Low cost, at-home incubation systems to culture Escherichia coli bacteria for water quality testing in North Carolina

Lauren McShea

The presence of E. coli in recreational or drinking water is a strong indicator of harmful microbial contamination, and therefore significant to test for when monitoring water quality[5]. However, nearly 33% of the North Carolina population relies on well water that is not regulated by the state government and E. coli testing typically requires expensive lab incubation[8]. This research was conducted in an attempt to design an accessible at-home incubation system with the ability to perform presence/absence E. coli testing in temperatures between 20°C and 25°C (68°F to 77°F) for North Carolina households or classrooms. Previous research has shown that Incubation of E. coli for water quality testing can be done without the use of a lab incubator in various contexts where ambient air temperatures are above 25°C (77°F)[1,4,6,7]. The development of a simple, low cost incubation system with the ability to maintain an average temperature of 35°C with ambient conditions at standard room temperature, between 20°C and 25°C (68°F to 77°F) would give greater public access to E. coli testing for private water quality monitoring. The incubation system designed for this experiment was based on an existing model created for incubation in ambient temperatures over 25°C (77°F) and modified to maintain successful incubation with lower ambient temperatures[1]. The system was made with a lifoam cooler with a 10 qt interior and used heated water in 2 standard plastic water bottles as a heat source. The interior temperature was monitored with a bluetooth temperature sensor to ensure the temperature remained within the desired range for E. coli culturing, 25°C (77°F) to 40°C (104°F), and the heated water bottles were replaced as the temperature reached its lower bound. In continuation of this research, the accuracy of the incubation system will be evaluated experimentally through comparison to lab incubation results at 35°C for 24 hours.

1. Bernardes C, Bernardes R, Zimmer C, Dorea CC. A Simple Off-Grid Incubator for Microbiological Water Quality Analysis. *Water*. 2020; 12(1):240. https://doi.org/10.3390/w12010240
2. Brown J, Stauber C, Murphy JL, et al. Ambient-temperature incubation for the field detection of Escherichia coli in drinking water. *J Appl Microbiol*. 2011;110(4):915-923. doi:10.1111/j.1365-2672.2011.04940.x
3. Elbing KL, Brent R. Recipes and Tools for Culture of Escherichia coli. *Curr Protoc Mol Biol*. 2019;125(1):e83. doi:10.1002/cpmb.83
4. Stauber C, Miller C, Cantrell B, Kroell K. Evaluation of the compartment bag test for the detection of Escherichia coli in water. *J Microbiol Methods*. 2014;99:66-70. doi:10.1016/j.mimet.2014.02.008
5. Stillo F, MacDonald Gibson J. Exposure to Contaminated Drinking Water and Health Disparities in North Carolina. *Am J Public Health*. 2017;107(1):180-185. doi:10.2105/AJPH.2016.303482
6. Engineering For Change. 2022. *Compartment Bag Test (CBT) Kit | Engineering For Change*. [online] Available at: [Accessed 6 March 2022].
7. Aquagenx.com. 2022. *Aquagenx® CBT EC+TC (Compartment Bag Test) Most Probable Number (MPN) Kit Instructions for Use: Drinking Water*. [online] Available at: [Accessed 6 March 2022].Williams, E., 2022. *Improving the Water Quality of Private Drinking Water Wells in North Carolina through Multidisciplinary Work | UNC Environmental Spotlight*. [online] Environmentblog.web.unc.edu. Available at: [Accessed 3 February 2022].