

Water Testing/Solar Water Pasteurization in Kenya and Tanzania

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Mobile Microbiology Laboratory includes:

- 25 Colilert MPN tubes (IDEXX, Westbrook, Maine),
- 25 *E. coli* count Petrifilms (3M, St. Paul, MN)
- 1 plastic spreader for the Petrifilms
- 25 4 oz Standup Whirl-Paks (Nasco, Modesto, CA)
- 25 sterile plastic pipettes, graduated, individually wrapped
- 1 battery-operated, long UV lamp (Spectronics Corp., Westbury, NY)

This kit combines the best test for *E. coli* in water, Colilert, which gives a presence/absence result for 10 ml, with the best test for *E. coli* in foods, the *E. coli* count Petrifilm, a quantitative test for 1 ml. The Petrifilm solves the problem of a quantitative test in such a simple way – replacing membrane filtration and MPN procedures. These tests are specific for *E. coli*, because they contain a substrate for the Beta-glucuronidase enzyme produced by *E. coli*, but not by other coliform bacteria. The tests yield striking results within 12-18 hours, MUG + fluorescent blue in Colilert, a blue colony with a gas bubble on the Petrifilm. I started using the Colilert MPN test in Sierra Leone in 1989, and the Petrifilm in Kenya and Zimbabwe in the mid '90s. The list price before any discount is about \$1.50 for Colilert MPN, \$1.20 for the *E. coli* count Petrifilm, \$0.12 for a Whirl-Pak, \$0.08 for a sterile pipette.

Combining these tests enable a risk assessment of the water source:

<u>Risk Level</u>	<u><i>E. coli</i> in sample</u>	<u>Colilert MUG+</u>	<u># Blue Colonies on Petrifilm</u>
Low	<1/10 ml	-	0
Moderate	1-10/10 ml	+	0
High	1-10/ml	+	1-10
Very High	>10/ml	+	>10

The quantitative *E. coli* count on the Petrifilm easily identifies high and very high-risk sources – such as one often finds in open water sources and shallow wells in Kenya and Tanzania. On the web site, you'll see photos of how my Australian colleague Christine Polinelli, and I have used these tests extensively in Tanzania and Kenya, both in villages and with government agencies. In our workshops, we have local people perform the tests, incubate them overnight, and interpret the tests the next day. The background we give the workshop participants includes how bacteria, so tiny they can't be seen, can multiply overnight to become millions and billions, and thus cause disease. They understand that 20-24 doublings of *E. coli* is needed to give a MUG+ test in Colilert, or to form a visible blue colony on the Petrifilm, and that this has occurred overnight. Not only are communities involved in doing world-class microbiology themselves, but they also have a new understanding of how germs cause disease. On the web site you'll see a photo of a village chief in Meatu District, Shnyanga Region, Tanzania, pointing to a MUG+ Colilert tube, understanding that the bacteria which caused the color change came from feces, and a village health worker in Tanzania looking at a Petrifilm with many blue colonies, understanding these bacteria came from feces – they shouldn't be in drinking water.

It is not sufficient to show people in developing countries how to test their water. One must also have a practical alternative when they verify their water is highly contaminated. That's where Christine and I have worked as volunteers for Solar Cookers International (SCI), which has its headquarters in Sacramento, California, and an East Africa Regional Office in Nairobi, on Githinguri Road, Kileleshwa. In 1995, SCI developed the world's simplest serious solar cooker, The Cookit, which was successfully introduced that year into the Kakauma Refugee Camp, Kenya, and subsequently in the Aisha Refugee Camp, Ethiopia. SCI has recently launched the Sunny Solutions project in Nyakach, Nyanza Province, near Kisumu and Lake Victoria. Village leaders and the 24 women who are the Solar Cooker Representatives in their communities have used the Colilert and Petrifilm tests, and found that their water sources from shallow wells or open sources are heavily contaminated, often with 20-50 *E. coli*/ml. We demonstrated how contaminated water could be heated in a Cookit to melt the wax of a reusable Water Pasteurization Indicator (WAPI), and pasteurize the water. The Colilert and Petrifilm tests show a dramatic difference before, and after heating in a Cookit. By conducting participatory workshops and by providing each solar cook in the Sunny Solutions project with a WAPI, solar water pasteurization has been quickly adopted in addition to solar cooking, with a reduction in diarrhea disease documented in a survey of 47 Nyakach households, interviewed five times in June-July, 2005.

A major reason why water quality issues are often bypassed in public health discussions in developing countries (far behind HIV/AIDS, malaria, TB) is because the obsolete and cumbersome water testing procedures developing countries follow. Christine and I found no water testing in Tanzania, and minimal testing in Kenya, using a 3 bottle MPN procedure for thermotolerant coliforms: a total of 9 bottles of MacConkey's broth are inoculated with either 10, 1.0, or 0.1 ml of the water sample, and the bottles are placed in a 35°C incubator as a presumptive test. Bottles with gas after 24 hours are used to inoculate a bottle of Brilliant Green Lactose Bile broth for a confirmed test, and these bottles are placed in an incubator at 44°C for a confirmed test. The thermotolerant coliform test requires a well equipped laboratory, with an autoclave, incubators, and lots of glassware. Results are not known until two days after testing, and the results are reported as a language which means nothing to the people whose water was tested.

The discovery that *E. coli* produces the *Beta-glucuronidase* enzyme led to the development of new tests for *E. coli* in water and foods, and these have replaced the thermotolerant coliform tests in the water and food industries in the United States. ***The Colilert and Petrifilm tests can break thermotolerant coliform gridlock in Kenya.*** Christine and I have introduced these tests to Environmental Health workers in Kinondoni and Temeke Municipalities, Dar es Salaam, Tanzania, and to the Water Resources Management Authority staffs in Nairobi, Kisumu, Nakuru, Machacos, Mombasa, and Embu. The competent staff members are astonished that excellent microbiology can be done so easily, and involve the people whose water is being tested. The Mobile Microbiology Laboratory we use has the potential to revolutionize water testing in Kenya immediately. With the Mobile Microbiology Laboratory, anyone can test water sources anywhere in the country, and have clear results overnight.

The majority of the 1.1 billion people in the world who do not have access to safe water are among the 2.4 billion people who use wood for cooking in a non-sustainable manner. Solar Cookers International's Sunny Solutions project in Nyakach, Kenya, demonstrates how poor people's only abundant energy source, sunshine, can be used with a Cookit and a WAPI to address both daunting challenges of contaminated water and lack of wood for cooking.