
Changes of carrot cell membrane and leakage of intracellular ion induced by low temperature blanching

UMEHARA A. (1), IMAIZUMI T. (2), KATSUNO N. (2), TAKAHISA N. (2)

1 International Joint Department of Food Science and Technology, GRADUATE SCHOOL OF NATURAL SCIENCE AND TECHNOLOGY, GIFU UNIVERSITY, Gifu, Japan

2 Faculty of applied biological sciences, Gifu university, Gifu, Japan

Low temperature blanching can improve the cell walls strength of vegetables by activating pectin methylesterase. Because cell membrane damage during this process modifies the environment in which the enzyme exists, the effect would be changed depending on the degree of the damage. In this study, we focused on the effects of low temperature blanching conditions on tissue conditions, including cell membranes.

Carrots were cut into discs having 20 mm diameter and 4 mm height. These samples were put into 200 mL deionized water for 40 min at 50 °C and 60 °C as low temperature blanching, respectively. Afterwards, cell membrane damage was evaluated by electrical impedance measurement and equivalent circuit analysis. Furthermore, the amounts of cations remaining in the tissues were quantified. The samples were homogenized with 1 % (w/v) hydrochloric acid and amounts of Ca²⁺, Mg²⁺ and K⁺ were measured by using an IPC-AES. Besides, pectin methylesterase were extracted from raw carrot with 1 M NaCl. Then, the activity in 20 mL of 0.5% citrus pectin solution with Ca²⁺, Mg²⁺ and K⁺ were evaluated by 0.01 M NaOH titration.

The equivalent circuit model was well fitted to the measured impedance values and the cell membrane capacitance was successfully determined. The capacitance value of the sample treated at 60 °C was less than at 50 °C. Thus, it was suggested that the treatment at 60 °C accelerated the cell membrane damage. In addition, significant cation reductions (Mg²⁺, K⁺) were occurred at 60 °C. These results showed that the degree of cell membrane damage differed with the treatment temperature and modified the ionic conditions in the tissue. Furthermore, significant increment of the pectin methylesterase activity due to the existence of Ca²⁺, Mg²⁺ and K⁺ at each specific concentration was found. Hence, it was assumed that low temperature blanching enhanced the enzymatic reaction not only by providing activation temperature but also by promoting the intracellular cation leakage.