

The influence of damage of cell membrane on softening of strawberry tissue due to freeze-thawing

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Acta Horticulturae 1049: 771-776. (2014)

Abstract

When fresh strawberry tissue is frozen and thawed, the tissue suffers from remarkable softening like other vegetables. So, many studies to prevent the softening have been conducted up to now. However, as for the effect of the pretreatment method prior to freezing for strawberry tissues, most researchers have focused only on one of the textural parameters, i.e. fracture stress that is considered as a textural index reflecting the cell wall hardness. And, there is no study that pays attention to an initial modulus reflecting the tension of cell membrane. In this study, we developed a method to analyze damages on strawberry tissue taking the membrane degradation into account. As a first step, both fracture stress and initial modulus were measured to evaluate the texture change caused by the degradation of cell wall and cell membrane, respectively. Additionally, the diffusion of water molecules in tissue was measured by using NMR to evaluate the degradation of cell membrane. From these methods, we attempted to clarify the cause of softening of frozen-thawed strawberry tissue. Further, we investigated the effect of the pretreatment with the CaCl₂ solution, which is well known as a texture preserving technique for freeze-thawing fresh strawberry. As a result, it was revealed that both cell wall and cell membrane got damaged, so that the remarkable tissue softening was induced. However, for strawberry tissue, damage on cell membrane was found to be dominant in textural softening. It was also clarified that the pretreatment with the CaCl₂ solution would suppress the decrease of fracture stress reflecting cell wall hardness but could not improve initial modulus reflecting cell membrane tension after freeze-thawing. As a conclusion, it was found to be necessary to control the damage on cell membrane to prevent the softening of strawberry tissue after freeze-thawing.