Drinking water quality of Railway stations of Jammu

Neelam kumari[1], Baba Uqab[1], Anita singh*
[1]Department of environmental sciences central university of Jammu.
***Corresponding author :** anitasaharan@gmail.com

ABSTRACT

Pure water is the priceless, indispensable and primary drivers of public health. Drinking water quality is an issue of concern for human health in both developing as well as in developed countries all over the world. Quality supply of drinking water to the public is very essential for health and human welfare, whereas, deteriorated water quality poses a key risk to health and human well being. Despite massive outlays for drinking water and sanitation in India, access to safe drinking water still remains a challenge. Public places like railway stations are the main source of drinking water for railway travelers, especially the poor. In this context present study was carried out in the year 2014 to assess the quality of drinking water at the railway stations of Jammu. pH, TDS, turbidity, DO, total hardness, calcium, magnesium hardness of various samples in the present study cross the limits set by WHO. In the present study, the pH of water samples varied from 6.32-7.34. The turbidity of all the samples was within acceptable range except for Vijaypur. The total hardness of water samples from all stations was within the permissible limit of WHO except the water sample from Bari Brahmna railway station which has hardness value higher than the other.

Keywords: Water, life, living beings, samples sanitation, drinking, fresh water, impacts.

INTRODUCTION

Drinking water, in adequate quantity and safe quality, is a vital requirement for life and a determinant of standard of living. Poor or no access to safe water supply can result in many diseases including diarrhea, flourosis, cholera, hepatitis. These diseases potentially constrain human resource development and productivity, especially for the poor. The National Water Policy 2002 reflects the significance attached to drinking water by stating, “adequate safe drinking water facilities should be provided to the entire population both in urban and rural

areas. Irrigation and multipurpose projects should invariably include a drinking water component, wherever there is no alternative source of drinking water. Drinking water needs of human beings and animals should be the first charge on any available water" (GoI 2002). However, around 22 per cent of households in India lack access to safe drinking water sources, like tap, hand pump and tube well (Census 2001). Hence, significant efforts are being made by the central and state governments for increasing the coverage of households with adequate and safe drinking water supply, along with sanitation services, which coincide with the Millennium Development Goals (UNDP 2003)

Railway stations are the main source of drinking water for railway travelers and analysis of the same water is very important in the evaluating of these supplies. A large number of railway passengers consume this drinking water on railway platforms and this contaminated water may be the vehicle of transmission of water born diseases (Patil *et al.*, 2001). Drinking water at railway stations is mainly supplied from bore wells. Most of the railway stations in India rarely have the much needed purifying technology (Gyonanth *et al.,* 2000). Water quality assessment helps in identification of any contaminants and checks the quality of water. As one of the essential amenities local government authorities provide drinking water to passengers at all the stations. But many times apathy has been observed towards the quality maintenance of water, storage tanks and particular area. This work seeks to check the quality of water made available at various railway stations of Jammu city.

Pure water is the priceless, indispensable and primary drivers of public health. Although more than three quarters of the earth's surface is made up of water, only 2.8 percent of the Earth's water is available for human consumption and however, fresh water constitutes only 0.6 percent out of it. The other 97.2 percent is in the oceans; however, this water is too salty to use for most purposes, and the salt remove is very costly. Most of the Earth's fresh water is frozen in polar ice caps, icebergs, and glaciers. As the population increases, more water is used and wasted. At present, with increase in the water demand, drinking water resources are sources undergoing contamination by human activities all over the world. There are certain trends within the drinking water supply system and sanitation sector, which disturb the public health and economic. The second unfortunate trend in the public health system in India is the growing gap between drinking water supply system and sanitation service (Patil, 2001). Almost all urban and small town communities have been provided with piped water supply and quality water from the source, even though the gap between water supply, sanitation and public health is bigger in India due to improper maintenance and continuous monitoring. The fundamental health

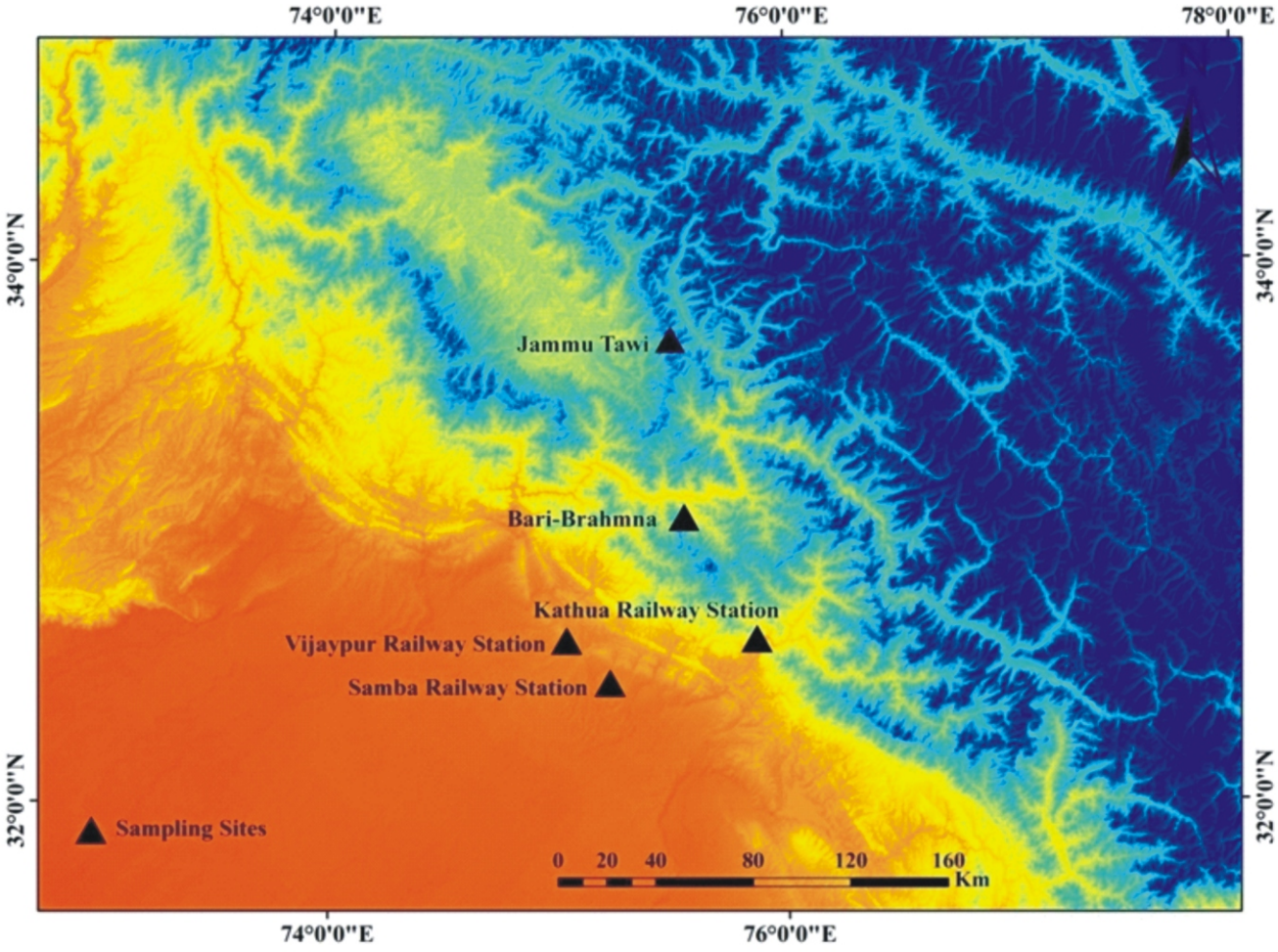
reasons for supplying quality drinking water is to reduce the incidents of water born diseases. Supply of pure drinking water, which is free from contamination and bacteria, is the fundamental duty of any government or organization. Such a drinking water supply system helps to promote wealth and welfare of public and economic level of any place.

MATERIAL AND METHODOLOGY

Water samples from all the sites were collected and taken to lab for physico chemical analysis. Dissolved oxygen, ph, and water temperature were measured on site. The methods were followed as per standards laid by APHA (1998).

Coordinates of sampling site and map

S.NO	SITE	COORDINATES
1	**Jammu tawi**	32°42′23″N 74°52′49″E32.7063°N 74.8802°E
2	**Bari-Brahmna**:	32°38′N 74°56′E32.64°N 74.93°E
3	**Vijaypur railway station:**	32°34'19"N 75°1'16"E
4	**Samba railway station**	32°31'41"N 75°7'12"E
5	**Kathua railway station**	32.37°N 75.52°E.



Physicochemical analysis

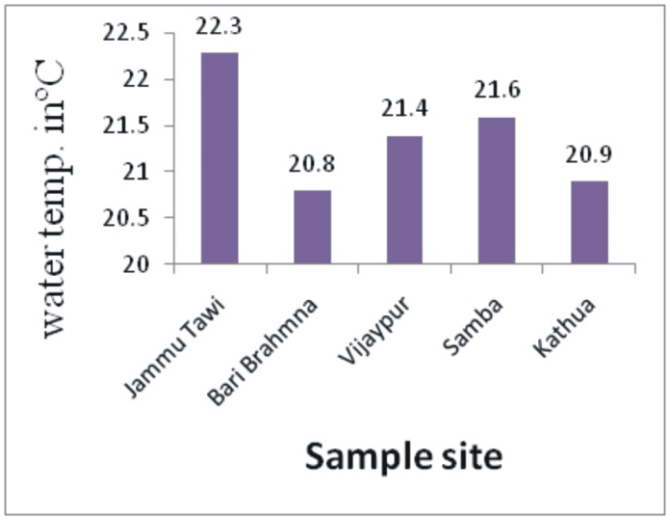
Analysis was carried out for various water quality parameters such as pH, electrical conductivity (EC), dissolved oxygen (DO), total alkalinity (TA), total hardness (TH), calcium hardness, magnesium hardness, chloride (Cl^-), nitrate, sulphate, Ortho Phosphate and TDS using standard methods laid down by APHA 1998

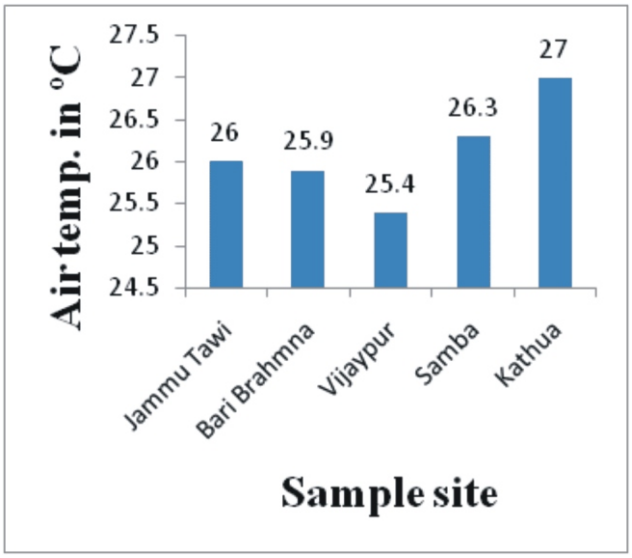
RESULT

In the present study, water samples were collected from the drinking water tap of different railway stations because these were most frequently used water source available for people for drinking purposes. During past few decades, the regulation of water quality has undergone several changes. Drinking water standards have been developed to define the quality of water that is safe for health and also acceptable for users. WHO, ISI, ICMR etc. have specified level for various inorganic, organic and biological pollutants. Water samples were analyzed for various physical parameters like pH, temperature, turbidity, conductivity and total dissolved solids and chemical parameters like DO, sulphates, chlorides, total hardness, calcium hardness, magnesium hardness, total alkalinity, carbonate alkalinity, bicarbonate alkalinity, acidity and nitrates.

Water and Air Temperature

Temperature of water is basically important because it effects the bio-chemical reactions in aquatic organisms. The average temperature of the water in the present study ranged from 20.8 to 22.3° C and that of air ranges from 25.4 - 27°C.

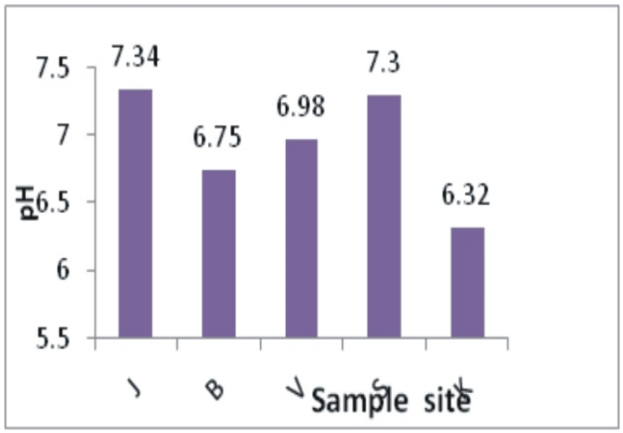




pH

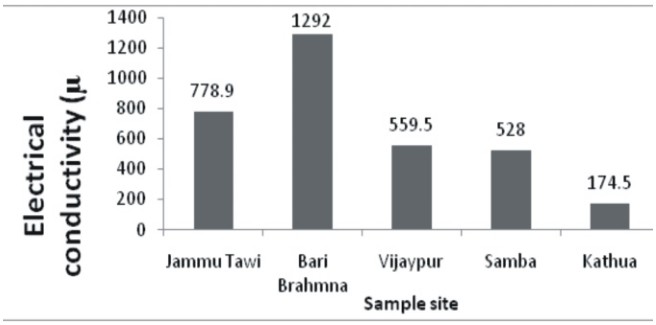
pH value indicates the intensity of acidity and alkalinity and measure the hydrogen ion concentration in water. pH would prove to be ecological factor of major importance. It is an important factor in water analysis since it enters into the calculation of acidity, alkalinity and

processes like coagulation, disinfection and corrosion control. WHO recommendations and permissible limit of pH in drinking water is within 6.5 to 8.5. The pH value higher and lower than this are not acceptable for drinking purposes. In the present study, the pH of water samples varied from 6.32-7.34. Thus the pH value of sample from Kathua shows a slight deviation from WHO limit.



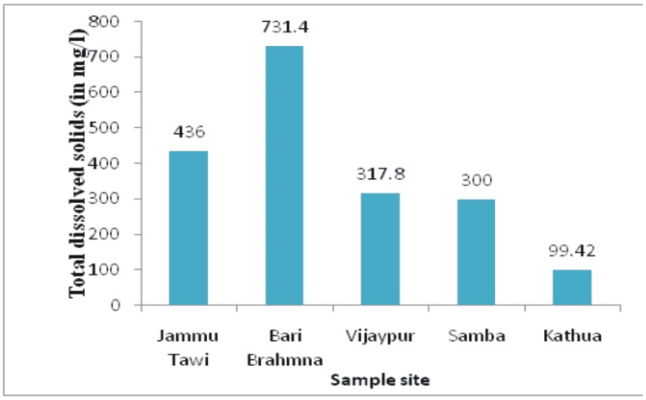
Electrical Conductivity

Electrical conductivity is a measure of water capability to transmit electric current and also it is a tool to assess the purity of water. Its value depends on the concentration and degree of dissociation of the ions as well as the temperature and migration velocity of the ions in the electric field. Thus, as concentration of dissolved salts increases conductivity also increases. It depends upon the presence of ions, their total concentration, mobility, valence and temperature. EC of our water sample ranges from 174.5- 1292 ms^{-1}.



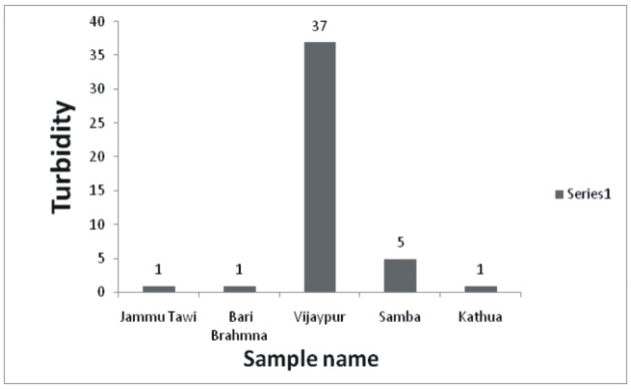
Total Dissolved Solids

TDS originate from dissolution or weathering of the rocks and soil, including dissolution of lime, gypsum and other slowly dissolved soil minerals. Dissolved mineral gases and organic constituents may produce aesthetically displeasing color, taste and odor. According to WHO and Indian standard, T.D.S. value should be less than 500 mg/L for drinking water which can be extended up to 1500 mg/l in case of non availability of any other alternate source, and value of TDS in our water sample ranges from 99.42-731.4. So, TDS value of all water samples is within acceptable limit except Bari Brahmna railway station whose TDS value is higher than acceptable limit but below the permissible level. This higher value is because Bari Brahmna is industrial area where large number of industries are existing.



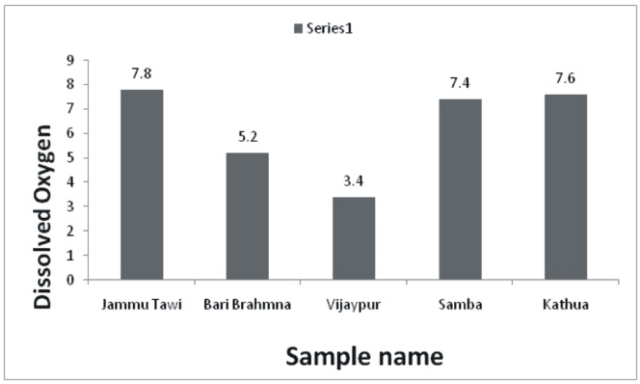
Turbidity

Turbidity is the cloudiness of a fluid caused by individual particles that are generally invisible to the naked eyes. The measurement of turbidity is a key test of water quality. The acceptable limit for turbidity in drinking water is 5 NTU and permissible limit i.e. in the absence of other sources this value may be extended up to 10 NTU. In the present study the turbidity value ranges between 1 - 37 NTU. The turbidity of all the samples is within acceptable range except for Vijaypur.



Dissolved Oxygen

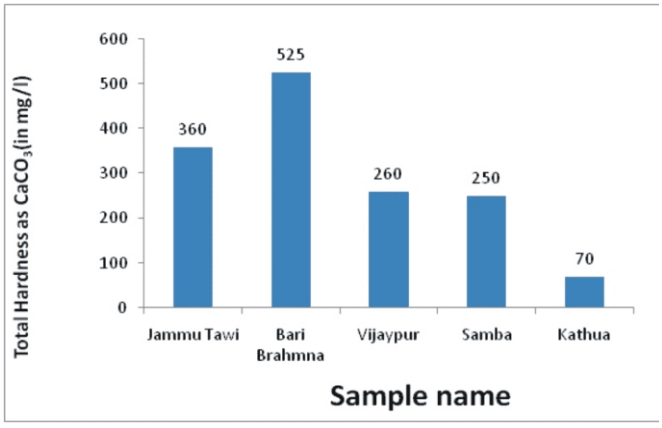
Dissolved oxygen is an important water quality parameter in assessing water pollution. Also, a high level of dissolved oxygen is generally considered more palatable in water, as opposed to there being a 'flat' taste. The acceptable limit of D.O in drinking water is 5mg/*l* minimum and D.O of our water samples ranges between 3.4-7.8. So, our water samples have a good amount of D.O except that of Vijaypur where D.O level is lower than acceptable range.



Total Hardness (TH), Calcium Hardness and Magnesium Hardness

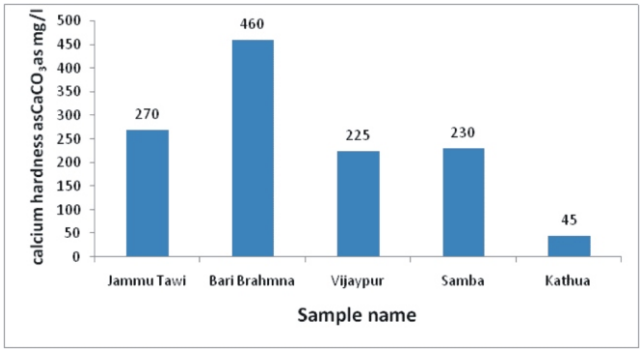
Hardness is an important parameter in decreasing the toxic effect of poisonous element. The hardness of our water samples was found to be in the range of 70-525 mg/l. The acceptable limit of total hardness (as $CaCO_3^{-2}$) is 200 mg/l (as $CaCO_3^{-2}$) which can be extended up to 600 mg/l (as $CaCO_3$).

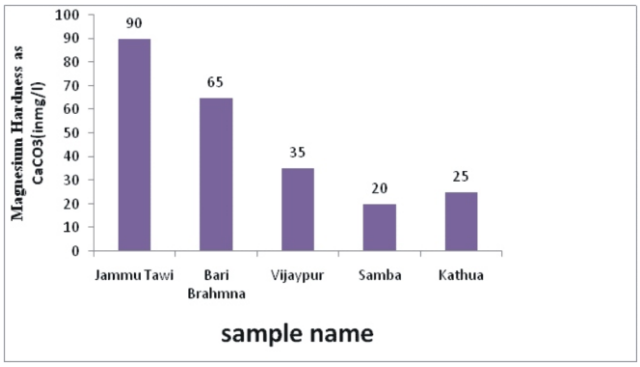
The total hardness of water samples from all stations is within the permissible limit of WHO except the water sample from Bari Brahmna railway station which has hardness value higher than the others. This higher value is because Bari Brahmna is industrial state where large number of industries are existing.



Calcium and Magnesium are important parameters for total hardness. The acceptable limits for Ca^{2+} and Mg^{2+} in drinking water are 75 mg/l and 30 mg/l respectively. If these components are present more than this, leads to encrustation in water supply structure and adversely affect the domestic use of water and permissible limits are 200 and 100 mg/l in absence of alternate source. Calcium hardness of water sample of Railway station ranges from 45-460 mg/l which lies in acceptable limit for only one station i.e. of Kathua and exceeds the limit for other stations.

Magnesium hardness of railway station water sample ranges from 20-90 mg/l which lies in acceptable range for two stations i.e. Samba and Kathua and for rest of the samples, the values exceeds acceptable limit and is within permissible range.

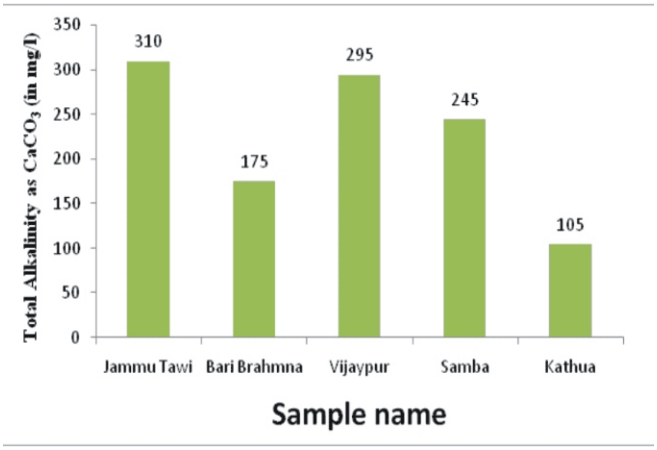




Total alkalinity as $CaCO_3^{2-}$(TA), Carbonate (CO_3^{2}), And Bicarbonate (HCO_3^{-}), Alkalinity

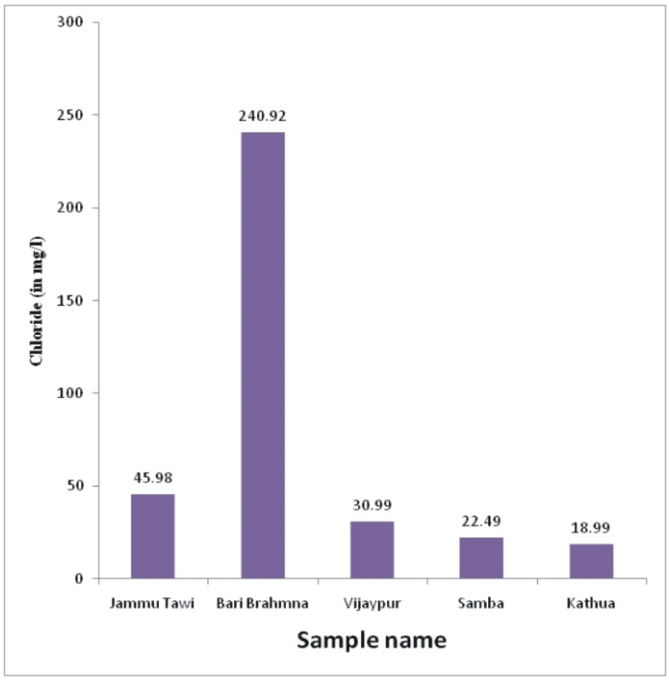
Alkalinity is a measure of the ability of water to neutralize acid. The constituent of alkalinity in natural system include mainly CO_3^{2-}, $HCO^{-}_{3,}$ and OH^{-} and other constituent which may contribute to alkalinity are $H_2BO_3^{2-}$, HPO_4^{2-} and HS^{-}. These compounds result from dissolution of mineral substances in the soil and atmosphere (Mittal and Verma, 1997). The acceptable limit for alkalinity (as $CaCO_3^{2-}$) is 200 mg/l and in absence of alternate source, the alkalinity value up to 600 mg/l is acceptable. Total alkalinity of our water samples range from 105-310mg/l. Thus, alkalinity is within acceptable range for two samples i.e. Bari Brahmna and Kathua and for rest of samples it is within permissible range.

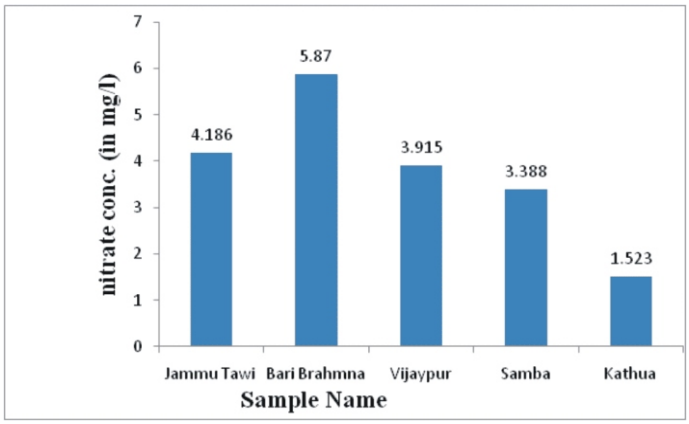
In the present study, CO_3^{2-} , HCO_3^{-} is discussed with TA because they are the main component of alkalinity. Carbonate is absent in all the samples that we collected and analyzed, so alkalinity of our water samples is only because of bicarbonate and these varied from 105-310 mg/l.



Chloride

Chloride occurs in all types of natural waters. People who do not have high chloride content in water are subjective to laxative effect (Ravi Parkash and Krishna Rao, 1989) Excess of chloride in inland water is usually taken as index of pollution. The salts of sodium, potassium and calcium contribute chlorides in water. Large contents of chloride in freshwater is an indicator of pollution. The high concentration of chloride is considered to be an indication of pollution due to high organic waste of animal origin. The acceptable limit of chloride is 250 mg/l and in Indian conditions maximum permissible limit of chloride in potable water is 1000 mg/l. Chloride values obtained in the study are found in the range between 18.99-240.92 mg/l. So, in all water samples of railway station chloride is within acceptable limit.





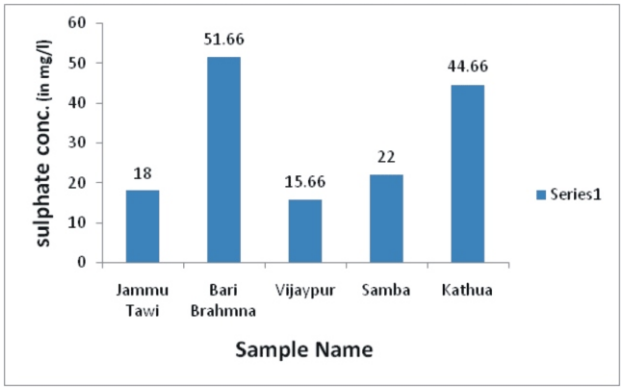
Nitrate

Generally water bodies polluted by organic matter exhibit higher values of nitrate. Concentration of nitrate depend on the activity of nitrifying bacteria which in turn get influenced by DO. The acceptable limit for nitrate in drinking water is 45 mg/l and permissible range is 100 mg/l. In the present study water samples from different sampling stations showed nitrate concentration between 1.523 - 5.87 mg/l .These are within the permissible level as per the drinking water standard.

Sulphate

Sulphate ion does not affect the taste of water, if present in low concentrations. It is naturally occurring anion found among all kinds of water bodies. It may undergo transformation to sulphur and then sulphur oxide depending upon the redox potential of water. Sulphate cannot readily be removed from drinking water, except by expensive process such as distillation, reverse osmosis or electro dialysis. The acceptable range of sulphate in drinking water 200 mg/l and

permissible range is 400 mg/l. The sulphate ion concentration in the present investigation varied from mg/l which is 18-51.66 the permissible level.



DISCUSSION

Temperature is having a direct impact on water as well as sewage water (Welch, 1952; Saether and Caritat, 1997:Skidmore, 2003). Temperature of water is basically important because it effects bio-chemical reactions in aquatic organisms. The average temperature of the water in the present study ranged from 20.8 to 22.3° C and that of air range from 25.4-27°C. Hydrogen ion concentration (pH) is used as an indicator for acidity in water. The pH value of sample from Kathua shows a slight deviation from WHO limit and for rest of samples it is within the permissible range. Dissolved oxygen value for water sample from Kathua has lower value than the minimum required limit and for rest of samples it is above the required level increase in levels of electrical conductivity and cations and input of sewage water may be the result of decomposition and mineralisation of organic materials (Aabida *et al*., 2008). Higher concentrations of total dissolved solids (TDS) in all sewage water may be attributed to higher concentrations of carbonates, bicarbonates, chlorides, sulphates, phosphates, nitrates, nitrogen and calcium (Kannan *et al*., 2004). TDS of all water samples lies within the acceptable range except that of one station. For that station, TDS value is in the permissible range. Chloride, the higher usage of washing agents like detergents, soaps and faecal matter (Von Sperling *et al*., 1996). In all water samples of railway station chloride is within acceptable limit. Hardness of water is equivalent to concentration of total inorganic salts which are able to precipitate when it is heated and it negatively affects the solubility of soaps in water (Al Manharawari and Hafiz *et al*., 1997.). The total hardness of water samples from all stations is within the permissible limit of WHO except the water sample from Bari Brahmna railway station which has hardness value higher than the others. Alkalinity of water is due to the presence of bicarbonates of calcium and magnesium (Bartram and Ballance *et al.,* 1995. The alkalinity **is** within acceptable range for two samples i.e. Bari Brahmna and Kathua and for rest of samples it is within permissible range**.** Nitrate is highly oxidized form of nitrogen compound and is commonly present in surface and ground waters. since it is final product of aerobic decomposition of organic nitrogenous matter (Bartram and Balance, 1996). Nitrate concencentration of all water samples is within

the acceptable limit. Sulphate occurs naturally in minerals and are used commercially and principally in the chemical industry. They are discharged into water in industrial wastes and through atmospheric deposition; however the highest level usually occur in ground waters (WHO, 2006). Sulphate concentration for all water samples is within the acceptable range.

CONCLUSION

On the basis of analytical findings following conclusions can be drawn:

The pH value of sample from Kathua shows a slight deviation from WHO limit and for rest of samples it is within permissible range. TDS of all water samples lies within the acceptable range except that of one station. For that station TDS value is in the permissible range. Turbidity of all water samples is within the permissible range for drinking water except for one station vijapur where it exceeds the limit. Dissolved oxygen value for water sample from Kathua has lower value than the minimum required limit and for rest of samples it is above the required level. The total hardness of water samples from all stations is within the permissible limit of WHO except the water sample from Bari Brahmna railway station which has hardness value higher than the other. The calcium hardness lies in acceptable limit for only one station i.e. of Kathua and exceeds the limit for other stations. The magnesium hardness lies in acceptable range for two stations i.e. Samba and Kathua and for rest of the samples the value exceeds acceptable limit and is within permissible range.The alkalinity is within acceptable range for two samples i.e. Bari Brahmna and Kathua and for rest of samples it is within permissible range. In all water samples of railway station chloride is within acceptable limit. Nitrate concencentration of all water samples is within the acceptable limitSulphate concentration for all water samples is within the acceptable range.

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