

Reduction of *Salmonella* and *Escherichia coli* O157:H7 in Drinking Water Using Microwave Technology

Coranyi Banegas*¹, Kathleen Fermin¹, Byron Chaves¹, and Mindy Brashears Ph.D.¹
*SOWER Program, ¹International Center for Food Industry Excellence, Texas Tech University



Abstract

The search for improved water decontamination techniques is of primary public health importance to reduce the incidence of waterborne illnesses and to provide a safer water supply worldwide. The objective of this study was to determine the efficacy of a multi-functional microwave system (MicroZap) on the reduction of *Salmonella* and *Escherichia coli* O157:H7 in water samples. Commercial water samples were inoculated with cocktails of 10⁶ CFU/ml of three strains of each bacterium and subjected to one of three treatments: A (2 cycles, 20% speed, 95% power, 3 min, final temperature: 49.6°C), B (4 cycles, 20% speed, 95% power, 6 min, final temperature: 76.1°C), and C (3 cycles, 20% speed, 95% power, 4.5 min, final temperature: 64.3°C). After treatment, samples were serially diluted and plated for enumeration on XLD media for *Salmonella* and MacConkey agar for *E. coli* O157:H7. Microbial counts were log-transformed and analyzed via ANOVA on the Statistical Analysis Systems (SAS Version 9.3, Cary, NC). Means were separated using Tukey's test and differences were considered significant at p<0.05. The experiments were performed in duplicate. With respect to the control, Treatment A did not result in significant reductions (p>0.05), whereas Treatments B and C yielded average reductions of 5.88 and 5.60 for *Salmonella* and *E. coli* O157:H7, respectively (p>0.05). The results of this study prove the efficacy of microwave technology as a decontamination method for water. Further studies are underway to expand our knowledge on other potential uses of this technology in developing countries.

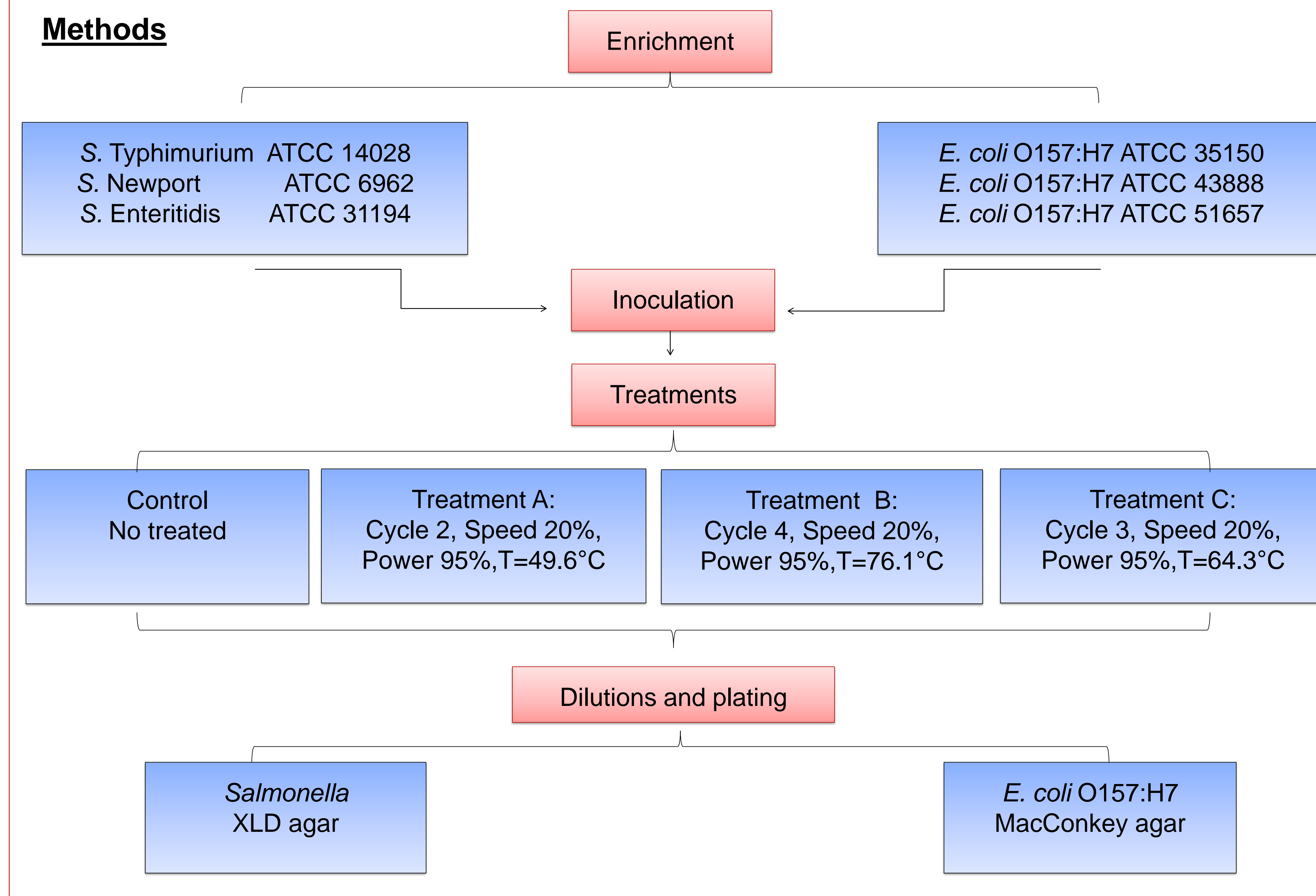
Introduction

Food and water safety is of primary importance from a public health perspective since the social, economic and health burden of diarrhea genic is very high, especially in developing nations (Jairus et al, 1999). Microwave technology has been used as a method for decontamination of a variety of food products, including raw poultry (Pucciarelli et al., 2005), frozen minced meat (Arias et al., 1997), cooked foods (Castro et al., 1997), and apple juice (Cañumir, 2002), among others. Target microorganisms include *Salmonella*, pathogenic *E. coli* and *Staphylococcus aureus*.

Extensive research conducted at Texas Tech University has already demonstrated the utility of microwave technology, not only to increase the safety and quality of food products, but to decontaminate non-biological materials, such as cloth towels used in sport facilities and that may potentially be contaminated with Methicillin-resistant *S. aureus* (MRSA). However, very little is known with the regard to the behavior of pathogenic bacteria in water sample subjected to this technology.



Methods



Results

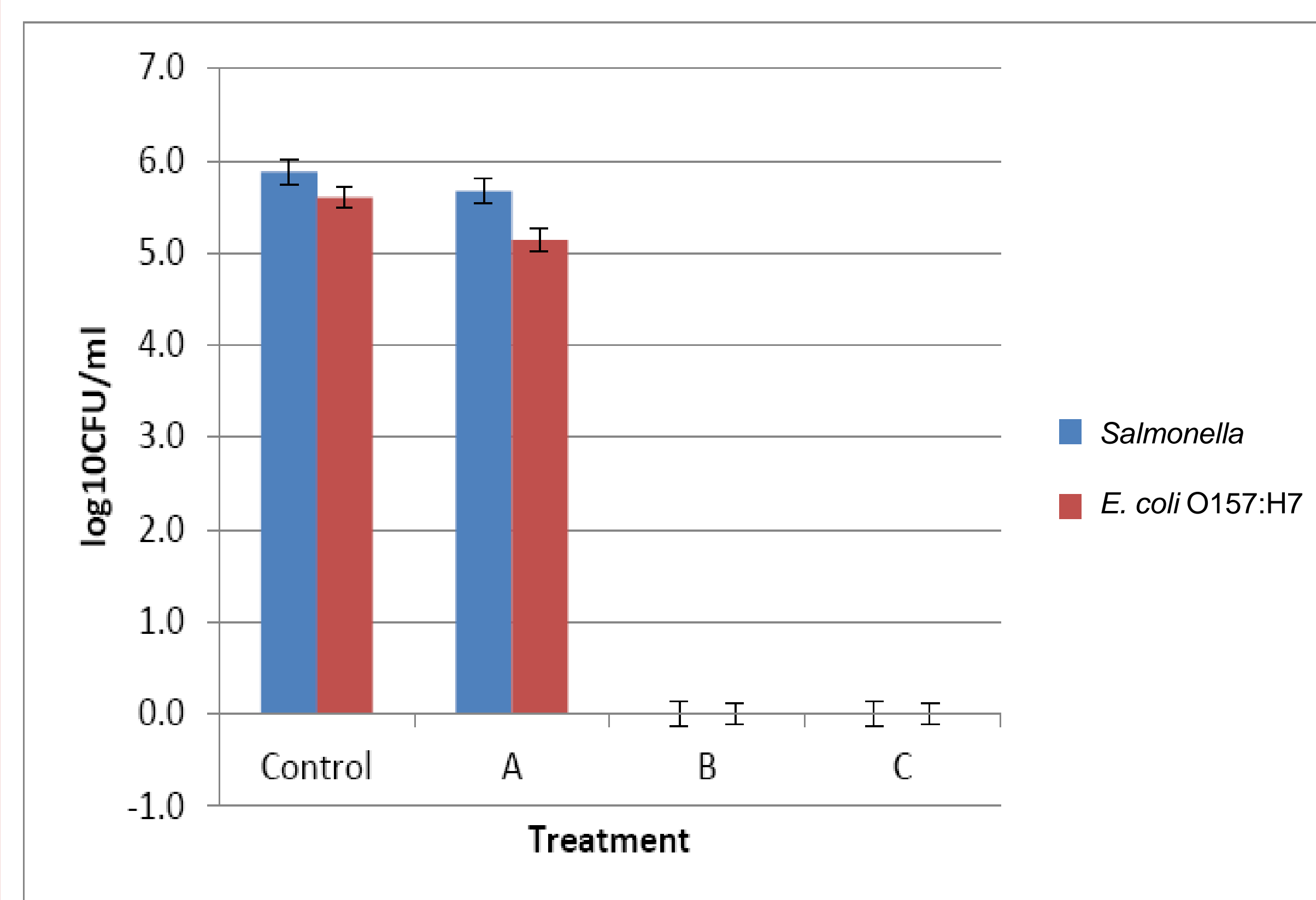
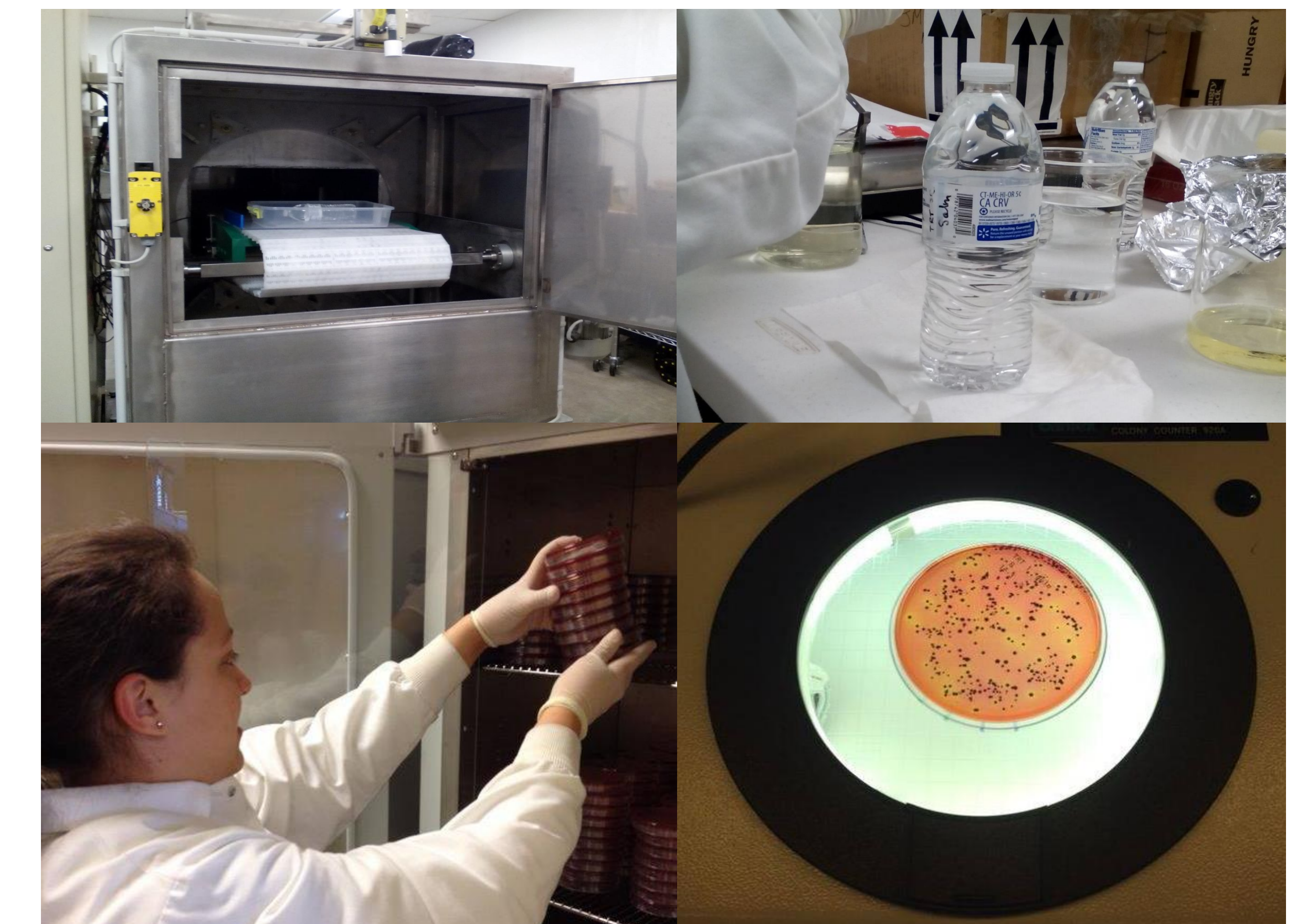


Fig. 1. Average reductions of *Salmonella* and *E. coli* O157:H7 in drinking water after application of three different microwave treatments

- Compared to the control, treatment A (final temperature of 49.6°C) did not show significant reduction in *Salmonella* or *E. coli* O157:H7 populations in drinking water (P>0.05).
- Comparing the control samples to treatment B (final temperature of 76.1°C) and treatment C (final temperature of 64.3°C) there were significant reduction in the *Salmonella* and *E. coli* O157:H7 counts (P<0.05)
- No differences were found when comparing the reductions of *Salmonella* and *E. coli* O157:H7 using either treatment.



Conclusions

Based upon the results of our experiments, it can be concluded that microwaves are effective in reducing the load of *Salmonella* and *E. coli* O157 in drinking water. This technology could be an alternative method for decontamination of water in developing countries.

The most effective treatment for water decontamination should include at least 3 cycles and reach at minimum temperature of 64.3°C to reduce approximately 5.5 log of both *Salmonella* and *E. coli* O157:H7.

Future research

- To determine efficacy of microwave technology against Gram-positive bacteria, spore-forming bacteria and parasites.
- To determine the thermal resistance of microorganisms to microwave (D-value) .
- To validate the use of the technology in naturally contaminated water (both drinking and wastewaters).

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