ASSESSMENT OF A SIMPLE, COST-EFFECTIVE METHOD TO TEST FOR FECAL AND ENVIRONMENTAL CONTAMINATION OF WATER SUPPLIES

AUTHORS

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ABSTRACT

Environmental and fecal contamination of water supplies is a common challenge across the world, in developing and developed countries alike. The World Health Organization estimates that globally, at least 2 billion people use a drinking water source contaminated with feces. [1]Consequently, water safety regulations, informed and supported by the public health community, have focused primary drinking water monitoring on microbial safety. According to the Government of Ghana's National Drinking Water Quality Management Framework[2], "...the priority for monitoring drinking water quality is to confirm microbial safety." For over a decade, Safe Water Network in Ghana has relied on testing of microbial parameters on a monthly basis by an external, third-party laboratory. While external testing remains an important element of a quality assurance scheme, it can be costly, present challenges in sample transport, and—exacerbated by COVID changes—take weeks to receive results. In Ghana and elsewhere, cost-effective, simple, ground-tested methods for microbial testing on-site can be a critical tool to help assure the provision of safe drinking water. In addition, these kits can be useful in diagnosing and remedying process control excursions. Safe Water Network's team in Ghana assessed the Aquagenx rapid microbial kits for total coliform and *E. coli* at three of their safe water stations. The results confirmed that the test kits are accurate and robust under "real-world" conditions and represent a significant improvement for the sector. If these test kits were to completely replace external microbial testing, a cost savings of over 70% would result.

BACKGROUND

Safe Water Network has been building and operating small water enterprises (branded *H_2OME!* Water Stations) for 15 years in Ghana. Water quality has been foundational to the organization from the beginning, with increasingly robust quality control and quality

[1] https://www.who.int/news-room/fact-sheets/detail/drinking-water

[2] https://www.gwcl.com.gh/national_drinking_water_quality__management_framework.pdf

assurance programs at the roughly 100 water stations in operation. As the organization grows and expands there is a strengthened culture of continuous improvement to operational standards, performance management, supervision, structures, digital technology, documentation and other elements to help reduce occupational health and food safety risk to our employees and consumers, respectively, and to protect the reputation of Safe Water Network. Innovations employed cut across new technologies, real time reporting, remote monitoring, risk analysis and mitigation, and other areas.

The Ghana National Framework emphasizes the importance of microbial monitoring, aligned with the World Health Organization guidance, and supports the use of indicators of environmental and fecal pollution (like total coliform and *E. coli*, among other organisms). The Framework establishes a monthly testing frequency for microbial parameters, and Safe Water Network routinely conducts this testing at an accredited external laboratory. External testing, while necessary, can represent a significant portion of operating costs. In addition, sampling protocols and transport can be challenging, and this has been made worse during restrictions from the COVID19 pandemic.

To help establish on-site micro testing capability, reduce external laboratory costs, and provide flexibility to obtain rapid microbial results, Safe Water Network's Ghana team procured total coliform and *E. coli* test kits (including incubator and UV light source) from Aquagenx[3]. The kits were assessed at three separate *H2OME!* water stations in Ghana, using positive and negative controls.

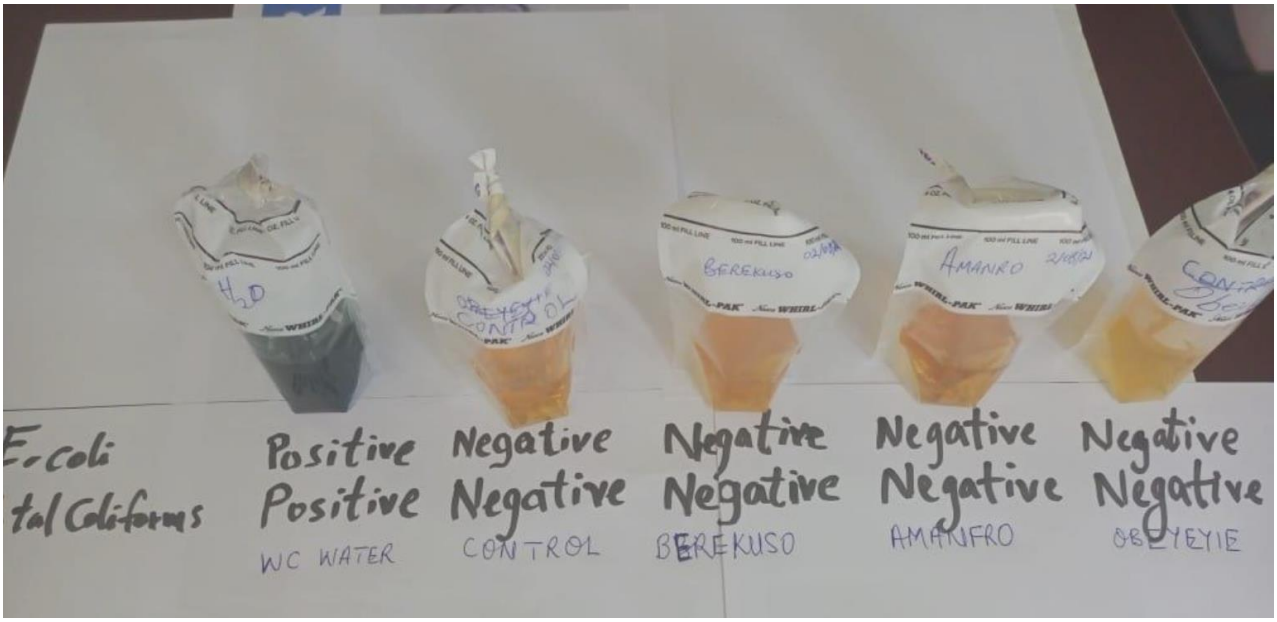
METHODOLOGY

1. Water samples collected from three (3) stations; namely Berekusu, Amanfro and Obeyeyie.
2. Positive and negative control samples were prepared. Packaged Voltic water as the negative control, and contaminated water from the water closet (WC) as a positive control.
3. Incubation compartment sanitized with 95% ethanol.
4. Sampling thio bags labeled with respective sample identification.
5. All safety and cross contamination protocols observed.
6. Samples emptied into thio bags carefully, reagent pillow contents added to sample and bag sealed.
7. Sample incubated at temperature of 25 -30˚C for 48 hours.

[3] https://www.aquagenx.com/

RESULTS

After 48 hours of incubation, sample containers were observed under visible and ultraviolet for total coliform and *E. coli* according to the instructions for interpretation.



How to Interpret Color-Change Test Results

Color in Thio-Bag	Yellow/Yellow Brown in ambient light and does not fluoresce blue under UV light	Yellow/Yellow Brown that ... fluoresces blue under UV light	Blue/Blue Green in ambient light	Blue/Blue Green that ... fluoresces blue under UV light
E. coli	Negative	Negative	Positive	Positive
Total Coliforms	Negative	Positive	Positive	Positive

OBSERVATIONS AND CONCLUSIONS

The general observation is that the Aquagenx CBT EC + TC P/A kit has produced the desired results and is very capable of meeting and even exceeding our expectations. Advantages of the kits are listed below.

1. Close-to-real time results to assess environmental and fecal contamination of water supplies, thereby assuring microbial water safety. Allows operational decisions to be made in hours vs. weeks.
2. Cost savings over external laboratory analyses. A cost savings in excess of 70% would be realized if all external monthly micro testing were to be replaced with these Aquagenx kits (see Appendix).
3. Improved control of water treatment technology with respect to microbial contaminant removal.

4. Enhanced internal field capabilities, allowing on-site quality diagnosis and investigation, quality assurance, and auditing.

In summary Safe Water Network Ghana team considers the use of these kits a major breakthrough for the technical services and the quality assurance and control functions.

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APPENDIX: COST COMPARISON ANALYSIS OF EXTERNAL MICRO TESTING VS. INTERNAL TESTING.

	Analytical Cost External Analysis		
1	No of Existing Stations used for Analysis	100	
2	No of Clusters	10	
3	Frequency - Monthly	1	
4	Cost per Analysis	250.00	
5	Analysis Cost per month	**25,000.00**	Cedis
6	Exchange rate per dollar	5.80	
7	Analysis Cost per month in USD	**4,310.34**	USD

	Analytical Cost for Internal Micro Analysis		
1	No of Existing Stations Used for Analysis	100	
2	No of Clusters	10	
3	Frequency - Monthly	1	
4	Cost of labour	1500	
5	Cost per 100 packs, shipment & duty	5,742.000	
6	Total Cost	7,242.000	
7	Analysis Cost per month	**7,242.00**	Cedis
8	Exchange rate per dollar	5.80	
9	Analysis Cost per month in USD	**1,248.62**	USD

Summary Cost Saved

	Cost Save External Vrs Internal Analysis		
1	External Analysis	4,310.34	USD
2	Internal Analysis	1,248.62	USD
	Total	3.061.72	USD