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Justification Of Effective Thermal Processing Modes For Plant Raw Materials In The Production Of Persimmon-Based Pureed Canned Foods

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Abstract

Optimal modes of heat treatment of plant raw materials were selected based on the application of a high-frequency electromagnetic field.

Keywords: Carrot, pumpkin, apple, persimmon, high-frequency electromagnetic field, blanching, dry matter, steam, vitamin.

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1. Introduction

The problem of organizing quality nutrition for children of preschool and junior school age is particularly acute9. A consumption imbalance of basic macro- and micronutrients has been identified, and the risks of developing alimentary-dependent diseases have been determined10. These diseases include endocrine system disorders, nutritional disorders, metabolic disorders, diabetes mellitus, and obesity, which are not typical for childhood11.

Given this, when creating food products for preschool and junior school-aged children, it is necessary to use raw materials containing biologically active substances that allow for the normalization of carbohydrate and fat metabolism in children's bodies and exhibit hypoglycemic, hypolipidemic, and antioxidant properties [1].

Persimmon is the most promising raw material from this point of view, due to the presence of a complex of biologically active substances in its composition. In this regard, improving the technology and developing recipes for persimmon-based pureed canned foods for baby food is relevant.

2. Literature Review

It is known that the recommended daily intake of nutrients for children differs from those for adults [2]. The need for vitamins per unit of body mass in a growing organism is significantly higher than in an organism that has completed growth [3]. The latter only needs to replenish losses, while the former also needs to saturate the newly formed cells of growing organs and tissues

with vitamins [4].

Table 1

Presents the norms for the daily requirement of nutrients for children of preschool and junior school age.

Indicators (per day)	Value of the indicator	
	Preschool children (3 to 7 years old)	Children of primary school age (7 to 11 years old)
Dietary fiber, g	10	15
Vitamins, mg:		
Vitamin C	50	60
Vitamin B1	0,9	1,1
Vitamin B2	1,0	1,2
Vitamin B6	1,2	1,5
Vitamin E, current equiv.	7,0	10,0
Vitamins, mcg:		
Vitamin B12	1,5	2
Biotin	15	20
Vitamin A, REE	500	700
Macronutrients, mg:		
Calcium	900	1100
Phosphorus	800	1100
Magnesium	200	250
Micronutrients, mg:		
Iron	10,0	12,0
Zinc	8,0	10
Iodine	0,10	0,12

Children's diets should contain food products enriched with vitamins, macro- and microelements, dietary fiber, and other biologically active substances necessary for normal growth and development [5].

The most effective and accessible way to fundamentally improve children's health is to consume food products containing a complex of biologically active substances that allow for the normalization of nutritional status. This, in turn, will ensure the prevention of alimentary-dependent diseases in children under 14 years of age.

It is known that the main goal of thermal processing of the initial crushed raw material through water blanching or steam blanching is to change its structural and mechanical properties, ensuring the softening of raw material tissues, increasing cell permeability, and enzyme inactivation. A drawback of the steam blanching method is the overheating of the surface layers of unevenly blanched material, which leads to a

deterioration of its consistency and losses during pulping [6].

One of the main tasks of the food industry, and first and foremost the canning industry, is to expand the assortment of multicomponent food products for children based on fruits and vegetables, not only in season but also during the off-season. This can be achieved by using high-quality and high-nutritional-value fruit and vegetable semi-finished products as the initial raw material.

However, the production process for both purees as a finished product and puree semi-finished products involves heat treatment (blanching), which leads to a significant reduction in the content of thermolabile functional ingredients such as inulin, vitamins C and P, β -carotene, and others, which reduces the physiological value of the resulting products [7,8].

One of the disadvantages of the blanching process is the loss of soluble dry substances (macro- and micronutrients) due to their extraction. Losses of soluble dry substances during water blanching range from 5–30%.

Losses of soluble dry substances during water blanching are twice as high as when using steam for these purposes, and losses of sugars and vitamin C are even greater. In the steam blanching method, losses due to extraction are lower, but they increase with increasing pressure [9].

One of the most promising areas in the thermal processing of plant raw materials and food products is the use of ultra-high frequency electromagnetic fields (UHF EMF), which allow for volumetric and contactless heating at a high speed. The use of UHF EMF allows for the intensification of technological processes, reduction of raw material losses, increase in finished product yield, and improvement of its quality and nutritional value [11].

3. Results And Discussion

Considering the high efficiency of processing plant raw materials in UHF EMF, we conducted studies to determine the effectiveness of using UHF EMF for the heat treatment of selected vegetable and fruit raw materials.

Tables 2–5 present data characterizing the effect of thermal processing methods on the chemical composition of vegetable and fruit raw materials.

Table 2:

Effect of Heat Treatment on Pumpkin Composition

Indicator Name	Value Before Blanching	Blanching with Steam	Blanching with UHF EMF
Amount of dry substances, %	13.1	12.6	14.4
Active acidity (pH)	5.78	5.5	5.74
Mass fraction of vitamins, mg/100g	9.09	4.6	4.79
36			

Table 3:

Effect of Heat Treatment on Carrot Composition

Indicator Name	Value Before Blanching	Blanching with Steam	Blanching with UHF EMF
Amount of dry substances, %	8.3	8.1	8.6
Active acidity (pH)	5.55	5.65	5.63
Mass fraction of vitamins, mg/100g	0.52	0.29	0.44
37			

Table 4:

Effect of Heat Treatment on Apple Composition

Indicator Name	Value Before Blanching	Blanching with Steam	Blanching with UHF EMF
Amount of dry substances, %	19.9	18.4	20.1
Active acidity (pH)	4.32	4.24	4.23
Mass fraction of vitamins, mg/100g	0.26	0.24	0.24
38			

Table 5:

Effect of Heat Treatment on Persimmon Composition

Indicator Name	Value Before Blanching	Blanching with Steam	Blanching with UHF EMF
Amount of dry substances, %	27.6	30.4	28
Active acidity (pH)	4.45	4.59	4.43
Mass fraction of vitamins, mg/100g	4.24	3.64	1.98
39			

4. Conclusion

Overall, in all products processed with UHF EMF, the preservation level of Vitamin C was on average 40–80% higher compared to steam processing. A decrease in the amount of dry substance was not observed during UHF EMF processing; on the contrary, in some cases, it increased. The pH indicators remained stable, which allowed for the maximum natural preservation of the organoleptic properties of the products. All this confirms that UHF EMF technology for the thermal processing of plant raw materials has a significant advantage over traditional steam blanching in preserving the physico-chemical and biological properties of the product.

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