COMPARATIVE STUDY OF THE WEIGHT OF DEHYDRATED AND OSMOTICALLY DEHYDRATED FRUITS

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Abstract

Dehydrated fruits popularly called "dried apples" are considered "true miracles" for health. Dehydrated fruits are rich in vitamins, fibers, microelements, they are preferably consumed in winter and spring, representing an appropriate solution for a balanced diet in the cold season.

Through dehydration, fruits maintain their nutritional value, taste, smell, and their volume and their weight is reduced five or tenfold. They occupy much less storage space, and transport, handling and storage can be done in any season, with lower expenses, compared to fresh and even canned ones.

Osmotic dehydration is a process of partial dehydration. This process does not remove enough moisture from a product to be considered a dry product, but has the advantage of requiring less energy used in dehydration.

The application of osmotic dehydration to fruits is a technique for producing foods with intermediate moisture or as a pretreatment before drying to reduce energy consumption and thermal deterioration.

The comparative study on the weight of dehydrated fruits was carried out for oranges, strawberries and apples, compared to the osmotic dehydration of the same fruit species, an operation carried out in the domestic dehydrator.

Key Words: dehydration, osmotic dehydration, weight, pretreatment

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INTRODUCTION

Drying is a widespread operation in the food industry, because it is one of the traditional methods of food preservation, by removing part of the water contained. Drying is also used due to processing, storage, transport and use requirements. Drying is the operation undergoing heat and substance transfer, by removing part of the liquid contained in the food masses, and using a moisture entrainment agent, which simultaneously provides the thermal energy necessary for the process (Banu Constantin, 2007).

Drying or dehydration as a method of preserving horticultural products is based on the removal of a certain amount of water from vegetables and fruits with the help of heat, until reaching the physico-chemical state that blocks the vital activities and microorganisms, but allows the maintenance of nutritional and organoleptic qualities. (Lazar Vasile, 2006).

The temperature, relative humidity and circulation speed of the hot air used as a heating agent are of particular importance in the dehydration process. The higher the air temperature, the faster the evaporation of water will increase, thanks to better heat transmission. The drying time will also be reduced.

When dehydrating fruit, it generally starts with lower temperatures and ends with a higher temperature by 20-30°C. Fruit dehydration is started at temperatures between 40-60°C and finished at 75-85°C. (Marca Gheorghe, 2004).

In the dehydration process, temperature, relative humidity and air movement are automatically adjusted according to the needs of the product, in dehydration facilities called dryers or dehydrators.

The choice of the dehydration process is made according to the following characteristics: physical aspects of the product: shape, size, state of aggregation; chemical aspects; the diversity of the presentation forms of the finished product and the amount of raw material intended for dehydration (Beceanu Dumitru and Chira Adrian, 2003).

During the dehydration process, water is removed from the products due to the phenomenon of diffusion, which can be external and internal.

External diffusion is due to the evaporation of water from the surface of the product: at the beginning of the dehydration process, fruits and vegetables have a high humidity, and the evaporation of water from their surface occurs in conditions similar to those on free surfaces;

the rate of evaporation is influenced by the evaporation surface, the temperature, the speed of air circulation and the relative humidity of the drying space.

Internal diffusion represents the movement of water from inside the product to the surface and determines the subsequent course of dehydration. This equalizes the humidity in all layers of the product subjected to dehydration and is carried out based on the difference in water potential caused by the different concentration levels in soluble substances of the liquid, both inside and on the periphery of the product (Potec Ion et all., 1983).

During the drying process, depending on the regime applied, sensitive transformations occur in the chemical composition, which influence the nutritional value. Proteins undergo denaturation that is dependent on temperature, pH and humidity. An important role is also played by mineral salts that reach high concentrations at the end of drying, favoring denaturation. Protein degradation causes a reduction in the digestibility of dry food and poor rehydration, as a result of the loss of selective permeability of cell membranes. Hot air-drying causes significant reductions in vitamin C, and losses of B vitamins are moderate. All these transformations, to which the products are subjected to by drying processes, determined the search for new methods, which allow a better preservation of the original product quality. (Brad Segal and Balint Constanța, 1982).

The set of phenomena that occur during dehydration lead to the concentration of the dry substance, to the reduction of the volume of the raw material used and to the increase of the volumetric weight, the increase of the nutritional value per unit of weight, to more or less profound physico-chemical changes in the state of the membranes and cellular components, which are externalized through the limits of rehydration capacity (Mănescu S., 1973).

Physico-chemical transformations are mainly related to tissue changes and increased osmotic pressure.

Tissue changes occur as a result of denaturation of proteins by coagulation, which causes a change in the state of hydrophilic colloids. The process is partially reversible by water reabsorption (rehydration).

The osmotic pressure increases during dehydration due to the increase in the sugar concentration of the cell juice. This fact explains the partial saccharoosmoanabiotic effect recorded during the dehydration of fruits in hot air (Gherghi Andrei).

Partial osmotic drying consists of treating the food product with concentrated sugar solution until the initial weight is reduced by 50%. For partial osmotic drying, whole or split fruits are placed in a concentrated sugar solution (65-75%) for 8-24 hours. Next, the fruit is drained of the syrup and then dehydrated with hot air.

The advantages of this partial drying are as follows: a preservation of the color and natural aroma is achieved, without the addition of SO_2 or bisulphites, as in the case of conventional drying; enzymatic browning is prevented; the degree of sweetness is intensified by the partial removal of acidity. (Banu Constantin, 2008).

Osmotic dehydration is an operation used to partially remove water from plant tissues by immersion in a hypertonic (osmotic) solution. Water removal is based on the natural phenomenon of osmosis through cell membranes. The driving force for the diffusion of water from the tissue into the solution is determined by the higher osmotic pressure of the hypertonic solution.

The diffusion of water is accompanied by a simultaneous reverse diffusion of solutes from the osmotic solution in the tissue. Since the cell membrane responsible for osmotic transport is not perfectly selective, the solutions present in the cells (organic acids, reducing sugars, mineral substances, flavor compounds and pigments) can be extracted into the osmotic solution, which affects the organoleptic and nutritional properties of the product.

Water evacuation and solute penetration occur mainly during the first 2-3 hours of immersion. After this, the difference in water content between the food and the solution gradually decreases, until the system reaches a state of dynamic equilibrium. (Nour Violeta, 2014).

MATERIAL AND METHOD

For the comparative study on the preservation by dehydration and osmotic dehydration of fruits, three varieties of fruits were analyzed: oranges, apples and strawberries, which were purchased from a supermarket and which were then dehydrated in the home dehydrator.

The fruits taken in the study were washed, and the inedible parts were removed, such as the seed pods for apples and the calyx for strawberries.

For dehydration, apples were cut into slices with a thickness of 2-3 mm, oranges were cut into rounds with a thickness of 3-4 mm, and strawberries were cut into halves, which were then weighed, the weight of each sample being 100 g. The osmotic solution was prepared from sugar and water in a ratio of 1:1,

The osmotic solution was prepared from sugar and water in a ratio of 1:1, resulting in a syrup with 48.7°R, in which the samples were introduced for osmotic dehydration, in a ratio of 1:4, respectively the 100 g samples in a quantity of 400 g of sugar syrup.

The samples were weighed again after a period of 3 hours, during which time the fruits were periodically pressed because they tended to rise to the surface, and during which osmosis, the migration of water from the fruit cells into the sugar syrup, took place.

Sliced and round fruits and those kept in the sugar solution were drained from the syrup and weighed again, then placed on parchment paper and placed on the dehydrator racks. From the moment the dehydration started, they were weighed every 30 minutes, after which a dehydration graph was made.

RESULTS AND DISCUSSION

In the comparative study of the weight of dehydrated and osmotic dehydrated fruits, we followed the weight of the fruits after osmosis, the organoleptic characteristics of the fruits obtained after dehydration and the weight of the fruits after dehydration.

1.Assessing fruit weight after osmosis

The data obtained when assessing the initial weight and weight after osmosis for the 3 varieties of fruit analyzed are listed in table 1.

Table 1

Initial weight and weight after osmosis of fruits

No. crt.	Fruit assortment	Initial weight g	Weight after osmosis g
1.	Oranges	100	95,2
2.	Strawberries	100	81,0
3.	Apples	100	85,8

From the data presented in the table, it can be seen that the initial weight of the analyzed samples was 100 g, and after 3 hours of osmosis of the fruits in the syrup, the weight of the fruits decreases depending on the species, and parts of the amount of water in the fruits passes into the syrup. Thus, the largest amount of water is lost by strawberries, which reach a weight of 81 g, apples have reached a weight of 85.8 g, and the lowest amount of water lost is oranges, which reach a weight of 95.2 g, this is due to the fact that the structure of oranges is different from other fruits, they contain closed cells, which if they are not sectioned, osmotic dehydration is less impactful.

2.Organoleptic analysis

Dehydrated fruits and those osmotically dehydrated in the dehydrator were analyzed from an organoleptic point of view.

The organoleptic characteristics of dehydrated fruits show certain characteristics depending on the species and the method of dehydration.

The orange slices kept their shape well in both variants - the color of the V1-Oranges variant is yellow-brown, matte, and that of the V2-Osmotically dehydrated oranges variant is yellow – bright, glossy. The taste is sour in the case of V1, and sweet-sour in the case of osmotically dehydrated V2, without a foreign smell. The texture is elastic in the case of both variants, with no foreign baking smell in both variants.

The pieces of strawberries cut in half, in the case of the dehydrated variant V1, kept their shape in proportion to 50%, their color is dark red, with burnt brown spots, and in the variant V2, osmotically dehydrated, the shape is uniform, characteristic of strawberries, and the color is bright red, glossy.

V1 dehydrated apple slices have a regular shape, with slight wrinkles, the color of the pulp is yellow-brown, the skin is reddish-brown. The texture is firm with a slight crumbliness. The taste is characteristic of dehydrated apples, with no foreign smell of baking.

The slices of osmotically dehydrated V2 apples have a regular, hemispherical shape, uniform in size, a yellow-white flesh color, the skin is reddish characteristic of the variety. The texture is elastic, the taste is sweet-sour, without a foreign smell.

3.Assessing of weight after dehydration

To assess the weight of the dehydrated fruits, they were weighed at the beginning of dehydration and subsequently every 30 minutes until total dehydration.

The results obtained in the case of the 6 varieties of dehydrated fruits in the dehydrator are presented in table 2.

Table 2

Weight of dehydrated and osmotically dehydrated fruits

N	Fruit assortment	The weight –g									
		Initial	30 min	60 min	90 min	120 min	150 min	180 min	210 min	240 min	270 min
V1.	Oranges	100	85,4	70,9	62,3	51,6	43,7	35,7	29,6	25,8	22,4
V2	Osmotically dehydrated oranges	95,2	85,9	74,6	68,4	58,6	51,7	43,9	38,4	31,3	27,1
V1.	Strawberries	100	89,1	76,0	62,8	50,0	39,1	31,5	26,2	22,3	19,2
V2.	Osmotically dehydrated strawberries	81,0	75,3	64,7	55,8	45,5	35,3	26,0	23,5	19,6	15,4
V1.	Apples	100	88,0	75,5	53,9	39,5	29,1	22,2	18,3	16,6	-
V2.	Osmotically dehydrated apples	85,8	66,9	54,8	42,5	31,4	25,3	18,2	15,0	13,9	-

From the data obtained during the dehydration of the 3 varieties of fruit, 2 variants each, one of the variants of each species being subjected to osmotic dehydration beforehand, for 3 hours, it is observed that the dehydration time is 270 minutes for oranges and strawberries and 240 minutes for the analyzed apples, both V1 and V2 osmotically dehydrated, but their weight is different.

By comparatively assesing each fruit species for the two variants, as well as the fruit species, it is found that there are significant differences.

The weight of dehydrated oranges – V1, decreases more in the first part, in the interval 0-120 minutes, from the initial weight of 100g, it reaches 51.6g, after which the intensity of dehydration is reduced and the final weight is reached after 270 minutes at the weight of 22.4g.

In the case of osmotically dehydrated oranges -V2, the weight decreases progressively, at a reduced rate, almost constantly in the interval 0-120 minutes, from the weight of 95.2 g to 58.6 g, after which the intensity decreases and more, reaching its final weight of 27.1 g after 270 minutes.

The comparative analysis of the two variants shows that the final weight of the osmotically dehydrated oranges -V2 is higher than the variant -V1, not osmotically treated, although V2 lost 4.8 g in weight through osmotic treatment, but due to the composition and the cellular structure of oranges osmotically treated with sugar syrup, dehydration is more difficult.

The graphic representation of the weight of dehydrated oranges depending on the dehydration time is presented in figure 1.

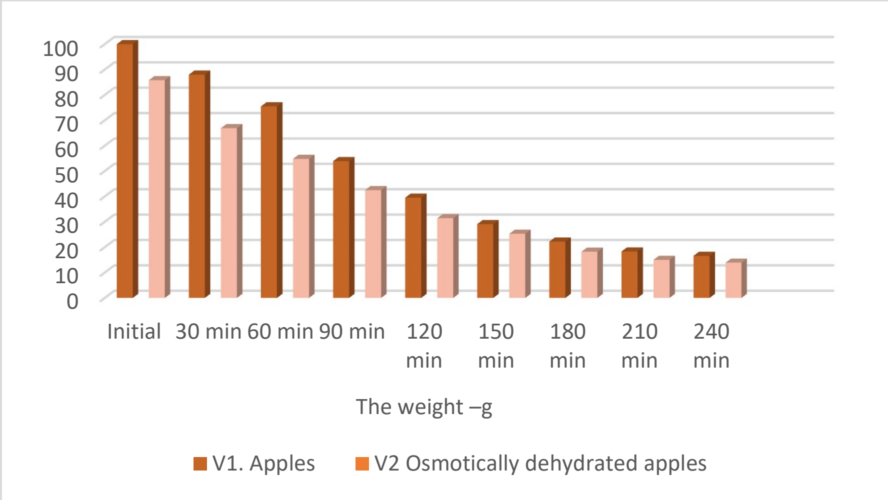

Figure 1 Graphic representation of the dehydration of oranges

The weight of strawberries – V1, in the first part of the interval 0-120 minutes decreases moderately, from the initial weight of 100 g it reaches 50 g, and in the end it reaches 19.2 g. In the case of osmotically dehydrated strawberries -V2, the initial weight was 81 g, and after 120 minutes it reaches 45.5 g, and at the end, after 240 minutes, the weight is 15.4 g.

The final weight of the two strawberry variants is different, respectively, V1 has 19.2 g, and the osmotically treated V2 has a lower weight of 15.4 g.

Comparing the two variants of dehydrated strawberries, it is observed that during the same period of time, the weight of osmotically dehydrated strawberries V2 is 3.8 g less than V1 - this is due to the porous structure resulting from osmosis, which favors the diffusion of water, so the partial osmotic dehydration favored the final dehydration of the V2 variant.

The graphic representation of the weight of dehydrated strawberries according to the dehydration time is shown in figure 2.

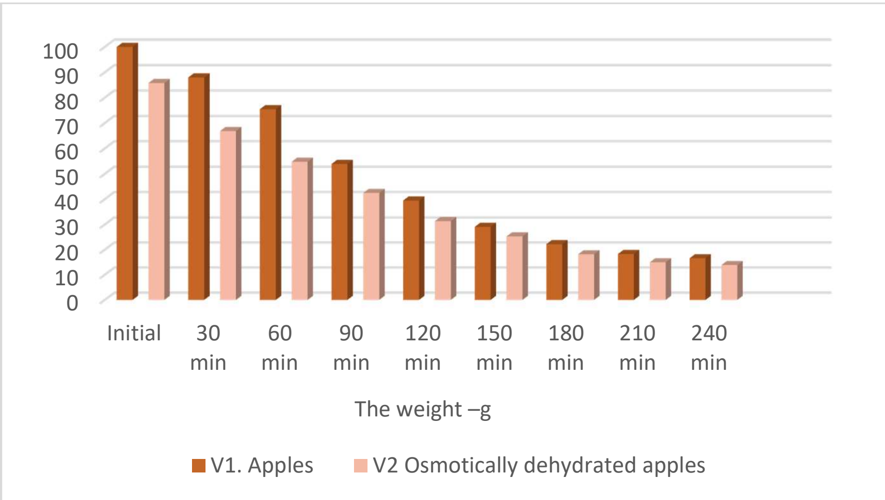

Figure 2 Graphic representation of the weight of strawberries

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The weight of apples -V1 decreases more in the interval 0-120 minutes, so from the initial weight of 100 g, it reaches 39.5 g after 120 minutes, after which the dehydration process is less substantial, and after 240 minutes, the final weight reaches 16.6 g.

The weight of osmotically dehydrated apples – V2, decreases significantly in the first part of the interval 0-120 minutes, thus from 85.8 g it reaches 31.4 g, and after 240 minutes, it reaches the weight of 13.9 g.

The final weight of the two apple variants analyzed is different in the same period of time, respectively the osmotically dehydrated apples V2 have a lower weight, respectively 13.9 g, compared to the V1 variant, which has a weight of 16.6 g, resulting in a difference of 2.7g, favored by the partial osmotic dehydration of the fruits.

The graphic representation of the weight of dehydrated apples according to the dehydration time is presented in figure 3.

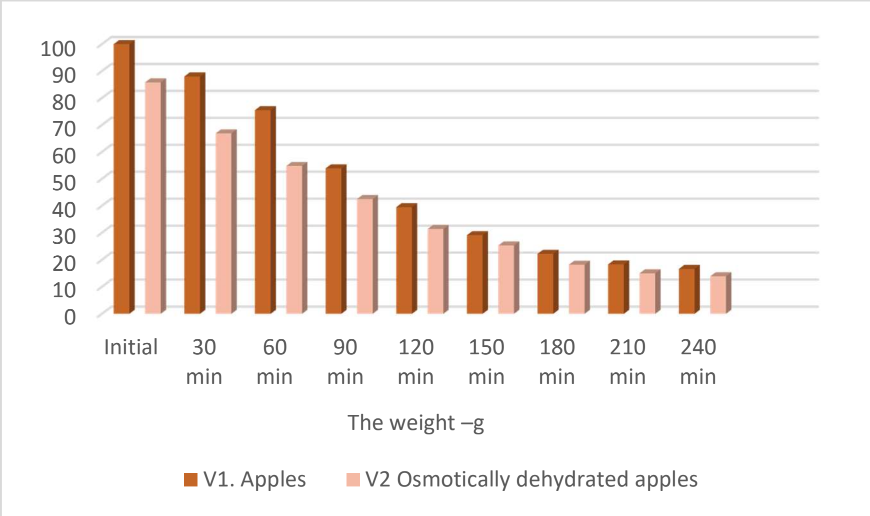

Figure 3 Graphical representation of the weight of apples

CONCLUSIONS

Dehydration is a method of preserving fruit for long-term storage. An important economic aspect of dehydrated fruits is the fact that their volume is significantly reduced after the end of the dehydration process.

For the comparative study on the preservation by dehydration and osmotic dehydration of fruits, three varieties of fruits were analyzed, namely oranges, apples and strawberries.

The samples taken in the study, those treated osmotically and those not osmotically treated, were dehydrated in the household dehydrator for 240 minutes in the case of apples and 270 minutes in the case of oranges and strawberries.

The organoleptic characteristics of the dehydrated fruits show certain characteristics depending on the species and the dehydration method: the osmotically untreated version-V1 and the osmotically treated version - V2.

The best organoleptic characteristics were osmotically dehydrated fruits, V2 apples, which kept their shape and color well compared to V1, followed by -V2 oranges, which kept their shape and color compared to V1, and strawberries V2, which have kept their shape and color compared to V1. The weight of each dried fruit species in the two variants is different, but there are also significant differences between the fruit species.

By comparatively looking at the weight of the dehydrated oranges in the two variants, it is observed that the final weight of the V2 osmotically dehydrated oranges is higher than the variant V1, not osmotically treated, although V2 lost 4.8 g in weight through osmotic treatment, but due to composition and cellular structure of oranges osmotically treated with sugar syrup, dehydration is more difficult.

The final weight of the two strawberry variants is different, respectively V1 has 19.2 g, and the osmotically treated V2 has a lower weight of 15.4 g - this is due to osmosis which favored the diffusion of water.

The final weight of the two apple variants assessed is different in the same period of time - the osmotically dehydrated V2 apples have a lower weight, of 13.9 g, which is determined by the osmotic treatment applied before dehydration, compared to the V1 variant, which has a weight of 16.6 g, in its untreated form.

Making a comparison between the three fruit species chosen for the comparative study of preservation by dehydration and osmotic dehydration, it is observed that the most efficient were the V2 osmotic dehydrated apples, in terms of the final weight reached after dehydration at 13.9g, followed by strawberries V2, which reached the final weight of 15.4g, and osmotically dehydrated oranges V2, had a higher weight of 27.1g, where partial osmotic dehydration prevented the final dehydration to a certain extent.

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