtained were within 1.331-4.03 and it is suggested that the waters are suitable for agricultural purposes [6].

Experimental

The study involves preliminary survey, monitoring of ponds and testing of water to ascertain the physicochemical parameters. The objective of the field survey was to locate and select the ponds for study. The ponds can be considered as representative of surface water [7]. Five perennial and artificial ponds were selected for the study [Table-1]. The ponds selected subdivision wise were one from Barnala, two from Bhimber, and two from Samahni. The samples were collected three times during the months June-July, November-December and February during 2004-2005 and average values for measured parameters were calculated. Measurements of 28 parameters were obtained through field and laboratory analysis of grab samples. The homogenized sample was transferred to a clean 1.5 L plastic bottle after rinsing several times with the sample. The temperature of water and air 1 meter above the surface of water was noted with mercury thermometer. Conductivity, salinity, and total dissolved solids (TDS) were measured with Orion 115 conductivity meter. The pH was recorded with Orion 420A pH meter. Hardness, chloride and alkalinity were determined by titration with standard EDTA, silver nitrate and hydrochloric acid. The dissolved oxygen (DO) in the samples was determined by Wrinkler method [8]. Chemical oxygen demand (COD) was estimated by micro-dichromate oxidation method [9]. Total nitrogen was determined using Kjeldahl method [5]. Spectrophotometry techniques were used to determine orthophosphate, nitrite and nitrate. Orthophosphate was determined by reducing phosphomolybdic acid formed with ascorbic acid to molybdenum blue. Total phosphate was estimated by persulphate acid digestion method, followed by determination as of orthophosphate. Nitrate was determined after derivatization with brucine sulphate. Nitrite was estimated using N-naphthyl ethylene-diamine as derivatizing reagent as reported [8]. Sulphate was determined by turbidimetry as $BaSO_4$ using double beam Hitachi 220 Spectrophotometer.

The metal ions Na, K, Ca, Mg, Fe, Pb, Cu, Zn, Ni, Cd and Co were determined with Varian Spectr AA-20 atomic absorption spectrometer with standard burner head and air acetylene flame. The analysis

was carried out in triplicate with integration time 3 second and delay time 3 sec. Na, K, Ca and Mg were determined after appropriate dilution. Sample (250 ml) containing nitric acid (1 ml) was heated gently at 90-95 ^{0}C and was concentrated to about 15 – 20 ml. The final volume was then adjusted to 25ml.The solution was analyzed for the contents of Fe, Pb, Cu, Zn, Ni, Cd and Co by air acetylene flame atomic absorption spectrometer at the conditions recommended by the manufacturer.

Conclusions

It is observed that seasonal variation in different physicochemical parameter values for each pond is not significant. Population density which varies considerably around the pond has some what effect on water quality of pond water. Higher concentrations of Pb, Cd, and organic nitrogen than permissible limits need some attention for the use of pond water for drinking purposes. The higher concentration of lead and cadmium in pond water may be due to geological nature of the catchments area.

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