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Physicochemical Characterization and Quality Assessment of Tap Water, Borewell Water and Pond Water arom Baramati Tehsil

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Abstract
This study examined the water quality of tap water, pond water, and bore well water in the Baramati region. Significant variations were observed across the three sources for parameters including alkalinity, hardness, dissolved oxygen and carbon dioxide, pH, colour, temperature, chloride, and salinity. Pond water exhibited the highest alkalinity and hardness, while tap water showed the highest dissolved oxygen. Bore well water presented the highest carbon dioxide and salinity levels. The pH across all samples was slightly alkaline. These findings highlight the diverse water quality characteristics of different water sources within the same geographical area, underscoring the importance of source-specific water quality assessment for various applications and for ensuring the health of aquatic ecosystems and human populations.

Keywords: Water quality, Water quality assessment, Comparative study, Aquatic ecosystems, Drinking water quality.

Introduction

Water, a fundamental necessity for life, constitutes approximately 70% of our planet and plays a crucial role in supporting human survival. It is indispensable for various aspects of our environment, economy, and society, including agriculture, industry, and domestic use. In Marathi and Sanskrit, water is respectfully referred to as "Jeevan," highlighting its vital life-sustaining properties. However, we face significant challenges related to water resources, such as overuse, pollution, drought, and scarcity. Recognizing these issues, governments have initiated several actions aimed at water conservation.

Water exists in three states: solid, liquid, and gas, and it performs essential functions within our bodies. These include maintaining body temperature, regulating bodily functions, and transporting nutrients to cells. Our survival depends on water; we cannot live without it. Consuming purified water is crucial for maintaining good health. It aids in proper bodily functions, tissue and organ cleansing, promoting healthy metabolism, efficient skin function, and detoxification. Furthermore, water is extensively used in agriculture. It is arguably the most significant chemical compound in human experience and a fundamental necessity. (Harvey, A. H., & Friend, D. G. (2004). Physical properties of water. In Aqueous systems at elevated temperatures and pressures (pp. 1-27). Academic Press.)

Sources of Water Pollution: Water pollution is not confined to the surface; it extends to oceans, seas, and groundwater. Presently, water pollution poses a significant global problem. It arises from various sources, notably the discharge of waste from households and industrial facilities. Human activities, such as improper garbage disposal and the throwing of various materials into water bodies, contribute significantly to this pollution. Additionally, human actions like washing clothes and releasing animal waste contaminate water sources. Water pollution can originate from agricultural practices, where chemical release pollutes water bodies. A major cause of drinking water pollution is industrialization. As populations increase, more people pollute drinking water sources, leading to increased illness and mortality. (Chaudhry, F. N., & Malik, M. F. (2017). Factors affecting water pollution: a review. *J. Ecosyst. Ecography*, *7*(1), 225-231.)

Need for Quality Assessment: The contamination of drinking water has numerous adverse effects, causing severe waterborne diseases. Therefore, regular checks on water quality are essential for domestic purposes. Clean water is also vital in fisheries, livestock production, forestry, hydropower generation, and other activities. More than 70% of the freshwater in liquid form within our country is utilized for irrigation, often without proper accounting for its impact. (Dwivedi, A. K. (2017). Researches in water pollution: A review. *International Research Journal of Natural and Applied Sciences*, *4*(1), 118-142.)

Physico-chemical Parameters of Any Need for Quality Assessment: Water is arguably the most crucial chemical compound for human existence and the most necessary resource. (Harvey, A. H., & Friend, D. G. (2004). Physical properties of water. In Aqueous systems at elevated temperatures and pressures (pp. 1-27). Academic Press.) Physical and chemical properties of water are essential considerations for assessing its quality and suitability for various uses.

Methodology

Water sample was collected from 3 different water bodies in 3 different seasons; Tap water was collected from Tuljaram Chaturchand College campus taps, Pond water from the botanical garden of Tuljaram Chaturchand College Baramati, and Bore well water from the surrounding area of Baramati.

Collection: Different sites were visited in the morning between 9:00 AM and 10:00 AM, and water samples were collected using clean, transparent polythene bottles. Immediately after collection, the water sample bottles were labelled.

Laboratory Analysis: Following the collection of water samples, they were transported to the laboratory for further analysis. The analysis was conducted using various parameters.

1. Alkalinity
2. Hardness
3. Dissolved O_2
4. Dissolved CO_2
5. pH
6. Colour
7. Temperature
8. Chloride
9. Salinity

1. Alkalinity

The burette was filled with 0.02 N H_2SO_4. A 25 ml water sample was measured into a conical flask and titrated with the acid solution. Phenolphthalein indicator was added, and the titration continued until the pink colour disappeared, indicating the endpoint for phenolphthalein alkalinity. Methyl orange indicator was then added, and the titration was resumed until the orange colour turned pink, signifying the endpoint for methyl orange alkalinity. The volume of H_2SO_4 used in each step was recorded. This procedure was repeated two more times for accuracy.

2. Hardness

The burette was filled with 0.01 M EDTA. A 25 ml water sample was measured into a conical flask, and 1 ml of ammonia buffer and 200 mg of Eriochrome Black T indicator were added, resulting in a wine-red colour. The sample was titrated against the EDTA solution until the colour changed to blue, indicating the endpoint. The volume of EDTA used was recorded, and the procedure was repeated two more times.

3. Dissolved O_2

The stoppered bottles were shaken to thoroughly mix the contents. After allowing the precipitate to settle, concentrated H_2SO_4 was added dropwise to dissolve it completely. A 25 ml aliquot of the clear solution was then taken, and 3-4 drops of starch solution were added as an indicator. The solution was titrated against sodium thiosulfate until the initial dark brown colour disappeared. This procedure was repeated two more times to ensure accurate results.

4. Dissolved CO_2

The burette was filled with 0.05 N NaOH. A 100 ml water sample was measured into a conical flask. A few drops of phenolphthalein indicator were added. If the sample turned pink, free CO_2 was absent. If the sample remained colourless, it was titrated against 0.05 N NaOH until a faint pink colour appeared, indicating the endpoint. The volume of NaOH used was recorded. This procedure was repeated two more times for accuracy.

5. pH

The pH of water is measured using a pH meter. This is an electronic device that measures the pH of a solution by detecting the concentration of hydrogen ions. It functions through a probe that is immersed in the solution and measures the voltage difference between the probe and a reference electrode. This voltage difference is proportional to the pH of the solution.

6. Colour

Pure water is colourless and transparent. The colour of water can vary depending on factors such as sediments, algae, and other dissolved substances. Water can appear blue, green, brown, gray, or other colours.

7. Temperature

Temperature is measured using a thermometer. The location and state of the water influence its temperature. A mercury thermometer is typically used. Mercury thermometers are traditional instruments that utilize mercury as the temperature-sensing element. Changes in temperature cause the mercury column to rise or fall.

8. Estimation of Chloride

The burette was filled with 0.0141 N silver nitrate. A 25 ml water sample was measured into a conical flask. A few drops of potassium chromate indicator solution were added. The sample was titrated against the 0.0141 N silver nitrate solution until the colour changed to a reddish-brown precipitate, indicating the endpoint. The volume of 0.0141 N silver nitrate used was recorded, and the procedure was repeated two more times.

9. Salinity

The burette was filled with 0.05 N silver nitrate. A 10 ml water sample was measured into a conical flask. A few drops of potassium chromate indicator solution were added. The sample was titrated against the 0.05 N silver nitrate solution until the colour changed to brick red, indicating the endpoint. The volume of 0.05 N silver nitrate used was recorded, and the procedure was repeated two more times.

Observations and Results

The comparison study assessed nine parameters in three water samples: tap water, pond water, and bore well water.

Results of parameters of water samples

Parameters	Water samples	Result
Alkalinity	Tap water	284 mg/lit
	Bore well water	272 mg/lit
	Pond water	236 mg/lit
Hardness	Tap water	188 mg/lit
	Bore well water	552 mg/lit
	Pond water	308 mg /lit
Dissolved Oxygen	Tap water	10.4 mg/lit
	Bore well water	9.6 mg/lit
	Pond water	12 mg/lit
Dissolve carbon dioxide	Tap water	22 mg/lit
	Bore well water	72 mg/lit
	Pond water	33 mg/lit
pH	Tap water	7.168
	Bore well water	7.434
	Pond water	7.314
Colour	Tap water	Transparent
	Bore well	Transparent
	Pond water	Greenish
Temperature	Tap water	28 Celsius
	Bore well water	29 Celsius
	Pond water	29 Celsius
Chlorides	Tap water	87.97 mg/lit

	Bore well water	211.93 mg/lit
	Pond water	86.57mg/lit
Salinity	Tap water	0.037 ppt
	Bore well water	0.092 ppt
	Pond water	0.045 ppt

Conclusion

- **Hardness Variation:** The significantly higher hardness in the bore well water suggests a greater interaction with geological formations rich in calcium and magnesium ions compared to the other sources. This could have implications for its suitability for certain uses (e.g., laundry, industrial processes).
- **Dissolved Oxygen and Pond Water Quality:** The higher dissolved oxygen in the pond water might be attributed to photosynthetic activity by algae and aquatic plants. However, the greenish color also suggests the presence of algae, which could lead to fluctuations in DO levels throughout the day and potential eutrophication issues.
- **Elevated Dissolved Carbon Dioxide in Bore Well Water:** The high dissolved carbon dioxide in the bore well water could be due to microbial respiration in the subsurface or dissolution of carbonate rocks. This can influence the pH and potentially the solubility of other minerals.
- **Chloride and Salinity in Bore Well Water:** The elevated levels of chlorides and salinity in the bore well water might indicate contamination from natural sources (e.g., saline aquifers) or anthropogenic activities (e.g., agricultural runoff, sewage). This could impact its potability and suitability for irrigation.
- **General Water Quality:** While all samples are slightly alkaline, the variations in other parameters like hardness, DO, CO_2, chlorides, and salinity highlight differences in the overall water quality of the three sources. Tap water appears to have the best overall quality based on the parameters measured.

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