Cost-effective and sustainable solutions to enhance the solar disinfection efficiency improving the microbiological quality of rooftop-harvested rainwater

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ABSTRACT

This paper investigates the efficiency of solar-based disinfection methods for improving the microbial quality of rooftop-harvested rainwater. Bacteriological water quality indicators including total and fecal coliforms, *Escherichia coli*, and Heterotrophic Plate Count were examined under different sunlight radiations. The efficiency of simple solar disinfection (SODIS) was enhanced at low pH values of the exposed rainwater. To enhance the concentrating effects of radiations, solar collector disinfection (SOCODIS) system was used. In addition, very simple and cost-effective techniques were employed to enhance the disinfection efficiency. This includes the wrapping of polyethylene terephthalate bottles with heat-resistant plastic bags to enhance the thermal/synergistic effects of radiations and the addition of natural acids (lemon/vinegar) for getting a low pH value of the rainwater in a natural way. Both simple SODIS and SOCODIS systems remained ineffective even under strong radiations and the best solution was to use the SOCODIS system with a combination of wrapping and addition of natural acids. A complete inactivation was achieved even at neutral pH by using reasonable concentrations of natural acids i.e. lemon/vinegar (0.5/0.4 ml) to avoid any taste/odor problem. Under moderate radiations, the same system was deemed best but at pH of 5. The only solution under weak radiations was to wrap the polyethylene terephthalate bottles by adding lemon/vinegar for obtaining a pH of 3 in the SOCODIS system.

Keywords: Drinking water; Lemon; Natural acids; Plastic bag; Point of use water treatment; Vinegar; Water disinfection