

Supplementary Information

Mobile Water Kit (MWK): A Smartphone Compatible Low-Cost Water Monitoring System for Rapid Detection of Total Coliform and *E.coli*

Naga Siva Kumar Gunda,^a Selvaraj Naicker,^a Sujit Shinde,^b Sanjay Kimbahune,^b Sandhya Shrivastava,^c and Sushanta Mitra^{*a}

^a Department of Mechanical Engineering, University of Alberta, Edmonton, AB, Canada, T6G 2G8 Fax: 780 491 2200; Tel: 780 492 5017; E-mail:sushanta.mitra@ualberta.ca

^b TCS Innovation Labs, Tata Consultancy Services, Mumbai, Maharashtra, India, 400 601

^c Department of Microbiology, Bhavans Research Center, Mumbai, Maharashtra, India, 400 058

1 Standard Confirmatory Tests

Classical microbiological tests, including estimation of number of the coliform groups by the multiple tube dilution tests (presumptive test, confirmed test, or completed test) (IS1622:1981) were performed on field water samples to cross-check the results obtained by MWK.

1.1 Test for coliform

The coliform group includes aerobic and facultative anaerobic gram negative, non-spore forming rod shaped bacteria which ferments lactose with gas formation within 48 hr at 37° C. The standard test for the estimation of number of the coliform groups may be carried out either by multiple tube dilution tests (presumptive test, confirmed test, or completed test) or by the membrane filter technique. The presumptive, confirmed and completed tests with Most Probable Number (MPN) or multiple tube dilution tests are presented as total independent procedures. Standard practice in water analysis is to plant five tubes for each dilution and a minimum three different dilutions are employed.

MacConkey broth was used as a presumptive medium for the enumeration of coliform bacteria in water samples. Ten tubes of 10 ml volume for single strength and five tubes of 10 ml volume for the double strength MacConkey broth were prepared and sterilized at 15psi for 15 min. Ten milliliters of water sample was then added to each of the five tubes for the double strength medium. For the single strength medium, 1ml of water sample was added to the first five tubes and 0.1ml of water sample was added to rest of the five tubes. All above said tubes were incubated at 37°C for 18-24 hr. The presence of coliform bacteria was identified by the yellow coloration (indicating the growth with acid) and gas production with inverted Durham tube. The results were recorded using MPN Table. All positive cultures were retained for further confirmatory tests.

1.2 Test for Faecal coliform

This procedure is used to differentiate coliforms of faecal origin from those of non faecal origin. Faecal coliforms are those coliform which can ferment lactose at 44.5° C within 24±2 hr with the production of gas. Brilliant green bile lactose (BGBL) broth medium is used for this test. All presumptive positive tubes of the coliform test were subcultured in BGBL medium and incubated at 44.5° C for 24 hr in a water bath. Gas formation within 24 hr was an indicator of the presence of faecal coliform.

BGBL broth medium was used as a confirmatory test for fecal coliforms. Four milliliters of the medium was dispensed into dilution tubes and sterilized at 15psi for 15 min. The samples that tested positive for the presence of total coliform in section 1.1 were inoculated into the dilution tubes containing the BGBL broth medium and incubated at 44.5°C for 18-24 hr. The presence of faecal coliform was confirmed by the production of gas in inverted Durham tube.

1.3 Test for *E.coli*

E.coli is one of the members of faecal coliform which ferments lactose with the production of gas at 44.5°C within 24 hr as well as produces indole from tryptophane at 44.5°C within 24 hr. All the positive tubes of BGBL broth at 44.5°C (faecal coliforms) were subcultured in tubes of peptone water and incubated at 44.5°C for 24±2 hr. A few drops of Kovacs reagent were then added to each of these tubes. The presence of *E.coli* was identified by the appearance of pink color while the absence of *E.coli* was indicated by the appearance of yellow color.

2 Confirmatory Results

The results obtained by the MWK were initially confirmed with conventional laboratory test results using most probable number (MPN) by randomly selecting two water sources. Table S1 provides the confirmatory test results for Sample # 9 and Sample # 11. The column 1 of Table S1 represents sample numbers. The columns 2, 3 and 4 represent the total coliform count (MPN/100ml), faecal coliform count (MPN/100ml) and *E.coli* count (MPN/100ml) in the water samples, respectively. It was found that for all these tests, Sample # 9 showed significant amount of coliform, which is corroborated by higher color intensity for Sample # 9 in Fig. 8. Similarly, for Sample # 11, one observes less amount of coliform, as compared to Sample # 9, which is again corroborated with lower color intensity in Fig. 8 for this sample.

The quantification of total coliform, faecal coliform and *E.coli* for the second field trial was conducted at the BRC, Mumbai, India, using well-established methods. It was observed that for all these tests, Sample # A2 and A5 had substantial amount of coliform, which is indicated by significant color intensity for these samples (refer Fig. 9). Likewise, for Sample # A1 and A3, less amount of coliform is identified, as compared to Sample # A2 and A5, which is again corroborated with much lower color intensity for these samples in Fig. 9.

Table S1 Laboratory test results by different established methods for water samples (Sample # 9 and Sample # 11) tested during the first field trial.

Sample Number	Total coliform count, MPN/100ml (Presumptive coliform count)	Faecal coliform count, MPN/100ml (Confirmed coliform count)	<i>E.coli</i> Count, MPN/100ml
Sample # 9	>1600	>1600	1600
Sample # 11	>1600	1600	170

Table S2 Laboratory test results by different established methods for water samples tested during the second field trial.

Sample Number	Total coliform count, MPN/100ml (Presumptive coliform count)	Faecal coliform count, MPN/100ml (Confirmed coliform count)	<i>E.coli</i> Count, MPN/100ml
Sample # A1	900	348	175
Sample # A2	≥ 1600	130	109
Sample # A3	300	<2	<2
Sample # A4	2	<2	<2
Sample # A5	≥ 1600	240	40