

Title Comparison of chlorine and peroxyacetic-based disinfectant to inactivate Feline calicivirus, Murine norovirus and Hepatitis A virus on lettuce

Author Audrey Fraisse, Sarah Temmam, Nathalie Deboosere, Laurent Guillier, Alexandre Delobel, Pierre Maris, Michèle Vialette, Thierry Morin and Sylvie Perelle

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Abstract

In recent years, raw fruits and vegetables have frequently been involved in foodborne transmission to humans of enteric viruses, particularly noroviruses and hepatitis A virus (HAV). Although viral contamination can occur during all steps of food processing, primary production is a critical stage on which prevention measures must be focused to minimize the risk of infection to consumers. Postharvest sanitation may be a valid technological solution for decreasing the bacterial load on fresh raw material, but there is a lack of data concerning the effectiveness of this process on enteric viruses. In this study, we compared the survival of two human norovirus surrogates, the feline calicivirus (FCV), and the murine norovirus (MNV-1), and of HAV on lettuce after water washing with bubbles and with or without ultrasound, and washing with bubbles in the presence of active chlorine (15 ppm) or peroxyacetic acid-based disinfectant (100 ppm). Cell culture and quantitative RT-PCR assays were used to detect and quantify the viruses on the surface of the lettuce after the sanitizing treatments. Levels of viral inactivation on the lettuce leaves were not significantly different between washing with bubbles and washing with bubbles plus ultrasound and were not dependant on the quantification method. A simple washing without disinfectant resulted in a decrease of approximately 0.7 log units in the quantity of virus detected for HAV and FCV and of 1.0 log unit for MNV-1.

In the experimental set-up including a washing step (with or without ultrasound) followed by washing for 2 min in the presence of disinfectants, 15 ppm of active chlorine was found more effective for inactivating FCV (2.9 log units) than HAV and MNV-1 (1.9 log units and 1.4 log units, respectively) whereas 100 ppm of peroxyacetic-based biocide was found effective for inactivating FCV (3.2 log units) and MNV-1 (2.3 log units), but not HAV (0.7 log units). Quantitative RT-PCR results indicated that the presence of viral RNA did not correlate with the presence of infectious viruses on disinfected lettuce, except for MNV-1 processed with chlorine (15 ppm). In comparison with water washing, a substantial additional decrease of genomic FCV titer (1.1 log units) but no significant reduction of the genomic titers of HAV and MNV-1 were found on lettuce treated with chlorine (15 ppm). No significant effect of the disinfection step of lettuce with peroxyacetic-based biocide (100 ppm peracetic acid) was found by qRT-PCR on all genomic viral titers tested. This study illustrates the necessity of determining the effectiveness of technological processes against enteric viruses, using a relevant reference such as HAV, in order to reduce the risk of hepatitis and gastroenteritis by exposure to vegetables.