

Fresh spinach and rucola can survive freezing. What about fresh oregano?

Freezing is one of the oldest food preservation methods since it preserves better the original color and flavor of foods. However, freezing and thawing of fruits, leafy vegetables and herbs causes quality degradation. This can be overcome by a new method that was developed by scientist from Lund University. This method includes two pretreatments before freezing and thawing: vacuum impregnation and pulsed electric fields. This innovative method managed to improve drastically the freezing tolerance of spinach and rucola. However, in the case of oregano this method is successful only for short period, since are formed dark brown spots on the leaf surface. The brown spots are dead areas of the leaf surface. Iliana Karasa, a master student from Lund University describes how the resting time after the pretreatments and before freezing and thawing affects the time that leaves remain viable.

It is an undeniable fact that the trends in food market have changed. Humans have an innate sense to attach to natural things. Thus, it is not surprising that nowadays consumers prefer to buy less processed food products. According to consumers, natural foods are healthier option. Food scientists need to adapt to the customers preferences and develop new methods of preservation. Freezing is one of the oldest food preservation methods, used widely for many food products. Nevertheless, freezing and thawing damages the integrity of frozen foods such as spinach and berries. This problem can be avoided thanks to the development of two pretreatment methods before freezing.

A decade ago, a group of food engineers at Lund University in Sweden developed a new revolutionary preservation method for leafy vegetables, to conserve their freshness, integrity and naturalness after freezing and thawing. Thanks to this method, leafy vegetables such as spinach can retain their freshness. This method can reduce the costs of off-season food and volume of food waste. The damage on fruits and leafy vegetables is caused by the formation of ice crystals during freezing. Ice crystals harm cells and cause leakage, thus their natural characteristics are lost. The solution for naturalness loss is the avoidance of cell damage. The method consists of two pretreatments (vacuum impregnation and pulsed electric fields), resting time, freezing and thawing.

Plants have developed a method to defend themselves against freezing temperatures by the accumulation of substances such as sugars and proteins inside and outside of the cell. One known sugar that plants use is trehalose. Trehalose can be found in nature or it can be produced

using microorganisms or enzymes. It has 40-45% the sweetness of sugar and it is safe to consume. In the industry, vacuum impregnation is used to accumulate substances in plants in a controlled manner. During vacuum impregnation, the air contained in plant tissues is replaced by the solution of trehalose.

Successful freezing tolerance may be achieved by the presence of trehalose in and out the plant cells. The next step after vacuum impregnation is the application of pulsed electric fields. During this process, the plant tissue is exposed to electric shocks of high voltage for fractions of seconds. The voltage that is used is 300-400 Volts. As a consequence, pores are formed on cell membranes that close shortly after. Through these pores, trehalose that is outside the cell can enter the inside of the cell. The application of pulsed electric fields causes some metabolic changes on plant cells, depending on the parameters that are applied. These metabolic changes take place due to the stress that cell goes through the process. Moreover, cell stress can cause organized and controlled destruction of cells. This phenomenon is called programmed cell death. In nature, the utility of programmed cell death is either the appropriate development of the plant body or the defense mechanism to stop the spreading of unwanted pathogenic microorganisms.

In this work, oregano leaves were vacuum impregnated in trehalose solution of the same concentration as the solutes inside the cell, processed with pulsed electric fields and then rested for 1, 2 or 3 days at 4°C and high humidity. It was proven that resting time affects the viability of processed oregano leaves after freezing and thawing. The longer the resting time, the longer their survival. The duration of survival is affected by the time that cells were left to recover from the stress that was caused by the two pretreatments, vacuum impregnation and pulsed electric fields. The viability loss is probably caused by apoptosis or necrosis, which are two categories of programmed cell death.

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Master thesis title: Application of pulsed electric fields in combination with vacuum impregnation with trehalose to improve the freezing tolerance of fresh *Origanum vulgare* leaves

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