FROZEN VEGETABLES

Food and Agriculture Organization of the United Nations

Vegetables Processing Toolkits

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1.- Frozen Vegetable Processing - General information

Freezing is one of the most used processes for conservation of foods. This process is based on the heat removal of the food to be conserved, by keeping the temperature sufficiently low at the point to considerably hindering or reducing the destructive action of the microorganisms, oxygen and enzymes on the product. The characteristics of the vegetables such as size, internal structure and cellular membrane thickness affect the patterns of the freezing process. The vegetable freezing is a widely used process since it presents higher efficiency in the preservation of the physiochemical and sensorial qualities of the vegetables.

The frozen food has no water available for the microbial development, therefore no possibility for deterioration by microorganisms, if storage is adequate. So, the shelf-life of the food is limited to the enzymatic, physical and chemical changes that may occur even at low storage temperatures. The retention of the qualities in the "in natura" product, such as flavor, aroma, color and texture is the main objective of the process and this retention is strictly related to freezing speed .

To obtain a frozen product with good quality, the freezing speed should be so high as possible, mainly at the temperature range between 4ºC and 0ºC. This is the water freezing range at which the ice crystals are formed. The speed will directly affect the size of the ice crystals that will be formed within the vegetal tissues. A very low freezing speed rather lead to the formation of few and large crystals, whereas the high speed provides the formation of many low-sized crystals, which is preferable. The formation of large crystals causes destruction of the vegetable tissues, therefore provoking loss in the sensorial quality of the product.

2.- Processing details for frozen vegetables

2.1.- Pre-refrigeration

After blanching, the vegetables should be subjected to a cooling process in order to avoid the high temperature to which the vegetable tissue was exposed to cause excessive losses of nutrients. In addition, the lowering of the temperature will impede the proliferation of contaminant microorganisms which cause deterioration in the vegetable tissues.

The cooling process is fundamentally important to assure the lowest energy consumption during the freezing stage. For a rapid and effective cooling, it is advised to use frozen water. The liquid medium makes possible a fast exchange of heat with the product.

This cooling may be performed through an ice bath, by pouring the vegetables into stainless steel tanks containing the frozen water.

2.2.-Drainage

After cooling with frozen water, the vegetables should undergo a drainage process for elimination of the excessive water that settles on the vegetable tissues.

2.3.-Weighting

When the conditioning phase is finished, the weighing and the calculation of the production efficiency from the dehydration process are performed. It should take care for all production to be within packaging. On the other hand, no excessive product should be within packages because this would cause economical loss.

The packages should contain 500 grams or 1 kilogram of product.

2.4.-Packaging

The vegetables should be wrapped in opaque and high-density polyethylene bags (PEHD), with low permeability to both moisture and oxygen. Usually, the white color is used for the polyethylene bag. The opaque film will protect the product from radiation, therefore avoiding its oxidation. Besides, the empty spaces inside the packages should be reduced in order to diminishing the mobility of the moisture inside the package. Finally, the bags should be sealed.

2.5.-Freezing

For freezing the vegetables such as carrots, broccoli, cauliflower and green bean it is advised to use a room cabinet freezer provided with cold air flow.

This is probably the simplest freezer used for freezing the vegetables, when working at lower scale. It is constituted by a freezing chamber in which the products are introduced. The insertion of the products may be accomplished by movable shelves provided with small wheels. The shelves may be loaded and unloaded manually. The product is placed on trays, and these ones are taken to the shelves. Although this freezer model is used for low-scale production, it provides lower freezing speeds. It is necessary to take care of the freezing chamber design in order to provide a good distribution of the air.

For larger structures, a continuous freezing tunnel with cold air flow might be used. In this freezer, the air passes on. the product already packed at the temperature range from -30ºC to -40ºC at a speed from 1.5 to 6.0 m/s, depending on the product. The high speed provides a good transference of heat. A belt conveyor takes the product through the tunnel. The air flow may be perpendicular or parallel to the product flow. The formation of ice may occur on the cooling coils due to the transfer of the product moisture to the air.

2.6.-Main Package

Besides the packing in opaque polyethylene films, a second packaging may be used for the product, such as paper/cardboard.

2.7.-Freezing Storage

Much care should be taken during storage, because this phase will be responsible for maintaining the quality of the frozen products.

To avoid all and any chemical or biochemical reaction, it is advisable to keep the frozen products at temperatures bellow -18 ºC. The fluctuations of temperature in the storage chambers may impair the quality of the products, as well as to reduce their useful life. The fast temperature fluctuations may cause accumulation of water on the internal surfaces of the packing. In some cases, the superficial dehydration followed by superficial oxidation can cause a problematic burning of the product. Besides, the temperature fluctuations might accelerate the formation of ice crystals inside the product.

THE STORAGE CHAMBERS MAY ALSO BE USED FOR SLOW FREEZING, AS LONG AS THE VOLUME OCCUPIED BY THE MATERIAL ENTERING INTO THESE CHAMBERS TO BE FROZEN DOES NOT EXCEED 20% OF THE TOTAL CHAMBER VOLUME.

3.- Frozen products

Frozen Brocolis

At the end of the freezing process, this product shows intense green coloration. The product should be under the bouquet form. No excessive ice should be inside packaging, since the water is removed during the centrifugation phase before the freezing process.

Frozen Couve-Flor

At the end of the freezing process, this product exhibits a white coloration with slightly greenish parts in the stems. He product should be under bouquet forms. No high amount of ice should be inside the packing, since the water is removed over the centrifugation process, before the freezing process.

Frozen Carrots

At the end of the freezing process, this product shows an intense orange coloration. It must be under some millimeter-thick roundel forms. There should not be too much ice within package, since the water is removed during the centrifugation phase before the freezing process.

Packaging

These products should be packed in opaque, polyethylene and high-density packages, preferably white-colored ones to protect the product from radiation.