

TECHNOLOGY OF CHURNED DESSERT PRODUCTS USING PUREE WITH FRUIT AND VEGETABLE RAW

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Broadening of the assortment of high nutritional value products with a high content of biologically active substances that promote the excretion of human heavy metals and toxins is topical task of the food industry. In order to solve this problem it is important to develop products fortified with nutrients that do not only improve a person's health, but also have a positive impact on the manufacturing process and the quality of finished products.

Due to the rapid development of tourism in Ukraine a good deal of restaurants, hotel and restaurant complexes, wellness centers increase every year. Therefore, expanding of the range of high nutritional value products applies mostly to restaurant institutions. Sweet dessert product with air structure of sambuc type and using of fruit and vegetable puree from natural raw materials was chosen as an object of the research.

Sambuc is a light airy dessert from whipped egg whites. Apart from egg whites Sambuc includes pre-crushed berries or flavored fruit with sugar. According to the traditional recipe that involves mixing of obtained apple sauce by baking with sugar and egg whites, whisking to form a loose mass; soaking, swelling, dissolution and filtration of structured creator, putting it in a squirt whipped mass with continuous stirring, pouring into molds, cooling and holding for structure formation for 3 ... 5 hours at 0 ... 8 ° C [1].

The paper suggests to take mashed apples and persimmons as raw materials for Sambuc recipe. Pectin is used to replace gelatin that is offered in a standard recipe to speed cooking technology of churned dessert products as structured creator.

The choice of raw materials is conditioned by the fact that persimmons are subtropical fruit rich in potassium, iodine, calcium, magnesium, manganese, phosphorus and iron, and vitamin A (carotene), C and P (rutin) [2]. Persimmon contains enormous number of useful trace elements that are simply necessary for our body to teamwork, has a positive effect on the immune system and increases the body's defenses. Due to the large amount of dietary fiber persimmon improves the gastrointestinal tract, helps to cleanse the liver and even normalizes the gonads. Besides persimmon contains large amount of beta-carotene, which is a powerful antioxidant that provides churned desserts with natural light orange color [5,6].

Apples apart from pectin and dietary fibers contain substances such as florydzyn that increases bone density, rich in iron and boron, that strengthen bones [1].

Pectin is an excellent adsorbent for the human body because it removes toxic substances, and it works very diligently and efficiently without disturbing bacteriological balance of the body. Many experts called pectin an aid-man for the human body because of its unique ability to rid the body of harmful substances such as radioactive elements, ions of toxic metals and pesticides [3].

Thus the combination of biologically active substances in fruit and vegetable puree raw materials, using pectin as structured creator enables to recommend them for improving the food and biological value.

The quality of the finished product depends to a large extent of the technological parameters, which should provide products manufacturing without any failures in production. Optimization processes based on mathematical modeling are hold and offered by us. To find the best optimal values we have developed a mathematical model of the technological process and made mathematical and statistical methods of research [4].

Designed parametric scheme of the process for preparing of loose air mass production of churned dessert such as Sambuc includes the operation of churning mass, preparation and structured creator mass to the finished product, shown in Figure 1, where the input factors are M_{wew} , M_{sc} , M_p - mass of whipped egg whites, structure of creating mass, mass of puree and t_c - temperature churning; disturbance: t_{csm} - temperature of creating structured mass, N_{sc} - number of structures of creating mass and t_{dc} – duration of churning; FS - parameters of the state is foam stability, W_{sf} - specific work on the formation of the product and t_{fp} - churning temperature of the finished product; output parameters are A - acidity; M_{fs} - mass fraction of solids; V_{sfp} - specific volume of the finished product.

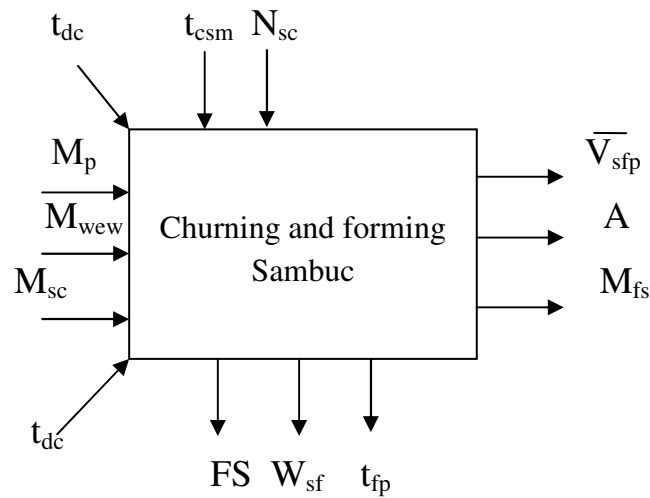


Figure 1. Parametric scheme of Sambuc

Among the input variables governing the process of preparing we have selected as optimizing factors amount of puree M_p , mass of whipped egg whites (M_{wew}) and quantity of creating mass (M_{sc}). In our opinion, these factors contribute to the change in specific volume and are important in the elaboration of technology for preparation Sambuc with using raw fruit and vegetable purees.

Taking into consideration the previous information, for this experiment we have selected the factors and the level of variation intervals listed in Table 1.

We have recorded the expected model in the form of incomplete polynomial of the third order:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_1 x_2 + \beta_5 x_1 x_3 + \beta_6 x_2 x_3 + \beta_7 x_1 x_2 x_3,$$

$$i = \overline{0,7},$$

β_i - coefficient of regression equation.

For the optimized search it was made the matrix of the experiment with given ranges of factor space: n - the number of significant factors in polynomial; $x_1 = t, ^\circ\text{C}$ – temperature of whipping; $x_2 = A, \text{g}$ - number of added acid; $x_3 = \tau, \text{min}$ - duration of whipping.

Table 1 - Ranges factor space

Level and step variation	X_1 ($t, ^\circ\text{C}$)	X_2 (A, g)	X_3 (τ, min)
Zero level	20	1,3	15
Interval of variation	4	0,2	5
The upper level	24	1,5	20
The lower level	16	1,1	10

Having performed the necessary calculations, we have developed a number of model churned dessert recipes and identified specific volume samples. The results of the experiment are shown in Table 2. Matrix of the plan is given in the coded form and in the natural kind.

Table 2 - Matrix of the experiment plan

№ sample	Coded values of the factors								Existing value factors			
	Z_0	Z_1	Z_2	Z_3	Z_1Z_2	Z_1Z_3	Z_2Z_3	$Z_1Z_2Z_3$	Y_1	Y_2	Y_3	$Y_{\text{cep.}}$
1	+	-	-	-	+	+	+	-	140,36	141,66	139,69	140,57
2	+	-	+	+	-	-	+	-	180,25	182,42	179,85	180,84
3	+	-	-	+	+	-	-	+	144,27	139,25	142,13	141,88
4	+	-	+	-	-	+	-	+	185,24	178,32	181,30	181,62
5	+	+	-	-	-	-	+	+	186,26	181,59	179,24	182,37
6	+	+	+	+	+	+	+	+	178,25	183,27	178,27	179,93
7	+	+	-	+	-	+	-	-	183,17	181,36	182,30	182,28
8	+	+	+	-	+	-	-	-	178,43	182,33	181,39	180,72

Having performed statistical analysis of experimental data with using of the Cochran criterion and conducted regression analysis of experimental numbers using Student and Fisher test there is an equation with remote insignificant values:

$$\hat{Y} = B_0 + B_1Z_1 + B_2Z_2 + B_4Z_1Z_2$$

These complexes are placed in the proper equation:

$$\hat{Y} = 171,2758 + 10,0478Z_1 + 9,5035Z_2 - 10,5002 Z_1Z_2$$

Calculated error of the experiment:

$$\epsilon_j = \left| \bar{y}_j - \hat{Y}_j \right| / \bar{y}_j * 100\%$$

$$\epsilon_{\text{cep}} = \Sigma \epsilon_j / N = 0,23\%$$

To calculate the values of factor variables that provide the maximum value of the specific volume (\hat{Y}), it was used the method of the extremum function of many variables [4], and as decisive fact it was recorded the maximum value of the specific volume of dessert.

$$\hat{Y} = f(Z_1, Z_2, Z_3) \rightarrow \max$$

Having performed calculations, we have obtained the optimal values of factors:

$$x_1 = 4Z_1 + 20 = 23,6 ^\circ\text{C}$$

$$x_2 = 0,2Z_2 + 1,3 = 1,5 \text{ g}$$

The resulted values of churning temperature (23,6 C) and number of added acid (1.5 g) belong to the realm of acceptable values and this is the best conditions for maximum specific volume of the finished product.

Among the structural and mechanical properties there were determined foam forming ability and foam stability of egg white in a technological system. We have analyzed and identified the benefits of dry egg white, compared with the native, the effect of pectin and citric acid on the formation of foam and its change over time. The research results are shown in the diagram (images 5, 6).

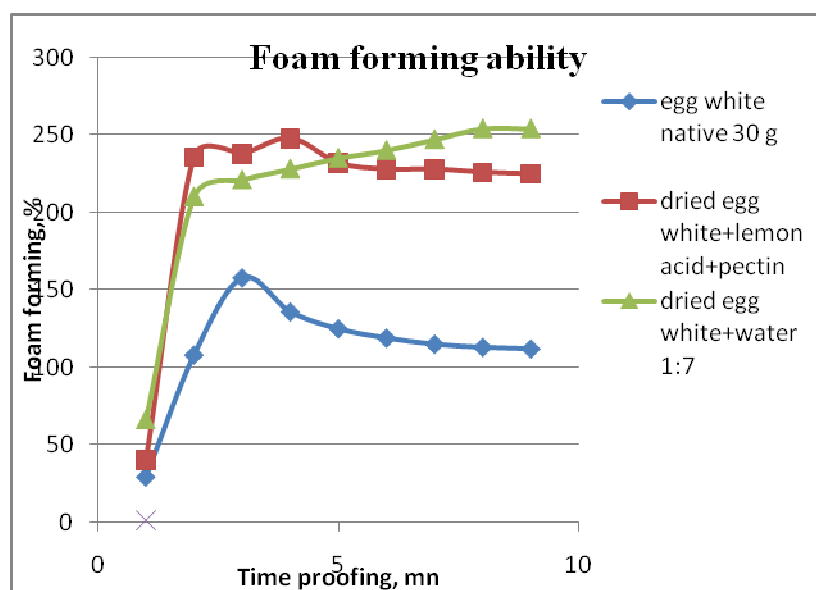
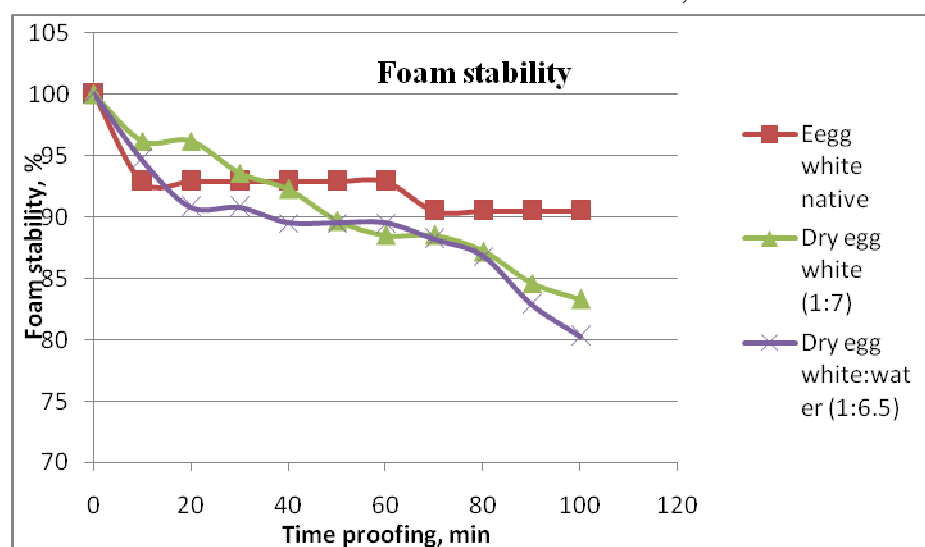


Image 5. Dependence graph of foam volume from the length of whipping

Analyzing the graph it is shown that the maximum height of the bubble for native egg white is obtained in the second minute of churning, for dry egg whites, reconstituted with water - in the third minute, and for a mixture of egg white powder, pectin and citric acid - in the seventh minute.



Since subsequent minutes of churning, foam height decreases. Thus, it indicates that with the higher content of ingredients the duration of churning increases. That is why churning after reaching maximum values is impractical.

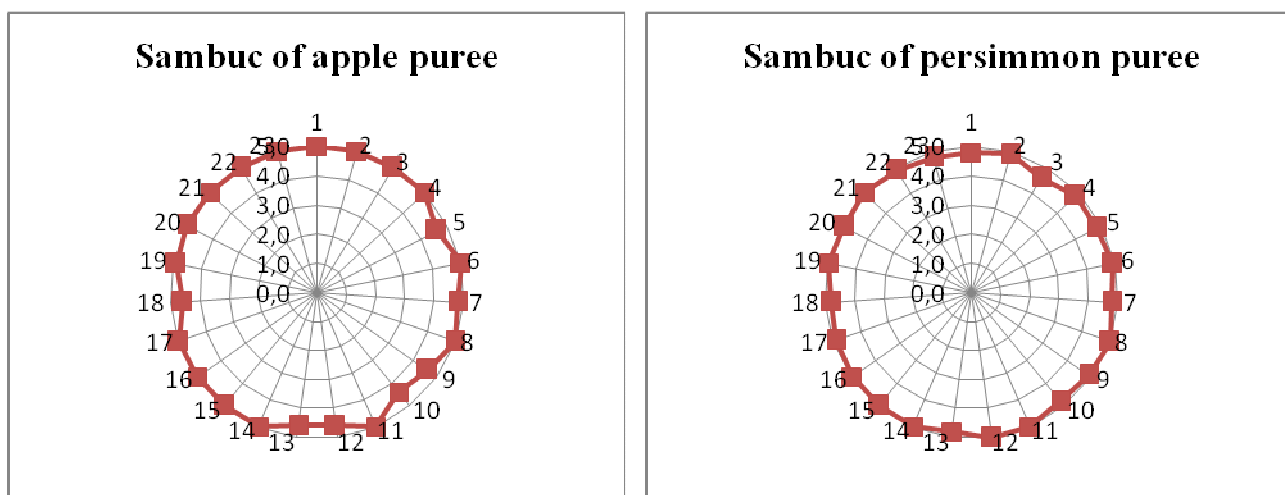
Image 6. Change graph of foam volume over time

We have examined the most optimal ratio of water and dried egg white to maximize the amount of foam in the number of dry egg white: water 1:6,5 and 1:7. For comparison, it is also investigated the change in the height of the foam in the native egg white.

Using these data, we have produced samples of churned dessert items and set physicochemical and structural and mechanical properties, defined organoleptic quality.

Energy value of churned dessert items was calculated: Sambuc on apple sauce is 256,05 kcal, Sambuc on persimmon puree is 251,17 kcal. Tasting Committee

praised the new kinds of desserts. Based on expert assessments it is built **profilohramy** of Sambuc organoleptic properties with using persimmon puree and



apple (Image. 7).

Imagine 7. Profilohramy organoleptic properties of Sambuc

Index name and characteristics: 1- exterior; 2 - surface condition; 3 - homogeneous inclusions; 4 - naturalness; 5- color; 6 - cleanliness; 7 - uniformity; 8 - naturalness; 9 - evidence of luster; 10 - intensity; 11- taste; 12 - sweetness; 13 - intensity; 14 - uniformity; 15 - naturalness; 16.- scent; 17 - clean; 18 - clear; 19 - balanced; 17- consistency; 18 - density; 19 - viscosity; 20 - fluidity.

Sambuc with using of persimmon puree has a light orange color. Thus, the high content of persimmon puree of beta-carotene, which is a natural antioxidant and provitamin A and a dye gives an original color to finished products. Photo of finished products are shown in imag. 8.

Image. 8. Sambuc assortment of different sauce, offered in baskets



Conclusion: On the basis of research and tasting evaluation, determination of Sambuc nutritional value with using of raw fruits and vegetables puree is found that the products are characterized by harmonious organoleptic properties and exhibit a preventive effect. On this basis, we recommend mashed persimmon and apples to be included into the formulation of modern desserts.

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