A STUDY ON PUMPKIN DEHYDRATION DEPENDING ON DEHYDRATION METHOD AND PRESENTATION FORM

Urs MARIANA[1]

**University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru Str., 410048, Oradea; Romania, e-mail: mariana_mediu@yahoo.com*

Abstract

Dehydration is the technological process by which the natural water content of food products is reduced to a level that prevents the activity of microorganisms, without destroying the tissues or depreciating the nutritional value of the products being dehydrated.
Dehydration is an economically advantageous preservation method, as it significantly reduces the volume of food, thus optimizing storage space. By reducing weight and volume, dehydration contributes to reducing the costs associated with packaging, storing and transporting products.
Pumpkin is an important ingredient in many traditional Romanian culinary dishes, especially in the autumn season, being used in the preparation of cream soups, purees, jams and other culinary specialties. Pumpkin seeds, consumed raw or roasted, are a popular and nutritious snack.
Pumpkin can be preserved for consumption all year round, frozen in the form of cubes or puree, or sterilized in jars, grated in the form of noodles, ready to be used in various dishes.
Pumpkin can also be processed through dehydration in the form of chips or cubes and can be an alternative consumption for a healthy diet, by replacing sugary treats in children's and adults' diets.
The study on the dehydration of pumpkin was carried out under laboratory conditions in two types of devices: a microwave oven and a household dehydrator. Two types of pumpkin were analyzed for dehydration: round and elongated or pear-shaped, divided into slices and cubes.

Key Words: dehydration, preservation, organoleptic characteristics, pumpkin

INTRODUCTION

Drying is one of the traditional methods of preserving food products, by eliminating a certain part of the total water contained. The removal of water from products can be achieved through several operations, depending on their initial physical state such as: mechanical, physico-chemical, and thermal operations.

Drying is a thermal operation, which is carried out with heat and substance transfer, to remove part of the liquid contained in food masses (water), using a moisture-entraining agent, which simultaneously provides the thermal energy necessary for the process (Banu Constantin and all, 2007).

The elimination of moisture is achieved up to a percentage level, at which the development of microorganisms is not allowed and which ensures the preservation of food products. The maximum water content that ensures the preservation and storage of products depends on their nature. Thus, for certain fruits, the humidity must be reduced to 18-20%, and for other products, the humidity must be 2-4%. (Popovici Mariana, 2012).

The main purpose of dehydration is to preserve products for a long time, extending the shelf life of foods by reducing water activity below 0.7.

Dehydration of fruits and vegetables has two effects: it ensures the stability of the product over time without the need for complex installations or special packaging, and it reduces the volume of products, resulting in smaller storage spaces and a reduction in sales and transport costs (Nour Violeta, 2014).

The most widespread drying method is convection at atmospheric pressure (hot air drying). During hot air drying, this is the vector that supplies the product surface with energy and also the vector for removing water vapor (Banu C., 2008).

In microwave drying, heat is generated inside the product through the interaction between the chemical constituents of the food and radiofrequency energy (915MHz and 2450

MHz). When the material is subjected to microwave energy, heat is generated inside the product through molecular excitation.

Most vegetables and fruits with large volumes are divided into cubes, slices, noodles, which favors dehydration by reducing the duration of production. (Dumitru Beceanu, Adrian Chira, 2003).

Scalding the raw material is an operation preceding dehydration. The main purpose of scalding vegetables is to inactivate all enzymes and especially oxidative enzymes, which are the most heat-resistant. Scalding destroys the vegetative forms of microorganisms and eliminates air from the tissues, which has the effect of: fixing, maintaining and even accentuating the color of the finished product; fixing and preserving vitamin C during subsequent processes; dehydration time is reduced because it helps accelerate the subsequent evaporation of water from tissues.

At the end of the dehydration period, after cooling for 2-3 minutes, the degree of dehydration is checked, when the dehydrated slices or cubes must be hard, break when bent, have a glassy and transparent appearance in section and a humidity of 8%. (Mănescu S., 1973).

The products obtained through dehydration differ from the raw material from which they come, following the removal of excess water, by: the concentration of the dry substance, a consequence that causes the volume to decrease and the volumetric weight to increase, the energy-plastic value to increase per unit weight; the change in the ratio between the main components of the dry substance; the quantitative decrease of some, the increase of others, the partial disappearance, if not total, of some components and the formation of others; the state of the membranes and cellular components that are externalized by the limits of the rehydration capacity (Ion Potec and all., 1983).

The drying process of fruits and vegetables takes place in two distinct stages. In the first few hours, the evaporation process takes place with the highest intensity, during which free water is eliminated, after which drying proceeds very slowly.

In the first period, the humidity on the surface of the product is higher than the hygroscopic humidity. If the drying conditions do not change, the drying rate for all products remains constant and unchanged, and as a result it is called the period of constant drying rate. In the second period, the drying rate is gradually reduced, proportional to the reduction in product humidity, which is why it is called the period of decreasing drying rate (Segal Brad and all., 1984)

At the beginning of the dehydration process, when the humidity is still high, evaporation of water from the surface of the product occurs by external diffusion, the more intense the evaporation surface, the higher the temperature and the air circulation speed. Simultaneously, the process of internal diffusion begins, the movement of water from the inside to the outside, as a direct consequence of the difference in osmotic pressure caused by the different concentration of soluble substances in the cell sap inside and on the surface of the product. Thus, the homogenous spread of humidity is achieved in all layers subjected to dehydration. If the speed of external diffusion from the product surface exceeds that of internal diffusion, the phenomenon of scalding occurs, which requires the regulation of the temperature and relative humidity of the air (Dumitru Beceanu, A.Chira, I.Pașca, 2008).

Pumpkin is a valuable food option for people following a healthy diet and weight control. With an energy value of approximately 22 kcal per 100 grams, it falls into the category of foods with low calorie density, while providing a diverse range of essential nutrients. The high-water content (approximately 91.8 g per 100 g) also supports the inclusion of pumpkin in diets aimed at weight loss (USDA FoodData Central, 2023).

MATERIAL AND METHOD

For the study on pumpkin dehydration, we analyzed two types of pumpkins: round and elongated or pear-shaped, which were dehydrated in the form of slices and cubes, in two devices: microwave oven and household dehydrator.

The samples taken for the study were weighed, and the weight of each sample subjected to analysis was 100g. The analyzed samples were placed on baking paper and introduced into the dehydration spaces.

For pumpkins prepared for dehydration, according to the operations presented above, the following data are drawn:

- initial weight of pumpkins;
- weight of cleaned pumpkins;
- weight of pumpkins put to dehydration, which was 100g;
- final weight of dehydrated pumpkin samples;

From the moment the drying process begins, the samples being studied are weighed every 30 minutes for samples in the household dehydrator and every 15 minutes for samples in the microwave oven.

RESULTS AND DISCUSSION

During the study of pumpkin dehydration, we determined the following: the losses resulting from the inedible parts during the cleaning process; the weight of the analyzed products and the time required to remove water from the products, starting from the initial weight of 100 g for each sample and reaching their final weight; the organoleptic properties of round and elongated or pear-shaped pumpkins dehydrated in the electric oven and household dehydrator and the total and percentage of water loss during the dehydration process.

1. Inferring the inedible part data

To determine the inedible part removed during cleaning, we weighed both previously named pumpkin varieties before and after cleaning. The results obtained were recorded in Table 1.

Table 1

Inedible part data table

Assortment of pumpkins	Initial quantity g	Quantity after cleaning g	Inedible part	
			g	%
Round pumpkin	1045.60	785.23	260.37	24.90
Elongated pumpkin	345.28	232.11	113.17	32.77

From the data presented in table no. 1, it is found that in the elongated type pumpkin, the amount of the inedible part was 113.17g, this representing a percentage of 32.77% of the total weight, and in the round type pumpkin, the inedible part was 260.37g, which corresponds to a percentage of 24.90%.

This difference shows that the percentage of inedible parts is higher in the elongated type pumpkin, compared to the round type pumpkin. The difference is because the round pumpkin has a thicker and better developed pulp, resulting in a lower percentage of inedible material compared to the elongated pumpkin which has a thinner pulp and a higher content of inedible part.

2. Inferring the weight of microwave-dried pumpkins as a function of time

To determine the weight of microwave-dried pumpkins, the two analyzed samples, both in the form of slices and cubes, were weighed at 15-minute intervals. The data that was obtained, relating to the initial and final weights of the two types of microwave-dried pumpkins, are presented in Table 2.

Table 2

Weight of microwave-dried pumpkins

Assortment of pumpkins	Weight - g - sliced pumpkins				
	Initial	15 min	30 min	45 min	
Round pumpkin	100	76	28	14.0	
Elongated pumpkin	100	70	22,2	10.6	
	Weight - g –cubed pumpkins				
Assortment of pumpkins	Initial	15 min	30 min	45 min	60 min
Round pumpkin	100	85	61	34	18.4
Elongated pumpkin	100	86,4	61,6	29	16.6

From the analysis of the data obtained from the dehydration of pumpkins in the microwave oven, a progressive decrease in weight is observed depending on the drying time. For pumpkin slices, the dehydration process lasted 45 minutes, while for cubes it took 60 minutes.

From the analysis of the data obtained from the dehydration of pumpkins in the microwave oven, a progressive decrease in weight is observed depending on the drying time. For pumpkin slices, the dehydration process lasted 45 minutes, while for cubes it took 60 minutes.

Samples in the form of slices:

The initial weight of both samples (round pumpkin and elongated pumpkin) was 100 g. After 45 minutes of drying, the round pumpkin reached a weight of 14.0 g, and the elongated pumpkin, 10.6 g. A significant decrease in weight occurred in an interval of 15-30 minutes, indicating a high rate of water removal. Thus, after 30 minutes, the round pumpkin reached 28 g from 100 g, and the elongated pumpkin 22.2 g.

Cubed samples:

Both samples had an initial weight of 100 g. After 60 minutes of drying, the final weight was 18.4 g for the round pumpkin and 16.6 g for the elongated pumpkin. In the case of the cubes, the weight loss was progressive, but with a lower water removal rate. After 30 minutes, the round pumpkin recorded 61 g, and the elongated pumpkin, 61.6 g.

3. Inferring the weight of the pumpkins dehydrated in the dehydrator as a function of time

To determine the weight of the pumpkins dehydrated in the dehydrator, the two samples analyzed, both in the form of slices and cubes, were weighed periodically every 30 minutes.

The data obtained regarding the initial and final weights of the two types of pumpkins, depending on the dehydration time, are presented in Table 3.

Table 3

Weight of pumpkins dehydrated in the household dehydrator

Assortment of pumpkins	**Weight - g - sliced pumpkins**							
	Initial	30 min	60 min	90 min	120 min	150 min	180 min	210 min
Round pumpkin	100	92	72	56	36	25	18	10.3
Elongated pumpkin	100	95	78	58	40	24	19	11.2
	Weight - g –cubed pumpkins							
Assortment of pumpkins	Initial	30 min	60 min	90 min	120 min	150 min	180 min	210 min
Round pumpkin	100	88	63	47	33	24	17	11.4
Elongated pumpkin	100	92	80	58	39	26	19	14.3

In the case of dehydrating pumpkins in a dehydrator, the process duration was 210 minutes for both slices and cubes of pumpkin, and the initial weight of all samples analyzed in the household dehydrator was 100g.

For pumpkin slices, from an initial weight of 100g, they reached 10.3g for the round pumpkin and 11.2g for the elongated pumpkin, after the 210 minutes of dehydration. A less pronounced decrease in weight is observed in the dehydrator in the first part of the process (0-90 minutes) compared to the microwave. Thus, after 90 minutes, the weight of the round pumpkin reached 56g, and that of the elongated pumpkin was 58g. In the interval of 90-210 minutes, the weight losses were moderate for the sliced samples.

For the diced pumpkin, from an initial weight of 100g, after 210 minutes of dehydration, the final weight was 11.4g for the round pumpkin and 14.3g for the elongated pumpkin. In the first 90 minutes, weight losses were greater for the diced round pumpkin, reaching 47g, compared to the diced elongated pumpkin, which reached 58g. In the interval of 90-210 minutes, losses were moderate for both cubed samples.

4. Assessing the organoleptic characteristics of pumpkin in the microwave oven and in the household dehydrator

From an organoleptic point of view, the pumpkins dehydrated in the microwave oven presented the following characteristics:

- The pumpkin slices took the form of chips by losing water, uniform in size. The predominant color was yellow, translucent, although some areas showed browning. No foreign odors were detected, and the consistency was hard.

- The pumpkin cubes had non-uniform shapes in size. The color was yellow-orange, without foreign odors. The taste and aroma were pleasant, characteristic of the pumpkin, and the texture was good. Small browned parts were observed at the corners.

The pumpkins dehydrated in the household dehydrator presented the following organoleptic characteristics:

The pumpkin slices were uniform in size and color, with a smooth surface. The color was a dull yellow-orange, without foreign odors and with a characteristic pumpkin taste. The texture was good, and the slices did not show browned parts.

The pumpkin cubes were uniform in size, with a smooth surface and an orange color. They did not have a foreign odor, the taste and smell were characteristic of pumpkin, and the texture was good; also they did not show browned parts.

The organoleptic characteristics of the samples dehydrated in the household dehydrator were superior to those obtained in the microwave oven. These are due to the controlled ventilation of the air circulating over the surface of the products during dehydration, as well as the longer duration of the dehydration process.

5. Inferring the total and percentage of water loss

Drawing on the data obtained from weighing the samples, we calculated the total and percentage weight losses of the analyzed pumpkins, which represent the evaporated water content, both for dehydration in the microwave oven and in the household dehydrator, and the results obtained are presented in Table 4.

Table 4

Total and percentage weight loss of pumpkins

Assortment of pumpkins	Total water loss in the microwave		Total water loss in the home dehydrator	
	g	%	g	%
Sliced round pumpkin	86	86	89.7	89.7
Sliced elongated pumpkin	89.4	89.4	88.8	88.8
Cubed Round pumpkin	81.6	81.6	88.6	88.6
Cubed elongated pumpkin	83.4	83.4	85.7	85.7

To highlight these losses, we made a graphic representation of the total and percentage water losses of the analyzed pumpkin samples, presented in Fig. 1.

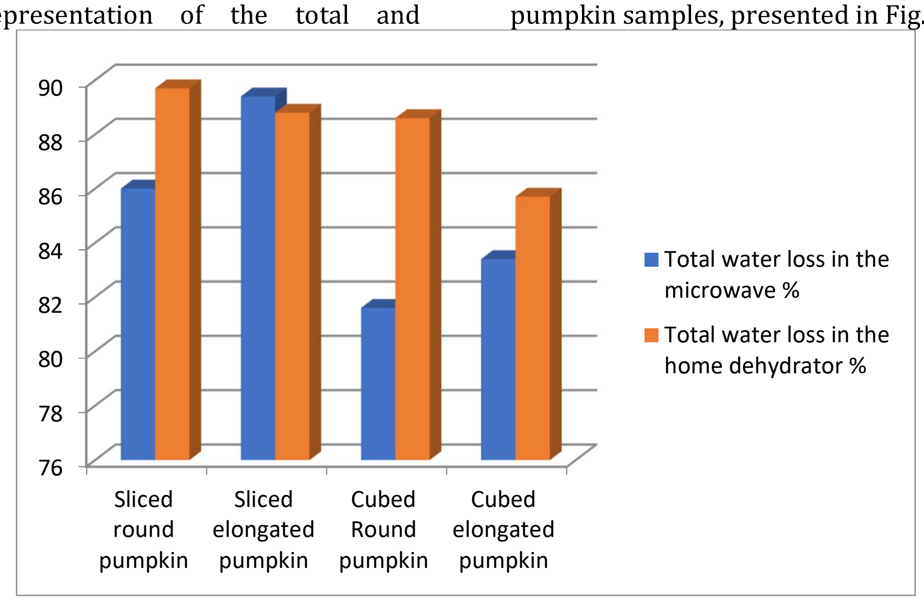

Fig.1. Graphical representation of the total and percentage water losses of the analyzed pumpkin samples

From the analysis of the obtained data, it was observed that weight losses are higher when dehydrating in the microwave oven for pumpkin slices (round and elongated) compared to cubes. This phenomenon is attributed to the larger evaporation surface offered by the slices.

A similar pattern was also recorded in the case of the household dehydrator: round and elongated pumpkin slices showed higher water losses than cubes.

It is worth noting the uniformity of the final weight of the pumpkins dehydrated in the household dehydrator. In this case, weight losses (respectively the amount of evaporated water) were between 85.7% (for elongated pumpkin cubes) and 89.7% (for round pumpkin slices), while in the microwave oven the losses are higher, 81.6% (round pumpkin cubes) and 89.4% (elonganted pumpkin slices).

CONCLUSIONS

Pumpkin is an easily accessible staple food, consumed in various forms, is specific to the autumn season and can be used in numerous culinary recipes or consumed baked, boiled.

Pumpkin is an essential source of nutrients, providing vitamins, minerals and antioxidants beneficial to health, being a valuable component of a balanced diet. In addition to the pulp, the seeds are also used, which are rich in essential substances such as proteins, carbohydrates, unsaturated fatty acids, vitamins, amino acids and various phytocompounds or they can be processed to obtain pumpkin oil.

Dehydration is an effective method of preserving vegetables and pumpkins, especially when the process is carried out gradually, adapted to the structural specificities of the products. Slow dehydration, at relatively low temperatures, gives dehydrated products organoleptic properties similar to those of fresh products.

In the case of dehydrating pumpkin in a dehydrator, the dehydration time was 210 minutes for both types of pumpkin and for the sliced and cubed shapes, compared to the microwave oven, where the dehydration time was 45 minutes for slices and 60 minutes for cubes for both types of pumpkin.

In the microwave oven, from the initial weight of 100g of the sliced samples, after 45 minutes, a weight of 14 g was reached for the round pumpkin and 10.6 g for the elongated pumpkin, and for the cubed samples the weight was 18.4 g for the round pumpkin and 16.6 g for the elongated pumpkin.

In the household dehydrator, from a weight of 100g of cubed samples, after 210 minutes a weight of 10.3g was reached in the case of round pumpkin and 11.2g in the case of elongated pumpkin, and in the cubed samples, the final weight was 11.4g in the case of round pumpkin and 14.3 in the case of elongated pumpkin.

From an organoleptic point of view, the characteristics of the pumpkins dehydrated in the home dehydrator were superior to those obtained in the microwave oven. This difference can be attributed to the efficient air ventilation in the dehydrator, which ensures more uniform drying and prevents browning. In both dehydration methods, weight losses were higher in the case of slices compared to cubes, due to the larger evaporation surface of the slices. The final weight of the pumpkins dehydrated in the home dehydrator was quite uniform, with water losses ranging between 85.7% (cubed elongated pumpkin) and 89.7% (sliced round pumpkin), while in the microwave oven the losses have a greater amplitude, 81.6% (cubed round pumpkin) and 89.4% (sliced elongated pumpkin).

REFERENCES

Banu Constantin, 2007. Food engineering treatise. Vol. I, AGIR Publishing House, Bucharest, page 967

Banu Constantin, 2008. Food industry treaty. General problems, ASAB Publishing House, Bucharest, page 289

Beceanu Dumitru, Adrian Chira, 2003. Technology of horticultural products, Economic Publishing House, page 470

Beceanu Dumitru, A.Chira, I. Pașca, 2008, Fruits, vegetables, flowers. Methods for prolonging freshness. Canned vegetables and fruits, M.A.S.T. Publishing House, Bucharest, page 308

Mănescu S., 1973, Technology of dehydration of vegetables, potatoes and fruits. Editorial Board of Agricultural Magazines, Bucharest, pages 68, 109

Nour Violeta, 2014, Industrial processing of vegetables and fruits, SITECH Publishing House, Craiova, page 438

Popovici Mariana, 2012, Unitary operations in the food industry, University of Oradea Publishing House, page 191

Potec I.,Maria Elena Ceaușescu, L.Roșu, Doina Anton, T.A.Tudor, A. Cotrău, 1983, Technology of preservation and industrialization of horticultural products, Bucharest, page 280

Segal Brad, Rodica Amarfi, V. Cubleșan, Georgeta Dima, 1984, Technological equipment in the horticultural products processing industry, Ceres Publishing House, Bucharest, page 236

USDA Food Data Central. (2023), Pumpkin, raw. U.S. Department of Agriculture