ASSESSMENT OF TOTAL AND FAECAL COLIFORM IN PERENNIAL SPRING WATER IN AIZAWL CITY, MIZORAM

[1]Sabrina Lalhmangaihzuali, [2]H. Lalramnghinglova and [3]B. P. Mishra
[1]Research Scholar, [2]Professor, [3] Professor
Department of Environmental Science
Mizoram University, Tanhril, Aizawl, Mizoram, India.

Abstract:

Coliform bacteria have been used to evaluate the general quality of water. Analysis of coliforms in perennial spring water from five areas in Aizawl city (viz., North zone –Bawngkawn Tuikhur, Central zone - Zotui, Electric Veng, East zone –Theihai Tuikhurarmed veng , South zone – SailoTui, Mission Veng, West zone – Vantlang Tuikhur, Govt. Complex) was done to assess the quality of the spring water throughout the year and possible risks from consumption by people living in the nearby locality. Coliform bacteria originate as organisms in soil or vegetation and in the intestinal tract of warm – blooded animals. Bacteria reproduce rapidly if conditions are right for growth. MPN method was used to determine the most probable number of bacteria from the various sites selected in and around Aizawl city. The water samples are incubated separately in a media at a different temperatures and is left for over a night at different temperatures. In north zone maximum MPN of total coliform was found in the month may whereas the minimum was found in the month of December. In central zone maximum MPN was found in the month of October and minimum was found in May. In east zone maximum was found in jan and minimum in November and april. In south zone maximum was found in June whereas minimum was found in February. In west zone maximum was found in july and minimum was found in month of april. Faecal coliform was absent in most of the months accept in May, September and October in all sites.

Keywords: Total coliform, faecal coliform, perennial spring water, Aizawl City.

I. INTRODUCTION:

Coliforms are bacteria that are always present in the digestive tracts of animals, including humans, and are found in their wastes. They are also found in plant and soil material. The most basic test for bacterial contamination of a water supply is the test for total coliform bacteria. Total coliform counts give a general indication of the sanitary condition of a water supply. A. Total coliforms include bacteria that are found in the soil, in water that has been influenced by surface water, and in human or animal waste. B. Faecal coliforms are the group of the total coliforms that are considered to be present specifically in the gut and faeces of warm-blooded animals. Because the origins of faecal coliforms are more specific than the origins of the more general total coliform group of bacteria, faecal coliforms are considered a more accurate indication of animal or human waste than the total coliforms. The presence of *E. coli* in water indicates that the water was contaminated by faecal pollution of human or other warm-blooded animals. (An *et al.,* 2002). Total coliforms and *E.* coli, the most common member of faecal coliform bacteria, are the important microbiological parameters of water quality (Dufour, 1977) Testing for bacteria is the only reliable way to know if your water is safe. You cannot tell by the look, taste, or smell of the water if disease-causing organisms are in it. The New York State Department of Health recommends that well owners test their water for coliform bacteria at least once a year.

Natural spring waters originate from groundwater and are usually rich in minerals such as calcium, magnesium, and potassium (Cabassud *et al.,2001; Leclerc and Moreau, 2002).*

Water pollution caused by faecal contamination is a serious problem due to the potential for contracting diseases from pathogens (disease causing organisms). In waters of the U.S., Canada and other countries, water quality is monitored to protect the health of the general public. Bacteria contamination is one monitored pollutant. In the U.S., faecal coliform testing is one of the nine tests of water quality that form the overall water-quality rating in a process used by U.S. EPA. The faecal coliform assay should only be used to assess the presence of faecal matter in situations where faecal coliforms of non-faecal origin are not commonly encountered (Doyle *et al.,* 2006). EPA has approved a number of different methods to analyse samples for bacteria (USEPA, 2008). Coliforms are relatively easy to identify, are usually present in larger numbers than more dangerous pathogens, and respond to the environment, wastewater treatment, and water treatment similarly to many pathogens. As a result, testing for coliform bacteria can be a reasonable indication of whether other pathogenic bacteria are present.

Total coliforms and E. coli are used as indicators to measure the degree of pollution and sanitary quality of well water, because testing for all known pathogens is a complicated and expensive process. (Facts on drinking water). The main source of pathogens in drinking water is through recent contamination from human or animal waste, from improperly treated septic and sewage discharges, leaching of animal manure, storm water runoff and domestic animals or wildlife.

During and after precipitation, bacteria and other harmful microorganisms from any of these sources may be washed into rivers, lakes, or groundwater. Poor well construction or poor maintenance can increase the risk of groundwater contamination Shukla *et.al* 1992.

The presence of E. coli in water indicated that the water was contaminated by faecal material of humans or other warm – blooded animals. The U.S. Environmental Protection Agency (EPA) recommended that E. coli is a better indicator if faecal pollution than faecal coliform for purposes of evaluating ambient fresh water quality (USEPA, 1986. Water quality is affected by a wide range of natural and human influences. The most important of the natural influences are geological, hydrological and climatic, since these affect the quantity and the quality of water available (1). Most probable number (MPN) is a typical test for fecal coliform (Mengesha *et al*., 2004).

II. RESEARCH METHODOLOGY

2.1. Description of study area/sites:

Aizawl is the capital of the state of Mizoram in India. It is the largest city in the state. Aizawl is located north of the Tropic of Cancer in the northern part of Mizoram. It is situated on a ridge 1,132 metres (3715 ft) above sea level, with the Tlawng river valley to its west and the Tuirial river valley to its east. As of 2011 India census, Aizawl had a population of 293,416. Females constitute 50.61% of the population and males made up the remaining 49.39%.

For detailed investigation, a total of 5 strings within the Aizawl city were selected in different locations (i.e., (one site each in North, East,West , South and Central zone).

Site 1: BawngkawnTuikhur (Near Bezalel Workshop) in North zone, with coordinates - N 23˚45'16.7"; E 092˚43'41.0".

Site 2: TheihaiTuikhur, AremdVeng in East zone, with coordinates - N 23˚44'16.0" E 092˚43'14.6"

Site 3: Public Tuikhur, Govt. Complex (Beside Public Step), with coordinates - N 23˚43'50.5"; E 092˚41'39.3"

Site 4: SailoTui, Mission Veng in South zone, with coordinates - N 23˚43'08.6"; E 092˚42'54.6"

Site 5: Central - Zotui, Electric Veng (Near ESRA Drug Store) in central zone, with coordinates - N 23˚44'25.0"; E 092˚43'05.5"

2.2. Materials and method

Collection of water:

The water samples were collected from selected sites at monthly interval (in triplicate), and brought to the laboratory for analysis.

2.3. Preparation of medium:

2.3.1. MacConkey Broth:
a) Single strength: 34.51g of MacConkey Broth was suspended in 1000ml distilled water.
b) Double strength: 69.02g of MacConkey Broth was suspended in 1000ml distilled water.

2.3.2. Brilliant Green Bile Broth: 40.01g of Brilliant Green Bile Broth was suspended in 1000ml distilled water.

2.3.4. EC Broth: 37.0g of EC Broth was suspended in 1000ml of distilled water.

2.4. Presumption Test:

i. Three rows of three tubes each were arranged and labelled in the test tube racks. First row was labelled as F1 and second and third rows was labelled F2 and F3 respectively.
   a) F1 contain 10ml of double strength of MacConkey Broth and inverted Durham's tube.
   b) F2 contain 10ml of single strength of MacConkey Broth and inverted Durham's tube.
   c) F3 contain 10ml of single strength of MacConkey Broth and inverted Durham's tube.
ii. With a sterile pipette 10ml of sample was added to each of the three F1 tube.
iii. With a sterile pipette 1ml of sample was added to each of the three F2 tube.
iv. 1:10 dilution of sample was prepared by adding 1ml of water sample to 9ml of sterile distilled water.
v. With a sterile pipette 10ml of 1:10 diluted sample was added to each of the three F3 tube.
vi. After gently shaking the tubes to mix the inoculum, the rack was incubated for 24hrs. at 35^0C for total coliform and 44^0C for faecal coliform.
vii. After 24hrs of incubation the test tube rack was taken out from the incubator and was left for few minutes to cool down.
viii. Few minutes later the tube was observed for separation. Tube that produced gas was separated from the tube that do not produce gas.
ix. Gas producing tube was taken in separate rack to undergo confirmatory test.

2.5. Confirmative Test:

i. From the gas producing tube, a loop full of broth was transferred to a confirmative broth.
ii. Brilliant Green Bile Broth was the broth used for confirmative test of total coliform and it was then incubated at 35^0C for 24hrs.
iii. EC Broth was used for confirmative test of faecal coliform. After loop transfer was done it was incubated at 44^0C for 24hrs.

iv. After 24hrs of incubation the presence of total and faecal coliform was confirmed if gas was in the confirmation broth.
v. The MPN of coliform was determined from the MPN log table.

III. RESULTS AND DISCUSSION:

The findings on Total Coliform and Faecal coliform counts are presented in Table 1 and 2. The total coliform count ranged between 7.3 MPN (February at site 2, November and April at site 3 and February at Site 4) to 2400 MPN (September, May, June and July at site 1, June at site 4 and June and August at Site 5). And the faecal coliform count if present in the water body ranged between 3(March in site1, October in site 3, April in site 4 and September and October in site 5) to 210 MPN (june at site 1).

At site 1 the maximum MPN of total coliforms count was during the months of May June and September with 2400 MPN and was minimum during the month of December with 14 MPN. And the maximum faecal coliforms was found during the month of june with value 210 MPN and it was minimum with 3MPN during the month of March

At site 2 the maximum MPN of total coliforms counts was found during the months of September and October with 290 MPN and minimum total coliforms count was found at the month of February with value 7.3MPN. And the maximum faecal coliforms was found during the month of june with value 15 MPN and it was minimum with 3.6 MPN during the month of September

At site 3 the maximum total coliforms count was found during the month of January and the value at this month was 93 MPN whereas the minimum value at the site was found in November and April and the value is 7.3 MPN. And the maximum faecal coliforms was found during the month of September and June with value 3.6 MPN and it was minimum with 3MPN during the month of October.

At site 4 the maximum MPN of total coliforms count was during the months of June with 2400 MPN and was minimum during the month of February with value 7.3 MPN. And the maximum faecal coliforms was found during the month of June with value 75 MPN and it was minimum with 3MPN during the month of April

At site site 5 the maximum MPN of total coliforms count was during the months of June and August with 2400 MPN and the minimum MPN was found during the month of April with 16 MPN. And the maximum faecal coliforms was found during the month of june with value 150 MPN and it was minimum with 3MPN during the month of September and October.

The presence of total and fecal coliform was highly accelerated during the month June when there was excessive rainfall. Other than site A all other sites are properly protected or are under constructed areas, but from the observation the protection do not completely prevent the entry of coliform to the water body although the protection and proper maintenance had prevent pollution at some level. Site A water which is located in open area has the highest MPN. Using of water that owes no threat to the consumer's health depends on continuous protection. Because of human frailty associated with protection, priority should be given to selection of the purest source. Polluted source should not be used unless other sources are economically unavailable. Ensuring bacteriological quality of drinking water sources is vital to public health function. On the other hand regular examination of water quality for the presence of organisms remain the most sensitive way of assessing the hygienic conditions of water (World Health Organization 2003).

table 1: monthly variations of total coliform counts in the five study sites.

Sites	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17
1	2400	150	24	14	20	15	240	93	2400	2400	1100	150
2	290	290	93	9.1	21	7.3	240	43	23	210	120	93
3	15	20	7.3	39	93	15	21	7.3	28	42	15	9.1
4	1100	160	460	44	28	7.3	39	21	1100	2400	210	150
5	460	53	42	53	39	20	64	16	1100	2400	1100	2400

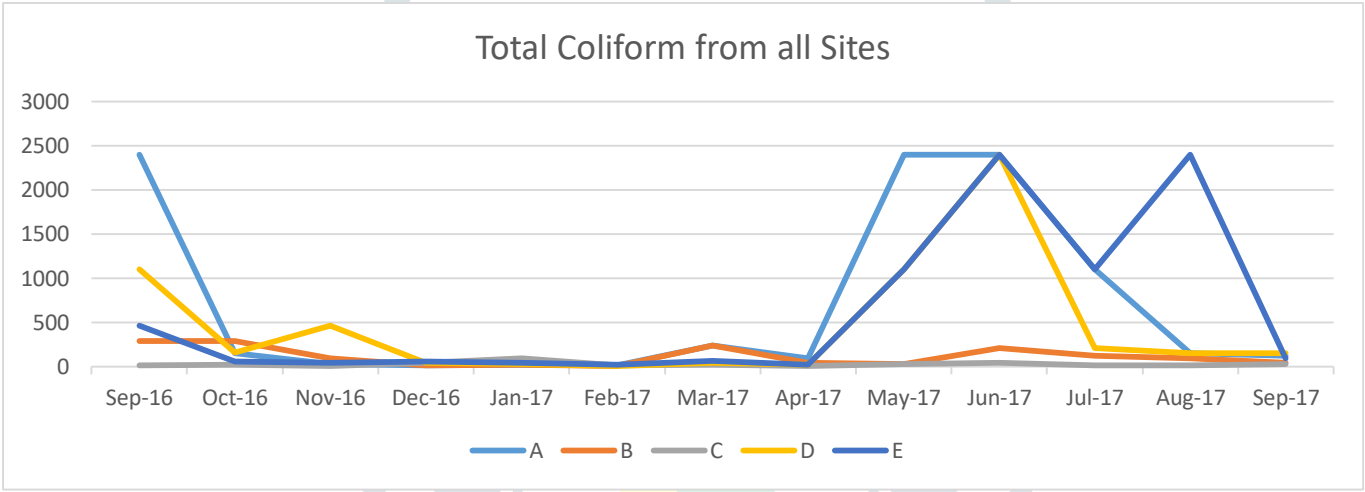

fig. 1: graphical representation of total coliform present from site 1, 2, 3, 4 and 5

table 2: monthly variations of faecal coliform counts in the five study sites.

Sites	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17
1	(6.2)7	0	0	0	0	0	3	3.6	0	210	3.6	0
2	3.6	0	0	0	0	0	0	0	0	15	0	0
3	3.6	3	0	0	0	0	0	0	0	3.6	0	0
4	0	0	0	0	0	0	0	3	0	75	0	0
5	3	3	0	0	0	0	0	0	0	150	0	0

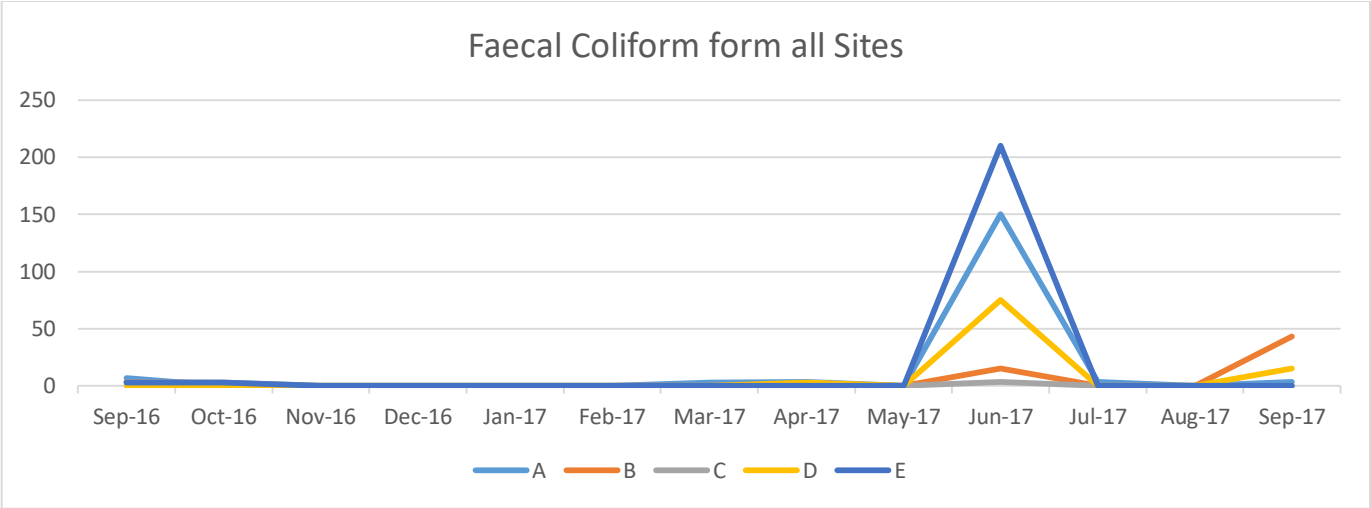

fig. 2: graphical representation of faecal coliform present from site 1, 2, 3, 4 and 5

IV. CONCLUSIONS:

In conclusion, majority of the water resources had unacceptable total coliform counts and faecal contamination during midyear at some study sites and if the water resources were tend to consume for drinking purpose it is highly recommended to treat the water for disinfection and periodic bacteriological appraisal of drinking water sources. The open spring water where there is no protective measures taken in the area the water is highly contaminated comparing to the water under constructed or protected areas. The contamination is also due to the leakage of sewage and improper drainage system of the houses near by the water resources. So in conclusion proper protection of the spring water where it was collected, proper drainage system as well as effluent discharging pipeline from every household could help in maintaining the water quality.

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References

An, Y.-J., Kamphell, D. H. and Breidenbach, G.P.: 2002, '*Escherichia coli* and total coliforms in water and sediments at lake marinas', *Environ. Pollut.* pp 120, 277- 284.

Cabassud, C., Burgaud, C. and Espenan, J.-M.: 2001, 'Spring water treatment with ultrafiltration and stripping', *Desalination,* pp 137, 123-131 .

Dufour, A.P.: 1977, *Escherichia coli:* The Fecal Coliform, inn: A. W. Hoadley and B. J. Dutka (eds.), *Bacterial Indicators/ Health Hazards Associated With Water,* ASTM Philadelphia, pp. 48-58.

Doyle, M. P., and M. C. Erickson. 2006. "Closing the door on the fecal coliform assay." *Microbe* 1:162-163. ISSN 1558-7460.

Environmental Monitoring and Assessment, March 2005, Volume 102, Issue 1-3, pp 131-137.

Facts on Drinking Water: Coliform Bacteria – Total Coliforms & E. Coli http://www.rpc.ca/english/pdf/water/California.pdf&ved=2ahUKEwiGutLvpbvdAhWIQI8KHWVtCQUQFjABegQIDBAE&usg=AOvVaw04tIlvlK-PD-9zCYCooqr3

Mengesha A, Memo W, Baye G (2004). A survey of bacteriological quality of drinking water in North Gondar. J. Health Dev., Ethiop, pp 112-115.

Shukla, S.C., B.D. Tripathi, **B.P. Mishra** and S.S. Chaturvedi 1992. Physicochemical and bacteriological properties of the water of river Ganga at Ghazipur. *Comp. Physiol. & Ecology*, 17(3): 92-96. ISSN: 0859-4848

U.S. Environmental Protection Agency (EPA). Washington, DC (2008). "Analytical Methods Approved for Drinking Water Compliance Monitoring under the Total Coliform Rule." June 2008.

WHO (2003). *Emerging issues in water and infectious disease.* Geneva: World Health Organization, pp. 16 – 17