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STUDY RELATED TO THE QUALITY OF LABORATORY LYOPHILIZED FRUITS

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Abstract

Lyophilization is a procedure of preservation through drying which consists in eliminating the water from a previously refrigerated product, by sublimating it through vacuum (the water from the product transforms itself directly from solid estate into steams). Lyophilized products greatly keep their nutritional values having as well a longer period of availability.

By dehydrating the fruits after the lyophilization process a great percent of the fruits' properties are preserved (carbohydrates, antioxidants, mineral salts, fibres).

Lyophilized fruits are usually used in mixtures of cereals and fruits, like musli for breakfast or as they are, because they can be hydrated and eaten as one pleases.

Lyophilization makes the products dehydrated without them losing their nutritional qualities, only a very small amount of it and they also keep their flavor vey well. In what the nutritional substances are concerned, vitamins A, C and E are the most affected but they only suffer moderate losses.

The study related to the quality of lyophilized fruits has been performed in laboratory conditions for three species of fruits: raspberries, cherries and strawberries for which an organoleptic appreciation has been done and for which we have determined the weight before and after they had been lyophilized and for which the amount of C-vitamin has also been calculated.

Key words: lyophilization, lyostat, quick freezing, preservation procedure, sublimation

INTRODUCTION

The actual lyophilization is performed in three main steps: freezing, sublimation or primary dehydration and secondary dehydration or desorption. By freezing, the water which is under the form of ice crystals is separated, a process which is firstly initiated in the extra cellular fluid then the humidity from the cells migrate towards the ice crystals contributing to their dehydration. Then there is a controlled heating under vacuum conditions thus leading to the submination of ice, water being slowly eliminated under the form of steams, without melting.Through this procedure there is a minimum modification of the cellular structure or of the chemical composition. (Naghiu A. et all., 2005).

The technologic process of lyophilization starts with a quick freezing of the processed products after which the products are introduced on special plates, in the liostat. The latter is a special device like an autoclave equipped with heating and vacuum systems as well as with systems that quicly

eliminate the water steams. When enough quantity of a powerful vacuum has been reached the products subject to lyophilization are reheated to obtain the sublimation of water without the ice melting. During the whole lyophilization process the temperature and the dehydration pressure will be checked until the end of this technological process. (Mănditță D., 2002).

Through lyophilization fruits lose the greatest part of water that they contain without the cellular structure being affected and the components of the dry substance remain unchanged. Thus they become porous so that they can be easily rehydrated. Due to the porous structure the air contact surface increases which make the product be very hygroscopic, fact which needs special packing of the final product. (Gherghi A., 1999).

The final quality of a lyophilized product greatly depends on the product's initial quality. There are two common technical requests of all the food products that are about to be lyophilized: the first request refers to ensuring a volume/surface alance as big as possible which would ease sublimation and the second technical request refers to the way products are lifted up and loaded to the place the actual lyophilization happens. In this way, the distribution of products to the lyophilization place must be done uniformly in what the composition, the weight and the thickness of the loaded products are concerned. (Mintaş I., 2009).

Lyophilization as a method of preservation, presents certain advantages from the food products' quality point of view in comparison with other food preservation methods. The influences of lyophilization manifest themselves through modifications of physical , chemical and biochemical nature of the food products. One of the physical modifications that appear at lyophilized food products and which represents an advantage is the decrease of weight after lyophilization which varies according to the product between 50-90%. (Mintaş I., 2009).

Lyophilized products keep the assembly of their sensorial properties very well (texture, taste, smell). The lyophilized product keeps its initial form, does not make foam, does not contract, there are no local concentrations of certain local soluble fractions. (Banu C., 1992).

In compasrison with the products dried through other methods, lyophilized products can be much more quickly and completely rehydrated. The quality of rehydration depends on a series of conditions as for example the quantity of water, the water's pH, the temperature and the duration of the process. (Niculiță P. and N. Purice, 1986).

After a food product has been lyophilized there is usually a modifiation that appears in the product's texture in comparison to the initial product. This modification is more obvious or less obvious according to the product, to the freezing method and to the conditions in which the actual freezing of the product took place. A quick freezing generally offers the

product a good texture while a slow freezing destroys the product's texture and after the rehydration the product is usually slack. (Niculiță P. And Mona Popa).

The most spread method of drying is that of the convection to atmospheric pressure. (drying with hot air). During drying with hot air, the air itself is the vector which supplies the surface of the product with energy and the vector which removes the water vapors.(Banu C., 2008).

When drying through lyophilization the main inconvenient consists in the energy consumption which is a few times bigger then the one realized at the classical dehydration technologies. For lyophilization we use very expensive raw materials which are also very perishable like the following: citrus fruits, fruits and vegetables with a hig content of vitamins. This dehydration method is definitely superior to the other commonly used methods. Lyophilized fruits can be easily rehydrated regaining their form, value, flavor, color and other sensorial features. (Banu C.,2009).

MATERIAL AND METHOD

In order to analyse the lyophilized fruits we have taken 3 samples of fruits belonging to 3 different types of fruits: raspberries, cherries and strawberries.

The 3 samples of fruits analyzed have been conditioned, put in glass bowls and weighed. For the fruits studied we have determined the quantity of soluble dry substance and the content of C vitamin.

In order to appreciate the quality of the laboratory lyophilized fruits with the help of the ALPHA 1-4 LdpPLUS lyophilizer, after 12 hours of dehydration we have continued by determining the final weight, by determining the content of C vitamin and by appreciating the organoleptic quality of the obtained lyophilized fruits.

In order to determine the content of C vitamin from the fresh and lyophilized fruits we have chosen the titrimetrical method based on treating the product with a solution of dichlorophenol indophenol.

The volume of dichlorophenol indophenol used in the sample case and the content of C vitamin from the analyzed lyophilized fruits is presented in table 1.

Table 1

Content of C vitamin in lyophilized fruits

Lyophilized fruits	V DCPI	mg vit C/10 ml	mg vit C/100 g	xdilution
Raspberry	2,5	0,011666667	11,66666667	1166,666667
Cherry	3,0	0,014047619	14,04761905	1404,761905
Strawberry	3,5	0,016428571	16,42857143	1642,857143

In order to quantify the results we have realized a calibration curve with a standard solution of C vitamin, of 0,05% concentration. The obtained calibration curve can be seen in fig. 1.

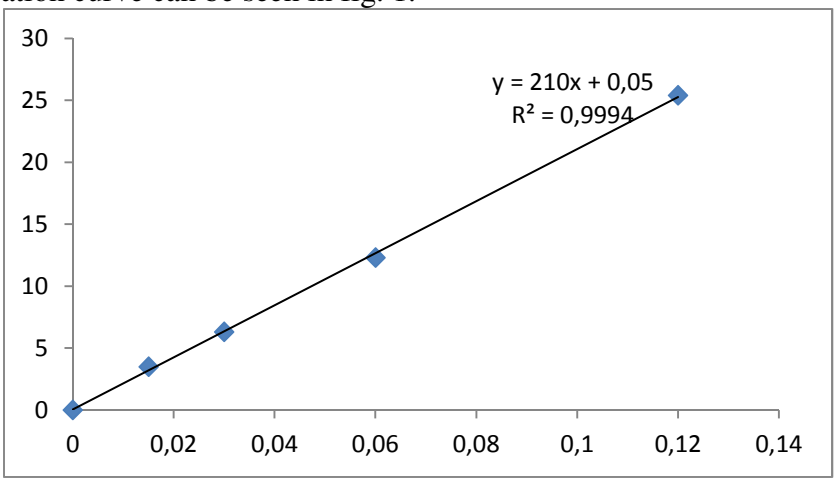

Fig.1. Calibration curve of the ascorbic acid.

RESULTS AND DISCUSSIONS

1.Appreciation of the organoleptic characteristics

The organoleptic characteristics of the three samples of analyzed lyophilized fruits are presented in table 2.

Table 2

Organic characteristics of the lyophilized fruits

Characteristics	Type of fruit		
	Raspberry	Cherries	Strawberries
Aspect	Whole fruits, of close size	Fruits divided into halves, non uniform size	Fruits divided into pieces, uniform size, present traces of juice
Color	Pink-raspberry like,close to the color of the fresh fruit	The skin is dark, blackish, easily wrinkled and the pulp is yellowish	Dark red
Consistency	Hard	Elastic pulp	The pulp is elastic
Taste and smell	Pleasant,specific	Pleasant, specific	Pleasant, flavored, specific

Organoleptically the raspberries have behaved the best during the lyophilization, they have remained whole and they had a red-raspberry color, like the fresh raspberries; the cherries have remained non-uniform due to their skin which prevents the uniform elimination of the water from the cellular structure and the skin remained wrinkled; the strawberries which have been divided are uniform in shape and color but when they were cut

their pores and capillaries have been sectioned and once the water evaporated then part of the cellular juice has also vanished.

1. **Determining the weight of the lyophilized fruits**

The data obtained when weighing the three species of lyophilized fruits and the content of soluble dry substance of the fresh fruits are mentioned and written in table 3.

Table 3

The dry substance and the weight of the analyzed fruits

Criterial number	Fruit	Soluble dry substance ^{o}Brix	Initial weight g	Final weight g	The dehydration degree
1.	Raspberry	11,1	25	7	3,5
2.	Cherry	10,8	25	6	4,16
3.	Strawberry	6,2	25	4	6,25

We have started the study from a weight of 25 g for each of the studied fruits: raspberry, cherry and strawberry. After the lyophilization the raspberry reached 7 grams, with a degree of dehydration of 3.5 times; the cherries reached 6 g after lyophilization and a degree of dehydration of 4,16 times; and the strawberries reached 4g after the lyophilization with a dehydration degree of 6,25 times.

It can be noticed that the dehydration degree is closely related to the soluble dry substance that the fresh fruits had previously contained. When the content of soluble dry substance increases then the dehydration degree decreases.

Thus the raspberry which had the highest content of soluble dry substance – 11,1^{o}Brix, presents the lowest dehydration degree of 3,5 times, the cherries which had a content of 10,8 ^{o}Brix soluble dry substance had a dehydration degree of 4,16 times and the strawberries which had the lowest content of soluble dry substance, of 6^{o}Brix, have the highest dehydration degree, of 6,25 times.

2.Determining the content of C vitamin

The data obtained when determining the content of C vitamin from fresh fruits in comparison to the content of C vitamin at the lyophilized fruits are presented in table 4.

Table 4

Content of C vitamin for fresh fruits and for lyophilized fruits

Criterial number	Fruits	Content of C vitamin for fresh fruits mg/100g	Content of C vitamin for lyophilized fruits mg/100g	C vitamin storage degree
1.	Raspberry	17,33	11,66	67,28
2.	Cherry	22,14	14,04	63,41
3.	Strawberry	27,25	16,42	60,25

Through the lyophilization of the three samples of analyzed fruits: raspberries, cherries and strawberries the content of C vitamin in the fresh fruits has been the following: in the case of the raspberry the content of C vitamin of the fresh fruit has been of 17,33mg/100g, and after the lyophilization the content reaches 11,66mg/100, which represents a C vitamin storage degree of 67,28%; the content of C vitamin at cherries decreases from 22,14 mg/100g to 14,04 mg/100g, and there is a C vitamin storage degree of 63,41%, and in what the lyophilized strawberries are concerned the C vitamin content decreases from 27,25mg/100g in the case of the fresh fruits to 16,42 mg/100g in the case of lyophilized strawberries and representing a C vitamin storage degree of 60,25% .

Out of the three species of analyzed fruits: raspberries, cherries and strawberries it can be noticed that the raspberries have kept the C vitamin the best after the lyophilization, in a percent of 67,28% and this fact happened because the fruits have been whole, they have kept their form even after the lyophilization in comparison to the cherries which have been cut into halves and in comparison with the strawberries which have been cut into small slices and which have had a surface with bigger pores and capillaries, thus allowing the oxidation and the loss of C vitamin.

CONCLUSIONS

Lyophilization is a process of drying very quickly previously refrigerated food products by eliminating ice with a forwarded vacuum, meaning by the process in which water directly goes from solid form into vapor form.

Lyophilization is used in food industry in order to obtain: coffee, tea extracts, vegetables, fruits, meat, fish. Lyophilizated products represent 10-15% of their initial weight and they do not need to be kept refrigerated.

Lyophilized fruits present different characteristics, the raspberry which was whole has got a homogenous form, of pink color, with pleasant smell and taste, well expressed, without caramel taste; cherries which have been divided in two have got an irregular form, their skin is dark-blachish, the pulp is bluish with a pleasant taste and smell and the strawberries which have been divided in slices have got homogenous form, they have red color, pleasant and specific taste and smell, without caramel taste and smell.

In what the content of C vitamin is concerned for the lyophilized fruits, this is kept in a percent of 60-67%, which, if associated with a lower content of weight, leads to an advantage of the preservation method and presents a high interest of using these types of food products.

As a method of food processing and preservation lyophilization offers a series of advantages related to the fruits' quality and to the preservation acceptable time period when the fruits are lyophilized but the production

costs are higher, overpassing enormously the specific energy consumption in comparison with other processing and preservation technologies.

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