Comparative Analysis of Sewage, Tap and RO Water in Mewar University.

Habiba Aminu Ibrahim[1], Singh, P.[1], Umar A. K[1]., Tiwari, P.K.[2]
[1]*Department of Environmental Science Mewar University*
[2]*Deaparrtment of Environmental Sciences, Mohanlal Sukhadia University, Udaipur, Rajasthan*

Abstract- Water quality is a critical factor for ensuring public health and environmental sustainability. This study presents a comparative analysis of the physical and chemical properties of sewage, tap water, and reverse osmosis (RO). Water samples were collected from three different sources; sewage, tap water and reverse osmosis. The analysis included the measurement of physical and chemical parameters of water viz., the pH, total dissolved solid (TDS), total suspended solid (TSS), electrical conductivity, chloride and alkalinity. Our findings reveal that sewage water contains high levels of contaminants and impurities, underscoring the need for thorough treatment to ensure safety. Although tap water is significantly cleaner than sewage water, it still exceeds recommended levels of dissolved solids and chlorides for drinking. Conversely, RO water exhibits the highest quality across all measured parameters, deeming it the most suitable option for safe drinking water. The comparative study underscores the importance of effective water treatment process. This analysis highlights the need for continuous monitoring and stringent regulation of water quality to protect public health.

Key Words: Reverse osmosis, Sewage, Total Dissolved Solid, Total Suspended Solid and Tap

1. INTRODUCTION

Water is the most abundant compound found on earth. It is the only compound which exists in all the three states of matter viz., solid, liquid and gas at temperatures normally found on earth. Nearly 70% of the earth's surface is covered by water but only 2.5% of this water is fresh water which is present in the form of freshwater lakes, glaciers, streams and groundwater. Most of the living organisms depend on fresh water for the sustenance of their life. However, this water is available to a limited world population and majority face freshwater scarcity. Freshwater bodies are either depleted due to climatic changes [1] [2] or getting polluted/ contaminated due to pollution by human activities viz., industrialization, urbanization, pollution explosion, increase in living standard [3] and some climatic factors like global warming, deforestation and drought. According to the United States Environmental Protection Agency (EPA), "Water quality standards are the foundation for water pollution control programs" (EOLSS Samples Chapters, 2023). These standards establish the thresholds for various contaminants and physical properties to ensure the water's designated use can be safely achieved [4]. Direct consumption of water from these sources poses various health problems especially in children like amoebic dysentery, cholera and other epidemic diseases. Need of the hour was to treat this water before consumption which includes, boiling, filtration, reverse osmosis, viz., [5]. Tap water, also known as potable water, is water that is treated and distributed for human consumption, cooking, and other domestic purposes [6]. The availability of tap has a major public-health benefits, since it typically vastly reduces the risk to the public contacting water borne diseases. Even tap water is considered safe, it can contain traces of contaminants in amounts not deemed to be dangerous for human health like fluoride, chlorine, minerals like magnesium, calcium and copper. There also might be a microscopic contaminants like bacteria and parasite. Sewage water is water associated with pollutants and contaminants. Microbiological parameter in tap and drinking water focuses on the detection of various pathogens using indicator organisms. Transmission route disease, also known as faecal-oral route, occurs when pathogens in faecal particles are transmitted into oral cavity of another host [7]. An increase in the production and discharge of wastewater is increasing. Most of these wastewater effluents are untreated or inadequately treated before being discharged, which has become a worrisome phenomenon due to its impact on

environmental health and safety [8] Reverse Osmosis (RO) is a process that uses semi-permeable spiral wound for separating and removing dissolved solids, harmful chemical and bacteria from water. It is most commonly known for its use in drinking water purification from sea water, removing the salt and other effluent materials from the water molecules[9]. The method is widely accepted as a cheap and secure means of purifying drinking water. It works well in dissolving chemicals and heavy metals such as: nitrate, sodium, crypto sporidium, fluoride, sulphides, giardia, arsenic, mercury, uranium, radium and lead. It is also effective in removing harmful and dangerous bacteria and chloride from water as it passes through the thin semi-permeable [10]. Sewage/wastewater are essentially the water supply of the community after it has been altered by the variety of uses .From the source of generation, wastewater can be defined as the combination of liquid(water) carrying waste materials from household, institutions, markets .It comprises 99.9% of water and 0.1% of solid [11]. This study was carried to compare the physical and chemical properties of sewage, tap and RO water with its standard permissible limits.

Study Area

This project was carried out in Mewar University, located in Chittorgarh district of Rajasthan State, India. Mear University is situated at latitude 24.578ºN and longitude 73.7125ºE. The surrounding of Mewar University is characterized by a mix of rural and urban populations. Mewar University was established in 2009 with the aim to provide high-quality education and promote research in various fields. The selection of Mewar University as the study area is a pivotal due to its strategic location in Rajasthan, which Is known for its educational advancements and research initiatives.

Materials and Methods

All chemicals used in this study were laboratory grade and the study was performed at room temperature. Physical parameters such as TDS, was measured with digital TDS meter while other parameters such as chloride and alkalinity were done by using titrimetric method, pH was measured by the use of pH meter which provide direct value, and TSS was determined by Gravimetric analysis.

Sample collection

The samples of 150ml of water were collected in neat and clean plastic bottles and stored at room temperature. The samples were analyzed individually. The analysis was carried as per the standard procedure of Indian Specifications on drinking water and compared with desirable and permissible limits.

RESULTS

Several studies were carried out on sewage, tap water and RO water determine different physical and chemical parameters through pH, total dissolved solid, total suspended solid, electrical conductivity, alkalinity, chlorine. The results of these summarized in table and figures.

Table 1: Comparison of different physical and chemical parameters of sewage, tap and RO water.

S. No	Parameters	Sewage Water	Tap Water	R.O Water	ISC Permissible Limit	Desirable Limit
1	pH	7.84	8.23	7.71	8.5	6.5
2	Total dissolved solid(ppm)	1025.0	732.0	175.6	2000.0	500.0
3	Total suspended solid(ppm)	0.044	0.032	0.028	1000	10
4	Electrical Conductivity((µS/cm)	87.8	366.0	512.5	3000	3000
5	Chloride(mg/L)	272.6	193.12	66.74	1000	250
6	Alkalinity(mg/L)	51	21	123	600	200

pH

Result shows that the pH of sewage water is 7.84, tap water was 8.23 and RO water was 7.71 which is under standard criteria of water quality permissible limit viz 6.5 to 8.5.

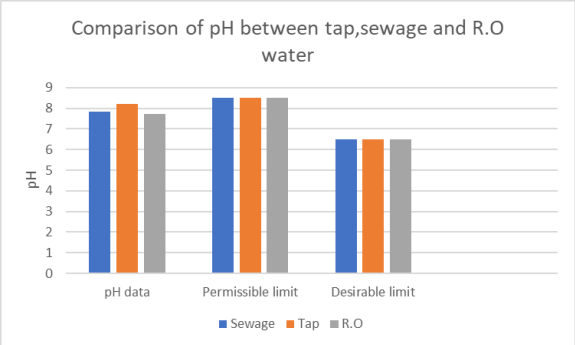

Figure 1: Comparison of pH in sewage, tap and RO water with permissible limits.

Total Dissolved Solid

From figure 2, it was found out that the TDS of sewage was 1025.0ppm, tap water was 732ppm, and RO water was 175.6ppm which shows that the water samples was well within the permissible limit of 2000 _ 500ppm. High TDS in sewage and tap water indicate the presence of various dissolved minerals, whereas the lower TDS in RO water shows effective filtration.

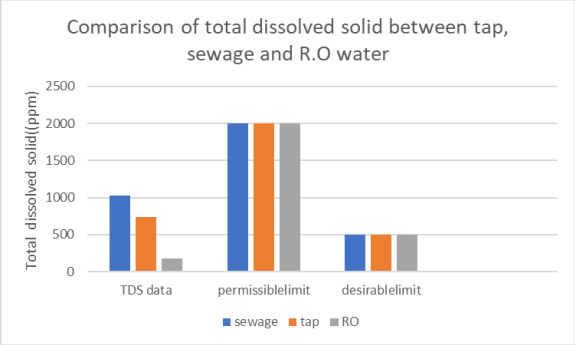

Figure 2: Representation of comparative study of TDS in sewage, tap and RO water.

Total Suspended Solid (TSS)

Figure 3 shown that, the total suspended solid of sewage was 0.044ppm, tap was 0.032ppm, and RO water was 0.028ppm which shows that the water samples was below the permissible unit of TSS.

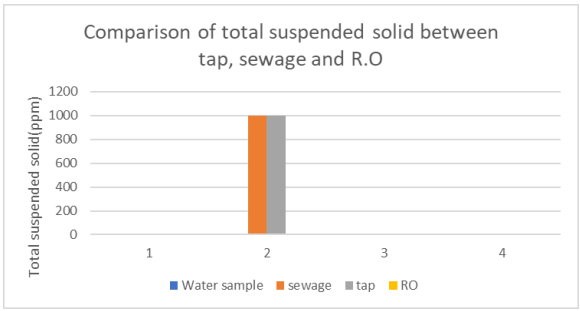

Figure3: Comparative study of suspended solid on sewage, tap and RO water and their permissible limits.

Electrical conductivity

The result from figure 4 indicates that, sewage was 87.8µS /cm, tap water was 366.0 µS/cm and RO water was 512.5 µS/cm are well within permissible limit of 1000 µS/cm.

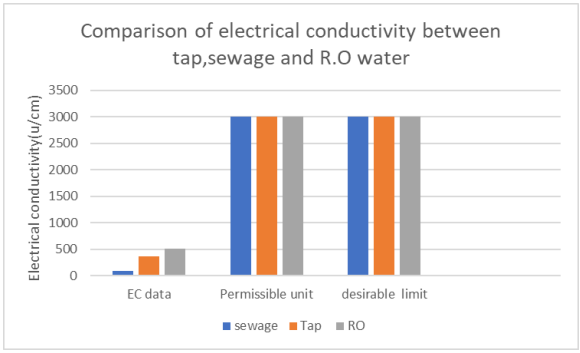

Figure 4: Representation of comparative study of electrical conductivity in sewage, tap and RO water

Alkalinity

Results from figure 5 show that the provided alkalinity values of sewage was 51mg/L, tap water was 21mg/L, and RO water was 123mg/L are within permissible limits for their respective types, although the RO water's alkalinity is higher than the Indian Standard Code of 600mg/L.

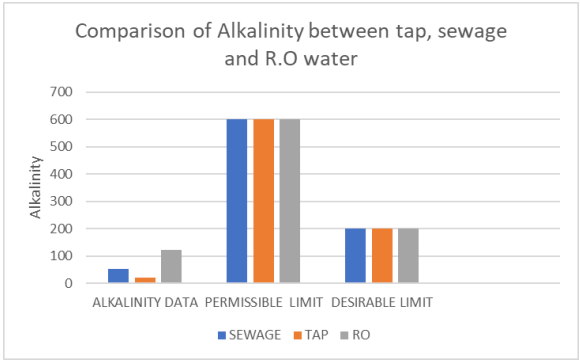

Figure 5: Comparative study of alkalinity on sewage, tap and RO water and their permissible limits.

Chloride

Result shows that for sewage 272.6mg/L, the chloride content is high while for Tap 193.12mg/L and RO water 66.74mg/L are within the permissible limit. High chloride levels in sewage water indicate contamination, while RO water's lower chloride level shows efficient removal of salts.

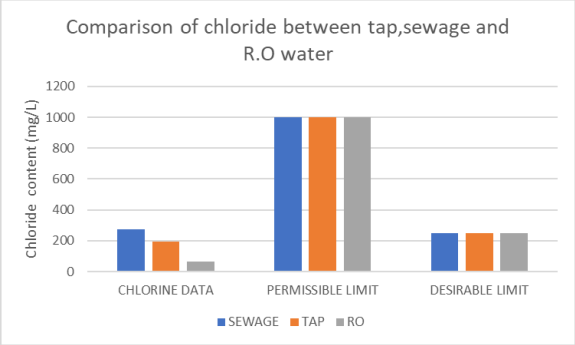

Figure 6: Representation of comparative study of chloride in sewage, tap and RO water

DISCUSSION

The pH values for all three types of water fall within the permissible limits, indicating that the acidity or alkalinity of the water samples is within acceptable ranges for most uses from figure 1. RO water has slightly lower pH compared to sewage and tap water, which could be attributed to the removal of certain ions that buffer the pH. [12], found that RO systems can slightly lower the pH of water by removing bicarbonates and other buffering agents. Total Dissolved Solid (TDS) of sewage was found to be 1025.0ppm, tap water was 732ppm, and RO water was 175.6ppm which shows that the water samples was well within the permissible limit. From figure 2. RO water shows a significant reduction in TDS compared to sewage and tap water, highlighting the efficiency of the RO process in removing dissolved solids. The TDS values are for sewage and tap water are higher, reflecting the presence of more dissolved salts and minerals in these sources. For example, handpump from Moga district was also on the borderline of TDS value, which is also not feasible for drinking [13]. Total Suspended Solids (TSS) of all samples are below the permissible limit for TSS. The low TSS values in RO water reflect the effective removal of particulate matter through the filtration process. The TSS of the RO treated water were insignificant for both BHW (<0.0001) but high in UV-treated SW (9.08 <43.6< 46.4) for RO, Control and UV treatment. This value is more than the WHO permissible limit of <5.00 [14]. Electrical Conductivity (EC) of sewage was 87.8u/cm, tap water was 366.0u/cm and RO water was 512.5u/cm are well within permissible limit. In PU sample unit has very high EC and even after RO treatment by the local vendor its quality is not good enough for drinking. The HU sample produces low EC of 120.1 µS/cm which is fit for drinking [15]. These research work shows that the provided alkalinity values of sewage was 51mg/L, tap water was 21mg/L, and RO water was 123mg/L are within permissible limits for their respective types, although the RO water's alkalinity is higher than typically expected. Alkalinity measure of ions which neutralize the H+ in water ions like bicarbonate, carbonate and hydroxide, respectively. It affects the taste of water. Both RO samples are within the range. While the level of RO waste water was 48% and 21% more than ground water of public distributer RO and home installed unit [15]. The Chloride obtained for sewage 272.6mg/L, the chloride content is high while for Tap 193.12mg/L and RO water 66.74mg/L are within the permissible limit in this study. High chloride levels in sewage water indicate contamination, while RO water's lower chloride level shows efficient removal of salts. The chloride levels are highest in sewage water, indicating contamination, while RO water's lower chloride level shows efficient removal of salts, making it safer for consumption. [13] demonstrated that eighty-six percentage had chloride levels more than desirable limits. This could be because of the presence of decayed organic matter in the pipes that are supplying the tap water.

CONCLUSION

From our study, the comparison of sewage, tap water and RO water samples highlights the efficacy of water treatment processes. The results indicate that the sewage water has high levels of contaminants and impurities, demonstrates the necessity for effective treatment before it can be considered safe for any use. Tap water, while significantly clearer and lower in

contaminants than sewage water, still contains higher level of dissolved solids and chlorides than recommended for drinking water. RO water, on the other hands shows the best quality across all measured parameters, making it the most suitable for safe drinking purposes.

Ethical Statement

This research does not require ethical approve.

Author Contribution

Habiba Aminu Ibrahim: Writing _ review & editing, Methodology, Writing _ original draft. Ms. Prachi Singh: Conceptualization, Supervising, Project Administration, Formal Analysis and Investigation. Umar Abdussalam Kura: Editing. Mr. Praveen Kumar Tiwari: Reviewing

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Conflict of interest

Because there were no financial or commercial ties that may be seen as having a conflict of interest, the authors state that there was no conflict of interest during the research

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