Air microbubble assisted washing of fresh produce: Effect on microbial detachment and inactivation

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Abstract

Chlorine based sanitizers are used during fresh produce washing to reduce microbial cross-contamination. However, the antimicrobial effectiveness of these sanitizers on pathogens attached to produce surface is limited. Therefore, we evaluated ability of air microbubbles to detach and inactivate bacteria from fresh produce and generate sub-lethal stress within bacteria to increase their susceptibility to sodium hypochlorite, thus improving latter's efficacy. At tested levels, air microbubbles did not cause damage to *E. coli* O157:H7 cell membrane or intracellular oxidation. Compared to water, microbubble-assisted washing had no improvement on bacterial detachment from grape tomatoes, blueberries, and baby spinach. Microbubble-assisted washing resulted in 3.3 ± 0.1, 0.8 ± 0.5, and 1.0 ± 0.4 log CFU/g reduction from grape tomatoes, blueberries, and baby spinach surface when used together with 100 mg/L sodium hypochlorite, indicating the role of produce surface properties on bacterial inactivation. However, these reductions were not significantly different from that obtained by washing these samples with 100 mg/L sodium hypochlorite in the absence of microbubbles ($P > 0.05$), indicating that air microbubbles did not increase the efficacy of sodium hypochlorite. Interestingly, microbubble assisted washing significantly increased ($P < 0.05$) soil removal from baby spinach, with the turbidity of sonicated water, which represented the soil content remaining on produce following washing (with or without microbubbles) process, reduced from 52.9 ± 11.5 (control) to 14.3 ± 2.4 NTU, compared to 31.0 ± 7.7 NTU for water washed samples. At tested conditions, air microbubbles may have limited effect on detachment and inactivation of bacteria in the presence of sanitizers, but they can improve cleaning efficacy of washing processes.