

Textural Quality and the loss in Nutrients of Potatoes and Carrots Affected by Blanching and Storage Conditions

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Abstract

As potatoes and carrots are important horticultural products and an important raw material for the food processing industry, so inevitably it is stored in fridges in order to be available all year long. Texture is a critical quality factor for vegetables. Successful production of acceptable products requires serious attention to textural changes and attaining of this aim involves a good knowledge of the factors that influence texture. Both the textural and the loss in nutrients of processed vegetables are influenced not only by variety and maturity at harvest, but by processing and storage conditions as well. Blanching combined with cold storage is an excellent preservation method to extend vegetables shelf-life. While many of the researchers in this area investigated the properties of those of thermally processed (sterilized, dehydrated, frozen) products, little attention has been given to the interactive nature of the stages in the various processing operations or to variations within a particular stage. The objective of this study was to investigate the effects of different blanching and storage conditions on textural and loss in nutrients of potatoes and carrots. Before Potatoes and carrots were frozen using plate and air blast, the samples were blanched using water and steam blanching with time variations within each method. The physical properties of interest were hardness, cohesiveness, and loss of sugar. The loss in sugar determined and the texture changes in the products during processing are illustrated.

Keywords: loss in nutrients of potatoes, blanching, storage conditions

1.Introduction

Three hundred tons of potatoes are daily needed for Jordan, (108000 tons per year). Noting that Jordan's annual productivity amounting to 95,000 tons spread over 6250 acres, with an average of 15.2 tons yearly per acre, this means that Jordan needs 36.11 tons per day of imported potatoes (13,000 tons per year). As well, Jordan need in carrots is 50 tons per day (18000 tons per year) and the annually total production of the carrots in Jordan is 3302 tons, which means that a deficit of local production of this product is up to 80%. Insurance required quantity of these crops to consumers in the Arab countries, particularly in Jordan needs to intensive scientific research, which is not limited to potato varieties, agricultural pests, and production technology but also addressed to the conditions of heat treatment, storage, conservation and their impact on the textural quality and the loss in nutrients.

Cold storage prolongs the life of the fruit tissues by slowing down the metabolic processes including respiration intensity and internal ethylene production [2]. Freezing preservation is achieved through the low temperature (i.e., below 0C), which slow all types of changes causing decay whether due to living microorganisms or to the enzymes naturally present, and freeze the water present in the food product as a result of ice crystallization. Under normal circumstances, although growth of all microorganisms is prevented at freezing temperature (i.e., below -18C), some may grow at the freezing temperatures but at a considerably slower rate. Shelf life of frozen foods can vary depending the kind of food, from three months to a year or longer [7]. Many vegetable foods are blanching for short period using either hot water or steam before freezing [7]. Both enzymes and microorganisms have a high heat sensitivity and can be destroyed by exposure to the temperature of boiling water at 70-105 C. This heat treatment process used prior to freezing is called blanching must be applied for a time sufficient to inactive enzymes which cause off-texture, off-flavors, off-color, and loss of nutritive quality. The loss of water-soluble minerals and vitamins during blanching should also be minimized by keeping blanching time and temperature at an optimum combination [8]. Texture has an important effect on the consumer acceptance of foods. Texture is a critical quality factor for vegetables. Successful production of acceptable products requires serious attention to textural changes and attaining of this aim involves a good knowledge of the factors that influence texture [1]. Many researchers have confirmed the close connection between mechanical properties and microstructure of biologic materials [1, 3-5]. The effect of freezing, frozen storage on vegetables quality has been investigated over several decades. Today frozen fruits and vegetables constitute a large and important food group [6]. The quality demanded in frozen fruit products is mostly based on the intended use of the product. If the vegetables is to be eaten without any further processing after thawing, texture characteristics are more important when compared to use as a raw material in other industries.

The goal of this paper is to study the effects of blanching and freezing conditions on the hardness, cohesiveness (a measure of the degree of difficulty in breaking down the internal structure), and sugar loss. The foods investigated were potatoes and carrots. The freezing processes chosen were, domestic freezing, air blast freezing and plate freezing together with steam and water blanching techniques.

2.1 Materials and Methods

The texture analyzer 50Kg CT3 were used to describe textural properties. The texture analyzer can measure the hardness/firmness, of potatoes and carrots in a compression test; in addition the cohesiveness, can be measured in a Texture Profile Analysis test (TPA).This application measures the firmness of potatoes carrots using the Kramer shear cell. This fixture incorporates the textural methods of compression, shearing and extrusion through slots at the base of the cell.

2.2 Equipment

50 Kg CT3 Instrument,
TA-KSC Kramer shear cell with five Blades,
TA-BT-KIT Fixture Base Table,
Texture Pro CT Software.

The principle of operation of the CT3 Texture Analyzer is to subject a sample to compression forces using a probe, or tension forces using grips. The resistance of the material to these forces is measured by a calibrated load cell which is reported in either grams or Newtons. A cross head speed of 1 mm/s and a compression to 20% of original size was selected for texture measurements.

3. Experimental

All samples were carefully cut into cylindrical pieces 8 mm in diameter,10mm long. The simples were blanched by

1. Immersion in hot water at 100°C for periods of 5, 7and 9 minutes followed by cooling in water at 12 °C.
2. Steam blanching-exposure to flowing steam at 110°C in an enclosed container for periods of 3, 5, 8 and 10 minutes followed by water cooling. The samples were then frozen by the following methods

1. Domestic freezing at -18°C.
2. Air blast freezing at both -30°C and -40°C.
3. Plate freezing at -30°C.

Hardness was expressed as maximum force for the first compression cycle, whereas Cohesiveness was reported as ratios between areas under second and first compression cycles. The mean result from a minimum of 6 samples was used in each case.

4. Results and Discussion

Hardness was examined throughout the process. An unexpected outcome of the investigation is that there appears to be no difference between the effects of water and steam blanching over the range investigated. This outcome is illustrated in figures 1,2,3 and 4. These Figures show a decrease in carrot and potato hardness with blanching time for steam and water blanching process. Freezing processes using various ways that followed the steam blanching showed extra lowering of hardness in carrots and potatoes. These results are illustrated in Fig.5 for carrots and Fig.6 for potatoes. The broad trends in hardness for carrots that have been blanched by steam and water then blast frozen and thawed are outlined in Fig. 7. On this Figure hardness is found to increase with lowering temperature of freezing for water blanching and conversely in case of steam blanching. The anomaly of increasing hardness with freezing temperature is due to changes in the cell membrane induced by the higher steam temperatures. Increasing blanching time leads to an increase in cohesiveness. This result is obtained Through the study of Fig.8 and 9.

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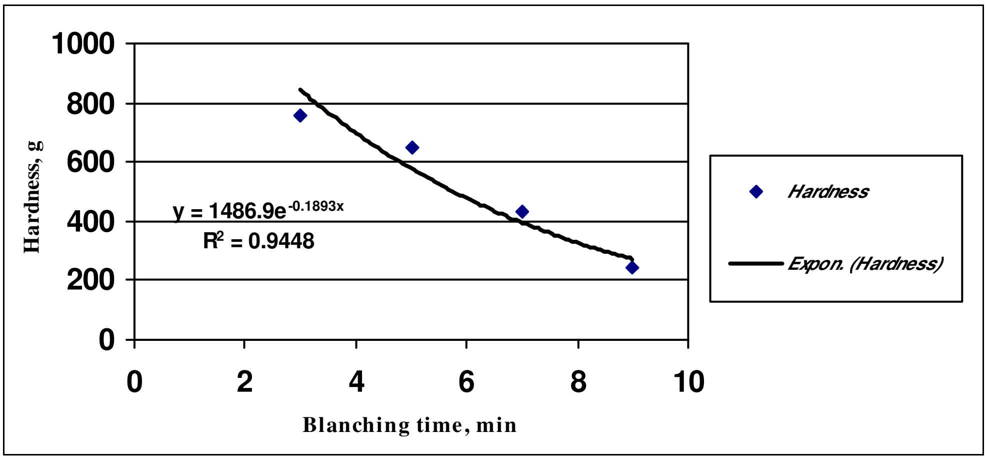

Fig. 1. Effect of steam blanching time on carrot hardness.

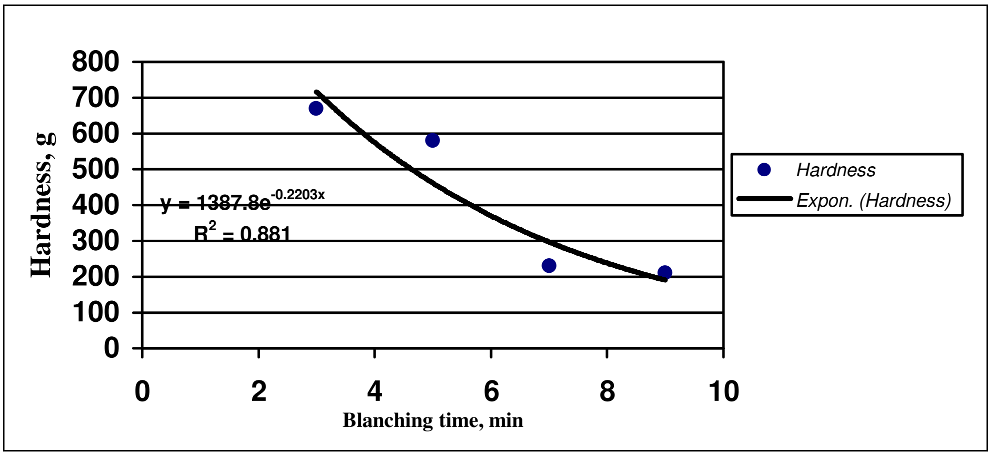

Fig.2. Effect of hot water blanching time on carrot hardness.

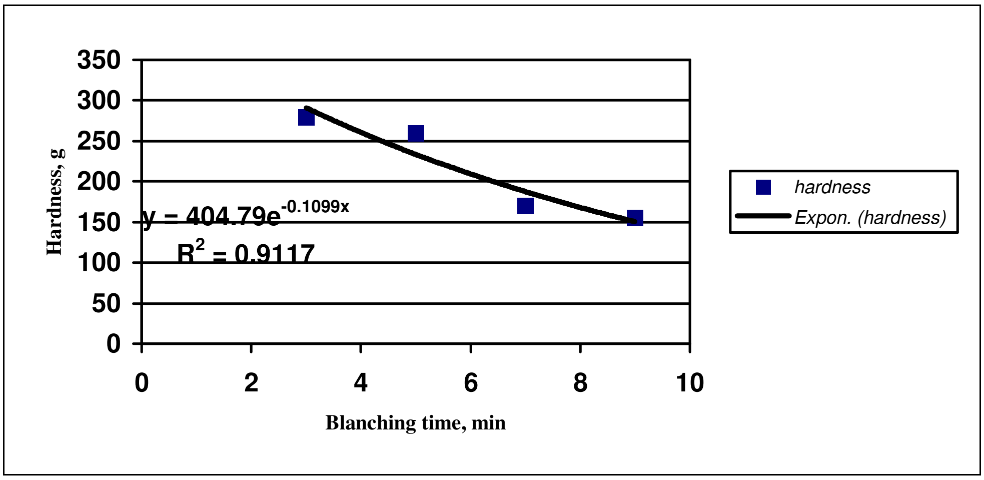

Fig.3. Effect of steam blanching time on potato hardness.

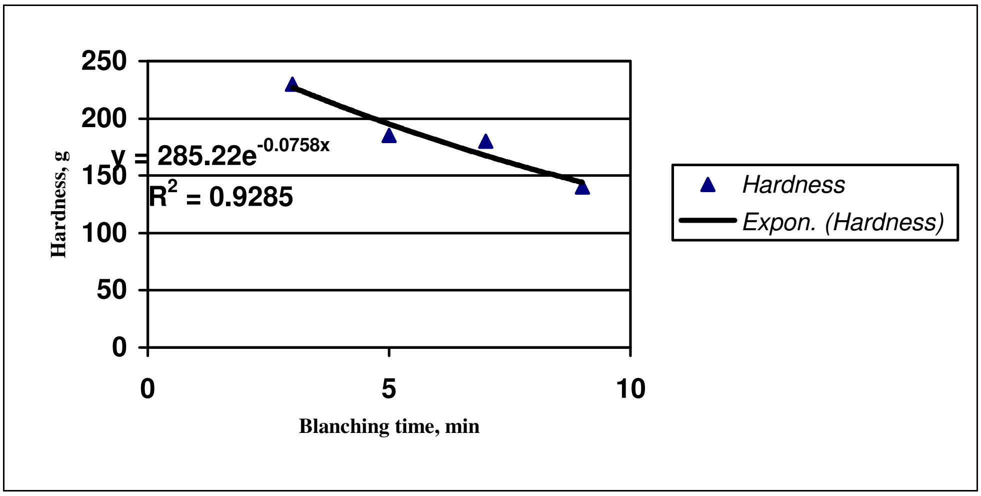

Fig.4. Effect of hot water blanching time on potato hardness.

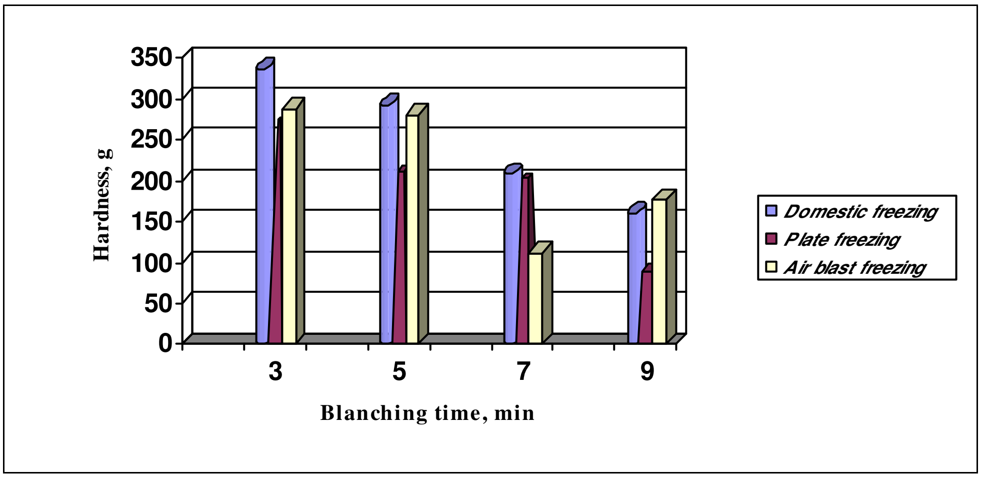

Fig.5. Hardness versus steam blanching time for carrots after freezing by various methods.

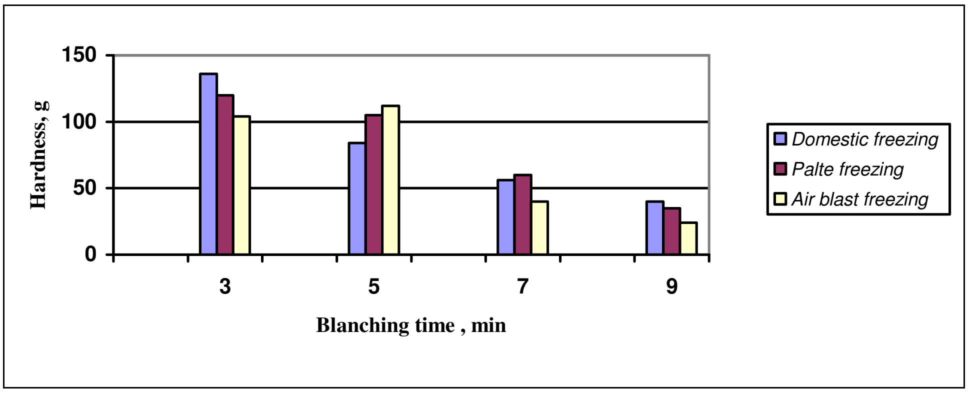

Fig.6. Hardness versus steam blanching time for potatoes after freezing by various methods.

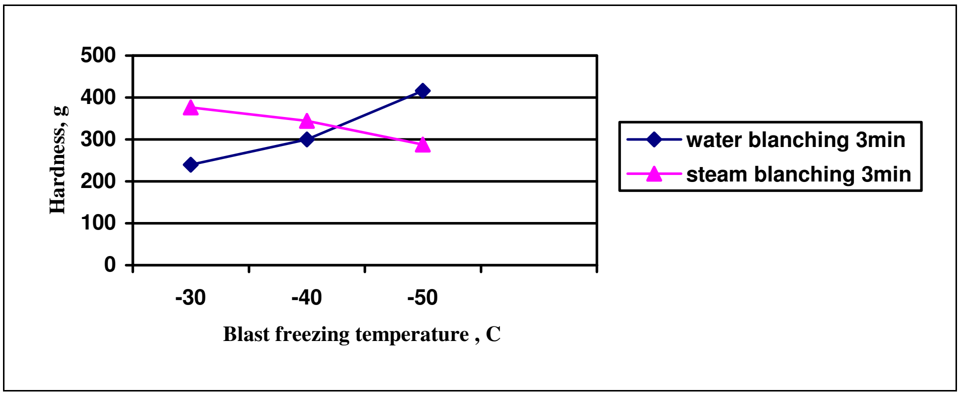

Fig.7. General trends in hardness for carrots that have been blanched, frozen and thawed.

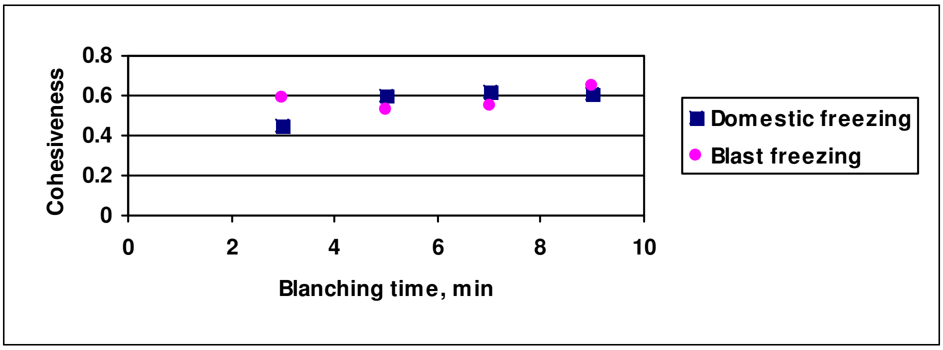

Fig.8. Cohesiveness of potatoes that have been blanched, frozen and thawed.

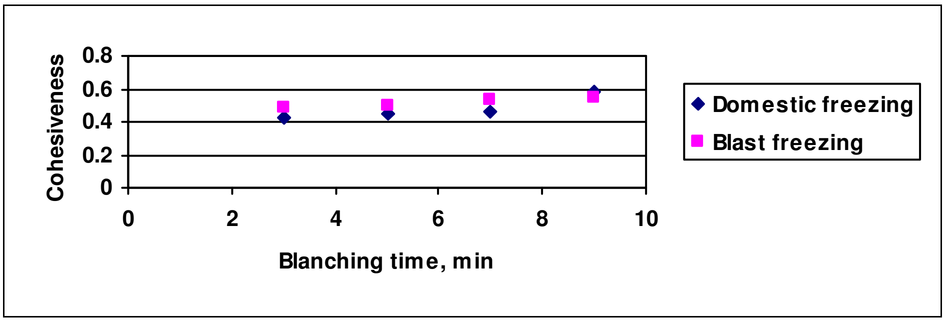

Fig 9. Cohesiveness of carrots that have been blanched, frozen and thawed**.**

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