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Case Study Article

WATER POTABILITY TESTING CASE STUDY OF MUMBAI REGION.

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Abstract: In a Metropolitan city like Mumbai in India safe, consistent, and reliable water supply is a challenging task. Large number of population lives in areas of Mumbai that are suffering from water quality problems and water shortages which is also studied by our institution in a community-based project CAASP (Community Assessment Awareness Survey Program).Many areas have contaminated water with fecal Coliforms bacteria as the primary contaminant of concern. There are many aid groups that are actively working to develop and improve the water supply in the developing world. An important first step in such work is an accurate appraisal of the existing water supply. This appraisal often requires a rapid, onsite field assessment of possible fecal Coliforms contamination with minimal equipment. Therefore, Department of Biotechnology and Department of Botany of R.D. & S.H. National College have initiated a community-based project to evaluate the potability of water from different location of Mumbai by MPN (Most Probable Number) method since year 2009-10. This project also aims to provide guidance to the citizen of Mumbai through our institution about the usability and importance of water testing.

Keywords: MPN test, Potable water, CAASP

Introduction: Water borne diseases like diarrhea, dysentery etc. are one of the major causes of death in many countries like India, Bangladesh, Indonesia etc. According to World Development Report (1992), 80% of the diseases in the world are related to water. According to a book published by World Health Organization and Organization for Economic Co-operation and Development, around 2.2 million of the 3.3 million water related deaths are caused due to diarrhea. The major reason for this problem is the unavailability of potable water to the masses. Absence of harmful chemicals, pathogenic micro-organisms is some of the characteristic features of potable water.

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To reduce the risk of people falling ill due to water borne diseases, it is essential that monitoring system for checking the physical, chemical and microbiological quality of drinking water are in place.

Most of the countries follow WHO guidelines for monitoring of drinking water. According to the guidelines, contamination of drinking water with micro-organisms belonging to a class of bacteria known as Coliforms are responsible for the occurrence of water borne diseases. This class of micro-organisms are indicators of fecal contamination in water.

Over past decades, many methods have been developed by researchers for the identification of fecal contamination in drinking water. Most of these methods are based on the guidelines set by the World Health Organization (WHO). Dilution technique of the Most Probable Number (MPN) method is used to identify the presence of Coliforms (Alexander, 1965; Foch and Joseph, 1973). This method is based on the characteristic reactions given by the bacteria in different media. It is used to identify and estimate the amount of total coli forms present in the water sample. In this CAASP project, 1000 water samples from different locations of Mumbai were tested using MPN method. IMViC analysis of these samples was carried out to identify the contaminating organisms. Out of 1000 samples 7.5% (i.e. 75 samples) were found to be contaminated.

Material and Method:

Sample: 1000 Water samples were collected from different locations of Mumbai. Samples were collected in sterilized water collection bottles from different sources.

Most Probable Number (MPN) Method: For presumptive test, water samples of volume 10 ml, 1 ml, 0.1ml were taken and inoculated in test tubes containing Lauyrl-tryptose broth of single strength and double strength media tubes were incubated at 37^0C for 24 hours. After 24 hours, if the test tubes show production of gas then the test is positive, MPN index is calculated and a confirmatory test is performed (Alexander, 1965; Focht and Joseph, 1973).

For confirmatory test, a loopful of culture is taken from the test tubes of presumptive test showing positive result and is streaked on Eosin Ethylene Blue Agar plate. Plates are incubated at 37^0 C for 24 – 48 hours. Presence of greenish metallic shine indicates presence of coliforms in the water sample (Betty H. Olson, 1978).The pure culturing was done by streaking the culture onto the media like MacConkey agar and then onto Nutrient Agar Slant.

Identification of isolated microorganisms: Isolates were tested for biochemical tests by using IMViC (Indole, Methyl Red, Voges-Proskauer, Citrate) test (Edmund M. Powers and Thomas G. Latt, 1977). The test organisms were inoculated into the tryptone water, MR and VP broth and streaking on Simon Citrate Agar plate and all test tubes and plate were incubated at 37^0C for 24 -48 hours (Michael E. Stiles and Lai-king NG, 1981; Edmund M. Powers *et al*, 1977, Vashist Hemraj *et al*, 2013). After incubation at 37^0C for 24 -48 hours, 1 ml Kovacs reagent (150 ml Amyl or isoamyl alcohol, 10 ml DMAB, 50 ml con. HCL) was added in Indole test tube. Formation of cherry red ring indicates positive result (James L. Botsford and R. D. Demoss, 1972; Vashist Hemraj *et al*, 2013). In MR broth 1ml methyl red pH indicator was added, change in color of media from yellow to red indicates organism is MR positive (Vashist Hemraj *et al*, 2013). In VP test, Voges-Proskauer reagent (5% α- naphthol, 60 % KOH) was added in VP broth, change in color of media from yellow to Creamson red or pink color indicates the organism is VP positive. In Citrate utilization test, change in color of media (Simons citrate agar slant/plate) from green to blue and growth of organism, determine that organism is Citrate test positive (Vashist Hemraj *et al*, 2013).

Based on the results of this test, by comparing with-Manual of Clinical Microbiology of ASM

(American Society for Microbiology) the micro-organism in the water sample is identified.

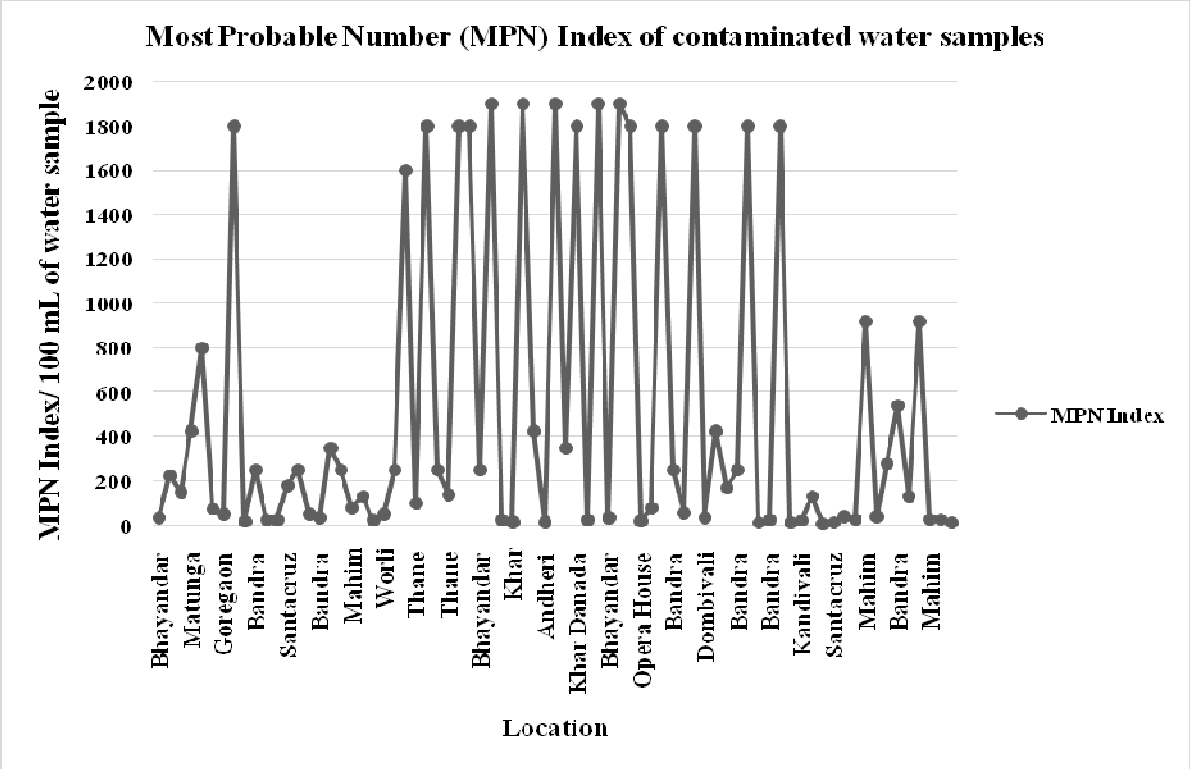
Result: The following data shows the MPN index of the contaminated water samples. In Graph No. 1. the peak represents the MPN/100mL of contaminated sample form different location of Mumbai.

Table No. 1: Most Probable Number (MPN) Index of contaminated water samples.

Sr. No	Sample no	Location	MPN Index/100 mL of water sample
1.	034	Bhayandar (West)	35
2.	043	Khar (West)	225
3.	066	Bandra (West)	150
4.	098	Matunga (East)	425
5.	122	Bhayandar (West)	800
6.	123	Malad (East)	75
7.	177	Goregaon (East)	50
8.	207	Bhayandar (East)	1800
9.	219	Bhayandar (West)	17
10.	229	Bandra (West)	250
11.	236	Borivalli (East)	25
12.	251	Mahim (West)	25
13.	266	Santacruz (West)	180
14.	280	Matunga (East)	250
15.	297	Bandra (West)	50
16.	300	Bandra (West)	35
17.	312	Khar Danada (West)	350
18.	325	Santacruz (West)	250
19.	343	Mahim	80
20.	356	Bandra (West)	130
21.	361	Borivalli (East)	25
22.	363	Worli	50
23.	364	Worli	250
24.	404	Khar	1600
25.	407	Thane (West)	100
26.	409	Andheri (West)	1800
27.	410	Andheri (West)	250
28.	421	Thane (West)	140
29.	426	Bandra (West)	1800
30.	447	Mahim	1800
31.	470	Bhayandar (West)	250
32.	475	Khar Danada (West)	1900
33.	476	Dharavi	25
34.	480	Khar	14
35.	488	Chandi Wali (West)	1900
36.	490	Bandra (West)	425
37.	491	Andheri (West)	14
38.	492	Bandra (West)	1900
39.	499	Khar Danada (West)	350
40.	526	Khar Danada (West)	1800
41.	535	Khar	25
42.	539	Borivalli (Wast)	1900
43.	553	Bhayandar (West)	35
44.	561	Mira Road (East)	1900
45.	589	Virar (West)	1800
46.	599	Opera House	20
47.	613	Andheri (West)	80
48.	624	Malad (West)	1800
49.	627	Bandra (West)	250
50.	630	Bandra (West)	55
51.	639	Bandra (East)	1800
52.	645	Dombivali (West)	35
53.	647	Khar	425
54.	652	Santacruz (East)	170
55.	661	Bandra (West)	250
56.	662	Andheri (East)	1800
57.	732	Mahim (West)	13
58.	757	Bandra (East)	25
59.	791	Santacruz (West)	1800

60.	901	Khar (West)	12
61.	902	Kandivali (West)	23
62.	903	Bandra (West)	130
63.	904	Bandra (East)	7.8
64.	906	Santacruz (West)	13
65.	907	Bandra (East)	40
66.	908	Bandra (West)	28
67.	909	Mahim (East)	920

68.	932	Santacruz (West)	40
69.	979	Dombivali (West)	280
70.	981	Bandra (West)	540
71.	994	Mahim (West)	130
72.	995	Mahim (West)	920
73.	996	Mahim (West)	28
74.	997	Mahim (West)	28
75.	998	Mahim (West)	13



Graph No. 1: Most Probable Number (MPN) Index of contaminated water samples from different location of Mumbai.

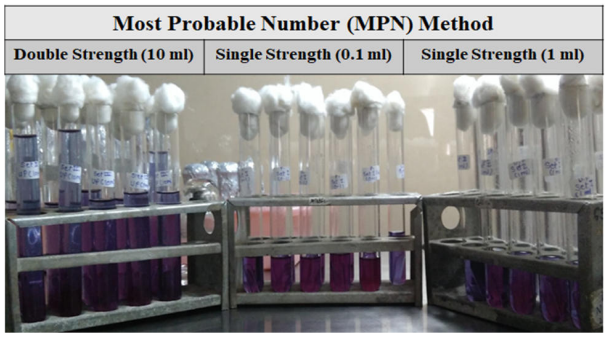


Figure no. 1: Presumptive test of MPN Method

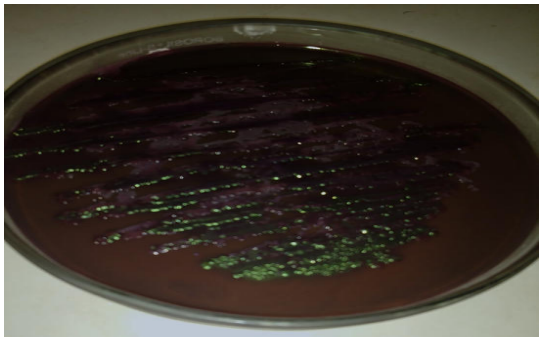


Figure no. 2: Confirmed test of MPN

Discussion: This community-based project CAASP (Community Assessment Awareness Survey Program) aimed to evaluate the potability of water by detection of fecal contamination. This study has been carried out since 2009, in this study it was found that, out of 1000 samples 75 samples showed positive result. IMViC analysis of this positive samples was carried out to identify the contaminant. To confirm the positive result, the samples were also sent to an ISO certified lab for evaluation.

The positive water sample showed presence of fecal Coliforms mostly of *Escherichia* spp. like *E.coli*. Coliforms like *S. typhi*, *Enterobacter aerogenes* etc. were also found. These micro organisms are indicators of fecal contamination in drinking water. Consumption of water contaminated with these organisms leads to various water borne diseases like diarrhea, dysentery etc.

Conclusion: This research insights on the evaluation of drinking water from different locations of Mumbai by detecting the presence of coliforms using MPN method. The contaminating species was also identified using IMViC analysis. This project was also aimed at making people aware of the diseases that can be caused due to consumption of fecally contaminated water.

Future Plan: Our future plan is to develop a Water Quality Field Testing Kits (WQFTKs) to detect fecal contamination in drinking water. Our plan is to make a cost effective, user friendly kit so that it can be used in the field.

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