

**Title** Effect of temperature and chlorination of pre-washing water on shelf-life and physiological properties of ready-to-use iceberg lettuce

**Author** Sascha Baur, Ralph Klaiber, Hua Wei, Walter Peter Hammes and Reinhold Carle

**Citation** Innovative Food Science & Emerging Technologies, Volume 6, Issue 2, June 2005, Pages 171-182

**Keywords** Iceberg lettuce (*Lactuca sativa* L.); Ready-to-use; Fresh-cut; Minimal processing; Pre-washing; Chlorine; Warm water; Sensory and microbiological quality; Phenylalanine ammonia-lyase

### Abstract

The effects of cold and warm, chlorinated water as well as warm water without chlorination for pre-washing trimmed, cored iceberg lettuce heads was assessed regarding the shelf-life and physiological properties of the resulting ready-to-use (RTU) produce. On a pilot-plant scale, lettuce heads were shredded with or without pre-washing (50 °C, no chlorine; 4 and 50 °C, 200 mg/l free chlorine; 60 s). After shredding, lettuce was washed for 90 s (tap water, 4 °C), spin-dried, packaged in 200 g consumer-sized bags, and stored at 4 °C for  $\leq 9$  days. Samples were analyzed for their headspace O<sub>2</sub> and CO<sub>2</sub> levels, sensory properties, microbiological status, and phenylalanine ammonia-lyase (PAL) activity at regular intervals throughout processing and storage. Parallely, instrumental color and texture measurements were performed. All pre-washing procedures of lettuce heads lowered the initial counts of total aerobic bacteria, pseudomonades, and *Enterobacteriaceae* by  $\geq 1.63$ ,  $\geq 1.55$ , and  $\geq 1.85 \log_{10}$  cfu/g, respectively, while the single-wash of shredded lettuce in tap water without any pre-washing resulted in significantly smaller reduction rates (0.23, 0.11, and 0.71  $\log_{10}$  cfu/g, respectively). During storage, all pre-washing procedures had a persistent effect on bacterial counts of the RTU lettuce. Furthermore, all pre-washing procedures delayed vascular tissue browning at cut edges and retarded the decline in the overall visual quality of the samples. Whereas wound-induced PAL synthesis was reduced by the use of warm water ( $\pm$  chlorine), O<sub>2</sub> depletion and CO<sub>2</sub> evolution in the corresponding bags were slightly enhanced, thus proving that processing kept the food as a living tissue.

#### Industrial relevance

Ready to use fresh like produce is getting increasing attention and industrial relevance. The aim of this study was to specifically overcome problems associated with product heterogeneity. Interestingly, the use of warm tap water without chlorination as a pre-washing step proved as effective alternative to the application of cold chlorinated water without substantially compromising vitality and freshness of the product.