New approach for decontaminating fresh and fresh-cut produce utilizing ClO2 gas

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Abstract

In this experiment, chlorine dioxide gas (ClO_2) was tested for its ability to inhibit growth and to kill the pathogenic organism (GFP-expressing) *Escherichia coli* O157:H7 inoculated on cherry tomatoes. Preliminary experiments were conducted to show that the low pH of the tomatoes (ca. pH 4.2) would not influence survival of *E. coli* O157:H7. Following the preliminary experiments, tomatoes were inoculated with the *E. coli* O157:H7 organism and varying ClO_2 treatments were applied in conjunction with current food industry antimicrobial applications such as chlorine (Cl_2) washes. Results of this experiment showed a significant reduction of *E. coli* O157:H7 associated with the tomatoes following treatment with ClO_2. Additional studies are on-going to confirm these results. The present study results are encouraging and could lead to the development of a new method for processing fresh fruits and vegetables.

Introduction

Microorganisms on food products have been an ongoing problem causing human illness and food spoilage. Outbreaks of foodborne illness are linked to a wide array of food but mainly raw or ready-to-eat produce, such as fruits and vegetables. Antimicrobial applications such as chlorine wash are currently used in the produce industry, however, outbreaks still occur. A new application being tested for use in the food industry is the treatment of ClO_2 that would be applied during the packaging stage for cherry tomatoes.

ClO_2 gas has the advantage over a Cl_2 wash of getting into the smallest of crevices that are unavoidable in raw produce. Combining these two antimicrobial processes into the packaging of raw produce has great potential for significantly reducing affiliated food borne pathogens.

Image 2: After inoculation the cherry tomatoes were left to dry on a wire mesh drying rack for 24 hours.

Methodology

The preliminary experiment was done by inoculating the tomatoes and enumerating the *E. coli* O157:H7 colonies at the time points 0, 15, 30, 60 minutes, and 24 hours. During these time points the pH was also measured to determine whether the low pH of the tomatoes (ca. pH 4.2) would influence survival of *E. coli* O157:H7. Results suggest the low pH had no effect on pathogen survival.

Image 1: Each sample was weighed out to be approximately 30 grams

Treatments involving ClO_2 gas and a 50 ppm chlorine wash, were applied to the inoculated (10^8 CFU/ml) cherry tomatoes, and were compared to control samples of inoculated cherry tomatoes left untreated by the Cl_2 or ClO_2. Following inoculation, the tomatoes were held at room temperature for 24 h and then subjected to one of the following treatments: **1)** control – no treatment, **2)** 90 second 4 ˚C water wash, **3)**90 second 4 ˚C 50 ppm chlorine wash, **4)** 90 second 4 ˚C 50 ppm chlorine wash and a 24 h exposure to ClO_2, or **5)** 24 h exposure to ClO_2. The ClO_2 was calculated and measured to contain 50 ppm over a 24 hour period in a 1 gallon air tight bucket. Following the treatments the tomato samples were processed for enumeration. The plates were incubated at 37ºC for 24 h, and each treatment (#2-5) was then compared to the control sample (#1) by enumerating the *E.coli*O157:H7 colonies.

Results

Figure 1: **Preliminary Experiment**

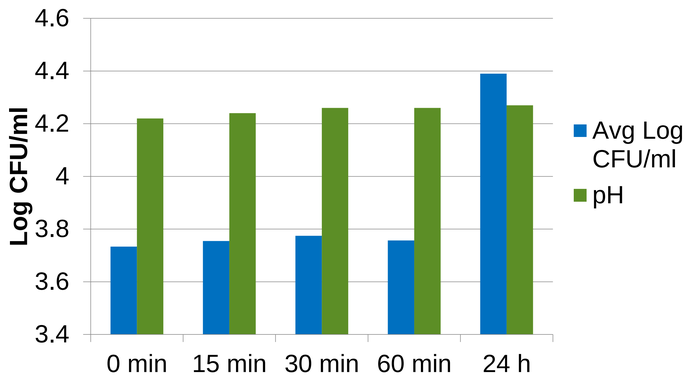
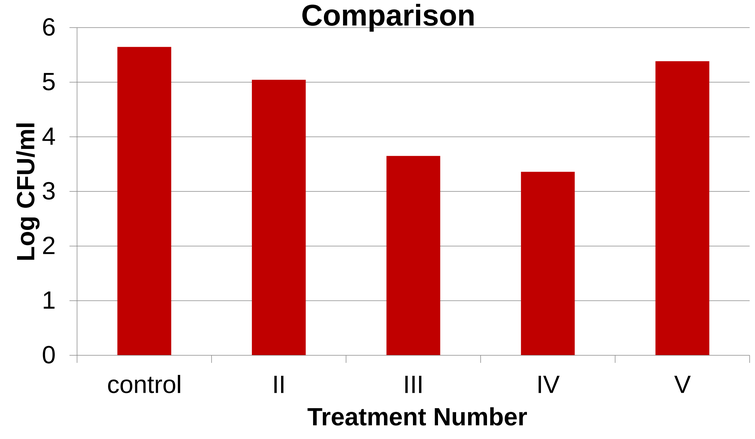


Figure 2: **Average Growth Treatment Comparison**



Summary

- The low pH (ca. pH 4.2) of the tomatoes showed no influence on survival of *E. coli* O157:H7
- In comparison to the control the sample that received a combined treatment of Cl_2 wash and ClO_2 had the largest impact on the growth of the organism.
- ClO_2 alone shows had no significant effects.
- Research is continuing on ClO_2 treatments; the applications of Cl_2 wash and ClO_2 will eventually tested at higher parts per million.
- Varying types of produce can have different effects and will require varying amounts of treatments due to the different surface textures.