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Water quality assessment and evaluation of human health risk of drinking water in Ranchi District of Jharkhand

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Abstract

The primary cause of water-borne disease epidemics, particularly in underdeveloped nations, is the consumption of drinking water tainted with dangerous bacteria that originated in excrement. Water bodies have been essential to the development of civilizations throughout history, and they are still important for the modern economic expansion of all modern cultures. Microbes can get into water sources through agricultural inputs and rainfall runoff, which can combine with sewage effluents. The coliform group of bacteria, which signals the possible presence of harmful organisms, is the organism that is typically searched for during the standard water analysis technique. Microbes that cause disease in humans multiply and spread through the medium of water. For this reason, one of the most crucial criteria for public health is the drinking of safe water. Water samples were collected from various sources (surface water and groundwater sources) throughout March to May 2023. Ten water samples were taken from the surface and groundwater in and around Ranchi Municipality Nagra Toli and Karamtoli areas The MPN index, fungal tests, colony count, and other biochemical test parameters were all analyzed. Comparing surface water to groundwater, it was discovered that the MPN index of the former was higher. Up to 140 MPN/100 mL of total coliform count were found. Samples of surface and groundwater revealed the presence of two distinct bacterial species. It becomes clear that *Escherichia coli* and Bacillus *Enterococcus faecalis* bacterial isolates were common. The current study's objectives were to identify the various microbial groups and perform several microbiological studies. To maintain the hygienic quality of the water supply, it is strongly advised to do bacteriological examinations on both the water entering the distribution system and the water already in the system on a frequent and regular basis. Regular inspections are necessary for both sanitary management and testing portable water.

Keywords: Epidemics; Underdeveloped; Excrement; coliform; Microbiological test

1. Introduction

Water is among the major essential resources for the sustenance of humans, agriculture, and industry. Social and economic progress are based and sustained upon this pre-eminent resource [1]. Availability and easy access to safe and quality water is a fundamental human right [2] and availability of clean water and sanitation for all has been listed as one of the goals to be achieved by the year 2030 for sustainable development by the United Nations General Assembly (UNGA) [3].

Water's quality is defined by its physical, chemical, biological, and aesthetic characteristics, which also affect its suitability for various applications such as safeguarding human health and the aquatic ecosystem. The majority of these characteristics are determined by substances that are suspended or dissolved in water, and human activity and natural processes can both have an impact on water quality. [4,5] Water security refers to a population's ability to maintain sustainable access to sufficient amounts and acceptable quality of water for socioeconomic growth and human well-

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being, as well as to protect against pollution and water-related disasters and to conserve ecosystems in an environment of peace and political balance.

Even while there is water available to most people on the planet, it is rarely safe to drink and is rarely available in enough quantities to meet basic health needs [7]. According to estimates from the World Health Organization (WHO), 1.1 billion people drink contaminated water worldwide, and 88% of diarrheal illnesses are caused by contaminated water, inadequate sanitation, and unkempt habits. Furthermore, the water supply industry is confronted with significant obstacles as a result of urbanization, global warming, and climate change. Water scarcity and poor quality, particularly in developing nations, have a negative influence on sustainable development. [8]

In the recent past, there has been a steady increase in the pollution of river waters with deleterious microbes, including bacteria, viruses, parasites, as well as fungi.[7] The majority of microbes in water are from feces from humans and other mammals [9]. Pathogens can enter waters either from a point source, non-point sources, or both. Rainwater surface run-offs, storm sewer spillages, or overflow cause non-point microbial pollution of waters, while point-source pollution comes from the discharge of untreated or partially treated effluents from wastewater treatment plants.[10]

It is impossible to overstate the significance of potable (drinking) water supply. Water supplies that are used for recreation and consumption have become contaminated by industrial, animal, and human waste due to population growth and industrialization. When there are direct or indirect changes to the content or quality of water, it is considered contaminated [11].

Disease and Transmission Route	Microbial Agent	Sources of Agent in Water Supply	General Symptoms
Botulism	*Clostridium botulinum*	Bacteria can enter an open wound from contaminated water sources. Can enter the gastrointestinal tract through consumption of contaminated drinking water or (more commonly) food.	Dry mouth, blurred and/or double vision, difficulty swallowing, muscle weakness, difficulty breathing, slurred speech, vomiting and sometimes diarrhea. Death is usually caused from respiratory failure.
Campylobacteria	Most commonly caused by *Campylobacter jejuni*	Drinking water contaminated with feces	Produces dysentery-like symptoms along with a high fever. Usually lasts 2-10 days.
Cholera	Spread by the bacterium *Vibrio cholerae*	Drinking water contaminated with bacterium	In severe forms it is known to be one of the most rapidly fatal illnesses known. Symptoms include very watery diarrhea, nausea, cramps, nosebleed, rapid pulse, vomiting, and hypovolemic shock (in severe cases), at which point death can occur in 12-18 hours.
E. coli infection	Certain strains of *Escherichia coli* (commonly E. coli)	Water contaminated with the bacteria	Mostly diarrhea. Can cause death in immunocompromised individuals, the very young, and the elderly due to dehydration from prolonged illness.
M. marinum infection	*Mycobacterium marinum*	Naturally occurs in water, most cases from exposure in swimming pools or more frequently aquariums. Rare infection since it mostly infects immunocompromised individuals.	Symptoms include lesions typically located on the elbows, knees, and feet (from swimming pools) or lesions on the hands (aquariums). Lesions may be painless or painful.
Dysentery	Caused by a number of species in the genera *Shigella* and *Salmonella* with the most common being *Shigella dysenteriae*	Water contaminated with the bacterium	Frequent passage of feces with blood and/or mucus and in some cases vomiting of blood

Figure 1 Various bacteria that are found in surface water and disease-related with them (Source: PMC (nih.gov))

All aerobic and facultative anaerobic, gram-negative, non-sporulating bacilli that digest lactose with acid and gas production within 48 hours at 37°C are considered to be prominent indicators of water pollution and belong to the coliform group of bacteria [12]. The presence of pathogens such as coliforms in treated drinking water could be the

result of inadequate or inefficient use of water treatment methods. Since coliforms are markers of bacterial contamination, their presence suggests fecal contamination of water, which could be the cause of serious, often fatal water-borne illnesses like typhoid, hepatitis, and cholera [13]. The following are some of the bacteria that can be found in surface water, the illness they can cause when ingested in significant quantities, and their symptoms.

If every pathogen needed to be detected, it would be impossible to analyze water samples regularly due to the time-consuming nature of the process and the need for specialized tools and techniques. Therefore, water is typically examined for the presence of an indicator organism, the coliforms group of bacteria, rather than being tested for diseases [14].

All gram-negative, aerobic, facultatively anaerobic, nonsporulating bacilli that digest lactose to create gas and acid are classified as coliform bacteria. *Enterobacter aerogenes* and *Escherichia coli* are the traditional species in this category [15]. However, the presence of coliform bacteria means that there may be pathogenic organisms present and that the water is not fit for human consumption [15]. Currently, the Ranchi district lacks an integrated sewage infrastructure, except the MECON and HEC areas. There isn't a linked sewage system in Lalpur. Overuse of resources and inappropriate waste disposal are the primary causes of surface water quality issues. There are several ways to assess the hygienic state of water, but the most practical one is to employ the standard microbiological examination technique, which is what's being used here to analyze water samples from Nagra toli, and Karam toli Ranchi, bacteriologically. The three fundamental tests used in the conventional microbiological technique to find coliform bacteria in water are 1. Assumptive evaluation 2. Verified examination 3. The test is finished.

Three successive phases are included in this test. Nevertheless, the MPN approach is limited to identifying the presence and number of coliform bacteria. The study emphasizes the pressing need to address waste and pollution as well as the necessity to build a replicable model for surface water through enhanced groundwater recharge.[16] Water quality assessment done by assessing the microbial contamination and the possible health risks due to exposure of humans to the harmful pathogens in the drinking water were determined.[16]

2. Methods and materials

2.1. Study Area

The selection of study Area is situated at Nagra Toli, Karam toli in Ranchi District, Jharkhand, India. we selected sampling locations from Nagra toli and Karamtoli pond which is situated at 85° 18'41" E and 23° 16'40" N (Source: Google Maps)

2.2. Collection of water sample

Samples of groundwater and surface water were collected monthly during the period March 2023 to May 2023 from different places in Nagra Toli and Karamtoli ponds near Science Block, Ranchi Women's College in sterile plastic containers for bacteriological analysis of these water samples during the above-given period.
The details of samples collected from different sources are as follows

Before being examined further, all of the samples were collected in sterile bottles and kept at 4°C. The date, time, and sample source were noted on the labels of the water samples. Within a day, the samples were transported and examined. Count of Colonies According to Harrigan and MacCance's (1976) description, the pour plate technique was used to determine the total viable count. Each sample was diluted starting at 10^{-1} and then serially up to 10^{-6}. One milliliter of each dilution was aseptically transferred in duplicate into sterile Petri dishes. Ten milliliters of each sample were transferred to 90 milliliters of sterile diluent. In each dish, 10–15 ml of melted plate count agar (45–46°C) is added. After giving the dishes, a good stir to help the sample get distributed throughout the medium, the plates were incubated for 48 hours at 37°C while the medium solidified. To calculate the total number of bacteria in terms of colony-forming units per milliliter (C.F.U. /ml), colony counters were utilized [17].

2.3. Media and reagent preparation

lactose fermentation broth [at pH 6.9, 3.0 Peptone - 5.0 Lactose - 5.0 Distilled water - 1000ml Beef Extract] and eosin methylene blue (EMB) agar were prepared. [at pH 7.2, Agar - 13.5 Eosin - 0.4 Peptone - 10.0 Lactose - 5.0 Dipotassium phosphate - 2.0, Blue Methylene - 0.065]in 1000 ml of distilled water, Dietary agar also prepared [Sodium chloride: 5 grams; Peptone: 5 grams; Agar: 20 grams; Beef Extract: 3 grams] in 1000 ml of distilled water. for reagent preparation, Selenitized Dextrose Broth, Azide Dextrose Broth, and green malachite were taken. The techniques used in Hugh and Liefson's medium. Gram staining was performed for identification. staining of the endospore also done by using Malachite green.

2.4. The most probable number test

This test comprises three methods

2.4.1. presumptive test

The purpose of the presumptive test is to specifically identify coliform bacteria. In a lactose fermentation broth with an inverted Durham tube, measured aliquots of the water to be tested are added. Lactose is a carbon source that these bacteria can use, although other enteric organisms cannot; using this media facilitates the detection of these bacteria.

Any tube that produces gas and acid due to lactose fermentation is likely contaminated with coliform bacteria. The Most Probable Number Test (MPN), a presumptive test, can be used to identify the number of coliform organisms present. The number of tubes in each group that exhibit gas after the incubation period is used to determine MPN [18].

2.4.2. confirmatory test

It is suggested that the water is not potable if a positive or dubious presumptive test is found. It is imperative to verify these findings, as a positive presumptive test could potentially be caused by non-coliform organisms that are not identified as markers of fecal pollution. Eosin-methylene blue (EMB), a selective or differential medium, should be streaked from a positive lactose broth tube acquired from the presumptive test in a verified test. Gram-positive organisms cannot grow in EMB because of the presence of the dye methylene blue. When an acidic environment is present, EMB creates a compound that precipitates out onto the traits of coliform colonies. In contrast to *Enterobacter aerogenes*, which develops pink colonies without a metallic sheen, *E. coli* generates green colonies with a metallic sheen and dark centers that are nearly black [18].

2.4.3. final test analysis

The final analysis of the water sample constitutes the entire test. It is used to determine if water samples that surfaced on the EMB plates used in the verified test contained coliform bacteria. To do a gram stain, an isolated colony is taken from the confirmatory test plate, inoculated into a lactose broth tube, and streaked on a nutrient agar slant. After the inoculation and incubation period, tubes exhibiting gas and acid in the lactose broth and a rod-shaped, gram-negative bacillus under a microscope verify that *E. coli is* present in the water sample and are regarded as positive presumptive tests.[18]

2.5. Test for presence of yeast and mold

Potato dextrose agar was diluted serially from each sample and used in the pour plate method to identify yeast or molds.10% tartaric acid was added when the media was being poured into the plates to raise the acidity of the media. From each dilution, 0.1 ml was taken, and the experiment was incubated for 72 hours at 28°C.

2.6. Test for fecal streptococci

Fecal streptococcus was counted using azide dextrose broth. After 48 to 72 hours of incubation at 35°C and turbidity checks, three tubes were made for each of the dilutions—10^{-1}, 10^{-2}, and 10^{-3}_and the findings were recorded and compared to the most likely number table.

2.7. Detection of salmonella

The medium employed for the selective enrichment of *Salmonella spp*. from clinical and food samples is selenite F broth. As a selective agent, sodium biselenite is added to a buffered lactose peptone broth. selenite-F Leifson came up with the idea for broth after he showed that selenite inhibited the growth of coliforms and some other microorganisms found in fecal specimens, like fecal *streptococci*. This helped to recover *Salmonella* species. He discovered that while the suppressed strains would eventually emerge, isolation of Salmonella could be achieved without causing an excessive proliferation of several intestinal flora members if subcultures from the enrichment broth were formed after 8–12 hours of incubation [19]. Since Selenite F Broth is primarily used for the isolation of *Salmonella* and *Shigella* from fecal material, the letter F stands for feces.

2.8. Identification of different bacteria

Biochemical assays were used to determine which microorganisms were more common in samples of drinking water. Plate count agar was used to select isolates of visually distinct colony types for subculturing. The cultures were then stored until they were needed for additional testing at 4°C in a refrigerator. These biochemical assays included the endospore staining test (Abualdahab and Gorani, 1983) and the Gram staining [20].

2.9. Biochemical tests

Gram Stain: As described by (William et al,2001), the gram stain is the most widely used and practical staining technique. It divides bacteria into two groups based on the makeup of their cell walls. A portion of a colony was emulsified in a loopful of distilled water to create a film on a clean slide. After that, the film was air-dried, somewhat burned, and discolored.

2.9.1. Endospore Staining

Dorner published a staining protocol for endospores in 1922. Dorner's approach was adapted by Shaeffer and Fulton in 1933 to expedite the procedure. Bacterial endospores are specifically stained by the endospore stain, a differential stain. Distinguishing bacterial spores from other vegetative cells and spore formers from non-spore formers is the primary goal of endospore staining.

2.9.2. Motility test

The motility test is used to identify the motility or non-motility of an organism. Because of their flagella, motile organisms can move past the site of inoculation. While certain motile cocci do exist, bacilli are the most common type of motile bacteria. A few remarkable bacteria move with the aid of axial filaments, which are invisible under a microscope, but most motile bacteria move with structures called flagella. Using a hanging-drop preparation, the test was used to differentiate between motile and non-motile bacteria. A wire loop was used to transfer a little loopful of the culture to a dry, clean, covered slip after a small amount of immersion oil had been applied to the slide's edge. Subsequently, the cover slide was placed over the cover slip with the drop positioned in the center of the cavity. The slide was then gently but thinly pulled down to ensure that the oil sealed the coverslip in place. The preparation was swiftly examined after the slide was swiftly and cleanly inverted and the culture drop was positioned as a hanging drop. It's important to distinguish between true motility and Brownian movement, which is defined as unbalanced impacts with surrounding fluid molecules caused by a continuous agitation of very small particles suspended in a fluid or drift in one direction due to a slightly tilted slide.

2.9.3. Oxidation/Fermentation (O/F test) test

used two tubes of Hugh and Liefson's medium and an inoculation from new cultures. While the other tube remained open, the first was sealed with sterile paraffin oil. The incubation process lasted for 24–72 hours at 370C. According to William et al. (2001), growth in the open tube alone was recorded as oxidative metabolism, whereas growth in both tubes was recorded as fermentation metabolism. The organic molecules known as carbohydrates are made up of carbon, hydrogen, and oxygen in the formula $(CH_2O)_n$. Depending on their complement of enzymes, organisms use carbohydrates in different ways. Because the pattern of fermentation is specific to some species, genera, or groupings of organisms, it has been widely employed as a technique for the biochemical differentiation of microbes.

3. Results and discussions

The data presented in Table (3) show that total and faecal coliform were found in surface water samples, whereas all groundwater samples were contaminated with coliform bacteria, with 100% of the samples exhibiting fecal contamination. This indicates that there was more contamination in the groundwater samples than in the surface water samples due to the presence of these microbial groups. The ground layers function as filters, so the groundwater must be free of any organisms; however, the presence of coliform bacteria in the groundwater could indicate that the treatment method was ineffective or that contamination occurred during distribution. The WHO determined that the groundwater samples from the aforementioned areas were unsafe to drink. About 80% of groundwater samples and 60% of surface water samples contained yeasts and Molds (Table 1, Figure1). When these microbiological groups are found in drinking water, it indicates that sewage or wastewater was mixed with the water. (Table 2, Figure 2) further demonstrates that the groundwater sample from Karamtoli Pond and Nagra Tali, which was collected from the tap and placed in a storage tank for use in an apartment complex, was taken from the tap. This sample's microbiological analysis revealed moderate levels of both total and faecal coliform. This could mean that the storage tank hasn't been cleaned, that there is a pipeline fault (which could be ancient), or the water has been contaminated during distribution.

Table 1 Results of microbiological parameters of surface water from, the following Places.

Sample	Total coliform (MPN/100ml)	Fecal coliform (MPN/1000ml)	Total viable count (CFU/100ml)	Yeast and Mould	Fecal strep.	Salmonella
Sintex plastic tank	63	26	2.6×10^4	No growth	--	_
Tap water	94	34	2.8×10^4	Smooth yellow colonies	5	_
Overhead water tank	70	31	4.2×10^4	Smooth white colonies	--	_
Pond	110	49	3.1×10^4	Smooth white colonies	8	_
Packaged drinking water	31	21	2.0×10^4	No growth	----	_

Table 2 Microbiological parameters of groundwater in the following sources

Sample	Total coliform (MPN/100ml)	Fecal coliform (MPN/1000ml)	Total viable count (CFU/100ml)	Yeast and Mould	Fecal strep.	Salmonella
Public well	140	34	3.1×10^4	Smooth white colonies	9	_
Deep boring	49	26	2.6×10^4	Smooth white colonies	8	_
Handpump	34	24	2.8×10^4	Smooth white colonies	--	_
Deep boring	34	31	2.0×10^4	No growth	--	_
Well	63	46	4.2×10^4	Smooth green colonies	10	_

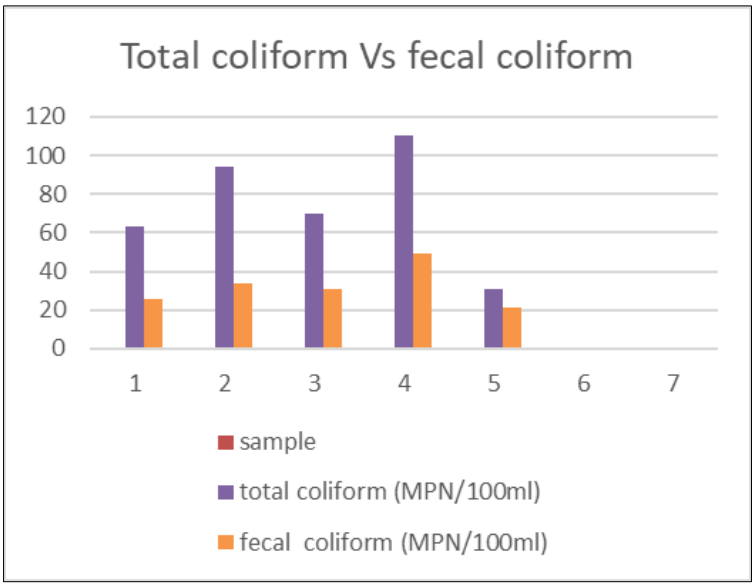

Figure 1 MPN values per 100 ml for total coliform Vs fecal coliform in a groundwater sample

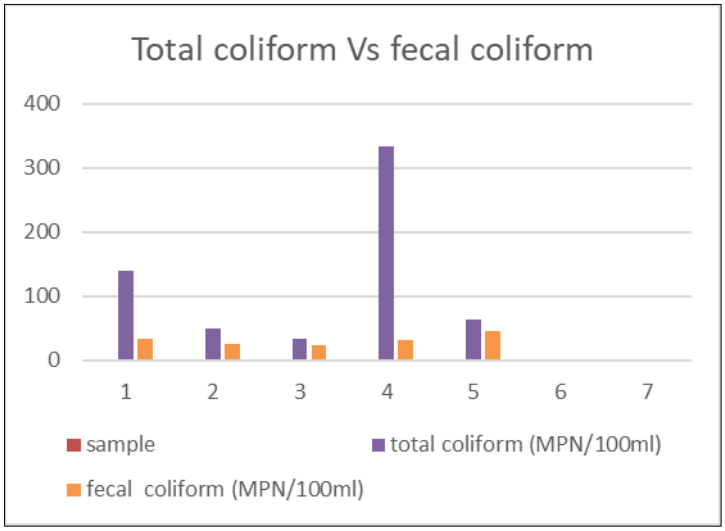

Figure 2 MPN values per 100 ml for total coliform Vs fecal coliform in a groundwater sample

Table 3 Microbiological identification test for surface water of different sources

Sample	Gram stain	Shape	Endospore staining	Growth In Air	O/F test	Motility	Genus
Sintex plastic tank	+	S	+	+	F		*Bacillus*
Tap water	+	S	+	+	F	-	*Bacillus*
Overhead water tank	-	R	-	+	F	+	*E.coli*
Pond	-	S	+	+	F	-	*Ecoli*
Packaged drinking water	-	S	+	+	F	-	*Bacillus*

+= Positive, --- = Negative= Rod-shaped= Sphere shaped, F=Fermentative;O= Oxidative

Coliforms are a class of bacteria that are found in water samples and are used as markers of water contamination. Among these, the *Escherichia coli* colony is represented by a pink colony with a metallic sheen, whereas the Enterococcus colony is represented by a pink to red colony: According to Table 5's data, *Bacillus* was discovered in 75% of the groundwater samples. The genus *Enterobacter* was identified in the sample from (Table 3, Figure 3) and this genus includes certain pathogenic species that may have an impact on human health. Isolates from every sample in Table (3) displayed several genus kinds. *Bacillus* and *E. coli were* identified as isolates. *Bacillus* was 60% and *E. coli* was 40% in surface water.

Table 4 Microbiological identification tests of groundwater

Sample	Gram stain	Shape	Endospore staining	Growth In Air	O/F test	Motility	Genus
Public well	+	R	+	+	F	-	*Bacillus*
Deep boring	+	R	-	+	F	-	*Bacillus*
Hand pump	+	S	-	+	F	-	*Enterococcus*
Deep boring	+	R	+	+	F	+	*Bacillus*
Well	+	R	_	+	F	+	*Bacillus*

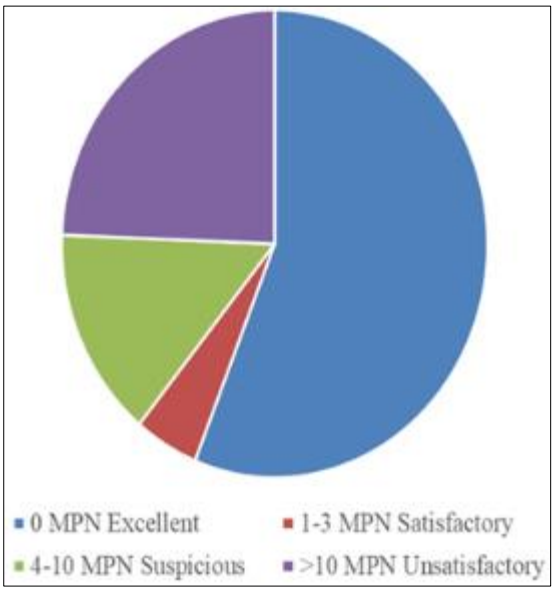

Figure 3 To determine the degree of fecal contamination, WHO standards were used to sort the samples based on the total fecal *E. coli.* The samples were graded Excellent (0 MPN/100ml), Suspicious (1--2 MPN/100ml) and Unsatisfactory (>2 MPN/100ml). The majority of the samples were unsatisfactory.

3.1. Statistical Analysis

The variance's positive square root is the standard deviation. It is among the fundamental techniques in statistical analysis. The standard deviation, often known as SD and represented by the symbol "σ," indicates the degree to which data values depart from the mean value. A low standard deviation indicates a tendency for the values to be near the mean, while a large standard deviation indicates a significant departure from the mean. In descriptive statistics, the standard deviation represents the degree of scatter or dispersion of the data points concerning their mean. It is a measure of the deviation of the data points from the mean and indicates how the values are distributed throughout the data sample.

Water samples from distinct locations, Nagra Toli and Karamtoli, were subjected to a most probable number (MPN) test for bacteriological analysis. Counts of yeast and Mold, total viable count, faecal coliform, and faecal *Streptococci* were among the tests that were performed. The microbiological burden of samples taken from groundwater and surface water is shown in Tables 2 and 3, respectively. Table (2) presents data indicating that 50% of surface water samples

contain coliform and fecal coliform. This indicates that the samples were deemed unfit for human consumption based on international drinking water standards, which stipulate that no more than 100 ml of a sample can contain detectable levels of pathogenic intestinal protozoa and *E.Coli* thermotolerant coliform bacteria. The presence of faecal *streptococci, E. coli*, and total coliform in these samples suggested that the water had come into contact with animal or human waste. These samples' presence of coliform bacteria suggested that either the water treatment system was not operating to its full potential or that the distribution system's water supply had become contaminated.

Table 5 Mean and standard deviation of MPN values of groundwater sample

Sample	**MPN /ml (xi)**	**(Xi - X)**	**(Xi -X) ^2**
Public well	1.40	1.04	1.0
Deep boring	4.9	-1.36	1.8
Hand pump	3.3	-0.56	0.12
Deep boring	3.4	2.5	6.25
Hand pump	6.3	-0.46	0.211
Total Mean = 3.86	19.3		9.46
t-test = 2.3			

Table 6 Mean and standard deviation of MPN values of surface water sample

Sample	**MPN /ml (xi)**	**(Xi - X)**	**(Xi -X) ^2**
Syntex plastic tank	6.3	0.92	0.84
Tap water	9.4	4.02	16.1
Overhead water tank	7.0	1.62	2.62
Pond	1.10	-4.28	18.3
Packaged drinking water	3.1	-2.28	5.19
Total Mean = 5.38	26.9		27.07
t-test = 0.88			

Table 7 Mean and standard deviation from total viable count (TVC) values of surface water sample

Sample	**Total TVC (CFU /g) (xi)**	**(Xi - X)**	**(Xi -X) ^2**
Sintex plastic tank	2.6×10^{4}	-0.56×10^{4}	0.3136×10^{4}
Tap water	2.8×10^{4}	-0.36×10^{4}	0.12×10^{4}
Overhead water tank	4.2×10^{4}	1.04×10^{4}	1.08×10^{4}
Pond	3.1×10^{4}	-0.06×10^{4}	0.03×10^{4}
Packaged drinking water	2.0×10^{4}	-0.06×10^{4}	0.03×10^{4}
Total Mean = 3.16	15.8×10^{4}		1.51×10^{4}
t-test = 11.2			

Table 8 Mean and standard deviation from total viable count (TVC) values of groundwater

Sample	Total TVC (CFU /g) (xi)	(Xi - X)	(Xi -X) ^2
Public well	3.1×10^{4}	-0.06×10^{4}	0.01×10^{4}
Deep boring	2.6×10^{4}	-0.5×10^{4}	6.35×10^{4}
Hand pump	2.8×10^{4}	-0.36×10^{4}	1.9×10^{4}
Deep boring	2.0×10^{4}	-0.06×10^{4}	5.38×10^{4}
Well	4.2×10^{4}	-1.04×10^{4}	12.81×10^{4}
Total Mean = 4.62	23.1×10^{4}		26.44×10^{4}
t-test = 8.10			

Dilution factor = 10^{4}, colony forming units = 3.16×10^{4} CFU

Results from Table (2) also show that *Salmonella* was not detected in the samples indicating (–). Since microbial pollution of surface and groundwater poses the greatest and most pervasive threat to public health, it must be always controlled. The presence of microorganisms, particularly fecal coliform bacteria (FC), is monitored to ascertain the water's quality. In this investigation, surface waters had a higher MPN index than groundwater. The study's analysis of the water made it abundantly evident that it was teeming with indicator species, which are signs of fecal pollution and, consequently, human influence. The principal bacterial indication of fecal pollution in water is the coliform bacterium [21]. Hazardous chemicals and dangerous microorganisms must not be present in potable water [22]. Surface water that has been cleaned and groundwater shouldn't include bacteria that indicate fecal contamination or pathogens. Since it is impossible to test water for every potential pathogen that could be present, the identification of fecal indicator bacteria provides a sensitive approach to assessing the quality of drinking water (WHO 2004). The primary cause of the rivalry that has resulted in pollution and environmental deterioration is an imbalance between supply and demand. Bacterial contamination of water sources may result from leaks, cross-connections, or inadequate raw water disinfection at the treatment facility. The main cause of water pollution is due to human impact. The presence of microorganisms, particularly fecal coliform bacteria (FC), is monitored to ascertain the water's quality. In this investigation, surface waters had a higher MPN index than groundwater. The study's analysis of the water made it abundantly evident that it was teeming with indicator species, which are signs of fecal pollution and, consequently, human influence. Four distinct bacterial species were found in our investigation's samples of surface and groundwater. *Enterococcus faecalis, Staphylococcus aureus, Escherichia coli,* and *Enterobacter aerogenes* were the most frequently isolated microorganisms. The EPA states that the presence of *E. coli* suggests recent pollution from sewage or animal waste. Enteric bacteria, such as *Enterococcu*s species and *E. Coli,* are more likely to survive in certain environments due to temperature and nutrient availability [23]. Drinking water contamination is the main way that enteric infections like *Shigella, Vibrio,* and *Salmonella* spread, according to [24]. However, reported that Salmonella was not detected in treated drinking water in the samples under discussion. Numerous bacterial species, including *Enterococcus* faecalis, *E. coli*, and *Streptococcus, bacillus*, were found to be present in the study's evaluation of the bacteriological quality of surface and groundwater.

This substantial rise in microbes could be the result of recent population growth combined with inadequate sanitation and treatment. This has led to sewage and water bodies becoming mixed, which has contaminated the water. This could be the cause of the coliforms and other organisms found in all of the water samples. Given the prevalence of multidrug-resistant organisms in the drinking water system, there may be a risk to public health if people consume the water sample that was collected for testing.

4. Conclusion

To compare the current study's findings with worldwide drinking water standards, a series of microbiological studies and the identification of the microbial groups that predominate in surface and groundwater were conducted. Every month, samples of water were collected from various sources, including groundwater and surface water. To maintain the hygienic quality of the water supply, it is strongly advised to do bacteriological examinations on both the water entering the distribution system and the water already in the system on a frequent and regular basis. Regular exams are necessary to maintain hygienic conditions. To prevent contamination from entering the system, piped supplies must be kept at a high enough pressure throughout the distribution system. Additionally, every distribution system must have a mechanism for chlorination on hand to handle any accidental pollution, which is always a possibility. Therefore,

regular, adequate surveillance and monitoring of these water sources should be conducted. If monitoring is not done, the water needs to be made clean again with boiling, chlorine, or some other technique. Since preventing chronic illnesses is frequently more effective and affordable than treating them, all parties involved, as well as the government and other pertinent organizations, should take seriously any efforts made to stop an epidemic from starting. However, as the current study is primarily a primary work, more research is required to reach a specific conclusion regarding the therapeutic implications.

Compliance with ethical standards

Disclosure of Conflict of Interest

The author has no conflict of interest in this research.

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