Title Suitability of aqueous chlorine dioxide versus sodium hypochlorite as an effective sanitizer for preserving quality of fresh-cut lettuce while avoiding by-product formation

Author Francisco López-Gálvez, Ana Allende, Pilar Truchado, Ascensión Martínez-Sánchez, Juan A. Tudela, María V. Selma and María I. Gil

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Abstract

Aqueous chlorine dioxide (ClO_2) has been postulated as an alternative to sodium hypochlorite (NaClO) for fresh-cut produce sanitization with the advantage of avoiding the risks associated with chlorination by-products. However, little is known about its influence on preserving quality and the potential formation of trihalomethanes (THMs) under typical processing conditions. The suitability of aqueous chlorine dioxide (3 mg L^{-1}) as an effective sanitizer of fresh-cut iceberg lettuce stored under active modified atmosphere packaging (MAP) at refrigerated conditions was determined and compared with sodium hypochlorite (100 mg L^{-1}). Fresh-cut lettuce washed with tap water was used as a control. The epiphytic microbiota were characterized by the evaluation of the major relevant microbial groups such as mesophiles, psychrophiles, *Pseudomonas* spp., *Enterobacteriaceae*, lactic acid bacteria, yeasts and moulds. Additionally, gas composition, sensory quality, vitamin C and individual and total phenolics were monitored after washing and during storage for 3 d at 4 °C followed by 7 d at 8 °C. In general, the natural microbiota of fresh-cut lettuce after washing and storage was equally affected by the different washing solutions, with the exception of yeasts which showed the highest growth after 10 d storage in samples washed with chlorine dioxide. None of the tested washings negatively affected sensory quality, which was acceptable after 10 d storage. Additionally, the content of bioactive compounds was not significantly affected either by washing solution or by storage time. The potential formation of THMs was evaluated by the analysis of lettuce washed in water with a chemical oxygen demand (COD) of 700 mg L^{-1} treated for 30 min with sodium hypochlorite (100 mg L^{-1}) or chlorine dioxide (3.7 mg L^{-1}). Trihalomethane formation was only detected in the process water in which sodium hypochlorite was applied (217 ± 38 μg L^{-1}). However, THMs formation in fresh-cut lettuce was negligible despite the sanitation procedure. The formation of THMs was only detected in fresh-cut lettuce when sodium hypochlorite was used under very extreme conditions where lettuce was washed in water with a high level of organic matter (COD = 1800 mg L^{-1}), high sodium hypochlorite concentration (700 mg L^{-1}) and long contact time (60 min). Our data suggest that aqueous chlorine dioxide is as suitable as sodium hypochlorite for fresh-cut lettuce sanitation with the advantage of preventing the formation of THMs.