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MODERN TECHNOLOGICAL APPROACHES FOR ENSURING OF HARMLESS AND QUALITY FRUITS

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Abstract

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The problem of the rational use of the food sources and their long-term preservation is of particular importance. Modern technologies offer a solution of this problem by applying of new methods for fruits preservation. Gamma sterilization is identified as a safe technology for reducing the risk of spoilage and prolongation of the storage term. It has been proved that the low irradiation doses are appropriate for fruits processing, which is a prerequisite for obtaining of high quality produce. In the present study was investigated the effect of the irradiation with low gamma ray doses (2.5÷3.5 κGy) on the chemical and microbiological characteristics of fruits not subject to long-term storage. By irradiation of packed strawberries and raspberries with 2.5 κGy dose the refrigerated storage term is prolonged with 12÷13 days, which is of substantial importance for preserving of their quality characteristics.

Key words: food quality, fruits preservation, gamma sterilization

Introduction

The applying of gamma sterilization of foods is identified as a safe technology for reducing the risk of food spoilage, being in such a way an element of the production of high quality products, processing and preparation. The investigations showed that the low irradiation doses are appropriate for processing of fruits and vegetables, for obtaining of safe foods. European standards for fruits and vegetables irradiation have been developed (Code of Good Irradiation, 1991). The legalization of these food-processing technologies in the European countries as conditions for safety, purity and prolonged storage term will help to supply the consumer with harmless and ecologically pure food. The treatment of foods with ionizing radiations opens broad perspectives before the food industry. In many countries, such practice has existed for many years. The ionizing radiations are a powerful means for inactivation of microorganisms and other pests in food industry. The spoilage speed of the strawberries and raspberries is in a direct dependence on their seeding with microorganisms, mould spores and fungal mycels (Miteva et al., 2008; Tzvetkova, 2003; Hamouz et al., 1999).The gamma irradiation of fresh strawberries and fruits reduces the number of the undesired microflora and prolongs their storage term. The objective of the present study was to follow up the effect of the irradiation with low gamma ray doses on the chemical and microbiological characteristics of strawberries and raspberries, which is of substantial importance for the preservation of their nutritious and technological qualities, as well as for prolongation of their shelf life.

In the irradiated fruits were not observed such harsh changes in the aroma and taste, which appear in irradiated products of animal origin. Doses up to 5 κGy are usually well beared by fruits (Miteva, 2003).

Irradiation has a substantial effect on the chemical components of fruits, on their structure and on the running of the biochemical processes (Hamouz et al., 1999; Hayashi and Todoroku, 1994; Yoshi et al., 1990).

The objective of the present study was to clarify the effect of the irradiation with low gamma ray doses on the storage term and the taste qualities of strawberries and raspberries.

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Materials and Methods

As experimental material was used raspberries and strawberries supplied from the commercial net. The irradiation was done on gamma irradiation installation "Gamma 1300", loaded with gamma sources -^{137}Cs. The average dose power in the air in the irradiation camera was 1m 75 Gy/min. During storage were carried out analyses of the physical-chemical characteristics – content of dry substance substance (BDS EN 12145), reducing sugars titrimetrically – method of Shoorl (Genadiev et al., 1968; Mashev et al., 1968), vitamin C – titrimetrically, and reaction of Tilmens (Genadiev et al., 1968; Mashev et al., 1968).

The microbiological analyses were carried out by the indices: total number of mezophylic microorganisms (ISO 4833), moulds and yeasts (BDS ISO 7954), coliforms (ISO 4831/ ISO 4832). The results were recorded in column forming units per gram (CFU/g) and in an algorithm of this value (log).

An organoleptic assessment was done.

Results and Discussion

The effect of irradiation on the chemical characteristics of the strawberries and raspberries was followed up which is of substantial importance for clarification of the influence of the ionizing radiations on their nutritious and taste, and technological qualities.

Because of the assessment of the dry substance, content it was established that storage at temperature 0÷4°C helps for increasing of the concentration for all investigated variants for both the strawberries and the raspberries. The irradiation factor leads to a decrease of the dry substance concentration in the strawberries, as for the irradiation variant with the lower dose this trend is considerably more weakly expressed. For the raspberries, an increase of the concentration of the studied index was established for irradiation with the lower dose of 2.5 kGy for both storage temperatures.

The content of sugars in both analyzed fruit kinds showed a similar dynamics in the changes of concentration as for the above mentioned dry substance analysis. This is an expected correlation as the two indices are related to each other. The variants irradiated with gamma ray dose of 1.5 kGy and stored at temperature of 0÷4°C, kept for a longer time their fresh appearance and taste qualities. While the irradiated with 3 kGy gamma ray dose more quickly worsen their taste characteristics.

The change of the content of hydrocarbons in the fruits is an index for maturity. The ripening is characterized by an increased content of dry substance and carbohydrates. This regularity was observed for the variants irradiated with gamma ray dose 2.5 kGy and stored at temperature 0÷4°C.

From the analysis of vitamin C content in the strawberries it has been established that in the non irradiated variants 1 and 4 its concentration is greater compared to the remaining variants treated with gamma rays. The irradiation increases the losses of vitamin C for both investigated objects as for the lower dose this trend is more weakly expressed which gives us grounds to consider the lower irradiation dose is much fit to be applied (Table 1).

The strawberries and raspberries were stored for a period of fifteen days. The storage terms for which the fruits keep their qualities in fit for consumption is presented by the results in Table 2.

The irradiated fruits kepp longer theor commercial qualities when stored at temperature of 0÷4°C. The dose lower than 2.5 kGy is more appropriate for use. The irradiated strawberries endure for a longer time compared to the irradiated raspberries.

The results obtained from the changes occurring in the microbial population of strawberries and raspberries are given in Table 3.

Table 2
Shelf life of strawberries and raspberries

Irradiation dose /kGy/	Shelf life /days/			
	Strawberries		Raspberries	
	t- 22°C	t- 0-4°C	t- 22°C	t- 0-4°C
Control	2	5	2	5
2,5	3	12	1	11
3,5	2	10	3	5

Table 1
Content of the main chemical indices in the investigated fruits – average data value for the period of the experiment

Index → Dose /kGy/; t°C of storage ↓	Dry substance - %		Sugars - mg %		Vitamin C - %	
	Strawberries	Raspberries	Strawberries	Raspberries	Strawberries	Raspberries
1. Control / 22°C	10.35±0.01	14.55±0.04	411±0.01	468±0.01	55.55±0.01	52.80±0.11
2. 2,5 kGy/ 22°C	11.00±0.11	14.60±0.10	460±0.00	477±0.03	44.60±0.07	43.80±0.01
3. 3,5 kGy / 22°C	11.40±0.02	13.77±0.04	551±0.02	603±0.00	25.26±0.01	25.90±0.00
4. Control / 0-4°C	12.90±0.03	15.64±0.02	556±0.02	520±0.02	54.46±0.04	55.48±0.10
5. 2,5 kGy/ 0-4°C	12.50±0.01	17.70±0.01	512±0.01	484±0.01	39.89±0.08	48.55±0.05
6. 3,5 kGy / 0-4°C	11.55±0.01	14.05±0.02	495±0.01	436±0.00	20.17±0.00	30.90±0.01

Table 3
Assessment of the gastronomical qualities of the two types potato semi-finished products irradiated with different gamma-ray doses

Type	Dose Gy	Fitness	Softness	Appear-rance	Consisten-cy	Mealiness	Wateriness	Structure	Taste	Color
A	Control	8	9	7	8	7	7	8	8	9
	100	8	9	7	6	8	6	7	7	9
	150	8	9	7	7	8	6	6	9	8
	200	8	9	7	6	8	5	6	8	6
B	Control	9	9	8	6	7	8	6	9	9
	100	8	9	7	6	6	6	6	9	9
	150	8	9	7	6	7	6	6	8	7
	200	8	9	7	6	7	8	6	7	6

In practice the irradiation technology hampers and partially stops the growth and development of microorganisms. The analyses show for the fruits stored at room temperature the total number of microorganisms is in the range from 3.30 up to 3.36 logarithmic units and for the fruits stored at 0÷4°C - from 3.11 up to 3.23. Predominantly non-pathogenic spore forming rod-shaped bacteria moulds and yeasts were observed. Coliform bacteria in small quantities were established only in strawberries for both storage regimes.

The treatment of the fruits with two gamma ray doses showed a good effect for decreasing of the number of mezophylic microbial cells in the range from 1 logarithmic unit for the low dose and up to 2 units for the higher irradiation dose.

The experiments proved that a complete reduction of yeasts and moulds is achieved yet in the low dose irradiated samples, stored at room temperature, which turns out to be sufficient for reaching of a high level of microbial purity. Pathogenic microorganisms were not established in none of the investigated samples.

The organoleptic assessment showed better values for the fruits, which were irradiated and stored at temperature 0÷4°C.

The irradiation of packed strawberries and raspberries with dose 2.5 kGy prolongs the shelf life under refrigerated conditions up to 12-13 days which is of substantial importance for keeping of their qualitative characteristics.

Conclusions

The ripening of the fruits is characterized by an increased content of dry substance and carbohydrates. It has been established that the gamma ray irradiation increases the values of these indices at temperature 22°C. The irradiation with a dose of 2.5 kGy helps the increasing of the dry substance content of the investigated raspberries at storage temperature 0÷4°C.

The irradiated strawberries and raspberries keep for a longer time their taste qualities and commercial appearance. The range between 2 and 3 kGy is most favorable for prolongation of the shelf life and keeping of the nutritious qualities of perishable fruits. The irradiation of packed strawberries and raspberries prolongs the shelf life (at lowered temperature) with 5-6 days up to 12-13 days, which is of great economic importance fro the transportation of the fruits from the producer to the consumer.

It has been established that the applied low irradiation dose of 2.5 kGy is sufficient for elimination of the undesired microflora in the investigated fruits and makes possible their storage at room temperature.

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