

**Title** Combined effect of ultrasound and organic acids to reduce *Escherichia coli* O157:H7, *Salmonella* Typhimurium, and *Listeria monocytogenes* on organic fresh lettuce

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### **Abstract**

This study was performed to compare the effectiveness of individual treatments (ultrasound and organic acids) and their combination on reducing foodborne pathogens on organic fresh lettuce. Lettuce leaves were inoculated with a cocktail of three strains each of *Escherichia coli* O157:H7, *Salmonella* Typhimurium, and *Listeria monocytogenes* and treated with ultrasound (40 kHz) alone, organic acids (0.3, 0.5, 0.7, 1.0, and 2.0% — malic acid, lactic acid, and citric acid) alone and combined with ultrasound and organic acids for 5 min. For all 3 pathogens, the combined treatment of ultrasound and organic acids resulted in additional 0.8 to 1.0 log reduction compared to individual treatments, without causing significant quality change (color and texture) on lettuce during 7 day storage. The maximum reductions of *E. coli* O157:H7, *S. Typhimurium*, and *L. monocytogenes* were 2.75, 3.18, and 2.87 log CFU/g observed after combined treatment with ultrasound and 2% organic acid for 5 min, respectively. Our results suggest that the combined treatment of ultrasound with organic acids was effective at increasing pathogen reduction compared to individual treatments without significantly affecting quality, and demonstrates its potential as a novel method to increase the microbial safety on organic fresh lettuce.