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Physico-chemical analysis of groundwater of village Jalalabaad, Dist. Tarn Taran, Punjab

Avinash Kaur Nagpal^{a*}, Sandip Singh^a, Vasudha Sambyal^b,

^aDepartment of Botanical and Environmental Sciences, Guru Nanak Dev Univ., Amritsar-5

^bDepartment of Human Genetics, Guru Nanak Dev Univ., Amritsar-5

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Abstract : Water is the biggest necessity for life and in developing countries like India groundwater is the most important source for drinking water, irrigation and industrial purposes. But due to widespread use of harmful chemicals in agriculture, pollution of rivers, industrial effluents etc. groundwater is getting increasingly contaminated with pollutants. This is creating chaotic situations in various parts of our country including Punjab. Considering the ever growing awareness on groundwater pollution, a study was conducted to analyse the physico-chemical characteristics of the groundwater of Jalalabaad village in Tarn Taran district of Punjab situated on the bank of the Beas river. Groundwater samples were taken from handpumps with depth of 50-75 feet and tube wells with depth of 200-225 feet. The results revealed that different parameters like pH, chlorides, conductivity, hardness, calcium content, total dissolved solids were in the permissible limits of Bureau of Indian standards. However the concentration of nitrates was very low in both the samples.

Key Words: Physico-chemical characteristics, Alkalinity, Hardness, Bureau of Indian Standards.

INTRODUCTION

Water is the biggest necessity for life. Drinking water is obtained from a variety of sources, depending on availability of surface water (rivers, lakes, reservoirs and ponds) and groundwater (aquifers) (Baig *et al.* 2009). In developing countries like India, groundwater is the most important source for drinking water, irrigation and industrial purposes. People in rural as well as urban areas are dependent on groundwater for their domestic and occupational needs. Groundwater constitutes about two third of the freshwater resources of the world and, if the polar ice caps and glaciers are not considered, groundwater accounts for nearly all usable freshwater (Chilton, 1996). But due to widespread use of harmful chemicals in agriculture, pollution of rivers, industrial effluents etc., groundwater is getting increasingly contaminated with

pollutants. The physio-chemical characters of water can be changed by inflow of different pollutants and nutrients through different sources like sewage, industrial effluents, agricultural runoff, etc. (Olimax and Sikorska, 1975). If these effluents are not treated before their disposal, they can be harmful for human consumption as well as for other uses (Khan *et al.*, 2013). Low-income communities, which rely on untreated surface water and groundwater supplies for domestic and agricultural uses are the most exposed to the impact of poor water quality (Ayoko *et al.*, 2007). Meteorological events and pollution are main factors affecting the physico-chemical parameters such as pH, TDS and conductivity having major influence on biochemical reactions that occur in water (Aydin, 2007). This is creating chaotic situation in various parts of our country including Punjab. Considering the ever growing awareness on groundwater pollution, present study was conducted to analyse the physico-chemical characteristics of groundwater of village Jalalabaad, district Tarn Taran, Punjab, India.

*Corresponding author :

Phone: 09417426060

E-mail : avnagpal@rediffmail.com

Study area

The study area, village Jalalabaad, lies in the north-western part of the state of Punjab, India and falls in the Tarn Taran district. The geographical coordinates of the village are 31.44797° N and 75.19321° E. The climate of the area is tropical steppe i.e. semi-arid and hot. There are four seasons in a year namely the cold season (November to March), hot season (April to June), southwest monsoon season (last week of June to the middle of September) and the post monsoon season (September to the start of November). During cold season the climate of area is affected by a series of western disturbances. The annual rainfall of the area is 545 mm, which sets in at the end of June and continues till middle of September. 74% of the

rainfall is contributed by the south west monsoon whereas western disturbances and thunder storms contribute the rest 26% of annual rainfall. The area is plain physiographically and topographic gradient is about 0.4m/km (Khan and Gupta, 2007). The village lies on the bank of perennial river Beas which is one of the three major rivers of Punjab. The land is mainly used for agricultural purposes. There is no major industry in the area but a thermal power plant is being constructed on the outskirts of the village in Goindwal Sahib. The groundwater is the main source for agricultural and drinking purposes. Due to indiscriminate use of fertilizers and pollution in Beas river the groundwater is under constant threat of contamination.

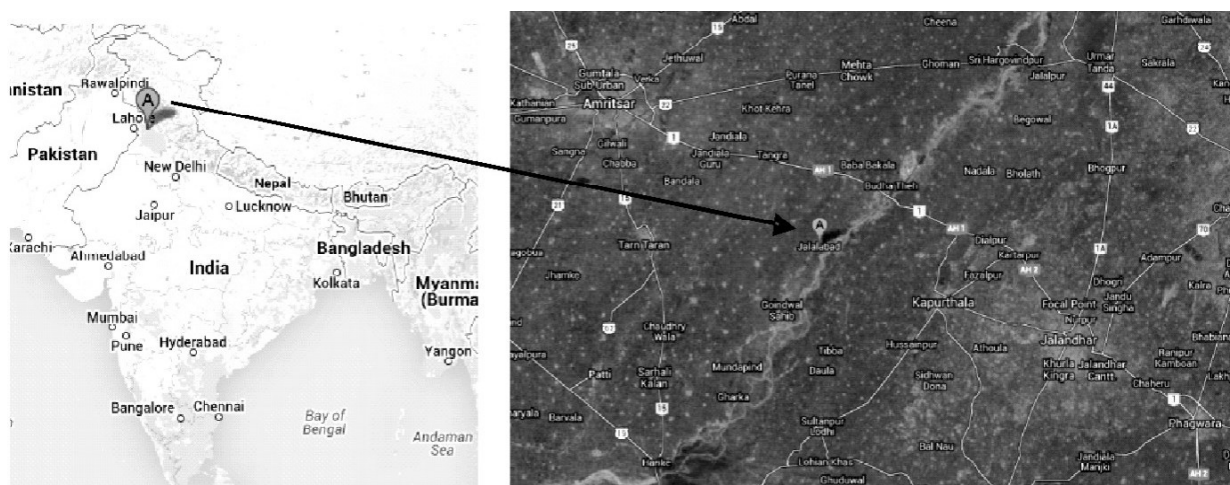


Fig. 1 Location map of the study area.

MATERIAL AND METHODS

Groundwater samples were collected from 6 hand pumps (depth 50-75 feet) across the village and were pooled to make one sample. Similarly water samples were collected from 6 tube wells (depth 200-225 feet) and pooled to make one sample. Hand pump and tube well samples were coded JA-H and JA-T respectively. The samples were collected in the month of August, 2013. Water samples were collected in sterilized screw-capped polyethylene bottles of two litres and were stored at low temperature to prevent vaporization and biodegradation before their physico-chemical analysis. The water samples were examined using Standard procedures of the American Public Health Association (APHA, 2012). The parameters

with extremely low stability such as pH and temperature were measured at the time of sample collection and other parameters were measured within 48 hours of sampling. The samples were brought to the lab in ice boxes to keep them at low temperature. The electrical conductivity was determined using conductometric method and total dissolved solids using gravimetric method. Total hardness, total alkalinity and calcium content were determined using titrimetric method and chloride content using argentometric method. Nitrate and phosphate content were measured using spectrophotometric method. To ensure accuracy analysis was done in triplicates and mean value was taken for consideration. The standard reagents used in analysis were prepared using double distilled water.

RESULTS AND DISCUSSION

The results on physico-chemical analysis of groundwater samples of Jalalabaad village are given in Table 1.

Table 1. Physico-chemical characteristics of water samples from Jalalabaad Village

S.No.	Parameter	BIS Desirable limit	JA-T*	JA-H*
1.	Temperature (°C)	-	25.667±0.333	27.667±0.333
2.	pH	6.5-8.5	7.37±0.031	7.16±0.11
3.	Alkalinity (mg/L)	200-600	626.667±17.638	646.667±6.667
4.	Conductivity (mS/cm)	-	1.187±0.003	1.617±0.003
5.	Chloride content (mg/L)	250-1000	48.386±3.506	65.604±3.443
6.	Total Hardness as CaCO ₃ (mg/L)	300-600	289.333±11.623	322.667±21.949
7.	Calcium content (mg/L)	75-200	76.16±2.371	73.984±1.961
8.	Magnesium Content (mg/L)	0-30	25.025±4.225	34.45±6.226
9.	Total dissolved solids (mg/L)	500-2000	20±0.224	280±2.557
10.	Nitrate content (mg/L)	45-100	17.485±0.053	35.440±0.008
11.	Phosphate content (mg/L)	-	0.106157±0.005	0.020169±0.001

*The values given are mean ± standard error.

BIS- Bureau of Indian Standards

JA-T= Tube well sample.

JA-H= Hand pump sample.

All the physico-chemical parameters were within the permissible limits of Bureau of Indian Standards (BIS) for drinking water except alkalinity and magnesium content which are slightly above the permissible limits. The temperature of water collected at the time of sampling was below 30 °C. According to Zajic (1971) water above 30 °C is unfit for public use. So collected water samples were fit for the public use. The pH of the two samples JA-T and JA-H was 7.37 and 7.16 respectively and their values fall within the prescribed range of BIS. Although pH is not harmful as such but if its value is more than 11 it can cause eye irritation and skin disorder and it is corrosive to pipes and containers if its value is less than 6.5 (Khan *et al.*, 2013). Total alkalinity of water is the ionic concentration which neutralizes hydrogen ions. The main constituents of alkalinity in neutral system are CO₃, OH⁻, HCO₃⁻, H₂BO₃²⁻, H₂PO₄⁻ and HS. The phenolphthalein alkalinity of samples was zero which indicates absence of hydroxyl and carbonate ions. The value of alkalinity was

slightly higher than the prescribed limit of 600 mg/L in both the samples which indicates water pollution. The conductivity values of the samples were very low. In a study of water quality of tap and well water in Algeria, Ramdani *et al.*, (2012) found that increase in conductivity is due to high concentration of minerals and it poses significant health risk. The chloride content in both the samples was very low and total hardness and calcium content was well within the permissible limits. However magnesium content was slightly above the permissible limit in hand pump samples. Total dissolved solids (TDS) is a measure of content of inorganic and organic substances present in a liquid in molecular, ionized or micro granular suspended form (Gichuki and Gichumbi, 2012). The amount of TDS was very low in both the samples. Being highly oxidized form of nitrogen compounds, excessive level of nitrates have a potential of causing shortness of breath, “blue babies” syndrome in infant diuresis, an increase in starchy deposits and hemorrhaging at the spleen (USEPA, 2004). But the nitrate and phosphate content of the samples were also well within the permissible limits.

CONCLUSION

In this study groundwater samples from Jalalabaad

village was taken for physico-chemical analysis in the month of August, 2013. The parameters were within the permissible limits of BIS for drinking water and water was found fit for public use in this study. But constant analysis of the water quality is mandatory in this area as the groundwater is subject to changes due to changing weather conditions and anthropogenic activities. Also water quality of river Beas must be ensured as increase in level of pollution in Beas would directly affect the groundwater quality. More extensive physico-chemical and biological studies are required for building practical guidance on avoiding and reducing contamination in groundwater.

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