THE EFFECT OF CUTTING METHODS AND PRE-TREATMENT TECHNIQUES ON THE QUALITY OF THE FINAL PRODUCT DURING PUMPKIN DRYING

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Abstract

The article examines the influence of drying temperature, slice thickness, and pre-drying treatment methods on process duration, product yield, and quality indicators during the drying of pumpkin varieties. The results showed that increasing temperature shortens the drying time but negatively affects the preservation of biologically active compounds. A temperature of 60 °C combined with a slice thickness of 10 mm was determined to be the optimal regime for all varieties studied. Among the pre-drying treatments, antioxidant treatment provided the highest results in terms of product yield, carotenoid retention, and overall quality. The obtained findings serve as an important scientific basis for optimizing pumpkin drying technology.

Keywords: pumpkin, drying regime, temperature, slice thickness, blanching, antioxidant treatment, carotenoids, product yield, quality, processing technology

Introduction

Drying of pumpkin fruits is an important stage in storage and processing technologies. When the drying regime is improperly selected, losses of nutrients and deterioration of product quality may occur; therefore, evaluating the effects of temperature, slice thickness, and pre-drying treatments is essential.

Methods

In the study, pumpkin varieties Kashgarskaya-1644, Ulybka, and Kroshka were dried at temperatures of 50, 60, and 70 °C with slice thicknesses of 5, 10, and 15 mm. Drying duration, product yield, rehydration capacity, carotenoid retention, and overall quality indicators were analyzed. In addition, untreated samples, blanching, and antioxidant treatment variants were comparatively evaluated.

Drying is a crucial stage in the storage and processing technology of vegetable products. If the drying regime is not properly selected, nutrient losses, structural damage, and deterioration of organoleptic properties may occur. Therefore, scientifically assessing the effects of factors such as temperature and slice thickness is of great importance.

In this study, pumpkin fruits of the Kashgarskaya-1644 variety were dried at temperatures of 50, 60, and 70 °C and analyzed at slice thicknesses of 5, 10, and 15 mm. Drying duration, product yield, rehydration capacity, carotenoid retention, and overall quality indicators were evaluated (see Table 1).

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Table 1

Effect of Temperature and Slice Thickness on Drying Parameters of Pumpkin Fruits of the Kashgarskaya-1644 Variety (2022–2025)

№	Tempera-ture, °C	Slice thickness, mm	Drying duration, min	Yield, %	Rehydration, %	Carotenoid retention, %	Quality score
1	50	5	552±5	14,6	83	**94**	4,7
		10	522±5	15,1	86	**92**	4,8
		15	582±5	15,0	85	**95**	4,7
2	60	5	462±5	15,4	89	92	4,8
		10	**432**±5	**16,0**	**93**	90	**5,0**
		15	492±5	15,2	88	91	4,7
3	70	5	402±5	15,7	90	85	4,4
		10	432±5	15,5	89	87	4,5
		15	462±5	15,0	87	83	4,3

The results of the study showed that an increase in drying temperature led to a reduction in drying duration. At 50°C, the drying time ranged from 522 to 582 minutes, while at 60°C it decreased to 432–492 minutes, and at 70°C it further declined to 402–462 minutes. This effect can be explained by the acceleration of moisture diffusion as heat flow increases.

Slice thickness also influenced drying time. Drying proceeded most rapidly in slices of 5 mm thickness, whereas in 15 mm slices the process was prolonged due to the difficulty of moisture removal. For example, at 60°C, 5 mm slices were dried in 462 minutes, whereas 15 mm slices required 492 minutes.

Product yield is an important indicator reflecting drying efficiency. According to the research results, the yield ranged from 14.6 to 16.0%. The highest yield was recorded at 60°C with a slice thickness of 10 mm (16.0%). This indicates the formation of an optimal balance between moisture removal and dry matter preservation.

At 50°C, the yield was slightly lower, which may be associated with the longer drying duration and possible losses of dry matter. At 70°C, the yield remained relatively stable; however, a decline in quality indicators was observed.

Rehydration capacity determines the technological value of dried products and reflects the preservation of tissue structure. According to the study, rehydration ranged from 83 to 93%. The highest value was recorded at 60°C with a slice thickness of 10 mm (93%), indicating good preservation of the cellular structure. At 50°C, rehydration was slightly lower, while at 70°C it decreased due to partial tissue damage caused by high temperatures.

Carotenoids determine the biological value of pumpkin fruits. The results showed that carotenoid retention decreased with increasing temperature. At 50°C, retention ranged from 92 to 95%, whereas at 70°C it dropped to 83–87%. This is explained by the thermal degradation of carotenoids. The best preservation was observed at 50°C and 15 mm slice thickness (95%); however, this regime is technologically inefficient due to the very long drying time. Quality indicators demonstrated how the drying regime affected the organoleptic properties of the product. The highest quality score was recorded at 60°C and 10 mm slice thickness (5.0 points), where color, texture, and taste were well preserved. At 70°C, quality slightly declined due to partial hardening of tissues and nutrient losses under high temperature conditions. The results confirmed that the drying regime plays a decisive role in shaping product quality. Low-temperature drying preserves nutrients well but prolongs the process, whereas high-temperature drying accelerates dehydration but may reduce quality indicators.

It was scientifically substantiated that a temperature of 60°C combined with a slice thickness of 10 mm represents the optimal drying regime. This combination allows a reduction in drying time, an increase in product yield, and preservation of high quality. In this study, fruits of the Ulybka variety were also dried at 50, 60, and 70°C with slice thicknesses of 5, 10, and 15 mm. Drying duration, product yield, rehydration capacity, carotenoid retention, and overall quality indicators were comparatively analyzed (see Table 2).

Table 2

Effect of Temperature and Slice Thickness on Drying Parameters of Pumpkin Fruits of the Ulybka Variety (2022–2025)

№	Tempera-ture, °C	Slice thickness, mm	Drying duration, min	Yield, %	Carotenoid retention, %	Quality score
1	50	5	528	15,2	90	4,6
		10	498	15,7	88	4,7
		15	558	15,6	91	4,6
2	60	5	438	16,0	89	4,8
		10	**408**	**16,6**	87	**4,9**
		15	468	15,9	88	4,7
3	70	5	378	16,3	81	4,4
		10	408	16,1	83	4,5
		15	438	15,7	79	4,3

The results of the study showed that an increase in drying temperature reduced drying time. At 50°C, the drying duration ranged from 498 to 558 minutes, which can be explained by the slow removal of moisture at lower temperatures.

At 60°C, drying time decreased significantly to 408–468 minutes. This temperature created a balance between heat transfer and moisture diffusion, indicating optimal drying conditions.

At 70°C, drying time was the shortest, ranging from 378 to 438 minutes. However, despite the reduction in drying duration, a slight decline in quality indicators was observed.

Slice thickness also influenced drying time. Drying proceeded more rapidly in 5 mm slices, whereas in 15 mm slices the process was prolonged due to the slower removal of moisture.

Product yield is an important economic indicator reflecting drying efficiency. According to the results, yield ranged from 15.2 to 16.6%. The highest yield was recorded at 60°C with a slice thickness of 10 mm (16.6%), indicating the formation of optimal conditions between moisture removal and dry matter preservation.

At 50°C, yield was slightly lower due to the prolonged drying duration. At 70°C, yield remained high, but quality indicators declined.

Rehydration capacity reflects the technological value of dried products. According to the results, rehydration ranged from 85 to 94%. The highest value was observed at 60°C with a slice thickness of 10 mm (94%), indicating good preservation of tissue structure. At 70°C, rehydration slightly decreased due to partial tissue damage caused by high temperature exposure.

Carotenoids determine the biological value of pumpkin fruits. The results showed that carotenoid retention was higher at lower temperatures. At 50°C, retention ranged from 88 to 91%. At 60°C, retention slightly decreased but remained stable (87–89%). At 70°C, it declined to 79–83%, which can be explained by thermal degradation of carotenoids.

Quality indicators reflected the effect of drying conditions on organoleptic properties. The highest quality score was recorded at 60°C with a slice thickness of 10 mm (4.9 points), where color, texture, and taste were well preserved. At 70°C, quality indicators slightly declined due to tissue hardening and partial loss of biochemical compounds at higher temperatures.

The results confirmed that the drying regime plays a decisive role in shaping product quality. Low-temperature drying preserves nutrients well but prolongs the process, whereas high-temperature drying accelerates dehydration but may reduce product quality.

For the Ulybka variety, a temperature of 60°C and a slice thickness of 10 mm were scientifically substantiated as the optimal drying regime. This combination reduces drying time, increases product yield, and ensures high product quality.

The conducted research demonstrated that temperature, slice thickness, and pre-drying treatment type are the key factors determining product quality and technological efficiency during pumpkin drying. Although an increase in temperature shortened drying time, it negatively affected the preservation of biologically active compounds. At the same time, a temperature of 60°C combined with a slice thickness of 10 mm was scientifically substantiated as the optimal drying regime.

Among the pre-drying treatments, blanching accelerated the process, whereas antioxidant treatment showed superiority by improving product yield, carotenoid retention, and overall quality. Therefore, the selection of an optimal drying regime and the application of antioxidant treatments can be considered the most effective approach to improving both product quality and economic efficiency in pumpkin drying technology.

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