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Inventory of Total and Fecal Coliform Bacteria in Ground Water in and around Ariyalur district Tamilnadu, India

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Abstract
Total coliform (TC) and fecal coliform (FC) bacteria were analyzed in ground water in and aroundAriyalur district, Tamilnadu, India.The analysis included a total coliform count by MPN method, was used for total coliform (TC) as well as fecal (FC) coliform bacteria. All samples were found contaminated with total coliform (TC) and fecal coliform (FC) and the counts were higher than the maximum microbial contaminant level by World Health Organization (WHO). Bacteriologically the water quality of the drinking water is unsatisfactory**.** The results of this studyshow the higher level of bacteriological synthesis insampling period. Industrial leads to the pollution of water resources and may place aquatic organisms and human health at risk.
Keywords: Ariyalur district, Ground water, Coliform, Water quality, Contamination

Introduction

Natural water contains microorganisms. Groundwater usually has fever microorganisms than surface water because of its long travel time in the sub-surface environment (JometSebastian et al2013). (Wani and Thorat 2007) reported that the maximum total viable count observed in ground water samples of Salim Ali Lake, which was due to the addition of organic matter from industries. (Adekunle et al 2007) illustrated that inadequate and unhygienic handling of solid-wastes in the rural area could have generated high concentration of microbial organisms. (Anna and Yeeung-Cheung 2009) summarized that the impairment of rural streams, lakes and coastal waters as a result of microbial pollution has a significant impact on human health. (Monika Sharma and Saharan 2013) illustrated that coliforms are bacteria that are always present in the digestive tracts of animals, including beings humans and are found in their wastes of Siwani block. As urbanization increases around the world, many of these reservoirs are being created to hinder in controlling runoff. There is considerable need for additional quantitative data and a better understanding of these small impoundments so they may be managed more effectively (Vijayan 2018). The disposal of wastes made by tourists may lead to the slight change in these parameters(Anima Upadhyay 2014). The high values of these parameters is the pollution caused due to anthropogenic activities (Shivam Trivedi & K. Ganesha Raj 2019)

Study Area

Ariyalur is one of the districts in Tamil Nadu state. It is rich in limestone resources. Big industrial houses like Birlas (Grasim Industries), India cements, Dalmia cements and Madras cements have their cement units here.

Materials and method

Bacteriological Analysis

The bacteriological analysis of ground water samples were performed as per the standard methods of APHA (1995) and Manivasagam (1985). The analysis included a total coliform count by MPN method,a enumeration of bacterial microorganisms by serial dilution.

Sampling

Bacteriological examinations were carried out on samples collected at representative points throughout the distribution system. The frequency of sampling and the location of sampling points were

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such as to insure accurate determination of the bacteriologic quality of the ground water. Samples were taken at reasonably evenly spaced time intervals.

Sample Bottles

Stoppered ground glass bottles capable of being sterilized and of suitable size and shape were used for sample collection. The bottles were sterilized for 60 minutes at a temperature of 170°C, and then uv-irradiation was also performed.

Coliform Count in Ground water By Multiple-Tube Fermentation Test (MPN – Method)

Multiple-tube fermentation test is used to detect coliform bacteria which were used as an indicator of fecal contamination. The test is performed sequentially in three states: presumptive, confirmed and completed. Coliform bacteria are aerobic or facultative anaerobic, gram-negative or rod-shaped, capable of fermenting lactose with the production of acid and gas within 24 hours of incubation at 37°C.

Presumptive Coliform Test

Principle

The presumptive coliform test is used to detect and estimate the coliform population of a water sample. In this test, known volumes of water (dilutions) are added to lactose fermentation tubes.The production of acid and gas by the fermentation of lactose is a positive test for coliform bacteria. The lactose broth used in this test is selective for the isolation of coliforms. A statistical method is used to estimate the population of coliforms, which means that the result obtained is expressed as the most probable number of coliforms.

Requirements

i. Water Samples

ii. Lactose fermentation broth 1X and 2X (pH 6.9)

Lactose 5.0 g

Peptone 5.0 g

Beef extract 3.0 g

Distilled water 1000 ml

For 2X broth, the quantities of all the ingredients are doubled except the distilled water.

1X = SSLB (Single Strength Lactose Broth)

2X = DSLB (Double Strength Lactose Broth)

Procedure

1. Arranged five DSLB and ten tubes with Durham tube.
2. Marked each tube according to the amount of water that is to be dispensed to it. (10 ml, 1.0 ml and 0.1 ml)
3. Using a sterile 10 ml pipette, transferred 10 ml of water sample to each of the DSLB broth.
4. With a 1.0 ml pipette, transferred 1 ml of water to each of the middle set of five SSLB tubes and 0.1 ml to each of the last five SSLB tubes.
5. Incubated the tubes at 37°C for 24 hours. Following incubation, the tubes are observed in each set that has 10% gas or more. A count of number of lactose fermentation tubes showing production of gas after the incubation period is taken and MPN of coliform is found by matching the results with those provided in the statistical table is given below Table (1).

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Table – 1Most Probable Number (MPN) of coliform bacteria present in 100 ml of groundwater, for various combination of positive and negative results when five 10 ml portion, five 1 ml portion and five negative results when five 10 ml portion, five 1 ml portion and five 0.1 ml portion are used

Combination of Positives	MPN Index / 100 ml	Combination of Positives	MPN Index / 100 ml
0-0-0	< 2	4-3-0	27
0-0-1	2	4-3-1	33
0-1-0	2	4-4-0	34
0-2-0	4	5-0-0	23
1-0-0	2	5-0-1	30
1-0-1	4	5-0-2	40
1-1-0	4	5-1-0	30
1-1-1	6	5-1-1	50
1-2-0	6	5-1-2	60
2-0-0	4	5-2-0	50
2-0-1	7	5-2-1	70
2-1-0	7	5-2-2	90
2-1-1	9	5-3-0	80
2-2-0	9	5-3-1	110
2-3-0	12	5-3-2	140
3-0-0	8	5-3-3	170
3-0-1	11	5-4-0	130
3-1-0	11	5-4-1	170
3-1-1	14	5-4-2	220
3-2-0	14	5-4-3	280
3-2-1	17	5-4-4	350
4-0-0	13	5-5-0	240
4-0-1	17	5-5-1	300
4-1-0	17	5-5-2	500
4-1-1	21	5-5-3	900
4-1-2	26	5-5-4	1600
4-2-0	22	5-5-5	$\geq$ 1600

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Results and Discussion

Bacteria are the microscopic organism that have existence for a very long time. The importance of microbiological quality of drinking water cannot be overemphasized in a relation in water borne disease (WHO 2011). The coliform count is the most commonly measured indicators of water quality. They are defined as gram negative, non-spore forming rods which are able to ferment lactose at 37° c with the production of gas with 24 – 48 hours. Many types of microbes live naturally in a soil and rock environment and are the part of the sub surface ecosystem. During the periods of high water table, for example, after prolonged rainfall ground water and surface water has greater contact with the soil organism and nutrients. The level of total coliform in water is generally used as an indicator of cleanliness and effectiveness of disinfection. The detection of total coliform in water at levels greater than 10/100 ml is an indication that the water needs to be treated. The use of Escherichia coil(E. coli) as an indicator of fecal pollution in drinking-water is well established. It is absolutely importantthat drinking-water must never contain any fecal indicator organism.

Source of Total and Fecal Coliform in ground water can include:

1. Agriculture runoff
2. Effluent from septic system or sewage discharge
3. Infiltration of domestic or wild animal fecal matter

Poor well maintenance and construction (particularly shallow dug wells) can also increase the risk of bacteria and other harmful organisms getting into a well water supply.

Fecal Coliform Bacteria

Fecal coliform bacteria are a subgroup of total coliform bacteria. They exist in the intestines and feces of people and animals. E coli bacteria is a subgroup of the fecal coliform group. Most E coli bacteria are harmless and exist in the intestines of people and warm-blooded animals. However, some strains can cause illness. The presence of E coli in adrinking water sample usually indicate recent fecal contamination. That means there is a greater risk that pathogens are present.

Total coliform bacteria

Total coliform bacteria are common in the environment (soil or vegetation) and are generally harmless. If a lab detects only total coliform bacteria in a drinking water the source is probably environmental and fecal contamination is unlikely. However if environmental contamination can enter the system pathogens could get in too. It is important to find and resolve the source of contamination. Total coliform bacteria include a wide range of aerobic and facultative anaerobic, gram- negative , non-spore-forming bacilli capable of growing in the presence of relatively high concentrations of bile salts with the fermentation of lactose and production of acid or aldehyde within 24 hours at 35-37° c. (Adetunji et al., 2007) The mean value of fecal coliform counts for ground water samples are observed to be 11-14,12-17 and 14-19 in pre monsoon, monsoon and post monsoon seasons, respectively (Tables : 2,3&4) and mean Total coliform bacteria count values are within the range of 15-22,19-24 and 23-34 for ground water sample for pre monsoon, monsoon and post monsoon seasons, respectively (Tables : 2,3&4).

Discussion

The most probable number is suitable number is a suitable and widely used method to determine the microbial quality of water. In our observation MPN for total coliform and fecal coliform are noted to be very higher than the permissible limit of WHO (0/100ml of MPN coliforms) in all the ground water samples for pre monsoon, monsoon and post monsoon season. The increase in microbial load isprobably due to addition of untreated sewage, drainage and industrial wastes

(Kaufmann et al., 1997). Thus microorganisms have samples of nutrients and hence grow in abundance. These heavy loads of microorganisms deplete the oxygen content as has been observed in our study.

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The very high values of total coliform and fecal coliform, recorded in the monsoon seasons for ground water, which may be due to the addition of organic matter from industries and land washings and domestic wastes by rain will augment the potent of bacterial count (Thorat and Sulthana, 2000). High MPN values suggest that the water is not suitable for drinking purpose. The presence of bacteria in water is an indicator for the presence of organism causing cholera dysentery and typhoid, etc.

The World Health Organization has reported that about 30,000 people die every day in developing countries because of unsanitary water supply. The absence of bacterialorganisms in some stations indicates that the environmental conditions (temperature, etc.) are not favorable for the bacterial growth.

The presence of fecal coliform in well water may indicate recent contamination of ground water by human sewage or animal droppings which could contain other bacteria, viruses, or disease causing organisms. This is why coliform bacteria are considered as indicator organisms. Their presence warns of the potential presence of disease causing organisms and alerts the person responsible for water to take precautionary action.

Table – 2 Mean values of Bacteriological Analysis (FC&TC) of Ground water

STATIONS	SAMPLE NAME	FC	TC
A1	Ground Water	12	17
A2	Ground Water	14	17
B1	Ground Water	12	15
B2	Ground Water	14	19
C1	Ground Water	12	17
C2	Ground Water	10	17
D1	Ground Water	13	18
D2	Ground Water	13	18
E1	Ground Water	14	18
E2	Ground Water	13	19
F1	Ground Water	12	20
F2	Ground Water	11	18
G1	Ground Water	11	20
G2	Ground Water	13	19
H1	Ground Water	12	21
H2	Ground Water	12	20
I1	Ground Water	11	21
I2	Ground Water	11	18
J1	Ground Water	12	19

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J2	Ground Water	13	21
K1	Ground Water	11	22
K2	Ground Water	11	22
L1	Ground Water	11	21
L2	Ground Water	11	21

sources of Ariyalurdistrict collected during pre-monsoon – 2015,2016 and 2017

Table – 3 Mean values of Bacteriological Analysis (FC&TC) of Ground water sources of Ariyalur district collected during monsoon – 2015,2016 and 2017

STATIONS	SAMPLE NAME	FC	TC
A1	Ground Water	13	19
A2	Ground Water	15	20
B1	Ground Water	13	21
B2	Ground Water	16	24
C1	Ground Water	13	20
C2	Ground Water	13	20
D1	Ground Water	14	21
D2	Ground Water	15	22
E1	Ground Water	15	21
E2	Ground Water	17	22
F1	Ground Water	15	22
F2	Ground Water	13	22
G1	Ground Water	13	23
G2	Ground Water	14.	22
H1	Ground Water	15	22
H2	Ground Water	14.	23
I1	Ground Water	14.	24
I2	Ground Water	13	24
J1	Ground Water	14	22
J2	Ground Water	14	22
K1	Ground Water	14	23

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K2	Ground Water	12	23
L1	Ground Water	13	24
L2	Ground Water	12.	24

Table – 4 Mean values of Bacteriological Analysis (FC&TC) of Ground water sources of Ariyalur district collected during postmonsoon – 2015 and 2016

STATIONS	SAMPLE NAME	FC	TC
A1	Ground Water	16	23
A2	Ground Water	17	23
B1	Ground Water	15	25
B2	Ground Water	18	26
C1	Ground Water	17	23
C2	Ground Water	15	25
D1	Ground Water	16	26
D2	Ground Water	17	28
E1	Ground Water	17	27
E2	Ground Water	19	30
F1	Ground Water	17	31
F2	Ground Water	15	33
G1	Ground Water	15	29
G2	Ground Water	16	31
H1	Ground Water	16	30
H2	Ground Water	16	32
I1	Ground Water	15	30
I2	Ground Water	14	32
J1	Ground Water	14	33
J2	Ground Water	16	33
K1	Ground Water	18	32
K2	Ground Water	16	33

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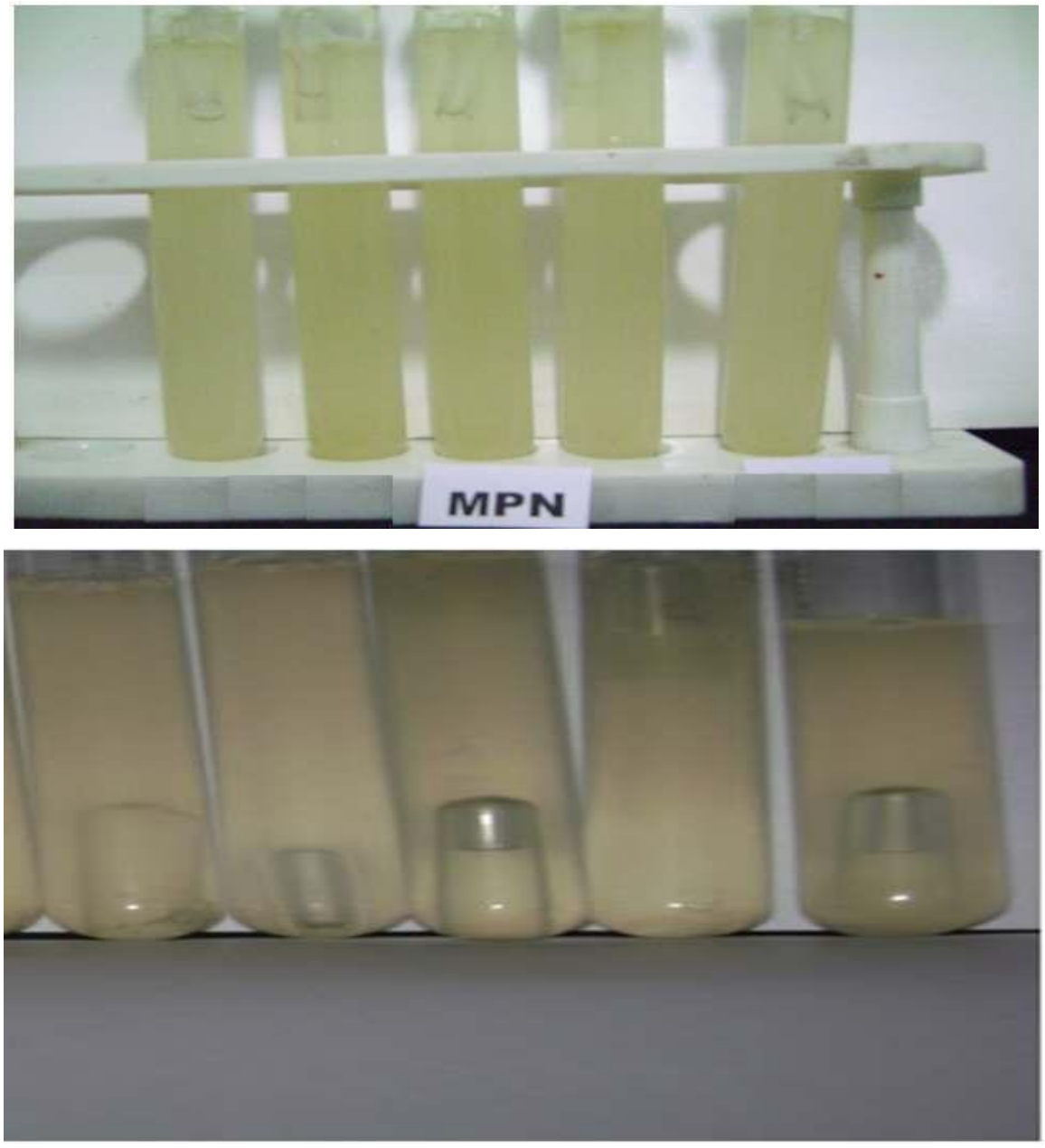
L1	Ground Water	15	34
L2	Ground Water	16	33

Figure: 1 Bacteriologicl analysis showing gas production



Conclusion

The water samples were subjected to bacteriological examinations like, Total coliform andfecal coliform of ground water samples. The FC and TC exceed the permissible limit of WHO. The bacteriological components indicate the presence of pathogenic microorganisms.After some treatments using chemical and mechanical methods the contaminated water can be used for drinking purposes. The water should be monitored properly before its usage as drinking water in order to avoid possible adverse effects. Therefore, the public should be made aware of using good drinking.

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