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QUICK FREEZING OF FRUITS AND VEGETABLES AND THEIR SUBSEQUENT STORAGE GOLD DRIED FRUITS EXPROT

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Abstract

Freezing is the process of lowering the temperature of a product below the cryoscopic (freezing point) until most of the water contained in the product crystallizes.

The crystallization process consists of two phases, including the nucleation of crystals and their growth. As the temperature decreases, the kinetic energy of water molecules decreases, and crystallization centers begin to form. The nucleation of crystals occurs when a group of water molecules is ordered and this structure is preserved, followed by its enlargement due to the involvement of new water molecules.

Keywords - Temperature, water molecules, crystallization, cooling process, Food, fruits and vegetables, Plant tissues, Ice crystals, solid-crystal phases.

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It has been established that, first of all, that part of the moisture begins to freeze, which has weaker bonds with hydrophilic colloids, which contains less dissolved substances. Such moisture is located in the intercellular space of plant tissues in which ice crystals begin to form first. The formation of ice crystals in the intercellular fluid causes an increase in the concentration of the solution, i.e. increase in

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osmotic pressure. As a result of the resulting difference in concentrations inside the cells and in the intercellular space, water moves from the cells to the intercellular space, ice crystals in the intercellular space increase, and the cells become dehydrated. When water turns into ice, an increase in volume occurs, which causes an increase in the volume of the intercellular space and compression of the cells, which contributes to their dehydration. In the process of cell compression, folds can form in the membrane, which can also lead to mechanical damage to the integrity of the cells. The process of increasing the number of crystals and their size in the intercellular space proceeds until the temperature drops to the level necessary to start crystal formation inside the cells, where part of the moisture has already passed into the intercellular space and an increased concentration of dissolved substances has been created. The less water left in the cell, the lower the crystallization temperature.

Slow freezing leads to the formation of large ice crystals in the intercellular space and causes serious mechanical damage to cell walls and membranes.

During rapid cooling, the mechanism of crystal growth has been studied. It has been established that when the solutions are supercooled, many crystallization centers (nuclei) are formed simultaneously inside the cells and in the intercellular space without significant migration of moisture from the cells into the intercellular space. Small crystals are formed, which are evenly distributed inside the cells and in the intercellular space, while it was found that even with a very fast freezing rate, crystal formation begins in the intercellular spaces. The larger the cell size of the plant tissue, the higher the freezing rate should be, so that smaller crystals are evenly formed inside and outside the cells, which less disrupt the integrity of the cell, which ensures a higher quality.

Mineral and organic substances are dissolved in the juice of fruits and vegetables. Lowering the temperature below the cryoscopic temperature is accompanied by a change in the concentration of the liquid solution, the degree of dissociation of the dissolved substances, and the properties of the solvent. During the freezing process, the concentration of dissolved substances in the remaining unfrozen aqueous solution constantly increases. With the concentration of dissolved substances as a result of freezing of water, the concentration rises to the saturation level, at which their crystallization begins, an equilibrium occurs between the crystallizing components of cell sap and water. The temperature of food products at which moisture completely freezes in them is called eutectic, or cryohydrate. The value of this indicator depends on the type and chemical nature of the unfrozen solution. Therefore, the maximum amount of ice is formed when the lowest eutectic point is reached, i.e. the temperature at which the last compound goes into the eutectic state ("end eutectic point"). Depending on the type of product, this value ranges from -55 to -70°C. With modern technologies for quick freezing of products and their subsequent storage, all frozen products contain a certain amount of unfrozen water. It is believed that the effect of maintaining quality is achieved and maintained throughout the entire storage period, if more than 80% of the free water of the product turns into ice during freezing and is stored in this state.

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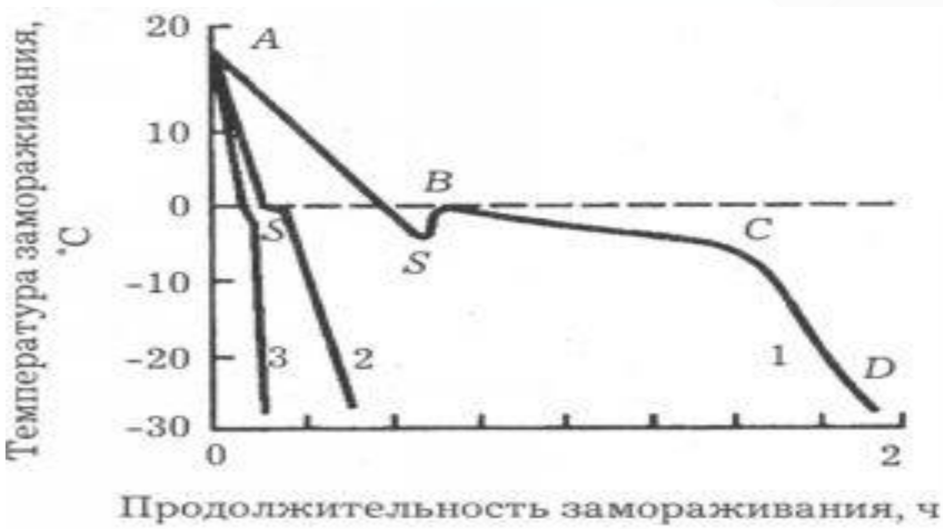

Fig.1. Freezing curves: 1 - slow; 2 - fast; 3 – ultrafast

On fig. curves are presented that characterize the processes occurring at different rates of food freezing. The nature of the freezing process depends on many factors, the determining of which are the temperature and the rate of freezing. For the process of slow (curve 1), fast (curve 2), and ultrafast freezing (curve 3), there are general patterns. During the freezing process, three temperature ranges can be distinguished in the center of the product - from + 20 to 0°C, from 0 to -5°C and from -5 to -18°C. The graph shows the main segments corresponding to different phases of freezing. Segment A-S corresponds to the period of cooling of the product to near-cryoscopic temperatures. At the first stage, the product is cooled from +20 to 0°C. The decrease in the temperature of the product here is proportional to the amount of heat extraction work.

Point S corresponds to subcooling of the product. At point S, freezing occurs, water crystallization begins. The release of the heat of crystallization causes an increase in the temperature of the product to point B. The segment B-C corresponds to the length of time at which the bulk of the moisture freezes. With slow freezing, the temperature of the product practically does not decrease; during this period, approximately 70% of the liquid fraction of the product crystallizes. With a further decrease in temperature (section (C-D)), little moisture freezes, little heat of phase transformation is released, the product temperature drops sharply. refrigeration work.

The lower limit of product cooling is determined by the economic efficiency of the process and the quality of the finished product.

Assortment of frozen fruits and vegetables

Quick-frozen products are conditionally divided into 2 large groups:

One piece products.

- Multi-component products and ready meals.

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As a raw material for single-component products, fruits and berries with a limited shelf life (strawberries, raspberries, currants, gooseberries, etc.) are widely used, which, along with retail sales, are used for further processing.
For the production of natural products, rapid freezing in liquid nitrogen or carbon dioxide snow and in fluidization plants is usually used.
It is economically and technically expedient to store raw materials intended for processing in crushed form, because with the same mass, they occupy 2-5 times less volume, but retain a high taste and biological value.
The product range is constantly being improved and expanded:
Fresh or crushed fruits and berries.
Fresh or crushed fruits and berries are replaceable with sugar (from 20 to 40%).
Pureed fruits and berries with sugar.
Fresh or crushed fruits and berries, in pulp with added sugar.
Fruit juices. They are sterilized, concentrated to 70%, cooled to -6°C in a drum freezer, packaged, frozen to -35°C and stored at -18°C.
Pre-cooked fruits and berries. Blackberries, blueberries, raspberries, cherries, apples, etc. Before freezing, they are dipped for several minutes (2-8) in boiling syrup (50 ° C according to the Brix hydrometer), cooled in a stream of cold air, placed in paper portion molds, packed under vacuum in a gas-tight film.
Before freezing, the core of apples can be filled with berry puree.
Baked apples. After stonecrop, the core of apples is stuffed with an aromatic composition (granulated sugar with the addition of cinnamon (1%)); granulated sugar with lemon juice and nutmeg extract, etc. Then they are baked in an oven at t 204°C until softened, cooled, packaged in a vapor-tight film and frozen.
Fruit cocktails are made from pieces of plums, cherries, pitted raisins, peaches, grapefruits, which are boiled in syrup (40%), packed, frozen.
Vegetables in sauce. Portion molds are filled with chopped vegetables, sauce is added (15%), 70% - H_2O; 10-25% butter; 0.5-2% starch, 0.5-3% sugar, 1.5-2.5% salt, aromatic components, onions, etc., sealed under vacuum, boiled, frozen.

CONCLUSION

For the production of the entire range of frozen vegetables and fruits, as well as various frozen ready-made vegetable and other dishes and semi-finished products, there is a valid regulatory and technical documentation, that is, technological instructions indicating all processes and processing modes, standards and specifications outlining the requirements for their quality.
But still, not all types and varieties of fruits and vegetables are suitable for freezing. High quality products are obtained from green peas, sweet peppers, beans, sweet corn, mushrooms, strawberries, raspberries, cherries, plums, currants, apples, pears, etc. Cucumbers, melons, watermelons are of little use.

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