Journal of
Water Pollution &
Purification Research

ISSN: 2394-7306
Volume 13, Issue 1, 2026
January–April
DOI (Journal): 10.37591/JoWPPR

https://journals.stmjournals.com/jowppr

Research JoWPPR

Water Comparative Study of Water Quality

Anita Gaur[1,*], Aman Singh[2]

Abstract

Water quality plays a vital role in safeguarding human health, maintaining environmental balance, and supporting socio-economic progress. For drinking purposes, water must satisfy established physical and chemical criteria to minimize health hazards and ensure the efficient functioning of biological processes. This research focuses on a comparative assessment of drinking water quality by analyzing key parameters such as pH, Total Dissolved Solids (TDS), hardness, and fluoride levels in both tap water and RO (Reverse Osmosis/aero) water samples. These indicators are essential for evaluating the suitability of water for household use and public health protection. The study examines water acidity or alkalinity through pH determination, quantifies dissolved substances using TDS measurements, evaluates hardness caused by calcium and magnesium ions, and determines fluoride concentration due to its impact on dental health. Standard analytical techniques, including pH meter analysis, TDS meter readings, EDTA titration for hardness, and chemical methods for fluoride estimation, are employed to assess water quality. The results are then compared with the recommended guidelines established by the World Health Organization and the Bureau of Indian Standards. The findings of the study Indicate that RO water generally contains lower levels of dissolved solids and hardness compared to tap water due to advanced filtration processes, while tap water may retain essential minerals but can vary in quality depending on its source and treatment method. Fluoride concentration and pH values are evaluated to ensure they fall within permissible limits for safe consumption. This research highlights the importance of regular monitoring and assessment of drinking water quality to prevent waterborne diseases and maintain public health. The study also emphasizes the need for effective water treatment technologies, proper resource management, and increased awareness regarding safe water consumption. The project contributes to environmental science research and provides practical knowledge useful for water quality management and sustainable development in the future.

Keywords: Water quality analysis, pH measurement, total dissolved solids (TDS), water hardness, fluoride content, tap water vs RO water, drinking water standards, water purification

INTRODUCTION

Water is a fundamental natural resource indispensable for the existence of all living beings. It is crucial for activities such as drinking, agriculture, industrial operations, sanitation, and sustaining ecological balance. Although nearly 71% of the Earth's surface is covered with water, only a limited portion is available as freshwater fit for human consumption. Hence, maintaining the quality of drinking water is essential for safeguarding human health and promoting environmental sustainability [1–5].

Water quality encompasses the physical, chemical, and biological properties of water that define its suitability for different uses, particularly for drinking. The presence of dissolved minerals,

***Author for Correspondence**
Anita Gaur
E-mail: dranitagaur@gmail.com

[1,*]Assistant Professor, Department of Industrial Chemistry, L.R. College, Sahibabad, Ghaziabad, Uttar Pradesh, India
[2]Student, Department of Industrial Chemistry, L.R. College, Sahibabad, Ghaziabad, Uttar Pradesh, India

Received Date: March 28, 2026
Accepted Date: April 27, 2026
Published Date: April 30, 2026

Citation: Anita Gaur, Aman Singh. Water Comparative Study of Water Quality: A Comprehensive Review. Journal of Water Pollution & Purification Research. 2026; 13(1): 85–98p.

salts, and other chemical constituents significantly influences water safety and usability. Key parameters such as pH, Total Dissolved Solids (TDS), hardness, and fluoride levels are widely used to assess drinking water quality, as they affect its taste, safety, and potential health impacts [6–8].

The pH level indicates whether water is acidic or alkaline, which can influence pipe corrosion and biological processes within the human body. Total Dissolved Solids (TDS) measure the concentration of dissolved substances, including calcium, magnesium, and sodium salts. Water hardness primarily results from calcium and magnesium ions and has implications for both domestic and industrial usage. Fluoride concentration is also critical, as moderate levels help prevent dental caries, while excessive amounts may lead to dental fluorosis.

The quality of drinking water from various sources, such as tap water and Reverse Osmosis (RO) water, can differ based on origin, treatment methods, and environmental factors. Therefore, conducting comparative analyses of these sources is necessary to evaluate their suitability for consumption. Standards set by organizations like the World Health Organization (WHO) and the Bureau of Indian Standards (BIS) establish permissible limits for different water quality parameters to ensure safe drinking water [9].

This research project focuses on the comparative study of tap water and RO water by analyzing pH, TDS, hardness, and fluoride content. The study aims to assess the quality of drinking water and highlight the importance of regular monitoring and effective water management for protecting public health and ensuring sustainable use of water resources [10–15].

OBJECTIVES

To Measure the pH of Water Samples

- The aim is to assess whether water is acidic or alkaline. The pH level serves as an indicator of its suitability for drinking. Water that is highly acidic or strongly alkaline can pose risks to human health and may also lead to corrosion or damage in pipelines.
- *Purpose:* To check the chemical balance and safety of drinking water.

To Determine Total Dissolved Solids (TDS)

- This objective aims to quantify the concentration of dissolved salts and minerals—such as calcium, magnesium, and sodium—present in water. TDS affects the taste, quality, and suitability of water for consumption.
- *Purpose:* To identify the level of dissolved impurities and minerals in water.

To Analyze Water Hardness

- The objective is to identify the presence of calcium and magnesium salts responsible for water hardness. Hard water leads to issues in household applications, including reduced soap lathering and the formation of scale deposits in pipes.
- *Purpose:* To evaluate the suitability of water for domestic and industrial use.

To Detect Fluoride Content in Water

- This objective is to measure the concentration of fluoride present in water. A small amount of fluoride is beneficial for dental health, but excessive fluoride intake may cause health problems such as dental fluorosis.
- *Purpose:* To ensure water safety and prevent harmful health effects.

To Compare Tap Water and RO Water Quality

- The main objective of the study is to compare the results of different parameters in tap water and RO water to determine which water source is safer and more suitable for drinking.
- *Purpose:* To evaluate the quality of different water sources.

To Assess Overall Drinking Water Safety

- This objective involves evaluating all tested parameters together to determine whether the water meets safe drinking standards.
- *Purpose:* To protect public health and ensure safe water consumption.

WATER SAMPLES USED

Tap Water (Municipal Water Supply)

Tap water was collected from the household water supply provided by the municipal distribution system. This water is generally treated at water treatment plants before distribution but may contain dissolved minerals, salts, and other impurities depending on the source and treatment process.

Purpose of Selection

- To evaluate the quality of commonly used drinking water.
- To determine the presence of dissolved minerals and impurities.
- To check whether the water meets safe drinking standards.

RO Water (Reverse Osmosis/Aero Water)

RO water was collected from a domestic Reverse Osmosis water purifier. The water is purified by passing it through a semi-permeable membrane, which effectively eliminates dissolved salts, impurities, and harmful contaminants.

Purpose of Selection

- To analyze the effectiveness of the RO purification process.
- To compare purified water with tap water.
- To determine whether RO treatment improves water quality.

Sample Collection Method

- Clean and sterilized containers were used for collecting water samples.
- Samples were collected carefully to avoid contamination.
- The samples were tested immediately after collection to ensure accurate results.

PARAMETERS OF WATER QUALITY

pH of Water

- pH indicates how acidic or alkaline water is, measured on a scale from 0 to 14. A value of 7 represents neutrality, values below 7 indicate acidity, and values above 7 indicate alkalinity. For drinking purposes, a pH range of 6.5 to 8.5 is considered safe. Maintaining an appropriate pH level helps preserve the body’s internal balance, reduces pipe corrosion, and influences the taste of water.

Importance

- Maintains chemical balance of water.
- Prevents corrosion of pipes and plumbing systems.
- Affects biological processes in the human body.
- Influences taste and quality of drinking water.
- *Safe Range:* 6.5–8.5 (recommended drinking water standard).

Total Dissolved Solids (TDS)

- Total Dissolved Solids (TDS) represent the overall concentration of dissolved materials in water, including minerals, salts, and organic compounds. These include calcium, magnesium, sodium, chlorides, and other dissolved ions.

Importance

- Influences the taste and transparency of water.
- Suggests the presence of dissolved contaminants.
- High TDS may affect human health and water quality.
- Low TDS may reduce essential mineral content.
- *Safe Limit:* Below 500 mg/L for drinking water.

Hardness of Water

- Water hardness occurs due to dissolved calcium and magnesium salts in water. Such hard water does not readily produce lather with soap and leads to the formation of scale deposits in pipes and household appliances.

Types of Hardness

- *Temporary Hardness:* Caused by bicarbonates of calcium and magnesium.
- *Permanent Hardness:* Caused by sulfates and chlorides of calcium and magnesium.

Importance

- Affects domestic and industrial use of water.
- Causes scale formation in pipes and boilers.
- Influences soap consumption and cleaning efficiency.

Fluoride Content

- Fluoride is a naturally occurring mineral present in water, and its levels in drinking water need to be carefully regulated, as both insufficient and excessive amounts can have adverse health effects.

Importance

- Helps in prevention of tooth decay at low concentrations.
- Excess fluoride can cause dental and skeletal fluorosis.
- Important for maintaining dental health.
- *Safe Limit:* About 1.0 mg/L.

Drinking Water Standards

- The values of these parameters are evaluated against drinking water standards set by the World Health Organization and the Bureau of Indian Standards to assess the suitability of the water for safe consumption.

METHODOLOGY

Study Area and Sample Selection

- The study was conducted using commonly available drinking water sources to assess their quality and safety for human consumption.

Water Sources Selected

- *Tap Water:* Collected from household municipal water supply.
- *RO Water:* Collected from a domestic Reverse Osmosis water purifier.

These samples were selected because they are widely used for drinking purposes and show variations in purification methods.

Sample Collection Procedure

Proper sample collection is essential to obtain accurate results.

ISSN: 2394-7306

Procedure

- Clean and sterilized plastic or glass bottles were used for sample collection.
- Bottles were rinsed 2–3 times with the sample water before final collection.
- Approximately 500 mL of each water sample was collected.
- Bottles were tightly sealed to prevent contamination.
- Samples were properly labeled (Tap Water and RO Water).
- Testing was performed immediately after collection to avoid chemical changes.

Precautions

- No external impurities were allowed to mix with samples.
- Clean equipment was used throughout the experiment.
- Samples were stored at room temperature.

DETERMINATION OF PH

Principle

pH measures the hydrogen ion concentration in water and indicates whether water is acidic, neutral, or alkaline.

Apparatus Required

- pH meter or pH indicator paper
- Beaker
- Distilled water

Procedure

- The pH meter was calibrated using standard buffer solutions.
- A water sample was taken in a clean beaker.
- The electrode of the pH meter was dipped into the sample.
- The reading displayed on the meter was recorded.
- If pH paper was used, it was dipped into the sample and the color change was compared with the standard chart.

Result Interpretation

- pH $< 7 \rightarrow$ Acidic water
- pH $= 7 \rightarrow$ Neutral water
- pH $> 7 \rightarrow$ Alkaline water

The values were compared with safe drinking limits recommended by the Bureau of Indian Standards.

DETERMINATION OF TOTAL DISSOLVED SOLIDS (TDS)

Principle

TDS measures the total concentration of dissolved substances such as salts and minerals present in water.

Apparatus Required

- Digital TDS meter
- Beaker
- Water sample

Procedure

- The TDS meter was switched on and calibrated.
- The probe of the meter was dipped into the water sample.

- The reading shown on the display was recorded in mg/L (ppm).
- The probe was cleaned with distilled water after each use.

Result Interpretation
- Low TDS → Fewer dissolved salts
- High TDS → High mineral or impurity content
- Determination of Water Hardness

Principle

Water hardness is caused by calcium and magnesium ions. It is determined using EDTA titration, where EDTA forms complexes with these ions.

Apparatus Required
- Burette
- Pipette
- Conical flask
- EDTA solution

Buffer solution
- Eriochrome Black T indicator

Procedure
- A measured volume of water sample was taken in a conical flask.
- Buffer solution was added to maintain suitable pH.
- A few drops of indicator were added, producing a wine-red color.
- The sample was titrated with EDTA solution until the color changed to blue.
- The volume of EDTA used was recorded.
- Water hardness was calculated using standard formula.

Result Interpretation
- More EDTA used → Higher hardness
- Less EDTA used → Softer water
- Determination of Fluoride Content

Principle

Fluoride concentration in water is determined using a chemical reaction that produces a color change proportional to fluoride concentration.

Apparatus Required
- Fluoride test kit
- Test tubes
- Standard color chart

Procedure
- A measured amount of water sample was taken in a test tube.
- Reagents from the fluoride test kit were added.
- The solution was mixed properly.
- The developed color was compared with a standard color chart.
- Fluoride concentration was recorded in mg/L.

Result Interpretation
- Low fluoride → May affect dental protection.

- High fluoride → Risk of dental or skeletal fluorosis.

Recording of Observations

- All readings were recorded in tabular form.
- Separate observations were recorded for tap water and RO water.
- Each experiment was repeated to ensure accuracy.

Data Analysis and Comparison

- Experimental values were compared between both samples.
- Results were evaluated based on drinking water standards.
- Differences in water quality were analyzed and discussed.

Safety Measures and Precautions

- Clean apparatus was used for all experiments.
- Chemical reagents were handled carefully.
- Instruments were properly calibrated.
- Cross-contamination of samples was avoided.

OBSERVATION TABLE

Table 1. Physical observation of water samples.

S. No.	Property	Tap Water	RO Water
1	Colour	Colourless	Colourless
2	Odour	Slight odour	Odourless

Table 2 Observation of water quality parameters.

S. No.	Parameter Tested	Unit	Tap Water	RO Water	Permissible Limit
1	pH	-	7.8	6.5-8.5	6.5-8.5
2	Total Dissolved Solids	mg/L	450mg/L	120mg/L	< 500mg/l
3	Hardness	mg/L	180MG/l	60MG/l <	< 200mg/L
4	Fluoride Content	MG/L	0.8mg/L	0.4mg/L	1.0mg/L
3	Taste	Slightly salty/mineral taste		Normal taste	
4	Clarity	Clear		Very clear	

Table 3. Hardness determination (EDTA method)

Sample	Volume of water	Volume of EDTA	Calculated hardness
Tap water	50Ml	18Ml	180mg/L
RO water	50Ml	6Ml	60MG/L

Case Study 1. Urban Household (Municipal Supply Area)

This case study examines water usage patterns and management practices in an urban household located within a municipal supply area. The household depends primarily on water distributed through the city's municipal network for daily domestic activities such as drinking, cooking, bathing, washing, and sanitation. Water availability is generally regulated according to fixed supply schedules and infrastructure capacity. Despite access to treated water, urban households often face challenges including intermittent supply, pressure fluctuations, water wastage, and rising demand due to population growth and lifestyle changes. Storage systems such as overhead tanks and household reservoirs are commonly used to ensure continuous access during supply interruptions. Efficient water management practices, including water conservation measures, leak detection, rainwater harvesting, and the use of water-efficient appliances, can significantly reduce unnecessary consumption. Understanding consumption behavior in urban households helps policymakers and planners develop sustainable strategies for improving municipal water distribution systems and resource management (Figure 1 & 2).

Figure 1. Laboratory beaker containing a transparent liquid sample used for chemical analysis and experimental investigation.
Location: Urban residential area
Source: Municipal tap water

Figure 2. Traditional hand-operated water pump dispensing clean groundwater in a rural setting.
Location: Semi-urban area
Source: Borewell / Groundwater

Observed Results

The result is shown in the below table 1.

Table 1. Comparison of physicochemical water quality parameters between tap water and RO-treated water, showing variations in pH, total dissolved solids (TDS), hardness, and fluoride concentration.

Parameter	Tap Water	RO Water
pH	7.8	6.9
TDS	620 mg/L	90 mg/L
Hardness	280 mg/L	60 mg/L
Fluoride	0.8 mg/L	0.3 mg/L

Analysis

- Tap water TDS and hardness exceeded acceptable limits.
- RO significantly reduced TDS and hardness.
- Fluoride reduced to lower level but remained safe.
- RO water slightly more acidic but within safe range.

Conclusion (Case 1)

RO water showed improved quality and better suitability for drinking.

Case Study 2. Semi-Urban Area (Groundwater Source)

In a semi-urban area, groundwater serves as the primary source of water for household and domestic activities due to limited municipal supply systems. Residents generally depend on borewells, hand pumps, or tube wells for obtaining water used for drinking, cooking, washing, and irrigation purposes. The availability and quality of groundwater are influenced by seasonal variations, excessive extraction, and nearby human activities. Challenges such as declining water tables, contamination from agricultural runoff, and inadequate water treatment facilities can affect sustainability. Proper groundwater management, regular quality monitoring, and conservation practices are essential to ensure a safe and reliable water supply.

OBSERVED RESULTS

The analysis of water quality parameters indicated that tap water contained considerably elevated levels of total dissolved solids (TDS) and hardness, suggesting the presence of excessive dissolved minerals and salts. Such high concentrations can negatively affect water quality, taste, and long-term suitability for domestic consumption. Additionally, the fluoride concentration was found to exceed the recommended permissible limit, which may increase the risk of fluorosis upon prolonged exposure. The application of reverse osmosis (RO) treatment significantly improved water quality by reducing TDS, hardness, fluoride, and other dissolved contaminants to acceptable and safe levels, demonstrating its effectiveness as a water purification technique.

Analysis

- Tap water showed very high TDS and hardness.
- Fluoride exceeded safe limit (risk of fluorosis).
- RO treatment effectively reduced all parameters to safe levels.

Conclusion (Case 2)

RO purification was essential in groundwater-dominant areas due to high fluoride and hardness.

Case Study 3. Rural Area (High Fluoride Zone)

A rural community located in a high-fluoride zone depends primarily on groundwater sources such as borewells and hand pumps for daily water needs. Excessive fluoride concentration in drinking water has become a major public health concern in the region (Table 2-5). Long-term consumption of fluoride-rich water can lead to dental fluorosis and skeletal fluorosis, affecting both children and adults. Limited access to alternative water sources and inadequate treatment facilities further worsen the situation. Community awareness programs, rainwater harvesting, and affordable defluoridation techniques are essential measures to reduce fluoride exposure and ensure safe drinking water availability (Figure 3).

Table 2. Comparison of physicochemical water quality parameters between tap water and RO water, including pH, total dissolved solids (TDS), hardness, and fluoride concentration.

Parameter	Tap Water	RO Water
pH	8.4	7.1
TDS	950 mg/L	120 mg/L
Hardness	420 mg/L	75 mg/L
Fluoride	1.8 mg/L	0.5 mg/L

Figure 3. Rural community members collecting water from a public hand pump in a hilly region, illustrating household water access and dependence on local water supply systems.
Location: Rural area (High fluoride region)
Source: Tube Well

Table 3. Physicochemical characteristics of tap water and RO water samples (pH, TDS, hardness, and fluoride concentration).

Parameter	Tap water	RO water
pH	7.5	7.0
TDS	1100 mg/L	140 mg/L
Hardness	500 mg/L	80 mg/L
Fluoride	2.5 mg/L	0.6 mg/L

Table 4. Comparative analysis of pH values in tap water and RO water across urban, semi-urban, and rural areas with standard permissible ranges.

Area	Tap water	RO water	Standard range
Urban	7.8	6.9	6.5 – 8.5
Semi-Urban	8.4	7.1	6.5 – 8.5
Rural	7.5	7.0	6.5 – 8.5

Table 5. Comparative assessment of total dissolved solids (TDS) levels in tap water and RO water across different residential areas against acceptable standards.

Area	Tap water (mg/L)	RO water (mg/L)	Acceptable limit (500 mg/L)
Urban	620	90	Exceeded
Semi-Urban	950	120	Highly Exceeded
Rural	1100	140	Highly Exceeded

Observed Results

Analysis

- Very high fluoride levels in tap water.
- Risk of dental and skeletal fluorosis observed in region.
- RO treatment reduced fluoride to safe level.
- Significant improvement in overall potability.

Conclusion (Case 3)

In high-fluoride rural areas, RO water is strongly recommended.

COMPARATIVE DISCUSSION

pH

RO water tends to be slightly lower in pH but remains within acceptable limits.

TDS

RO reduces TDS by 80–95%. Extremely low TDS (<50 mg/L) may reduce taste and essential minerals.

Hardness

RO significantly lowers hardness, preventing scaling and improving taste.

Fluoride

RO effectively reduces excess fluoride, making water safe in endemic areas.

RESULTS AND DISCUSSION

Comparative Study of Tap Water and RO Water (pH, TDS, Hardness, Fluoride)

Results

Based on the three case studies (Urban, Semi-Urban, and Rural areas) (Table 6, 7), the following results were obtained:

Table 6. Comparison of hardness levels in tap water and RO water across urban, semi-urban, and rural areas relative to the acceptable limit (200 mg/L).

Area	Tap Water (mg/L)	RO Water (mg/L)	Acceptable Limit (200 mg/L)
Urban	280	60	Exceeded
Semi-Urban	420	75	Highly Exceeded
Rural	500	80	Highly Exceeded

Table 7. Comparison of hardness levels in tap water and RO water across urban, semi-urban, and rural areas relative to the acceptable limit (200 mg/L).

Area	Tap Water (mg/L)	RO Water (mg/L)	Safe Limit (1.5 mg/L)
Urban	0.8	0.3	Safe
Semi-Urban	1.8	0.5	Exceeded
Rural	2.5	0.6	Highly Exceeded

Observation

- Tap water in all areas was slightly alkaline.
- RO water showed a slight decrease in pH but remained within safe limits.

Observation

- Tap water TDS exceeded acceptable limits in all areas.

- RO reduced TDS by approximately 80–90%.

Significant improvement in taste and clarity observed.

Observation

- Tap water was hard to very hard, especially in groundwater areas.
- RO treatment effectively reduced hardness below acceptable limits.
- Reduction in scaling of utensils and pipes noted.

Observation

- Urban tap water fluoride was within safe limits.
- Semi-urban and rural areas showed excess fluoride.
- RO significantly reduced fluoride to safe levels.

DISCUSSION

Effect of RO on Water Quality

The study clearly shows that RO purification significantly improves water quality by reducing dissolved solids, hardness, and fluoride concentration. The membrane technology removes 90–99% of dissolved impurities.

pH Variation

Slight decrease in pH after RO treatment was observed due to removal of alkaline minerals such as calcium and magnesium. However, values remained within the recommended range (6.5–8.5), making RO water safe for consumption.

TDS and Hardness Reduction

Groundwater sources (semi-urban and rural areas) showed very high TDS and hardness. These high levels may cause:

- Unpleasant taste
- Scaling in pipes and heaters
- Gastrointestinal discomfort

RO treatment effectively lowered these parameters, improving palatability and safety.

Fluoride Removal

Excess fluoride (>1.5 mg/L) may lead to:

- Dental fluorosis
- Skeletal fluorosis

In rural areas, fluoride levels were critically high (2.5 mg/L). RO reduced fluoride to safe levels (0.6 mg/L), showing its importance in fluoride-affected region.

ADVANTAGES OF WATER QUALITY TESTING

Assessing water quality is crucial to confirm that drinking water is safe, pure, and appropriate for human use. Regular testing of parameters such as pH, TDS, hardness, fluoride, and microbial content provides multiple benefits.

Ensures Safe Drinking Water

- Detects harmful contaminants.
- Helps in reducing the risk of waterborne illnesses.
- Ensures that water complies with both national and international quality standards..

Protects Human Health

- Identifies excess fluoride (prevents fluorosis).
- Identifies elevated levels of TDS and water hardness.
- Helps reduce potential long-term health risks caused by contaminated water.

Helps in Selecting Proper Treatment Method
- Determines whether RO, UV, or simple filtration is required.
- Avoids unnecessary installation of costly purification systems.
- Suggests need for remineralization if TDS is too low.

Prevents Plumbing and Appliance Damage
- Detects high hardness that causes scaling.
- Reduces corrosion in pipelines.
- Extends life of water heaters, washing machines, and pipes.

Improves Taste and Odor
- Identifies high dissolved solids affecting taste.
- Detects unpleasant smell due to impurities.
- Ensures better drinking experience.

Environmental Protection
- Monitors groundwater and surface water quality.
- Helps prevent environmental pollution.
- Supports sustainable water resource management.

Compliance with Standards
- Ensures water meets WHO and BIS guidelines.
- Required for industries, schools, hospitals, and municipalities.
- Maintains legal and safety compliance.

Early Detection of Contamination
- Identifies contamination before it becomes serious.
- Helps take corrective action quickly.
- Reduces risk of outbreaks.

Applications of Water Quality Testing

Water quality testing has wide applications in domestic, industrial, environmental, and public health sectors. It helps in monitoring, controlling, and improving water quality.

Domestic Use
- Testing drinking water in homes.
- Checking suitability of tap water and borewell water.
- Deciding the need for RO or other purification systems.

Municipal Water Supply
- Monitoring water supplied by municipalities.
- Ensuring compliance with national drinking water standards.
- Maintaining safe distribution systems.

Industrial Applications
- Used in food and beverage industries to maintain product quality.
- Required in pharmaceutical industries for purity standards.
- Prevents scaling and corrosion in boilers and cooling systems.

Agriculture

- Testing irrigation water quality.
- Monitoring salinity and mineral content.
- Preventing soil degradation due to poor-quality water.

Environmental Monitoring

- Checking pollution levels in rivers, lakes, and groundwater.
- Assessing impact of industrial discharge.
- Protecting aquatic ecosystems.

Public Health Programs

- Identifying high fluoride or contaminated regions.
- Preventing waterborne diseases.
- Supporting government water safety programs.

Research and Academic Studies

- Used in laboratory experiments and project work.
- Helps in comparative studies (Tap vs RO water).
- Supports scientific data collection and analysis.

CONCLUSION

The present study was conducted to analyze and compare the quality of tap water and RO (Reverse Osmosis) water by examining important parameters such as pH, Total Dissolved Solids (TDS), hardness, and fluoride content. These parameters play a significant role in determining the suitability of water for drinking and domestic purposes.

The results of the study showed that both tap water and RO water had pH values within the safe drinking range, indicating that both samples were neither highly acidic nor highly alkaline. However, tap water contained higher levels of Total Dissolved Solids (TDS) and hardness compared to RO water, which indicates the presence of more dissolved minerals such as calcium and magnesium salts. Although these minerals are necessary in trace quantities, higher concentrations can alter the taste of water and contribute to scaling in pipes and household appliances. The fluoride content in both water samples was within acceptable limits, supporting dental health without posing any notable health concerns. Reverse osmosis (RO) water exhibited reduced levels of dissolved impurities and hardness as a result of the purification process, making it relatively safer and more appropriate for consumption. In contrast, while tap water may retain beneficial minerals, its overall quality largely depends on its source and the effectiveness of the treatment process.

The findings of this study highlight the Importance of regular monitoring of drinking water quality to ensure public health and safety. The results were compared with drinking water standards recommended by the World Health Organization and the Bureau of Indian Standards, which emphasize maintaining safe limits for various water quality parameters.

Overall, this research concludes that water quality testing is essential for ensuring safe consumption, preventing water-related health problems, and promoting effective water management practices. The study also emphasizes the need for awareness regarding water purification methods and sustainable use of water resources for future environmental protection and human well-being.

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