

Qualitative and Quantitative Analysis of Potable Water Samples of Different Localities in Jaipur

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Abstract—Due to rapid urbanization and change in life style, water is more prone to contamination in cities. Analysis of four water samples was carried out, from different areas of Jaipur district of Rajasthan to check the various physical and chemical parameters. Mainly drinking water samples were taken as its contamination results in various water-borne diseases. Contaminated water is very much responsible for various water borne diseases like Cholera, Typhoid, and Dysentery in human beings. Therefore water quality must be regularly checked and analyzed in terms of various physical and chemical parameters to maintain public health. Parameters that are tested include temperature, pH, conductivity, Total dissolved solids, turbidity, alkalinity and hardness. The physical and chemical properties of the various sources of water compared favorably with the World Health Organization Standards (WHO).

Keywords: Jaipur, Ground water, pH, TDS, Alkalinity, Hardness.

1. INTRODUCTION

Water is the basic and vital need of all forms of life on earth so it becomes our prime responsibility to maintain the quality of water. It is widely distributed and abundant substance in nature. One-third part of Earth comprises water i.e. about 71%. Out of which, 96.6% is in the form of sea water, 1.7% is in the form of glaciers and remaining 1.7% water is available as fresh water resource for the use of human being and other life [1].

All human beings depends on water for drinking, bathing, cooking, irrigation and industrial purposes such as production, cooling, purification of products, separation of components, transportation, recreation and waste disposal.

The amount of water is already limited in many parts of the world. It is the result of climate change and increasing consumption of water due to increasing population. Variation in quality of water also occurs due to change in chemical composition of the aquifers and underlying sediments. These physicochemical characteristics of water help in the determination of sources of pollution and conducting further investigation on the biological impacts of poor quality water on health and steps taken for its treatment.

Increase in urbanization, industrialization, agriculture activity and various human activities has increase the pollution level of surface water and ground water. As the safe and potable drinking water is needed, various treatment methods are adopted to raise the quality of drinking water. Water should be free from the various contaminations viz. organic and inorganic pollutants, heavy metals, pesticides etc. as well as all its physical and chemical parameter like pH, electrical conductivity, hardness, chloride, total dissolved solid, alkalinity, dissolved gases should be within a tolerable limit [2].

2. EXPERIMENTAL

2.1 Material and Chemicals Required

Chemicals involved in all chemicals tests were of analytical grade and were acquired through Shivam Enterprises, Jaipur.

2.2 Sample Handling

Results of physicochemical analysis depends on sample collection and storage procedures.

In general, the time between sampling and analysis should be kept at a smallest time interval. Water sample is stored in glass or high density polyethylene bottles at approximately 4 °C in the dark. Sample bottles must be clean properly disinfection is not recommended. Special preservatives may be required for some analyses. Residual chlorine, pH, and turbidity should be tested immediately after sample collection, as they will change during storage and transport [7].

A good sampling program ensures the sampling points selection in line with aim of the study. As we know, a number of natural and man-made factors are responsible for water pollution which means there is no general governing rule for the selection of sampling sites. To estimate quality of water, extensive research and surveying is needed about various factors like waste discharge, geographical variations, pollutants level and sources, underground water resources, chemical treatments methods, agricultural waste, seasonal

variations, surface runoff etc. Water analysis also depends on population density and equivalent, general behavior of local community, water use pattern etc. We have collected the ground water samples from different localities in Jaipur as shown in (Table 1)

Table 1: Location of ground water examples

S. No.	Water Sample	Location
1	Sample-1	Sitapura
2	Sample-2	Sanganer
3	Sample-3	Mansagar Lake

2.3 Measurement of pH

At the time of sample collection, pH of all three water samples were measured with the help of portable electrically operated pH meter (Model MP220) with the help of glass electrode. The calibration was done by using three standard buffer solutions of pH 4.0, 7.0 and 9.4. The pH of the sample must lie in between these values. Temperature of the samples was determined at the same time. All the readings were taken when indicated value remains constant for about 30 seconds. At the end of each measurement, the pH meter glass electrode was washed with distilled water and cleaned with tissue paper.

2.4 Total Dissolved Solids

These are well defined as solid matter, suspended or dissolved substances in water. These solids affect water quality adversely in many ways. Water with high dissolved solids is of inferior quality and may show an unfavorable physiological reaction in the transient consumer. It is because of this reason; there is a permissible limit of 500 mg for some organic substances. The total dissolved solids (TDS) of the water samples were measured using pre-calibrated total dissolved solid meter. Before measurement, the beaker and electrode were washed with the distilled water. Conductivity cell was calibrated with the help of KCl solution. All these measurements were taken at room temperature. After this, the samples were taken into beaker in specific volume to dip the conductivity cell and then the button was pressed. The scale was already set before the TDS of each sample was noted.

2.5 Electrical Conductivity

The electrical conductivity of the each sample was also measured using pre-calibrated conductivity meter. Before measurement, the beaker and conductivity cell must be washed several times in the distilled water and the measurements were taken at room temperature. The instrument was calibrated first with standard KCl solution. Then the samples were taken into the beaker, in enough capacity to dip the electrode, after that the button was adjusted to desired conductivity scale conductivity of each sample was then noted.

2.6 Total Hardness

Hardness is defined as the property, which makes water to form an insoluble precipitate with soap, which is due to the presence of calcium and magnesium ions in it. Hard water is primarily of concern because it requires more soap for effective cleaning, also causes yellowing of fabrics and forms scales in boilers, water heaters, pipes and cooking utensils. The permissible limit of hardness in water should not exceed 500 mg/L measured as calcium carbonate equivalents. 2 ml of buffer solution was added to 20 ml of water sample followed by the addition of 1 to 2 drops of Erio-chrome Black-T as indicator. Then this solution was titrated against aqueous solution of Disodium salt of Ethylene Diamine Tetra Acetic Acid (EDTA) from burette. Blue colour was observed at the completion of reaction.

2.7 Alkalinity

Water shows alkaline nature due to presence of hydroxide, carbonate and bicarbonate ions. Water having high alkalinity is not suitable for industrial purposes as well as for domestic purpose. Alkalinity can be determined by titrating water sample with standard acid solution of H_2SO_4 and using Methyl Orange as indicator. End of titration can be observed as colour changes from pink to colourless.

2.8 Determination of Chlorides

Different types of chlorides may be present in water, which may impart salty taste to water. These chlorides are in the salt form of sodium, potassium, calcium, magnesium etc. Out of these salts, Sodium Chloride and Calcium Chloride are majorly responsible for salty taste. The permissible limit of chloride content in water is 260 mg/Liter according to WHO. High chloride content may be problematic to sewage water treatment, boiler problems are associated with this and drinking water taste may be differ and saline. Precipitation method of titration was used to determine chloride content with the help of Silver nitrate as standard solution and Potassium dichromate as indicator. During titration, chlorides will convert into brick red precipitate of silver chlorides. End point can be observed as appearance of brick red colour.

2.9 Turbidity

Turbidity may be due to presence of colloidal impurities and suspended impurities in the form of sand, clay and other organic debris. The transparent nature of water decreases due to high turbidity level, which is harmful for industrial processes. Digital nephelometer is used to determine turbidity with the help of formazine to calibrate the instrument.

3. RESULTS AND DISCUSSION

3.1 Temperature

The temperature of the water samples was observed at the sample collection site with the help of normal thermometer in March 2018. It lies between 20°C to 25°C, and the average

temperature is found to be 23°C (Table 2). The maximum acceptable standard of drinking water is 25°C.

Table 2: Temperature of Water Samples

S. No.	Sample Site	Temperature (°C)
1.	Sitapura	22.5
2.	Sanganer	21.4
3.	Mansagar lake	24.5

3.2 pH

The hydrogen ion concentration in term of pH value of water samples taken from the different places of Jaipur as mentioned above (Table 1) ranges from 7.54 to 7.78. The permissible limit of potable water ranges from 6.5 to 8.5. The pH value of all three samples are reported in Table 3 (Figure 1).

Table 3: PH of Water Samples.

S.No.	Sample Site	pH
1.	Sitapura	7.78
2.	Sanganer	7.74
3.	Mansagar lake	7.54

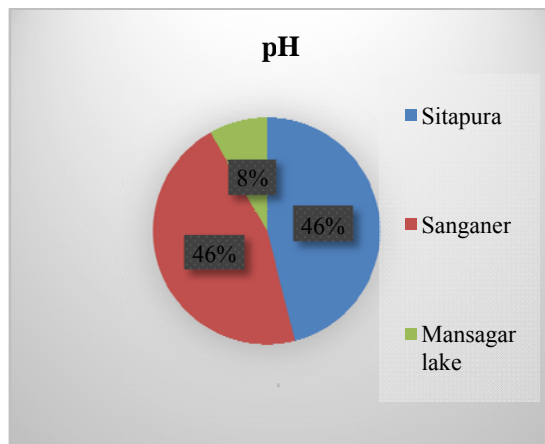


Fig 1: pH of water samples

3.3 Total Dissolved Solids and Conductivity

Average value of total dissolved solids (TDS) and electrical conductivity of water samples was found to be 656.5mg/L and 1010µmho/cm. The maximum value of the conductivity of well water is approximately 1400 µmho/cm. The minimum conductivity value is 500 µmho/cm. The obtained value after analysis when compared with the standard value is 200 µw/s of conductivity. The TDS level was found to be maximum for Sanganer region as 845 mg/L whereas minimum TDS level was 410 mg/L for Sitapura area. All the data are represented in Table 4 (Figure 2 and 3).

TABLE 4. TDS and Conductivity

S.No.	Sample Site	TDS (mg/ L)	Conductance (µmho /cm)
1.	Sitapura	409.5	1428
2.	Sanganer	845	1289
3.	Mansagar lake	715	500

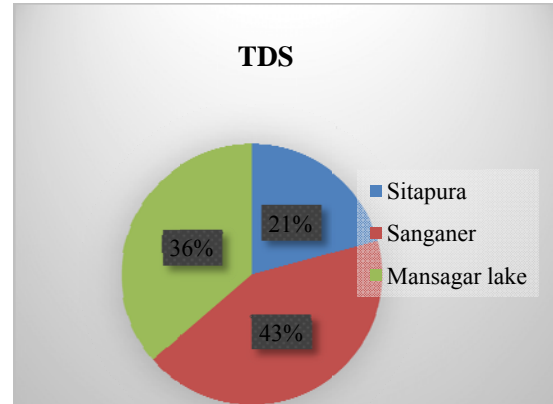


Fig 2: TDS of water samples

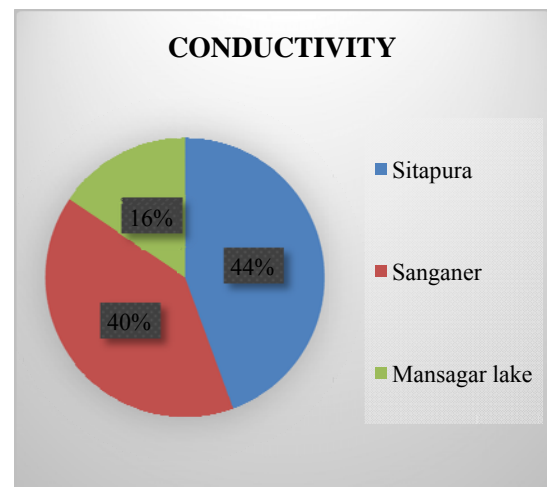


Fig 3: Conductivity of water samples

3.4 Hardness

The mean of hardness of water samples taken 301.11 mg/L. The minimum value of calcium hardness is 250 mg/L found in ground water in Sitapura area of Jaipur and maximum value of calcium hardness is 370 mg/L found in Mansagar lake of Jaipur. Permissible limit of hardness in drinking water is 500 mg/ L. All the statistics are represented in Table 5 (Figure 4)

TABLE 5: Hardness in Terms of Calcium Content of Water Samples

S.No.	Sample site	Hardness (mg/ L)
1.	Sitapura	250
2.	Sanganer	285
3.	Mansagar lake	370

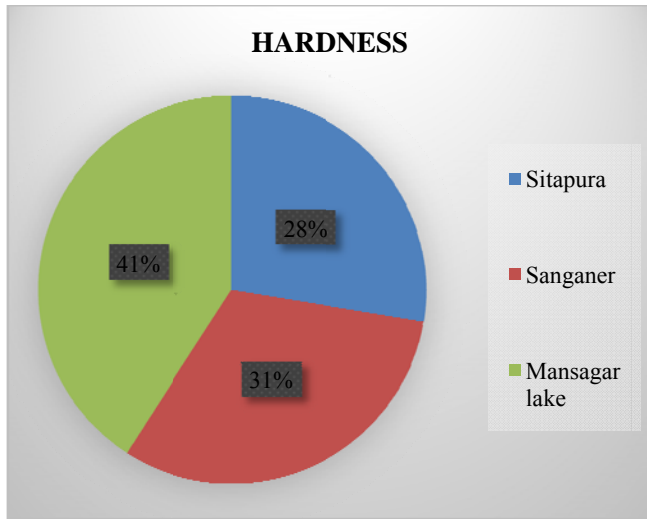


Fig 4: Hardness of water samples

3.5 Alkalinity

The mean of alkalinity of water samples is 307mg/L, minimum alkalinity found in Jaipur district water sample was 120 mg/L in Mansagar lake. The maximum range of alkalinity is 476 mg/L in Sitapura zone. According to World Health Organization, the allowable limit for alkalinity is 500 mg/L. All results are expressed in Table 6 (Figure 5)

TABLE 6. ALKALINITY OF WATER SAMPLES.

S. No.	Sample site	Alkalinity(mg/L)
1.	Sitapura	476
2.	Sanganer	325
3.	Mansagar lake	120

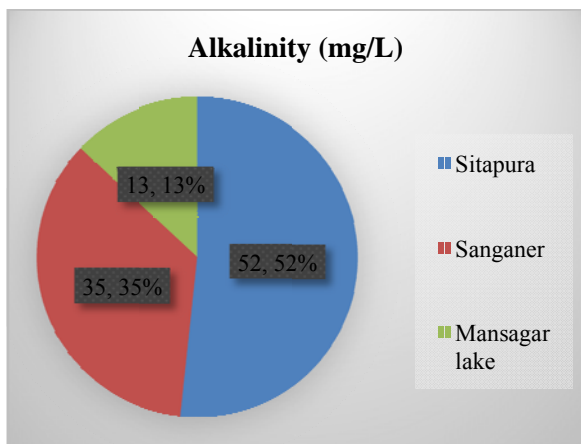


Fig 5: Alkalinity of water samples

3.6 Turbidity

The permissible limit of turbidity by World Health Organization is 5 NTU. Minimum turbidity found in Jaipur

district water sample was 1.24 NTU in Sanganer area and maximum range of turbidity is 1.54 NTU in Mansagar Lake (Table 7, Figure 6).

Table 7: Turbidity of Water Samples.

S.No.	Sample site	Turbidity (NTU)
1.	Sitapura	1.34
2.	Sanganer	1.24
3.	Mansagar lake	1.54

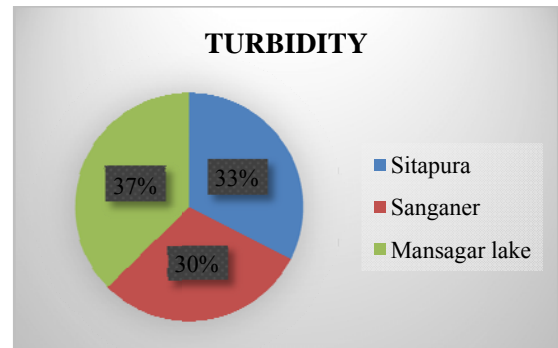


Fig 6: Turbidity of water samples

3.7 Comparative Analysis

All the results of various physio-chemical parameters were matched with the permissible limit prescribed by World Health Organization. All results are presented in Table 8.

Table 8: Comparative Analysis of Water Samples.

S. No	Parameter	Sitapura	Sanganer	Mansagar lake	Permissible limit by WHO
1.	pH	7.78	7.74	7.54	7-8.5
2.	TDS (mg/L)	409.5	845	715	500
3.	Conductivity (µmho/cm)	1428	1289	500	750
4.	Hardness (mg/L)	250	285	370	500
5.	Alkalinity (mg/L)	476	325	120	200
6.	Turbidity (NTU)	1.34	1.24	1.54	<5.0

4. CONCLUSION

Various physio-chemical parameters were studied in different samples of underground water. High conductivity was observed which indicates presence of minerals in earth crust in Sanganer and Sitapura zone. This data may be helpful for future purpose of water use whether for industrial commitments of domestic purposes.

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