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INFLUENCE OF THE BLANCHING PROCESS ON PRODUCT QUALITY IN THE PRODUCTION OF PASTILA FROM APRICOT AND PLUM FRUITS

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Annotation: This article examines the effect of blanching at different temperatures and durations on product quality in the production of pastilles from apricot and plum fruits. The study determined the color, viscosity, and vitamin C retention of the pastille. Based on the results of analysis of variance (ANOVA), the effect of blanching regime on vitamin C retention was determined.

Keywords: Fruits, pastila, enzymes, vitamin C, product color, pulp viscosity, blanching.

In order to increase the variety of healthy food products and improve the nutritional composition of the population, it is an urgent task to improve existing technologies for the production of functional food products from natural and ecologically clean fruits and vegetables and to develop new scientifically based technologies.

In the process of studying the effect of convective drying on the quality of pumpkin products, 5 mm thick pumpkin slices were convectively dried with hot air at temperatures of 50, 60, 70, and 80 °C. To reduce the drying time to 300 minutes or less, it is recommended to use a higher drying temperature, i.e., 70-80 °C [1].

The effects of high humidity hot air impingement blanching (HHAIB) over a range of application times (30, 60, 90, and 120 s) on drying characteristics, hardness, cell wall pectin fractions contents and nanostructure, as well ultrastructure of apricot were investigated. Results showed that HHAIB reduced drying time and decreased the hardness of apricot by 20.7%–34.5% and 46.57%–71.89%, respectively [2].

The most suitable raw materials for the production of pastila are fully ripe or slightly overripe, healthy and unrotten fruits. Pastila obtained from such fruits has high taste, good color and aroma [3].

The correct temperature and processing time should be selected taking into account the characteristics of the raw material, as well as biochemical parameters (soluble solids content, ph) [4]. It is important to use modern innovative technologies and equipment that ensure the maximum preservation of high-quality organic raw materials, nutrients and antioxidants [5].

In fruit and vegetable processing technology, blanching is considered one of the essential technological processes that shapes product quality. Blanching is the process of treating raw materials with hot water or water vapor for a short period, the main task of which is to reduce enzymatic activity, reduce the number of microorganisms, and preserve the natural color and nutritional value of the product.

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Plum and apricot fruits contain enzymes such as polyphenol oxidase, peroxidase, and ascorbinoxidase, which become active as a result of crushing or grinding the fruits. These enzymes accelerate oxidation reactions, leading to the darkening of the product color, the breakdown of ascorbic acid, and a decrease in organoleptic indicators.

During the blanching process, the denaturation of enzymes occurs at temperatures between 80–95°C. As a result, enzymatic reactions slow down or stop completely. At the same time, partial hydrolysis of protopectin substances in the cell walls is observed, facilitating the pulp formation process.

According to scientific literature, the optimal blanching regime used in the production of fruit puree and pastila is selected depending on the type of raw material, its degree of ripeness, the amount of dry matter, and the composition of biologically active substances. Excessively high temperatures or prolonged heat treatment can cause the breakdown of ascorbic acid, anthocyanins, and carotenoids.

In this regard, determining the optimal blanching parameters for a mixed puree made from plum and apricot fruits is of great scientific and practical importance.

In the experiment, various temperature and duration blanching regimes were studied to improve the quality of plum and apricot pulp. During the study, temperature values ranging from 80–95°C and durations of 2–4 minutes were tested. Vitamin C content, product color, and pulp viscosity indicators were selected as evaluation criteria (Table 3.1).

Table 3.1.

Comparison of blanching modes in pastila production

Experiment №	Temperature (°C)	Duration (minutes)	Vitamin C content, %	Color (points, 1-5)	Puree Viscosity (CP)
B-1	80	3	74,2±1,8	4,2±0,2	1840±65
B-2	85	3	71,8±2,1	4,4±0,2	1920±70
B-3*	90	2	76,5±1,6	4,6±0,1	2050±55
B-4	90	4	68,3±2,4	4,1±0,3	2180±80
B-5	95	2	65,1±2,8	3,8±0,3	2240±90
Control (without blanching)	–	–	52,4±3,2	3,2±0,4	1540±95

As seen from the table data, quality indicators improved in all variants where blanching was applied compared to the control sample. In particular, the retention rate of vitamin C increased from 52.4% in the non-blanched sample to 65.1–76.5%. Optimal regime - B-3 (90°C, 2 minutes): under these conditions, vitamin C retention is highest (76.5%), color rating is 4.6 points, and the puree viscosity is within the technological norm (2050 cR). Vitamin C content is 24.1% higher compared to the control sample. When the temperature increased by 95°C or the duration was extended by 4 minutes, vitamin losses increased significantly. This indicates that blanching slows down enzymatic oxidation processes and has a positive effect on the preservation of ascorbic acid (Fig. 3.1).

As seen from the diagram, the ascorbic acid retention rate in variant B-3 was the highest, amounting to 76.5%. Compared to the control sample, this indicator was higher than 24.1%.

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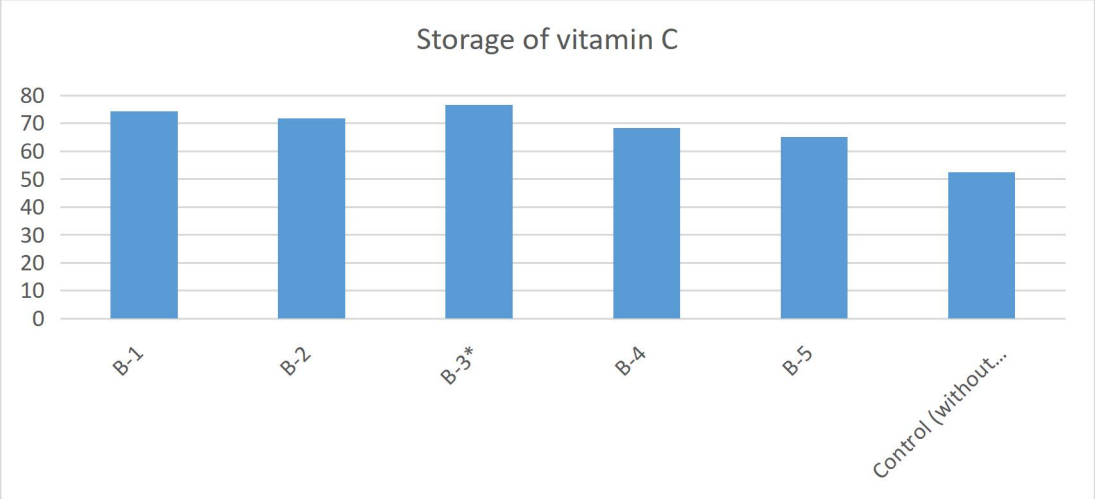


Figure 3.1. Comparison of vitamin C retention during blanching.

Ascorbic acid (vitamin C) is one of the most heat-sensitive biologically active substances. Therefore, the degree of vitamin retention is considered an important criterion when selecting blanching parameters.

Under the influence of heat, ascorbic acid undergoes the following reaction:

$$C_6H_8O_6 \rightarrow C_6H_6O_6 + 2H^+ + 2e^-$$

As the temperature and duration increase, the reaction rate also increases.

Statistical analysis of results

The results of one-factor variance analysis (ANOVA) showed that the blanching regimen significantly affects vitamin C retention ($P<0.05$) (Table 3.2).

Table 3.2

Results of the Analysis of Variance (ANOVA) of Apricot and Plum Fruit Balancing (2023-2025).

Variation source	SS	Df	MS	F
Between options	1182,4	5	236,5	12,84
Error	220,9	12	18,4	
Total:	1403,3	17	254,9	12,84

Since the calculated F value is higher than the table F value, the difference between the experimental variants was found to be statistically significant.

Let us verify the correctness of the calculations according to the provided ANOVA table.

1. Average square (MS)

Among options:

$$MS_{variant} = \frac{SS_{variant}}{df_{variant}} = \frac{1182.4}{5} = 236.48 \approx 236.5$$

Error:

$$MS_{error} = \frac{SS_{error}}{df_{error}} = \frac{220.9}{12} = 18.41 \approx 18.4$$

2. Criterion F

- The F = 12.84 value in the tables is consistent due to the improvement.
- Statistical summary
- Degrees of freedom:
- $df_1=5$

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- df_2=12

Critical value at 5% confidence level:

$$F_{0.05}(5,12)\approx 3.11$$

Because:

$$F_{account}=12.84>F_{critical}=3.11$$

The difference between the variants is statistically significant (P < 0.05).

The results were evaluated using one-way analysis of variance (ANOVA). According to the results of the analysis, the sum of squares between the variants was 1182.4, and the residual (error) variance was 220.9. The mean squares were 236.5 and 18.4, respectively. The calculated Fisher's criterion was F=12.84, and the table value was significantly higher than F_0.05 (5;12) =3.11. This indicates the presence of statistically significant differences between the studied variants (P<0.05). Thus, it was established that the studied factor had a significant impact on product indicators, and the differences between the variants were not random.

Based on this dispersion analysis (ANOVA) table, calculations were also performed to determine $LSD_{0.05}$.

The calculation of $LSD_{0.05}$. (Lowest Difference) was carried out as follows:

$$LSD_{0.05}=t_{0.05}\sqrt{\frac{2MS_e}{n}}$$

In here:

$M\,S_e$ = 18,4 — error dispersion;

$d\,f_e$ = 12— error degrees of freedom;

$t_{e0.05;12}$ = 2,179 — table value of the result criterion;

n = — the number of occurrences of each variant.

Given in table:

$$df_{total}=17=N-1$$

it means,

$$N=18$$

and

$$df_{variants}=5=k-1$$

in this

$$k=6$$

number of options is 6.

And so:

$$n=\frac{18}{6}=3$$

The number of repetitions is 3.

Calculate:

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$$LSD_{0.05}=2.179\sqrt{\frac{2x18.4}{3}}$$

$$=2.179\sqrt{12.27}$$

$$=2.179x3.503$$

$$=7.63$$

Result $LSD_{0.05}=7.63$

Based on the results of the dispersion analysis, a significant difference between the mean values was estimated using the Least Difference (LSD) method. As a result of the calculations, it was established that the LSD value of 0.05 is 7.63. Accordingly, when the difference between the average indicators of the variants is greater than 7.63 units, it is considered statistically significant ($P<0.05$).

Conclusion

Thus, for a puree made from plum and apricot fruits, the blanching regime at a temperature of 90°C for 2 minutes was found to be optimal. This regime ensures high ascorbic acid retention (76.5%), an attractive product color (4.6 points), and an optimal viscosity (2050 cP) for pastila production. At the subsequent stages of the study, this blanching regime was adopted as the primary technological parameter and used to improve the pastila preparation process.

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