



Bacterial indicators an important parameter to investigate pollution status of Jojari river (Jodhpur)

Ranjeeta Mathur¹, Abhishek vaishnav²

¹ Assistant Professor, Department of Zoology, Lachoo Memorial College of Science & Technology, Rajasthan, India

² Research Scholar, Department of Zoology, Jai Narain Vyas University, Rajasthan, India

Abstract

Water is an important natural resource for the survival of the organism. Approximately 98% of the water is sea water and it is unusable for drinking because the high concentration of salt. About 2% of planet water is fresh and 1.6% is locked up in glaciers. Another 0.36% is found underground in aquifers and wells. The quality of water is affected by human activities and is declining due to rise of population growth, urbanization, agricultural development and other factors. This result in industrialization water pollution. Water pollution has excessive amounts of a hazard (pollutants) in water in such a way that it is no long suitable for drinking, bathing, cooking and other uses. Water bodies usually consist of a wide variety of microorganisms, some of which are pathogenic and some of which are not. Some of the non-pathogenic microorganisms may lead to problems in water supplies such as unpleasant taste and odor which may serve as indicator of safety. Pathogenic contaminants include bacteria, helminthes, protozoa and viruses. The present study was undertaken to evaluate the bacteriological pollution level of Jojari river water, Industrial effluents situated near salawas, Jodhpur in the state of Rajasthan. Jojari River is also known as the black river because this river is being polluted by indiscriminate disposal of sewerage, industrial wastes which affect their Physico-chemical end bacteriological parameters. At present, the polluted water of the Jojari River is being used for agriculture, due to which human health and daily life are affected. The presence of coliform bacteria in the water samples warrants for proper measures to reduce the pollution at point sources and requires proper remediation strategies to combat contamination in the river water.

Keywords: Jojari river, bacteriological analysis, coliforms, escherichia coli, water quality, indicators of pollution

Introduction

Our survival on Earth depends on urge basic resources - water, air and soil, nature's natural sustain three valuable gifts to mankind. Essential to sustain the life of living organisms. About 71% of the earth surface is water covered. Out of which 97.5% is salt water & approximately 2.5% is fresh water on the earth. Water is one of the main resources essential for the overall socio-economic development of any region and it requires careful planning and appropriate exploration (Khadri, S.F. and Pradhan G.V., 2013).

The qualities of water vary widely depending on the location and environmental factors. Water pollution is a major serious problem for all over the world. It affects drinking water of rivers, lakes and oceans all over the world. It consequently harms the health and wellbeing of human life and the natural environment. Water pollution is the leading worldwide cause of death and disease, e.g. due to water-borne diseases (West, Larry 2006).

As industrialization and population spread around the globe, so the problem of pollution is much smaller, no one believed pollution would ever present a serious problem. Today with around 7 billion people on the planet, it has become apparent that these are limits. Pollution is one of the signs that humans have exceeded those limits. On land the natural water system is being polluted by the addition of Industrial wastes, urban wastes, pesticides and related pollutant (Pathak A.K., 2013) [7].

Water pollution may be defined as alteration in the physical, chemical and biological characteristics of water which may cause harmful effects on human and aquatic life. Water

pollution influencing the distribution and diversity of aquatic life. Pathogenic microorganisms, including bacteria, helminths, protozoa, and viruses, pose significant health risks when present in water supplies. Industrialization near river catchment areas has been impacting the water quality of reservoir resources and is also considered the major problem in maintaining the quality of river water (Suthar *et al.* 2010; Abraham 2011) [8, 1].

Jodhpur is Rajasthan's second-largest city with a population of over 12 lakhs but it didn't have a sewage system till 2002. Even now, 40% of the population lies outside the sewage network. The two STPS can treat only 50 % of the sewage while the rest makes its way into Jojari.

Materials and Methods

1. Study Area

The study was conducted in the vicinity of the Jojari River, located in Jodhpur, India.

2. Sample Collection and Preparation

Water samples were collected from various points along the Jojari River using sterile containers. Samples were transported to the laboratory under cold chain conditions and processed within 6 hours of collection.

3. Bacteriological Analysis

3.1 Microbiological Analysis

Procedure for Catalase Test

1. Water samples were cultured on nutrient agar slopes for 24 hours.
2. Ten milliliters of hydrogen peroxide solution was added to the agar slope.
3. The appearance of vigorous gas bubbles indicated a positive test result.

Procedure for Indole Test

1. Benzaldehyde was dissolved in amyl alcohol at 50°C, and acid was carefully added until the reagent turned red. The solution was then cooled to 4°C until it turned golden yellow.
2. Tryptophan broth was inoculated with the test organism and incubated at 37°C for 24-28 hours.
3. Kovac's reagent was added, and the upper layer of the liquid was examined for a dark pink color, indicating the presence of *E. coli*.

Procedure for Methyl Red-Voges Proskauer (MR/VP) Test

1. VP medium and distilled water were placed into a test tube, and the organism was heavily inoculated.
2. Incubation was carried out at 37°C for 6-8 hours.
3. After incubation, potassium hydroxide and alpha-naphthol reagent were added, and the formation of a thin layer on the liquid surface was observed.

3.2. Bacterial Enumeration

Total heterotrophic bacterial count and total coliform count were determined using the serial dilution method and pour plate techniques. Nutrient agar was used for aerobic heterotrophic bacteria, while Sorbitol MacConkey (SMAC) agar and SS agar were used for coliform bacteria. Petri dishes were incubated at 37°C for 24 hours, and bacterial colonies were counted using a digital colony counter.

3.3. Environmental Factors

The distribution of bacteria in the water was influenced by environmental factors such as dissolved oxygen, pH, salinity, temperature, and seasonal variations. In the present study, bacterial loads were found to vary between rainy and dry seasons, with higher microbial counts observed during the dry season.

3.4. Data Analysis

The results obtained were compared with WHO standards for water quality to assess the level of contamination and potential health risks associated with water use.

Results and Discussion

Microbial analysis of the sampled water confirmed the presence of *Staphylococcus*, and *Escherichia coli* (*E. coli*) in the Jojari River water, indicating contamination. These findings suggest that the water does not meet the drinking water standards recommended by the World Health Organization (Parihar, Sharma, & Sharma, 2003; Mohan, Gaur, & Chodhary, 2007) [6, 5].

Staphylococcus aureus can cause various suppurative infections and toxinoses in humans, including skin

infections, pneumonia, and food poisoning (Fujioka *et al.*, 1999; Kenneth, 2008) [3, 4].

Total coliforms, including *Escherichia*, *Citrobacter*, *Enterobacter*, and *Klebsiella*, are traditionally considered indicators of water quality. While they are not necessarily indicative of fecal pollution, their presence can provide information on water source quality (Allen *et al.*, 2000; Clark, 1968) [2].

Escherichia coli is commonly found in human and animal feces and can indicate fecal contamination in water. Its presence suggests a potential health risk, even in remote areas where human fecal pollution is less likely (Fujioka *et al.*, 1999) [3].

There is a wide range for types of microbial pathogen which can occur in wastewater, the type and number present are highly dependent on the socioeconomic conditions and customs of the communities creating the wastewater. In order to propose an efficient way of treating wastewater, there is need to understand the negative environmental impacts posed by the untreated or inadequately treated wastewater entering the nearby ecosystems, especially on the lives that depend on the ecosystem for sustenance.

Conclusions

The high bacterial load in the Jojari River water indicates contamination and renders it unsuitable for drinking or domestic use without prior treatment. This contamination poses health risks to individuals using the water and threatens aquatic organisms in the ecosystem.

Initiatives to address this issue should include regular monitoring of water quality, proper management of domestic and industrial waste, enforcement of wastewater treatment regulations, improved agricultural practices, and community awareness programs on waterborne diseases.

Total coliforms can be detected using simple and inexpensive cultural methods, making them useful indicators of water quality. *Escherichia coli* is often preferred as an indicator of fecal contamination and treatment effectiveness. However, its absence does not guarantee the absence of pathogens, highlighting the need for comprehensive wastewater treatment strategies.

Understanding the negative environmental impacts of untreated wastewater is crucial for proposing effective treatment methods and protecting ecosystems and human health.

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