

Effects of pressure reduction modes on vacuum cooling efficiency and quality related attributes of different parts of pakchoi (*Brassica Chinensis* L.)

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Abstract

Rapid/moderate/slow pressure reduction modes of vacuum cooling (VC) with pressure reduction rates ranging from 0.0043 to 0.0502 s⁻¹ were developed. The effects of VC in different modes on the cooling efficiency and quality-related attributes of different edible parts of pakchoi including total and free water contents, colour differences, respiration rates, membrane stability and microstructures were investigated, and the cluster analysis (CA) was employed for visualizing and classifying the VC-induced quality variation. Results showed that the leaf and the petiole exhibited different temperature changes and vacuum tolerances, of which the adaxial epidermis of the leaf was more sensitive to VC, showing more severe cell damage due to the internal moisture gradient. The rapid pressure reduction mode ($\alpha_1 = 0.0502 \text{ s}^{-1}$) could predominately improve cooling efficiency and minimize the quality attenuation, while the moderate pressure reduction mode ($\alpha_2 = 0.0184 \text{ s}^{-1}$) contributed to better temperature uniformity and colour acceptance. Moreover, the result of CA further confirmed the above conclusions, suggesting that α_1 and α_2 endowed pakchoi with similar quality-related attributes to the fresh one. The current study proved that the slow pressure reduction mode should be avoided for uses in VC of leafy vegetables.