Title Quality of minimally processed carrots as affected by warm water washing and chlorination

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Abstract

Different applications of cold and warm tap water (4 °C and 50 °C) with and without chlorination, respectively, in the washing of uncut peeled carrots (*Daucus carota* L.) were conducted, and their effects on sensory and microbiological properties during storage for 9 days at 4 °C were assessed. To minimise cross-contamination of almost sterile inner root parts with the highly contaminated outer cortex during processing the peeled carrots were washed prior to cutting. The washing treatments were carried out using a commercial processing line, thus facilitating the scale-up to industrial production. Populations of aerobic mesophilic bacteria, lactic acid bacteria and enterobacteria on these minimally processed carrots were determined, and the sensorial quality of shredded carrots was evaluated by a sensory panel throughout storage. Additionally, colour, texture, sugars, and trichloromethanes were analysed. Washing uncut carrots with cold chlorinated water (200 mg/l, 4 °C) and warm tap water (50 °C) ensured sugar retention and reduced aerobic mesophilic bacteria by 1.7 and 2.0 $\log_{10}$ colony forming units per gram (cfu/g), respectively, while washing with warm chlorinated water (200 mg/l) resulted in a 2.3 $\log_{10}$ cfu/g reduction. By-product formation due to chlorination was negligible. Sensorial properties of the latter samples were slightly affected. It was shown that both washing uncut knife-peeled carrots with cold chlorinated water (4 °C) and warm tap water (50 °C), respectively, provided good microbiological safety paired with improved sensorial properties. Moreover, fresh-like character of the products was retained, as indicated by the persisting respiration of the living tissues.

Industrial relevance

Minimally processed vegetables are an increasing market. Shelf-life extension and consumer safety are of immense relevance for the fresh-cut industry; therefore, the application of antimicrobial agents such as chlorine is widespread. However, various consumer groups object to the use of chlorinated water. The present study aimed at comparing the efficacy of cold and warm tap water with and without chlorination, respectively, in washing uncut carrots during the production of shredded, packaged carrots while operating on pilot-plant scale under conditions of industrial practice. In view of microbial reduction and maintenance of sensory properties, the use of cold chlorinated water and warm tap water, respectively, proved to be effective for washing peeled carrots. By-product formation due to chlorination was negligible.