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ASSESSMENT OF THE QUALITY OF TAP DRINKING WATER IN VARIOUS AREAS OF RAJASTHAN, INDIA

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Abstract - *This study was carried out to analyze the quality of tap water available in public utility areas and determine its contaminants and compared with the Indian drinking water quality specifications IS-10500-2012. The samples were collected from Ajmer, Chittorgarh, Gangrar, Bhilwara, Kota, Bundi and Udaipur. The physico chemical parameters of the samples collected were found to be beyond permissible limits except for pH, sulphate and sodium in all of the stations. . After considering the physico- chemical analyses of the water parameters collected, it is determined that the water available for drinking is not safe and it needs immediate attention.*

Key Words: Physico- chemical, Chittorgarh, Tap water, Nitrate, Public utilities

1.INTRODUCTION

The majority of Indian consumes groundwater which is pumped via hand pumps from bore wells, dug wells and surface water sources such as rivers, streams, ponds and lake. Although 86 percent has access to safe drinking water according to census but it seems exaggerated that the census consider tube wells and hand pumps safe. Whereas, studies have evidence that they are mostly the medium of waterborne diseases.

Due to the release of highly untreated industrial and pharmaceutical waste into the surface water sources it becomes polluted with contaminants, making it unfit to consume. Most people in India consume water after it boils as it tends to kill bacteria but in urban areas with highly dense population it makes even a harder approach to do that and moreover people prefer to drink directly from tap which are very less likely treated or filtered. According to 2011 census of safe drinking water it states that only 32% of India's households have access to treat tap water supplied through pipelines and around 11.5% gets untreated tap water. Out of the 32% getting treated tap water, there's evidence that the water gets contaminated due to pipe leakage.

This thesis, explores the quality of tap water available to public in public utility areas, with respect to its presence of minerals, contaminations and other properties from different areas in Rajasthan district. Thus, on the basis of evidence from the analyses, this thesis demonstrates the quality of tap water available for consumption.

1.1 Significance of the study

People throughout the country suffer from water borne diseases and either through water contamination or through unhygienic usage of water. India as a country suffers great losses in economy as well as work force due to the absence of people which gets caught up in the cycle of suffering from water borne diseases. The supply of pure and safe drinking water is inadequate in the town areas and almost non-existent in the rural areas. Again, due to chemical and bacteriological contamination of tap water either due pipe leakage or pollution near water catchment areas affects a large number of people thus leading people to take different alternatives such as buying and consuming bottled water. People take different routes such as buying filters and purifiers.

2. Literature Review

It has been said that presence of contamination of water tends to affect the odour, colour, appearance or taste can be evaluated by anyone, which is not entirely true. In order to find the quality of the water it needs to go several tests and water cannot be said safe if it is not been through tests that determines the safety of the water. Therefore, considering the above facts it's really important to monitor the quality and test of tap water that people consume.

A number of works has been carried out on the subject surrounding on tap water around the world and India. It has been a major concern on the safety of drinking water and its causes to human health. Therefore, this study of literature provides the information and provides helps in similar study in future. Few studies related to the present study have studied and their abstract has been provided though it has not been fully illustrated.

According to Bureau of Indian Standard, (2019), a sample test was carried out from 21 major cities of India, in which 15 cities failed to meet the safety parameters of tap drinking water by one or more. Among the cities, Mumbai was found to be the safest and Delhi the worst among the 21 cities. When the test was carried out, total dissolve solids (TDS), turbidity, total hardness, total alkalinity, minerals, metals and presence of E Coli and coliform were found. These parameters can cause severe illness to human health and proper measures should be taken. One of the researchers

stated that the water supply of those areas cannot be stopped as it will create huge problems to the residents of the areas, so he suggested that proper effort should be done to keep the tap water as safe as possible.

Prajapati Dipak et al., (2018) studied the quality of tap water of selected cities in Ahmedabad city, assessing its chemical and physical parameters and it was all within the permissible limit and it was found potable for drinking. In this study, the physical and chemical analysis of 10 station samples were done in which parameters such as pH, Turbidity, TDS, TO, Total Hardness, TS, Chlorine, Fluoride concentration and microbiological analysis were included. All of the parameters were within the maximum permissible limit of WHO but there were some differences in TS, Chloride, Hardness and Fluoride. There was no form of coliform contamination present in the water and found to be potable.

Sanjay R Singh et al., (2015) studied the quality of tap drinking water in Visakhapatnam which was available in public utilities and it was found to be of poor quality and highly contaminated. In this study, the parameters of pH, TDS, chlorides and E. coli count were analysed using standard methods from six sample stations which were highly populated utility areas. The physical chemical and microbiological analyse was carried out in this study. The parameters such as TDS, Chloride, pH were found within the permissible limit as specified by BIS 105000. But out of the six samples, four of them with high E Coli count d found to be contaminated. The two samples were also found to be very poor quality and unfit for drinking.

3. Methods and materials

3.1 Methodology

3.1.1. Collection and storage of samples.

Water samples were collected in pre-cleaned polythene containers. The containers were pre-washed with chromic acid, rinsed in distilled water several times and dried before use. When Physico-chemical analysis was carried out, polythene bottles were used for sampling or storage. After collection of water sample, it was processed within one hour, in case of delay, the sample should be stored below 10°C and must be analyzed and processed within. Storage and preservation of the samples were done following standard procedures (APHA, 1998). Parameters like pH and temperature were done immediately after the collection of the samples. The containers were filled and tightly stoppered to avoid contact with air or prevent agitation during transportation.

3.1.2. Sampling sources.

Samples were collected from tap drinking water available to public for drinking and the area which were closely located near my university. The samples were collected from some selected areas of Rajasthan state such as Chittorgarh, Bhilwara, Kota, Gangrar, Udaipur, Bundi and Ajmer.

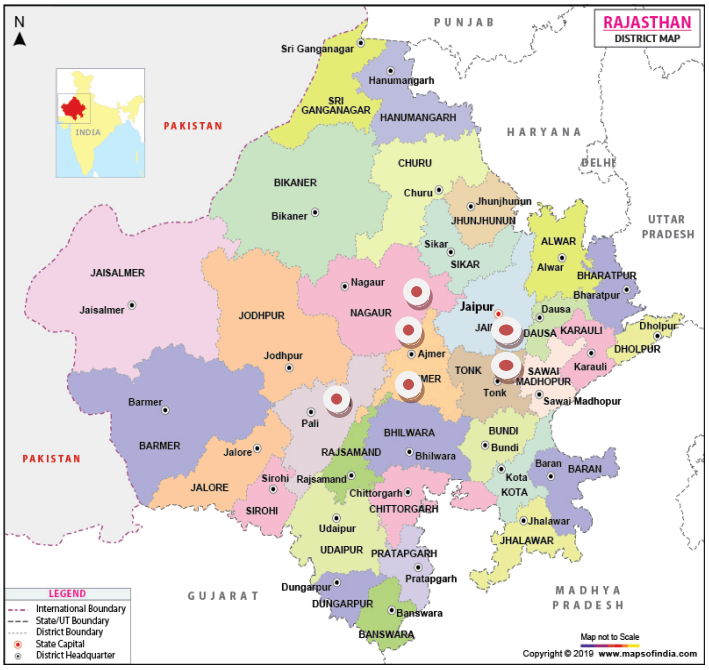

Fig 3.1.a Locations of the sample stations in Rajasthan state

4. RESULTS AND DISCUSSION

4.1. Results

Quality water is vital to the social, health and economic well-being of the prairies and its people. Although we as humans recognize this fact, we disregard it by polluting our rivers, lakes and oceans. Every effort should be made to achieve drinking water quality as safe as practicable. The lack of a source of clean drinking water is arising public health concern worldwide. Waterborne diseases are a consequence. Rapid increases in population over the past century have aggravated the pressure on existing water resources. A critical step in assuring the quality of drinking water resources is to identify the cause of current or potential contamination problems. The quality of potable drinking water has been a major issue in the developing nations for the last few decades. India is currently facing critical water supply and drinking water quality problems. Water supplies in India are no longer unlimited. In many parts of the country, water supplies are threatened by contamination and future water supplies are uncertain. The maximum minimum and average values of parameters for drinking water are given below in table in which some exceeds the permissible limits.

Table No 4.1.1: The maximum minimum and average values of parameters of the drinking water samples.

Parameters	Maximum	Minimum	Average
Temperature	-	-	-
pH	8.52	3.05	6.87
TDS(ppm)	2000	186	1286
Hardness(mg/l)	600	70	400
Calcium(mg/l)	440	28	160
Magnesium(mg/l)	993	63	360
Chromium(mg/l)	0.15	0.132	0.13
Iron(ppm)	0.34	0.22	0.24
Nitrate(ppm)	255	7.86	82.3
Fluoride(ppm)	5.12	0	0.61
Sulphate(ppm)	1.147	0.38	0.58
Sodium(ppm)	9.3	0.58	4.13
Potassium(ppm)	19.2	0.67	4.18

The Physico-chemical characteristics of water from 7 sampling stations from some of the main district of Rajasthan state, India was analyzed in order to assess their potability.

Table No 4.1.2: Data of different parameters collected from the water samples.

Parameters	CH	GA	BH	UD	BU	KO	AJ
Temperature ℃	31	30	31	28	28	31	30
pH	7.9	8	7.31	6.05	7.25	7.36	7.30
TDS(ppm)	1560	820	542	343	1122	480	540
Hardness(mg/l)	781	610	534	150	593	272	535
Calcium(mg/l)	442	344	215	61	234	107	215
Magnesium(mg/l)	995	550	482	136	530	245	480
Chromium(mg/l)	0.139	0.120	0.129	0.136	0.143	0.143	0.130
Iron(ppm)	0.233	0.232	0.213	0.260	0.260	0.232	0.235
Nitrate(ppm)	92.3	103	30	11.7	148	20.6	27
Fluoride(ppm)	0	0	0	0	0	0	0
Sulphate(ppm)	0.233	0.248	0.510	0.5	0.5	0.5	0.507
Sodium(ppm)	3.1	2	2.3	0.97	2.7	0.97	2.2
Potassium(ppm)	3.7	3.5	13.3	3.1	6.6	3.1	18.6

CH= CHITTORGARH

GA= GANGRAR

BH= BHILWARA

UD= UDAIPUR

BU= BUNDI

KO= KOTA

AJ= AJMER

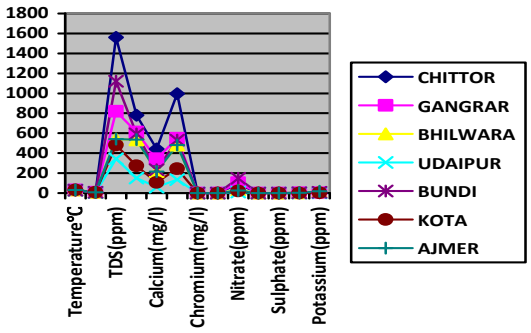

Fig. 4.1.a Graphical data representation of each sample station and its parameters.

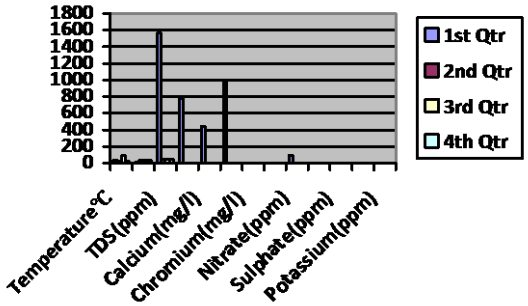

Fig.4.2.b Variation of parameters collected from Chittorgarh.

4.2. Discussion

Results mentioned above in the table and charts shows the collective parameters obtained after examining the samples of tap water collected from each sites.

Temperature

Temperature influences physical, chemical and biological qualities of water. In the present investigation water temperature lies between 28-31°C.

pH

It is important to monitor the pH of drinking water for several reasons. When a water source has a low pH, it is likely that there are other harmful contaminants in the water. As the pH decreases and the acidity increases, fewer and fewer organisms can survive. Acidic water is synergistic, which means that a combination of a low pH and an increased concentration of certain substances is far more harmful than the sum of the parts. Acidic water can also cause problems for human consumption. While slightly acidic water is not dangerous, on its own, it can be quite dangerous when combined with other compounds. In the present study the pH values in all seven samples range from 6.05 to 8, which are all within the permissible limit.

Total Dissolved Solid

TDS stands for total dissolved solids, and represents the total concentration of dissolved substances in water. TDS is made up of inorganic salts, as well as a small amount of organic matter. According to the Bureau of Indian Standards on drinking water desirable limit of TDS is 500 mg/l, but in stations like Bhilwara, Udaipur, Kota and Ajmer the TDS level is very low which indicates that certain minerals might be lacking.

Hardness

The hardness of water is determined primarily by the amount of calcium and magnesium it contains. Higher levels of these and other minerals make water hard. Water softening systems work by reducing the concentrations of minerals from the water. Instead of having higher levels of calcium and magnesium, soft water tends to have higher concentrations of sodium, or salt. In the present study, hardness of water in Chittorgarh, Gangrar were found to exceed the permissible limits. Bhilwara, Bundi and Ajmer were also found to be quite high. Although hardness in larger scale might cause problems but hard water is not a health hazard and according to The National Academy of Sciences states that drinking hard water contributes to the dietary need for calcium and magnesium.

Calcium

Calcium is an important determinant of water harness, and it also functions as a pH stabilizer, because of its buffering qualities and Calcium also gives water a better taste. Calcium is largely responsible for water hardness, and may negatively influence toxicity of other compounds and other elements such as copper, lead and zinc are much more toxic in soft water. In stations like Kota and Udaipur the calcium levels are low and stations like Gangrar, the calcium level is high but in Chittorgarh, the calcium presence is very high which exceeds the permissible limits and can cause various health problems.

Magnesium

It is a dietary mineral for humans, one of the micro elements that are responsible for membrane function, nerve stimulant transmission, muscle contraction, protein construction and DNA replication and is an ingredient of many enzymes. Magnesium and calcium often perform the same functions within the human body and are generally antagonistic. The present study shows that the presence of magnesium is very high in Chittorgarh and quite high in stations like Gangrar and Bundi.

Chromium

Chromium is an odourless and tasteless metallic element. Chromium is found naturally in rocks, plants, soil and volcanic dust, and animals. EPA has a drinking water standard of 0.1 milligrams per liter (mg/l) or 100 parts per billion (ppb) for total chromium. This includes all forms of chromium, including chromium-6. Water systems are required to test for total chromium. The chromium level is high in all the stations and it exceeds the permissible limits so it should be treated carefully before consuming to avoid health problems.

Iron

Iron is found at concentrations greater than 10 milligrams per liter (mg/L) or 10 parts per million. As little as 0.3 mg/l of iron in water can cause water to turn a reddish brown color. Iron is mainly present in water in two forms: either the soluble ferrous iron or the insoluble ferric iron. Water containing ferrous iron is clear and colorless because the iron is completely dissolved. When exposed to air in the pressure tank or atmosphere, the water turns cloudy and a reddish brown substance begins to form. This sediment is the oxidized or ferric form of iron that will not dissolve in water. This study shows that the iron present in the water is below desirable levels in all the stations and it needs to be monitored as it is not hazardous to health but it is considered a secondary or aesthetic contaminant and essential for good health as it helps transport oxygen in the blood.

Nitrate

Nitrate (NO 3) is a compound of nitrogen and oxygen found in nature and in many food items in our diet and the concentration of nitrates in the ground water is low. The main adult human intake of nitrates is from food rather than from water. Vegetables contain significant amounts of nitrate and drinking water normally contributes only a small percentage of our total nitrate intake. Low levels of nitrates may occur naturally in water, sometimes higher levels, which are potentially dangerous to infants High nitrate levels in drinking water pose a health risk to infants because they may cause methemologlobinemia, a condition known as

the blue baby syndrome. Nitrate becomes toxic when it is reduced to nitrite, a process that can occur in the stomach as well as in the saliva. Bundi, Gangrar, Chittorgarh have high levels of nitrate and it should be monitored in order to prevent health problems and risks.

Fluoride

Drinking fluoridated water keeps teeth strong and reduces cavities (also called tooth decay) by about 25% in children and adults. Most water contains some fluoride but usually not enough to prevent cavities. Community water systems can add just the right amount of fluoride to local drinking water to prevent cavities. The Environmental Protection Agency (EPA) has set a maximum amount of fluoride allowable in drinking water of 4.0 mg/L because long-term exposure to levels higher than this can cause a condition called skeletal fluorosis, in which fluoride builds up in the bones. None of the stations showed any levels of fluoride while studying the samples.

Sulphate

Sulfate (SO4) can be found in almost all natural water. The origin of most sulfate compounds is the oxidation of sulfite ores, the presence of shales, or the industrial wastes. It is one of the major dissolved components of rain. When a high concentration of sulphate is present in the water we drink, it can have a laxative effect when combined with calcium and magnesium, the two most common constituents of hardness. Bacteria, which attack and reduce sulfates, form hydrogen sulfide gas (H2S). After analysing the samples, it was found to be within the permissible limits in all the stations.

Sodium

Sodium is essential for normal functioning of the human body. It can be found in all body tissues and fluids, and it is not generally considered harmful at normal levels of intake from combined food and drinking water sources. It is essential to monitor the sodium level because if the level is high, one might experience things like confusion, drowsiness, and headachesand can also result in hypertension (High Blood Pressure) and bradycardia (Low Heart Rate) if the pressure increases and it is also the electrolyte most affected by over hydration, leading to a condition called hyponatremia. In the studied carried out, it was found to be within the permissible limits.

Potassium

Potassium shortages are relatively rare, but may lead to depression, muscle weakness, heart rhythm disorder and confusion. Potassium loss may be a consequence of chronic diarrhoea or kidney disease, because the physical potassium balance is regulated by the kidneys. When kidneys operate insufficiently, potassium intake must be limited to prevent greater losses. The potassium levels in Ajmer and Bhilwara was high but the rest of the stations were within permissible limits.

5. Conclusion

Due to the increase in industries and growth in population, the water available have been badly affected and it leads to critical aspects of health concerns as well as environmental impacts. It should be studied and proper measures should be taken in order to avoid further problems in our near future. In this present study the tap water available for drinking on public facilities such as shops, restaurants, bus stations and railway stations which were located on the various areas of Rajasthan state, the water available to public was found to be above the permissible limits and some below the desirable limits. According to the standards specifications of WHO and ISI, parameters such as hardness, calcium, nitrate, potassium and chromium of the water samples were found to be exceeding the permissible limit and parameters such as iron, TDS and fluoride were below the desirable limit and should be monitored to prevent health problems. Since the water has been processed and available for drinking, the BOD and DO quality of the water samples were neglected. The physico- chemical parameters of the tap drinking water available to the public in these areas were found to be contaminated and unsafe for drinking. Proper measures should be taken and the water should be treated properly from the source as thousands people drinks the water on a daily basis and it can lead to various health problems. Contaminants on the pipeline or leakage can also lead to contamination of the water so it should be monitored accordingly.

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