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PRODUCTION OF SWEETS USING "TARY" MILLET OATMEAL

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INTRODUCTION

The growth in domestic production and expansion of the assortment is dictated by a significant decrease in the supply of imported raw materials, on which the confectionery industry was previously based.

It is possible to solve the tasks set for the industry by using new types of non-traditional raw materials in candy production, which have higher biological value and are able to give the products high taste qualities and attractive marketable appearance.

Praline and fondant-praline candies occupy a large part of the confectionery production. The basis of praline mass is expensive nut products, mostly imported from foreign countries. Praline mass consists of no fiber and have a low content of minerals. The following raw materials are used for the praline masses: peanuts, almonds, cashews, etc., which have a high caloric value. The confectionery industry uses cereal raw materials such as corn, wheat, etc. in the production of confectionery masses.

A perspective raw material as a filler and substitute for nuts is the national millet flour, which contains a number of valuable nutrient substances: essential amino acids, mineral salts, vitamins, cellulose, starch. The millet flour has good properties compared with roasted ground wheat, corn, roasted corn flour.

Production of confectionery masses with the use of millet flakes with increased biological value is of scientific and practical interest.

The implementation of local non-traditional raw materials for obtaining new types of confectionery products of increased nutritional value, enriched with proteins, microelements, mineral salts, providing for the replacement of basic raw materials, is an urgent task.

1. The basis for the development of the topic

In the production of praline candies using the national non-traditional product of "tary" flour one of the main processes is the process of molding. In the literature the process of molding praline masses according to the new recipe is not sufficiently covered. In this case, it is necessary to conduct research on the study of the process of molding praline candy pressing with the use of a non-traditional product tary oatmeal.

Initial data for the development of the topic. It is known about the visco-elastic properties of candy masses, technological processes of candy production, and experimental facilities for determining the rheological properties of candy masses.

Justification for the necessity of the research work. The stress-strain state of praline candies using the national non-traditional product of tary oatmeal has not been studied.

Information about planned scientific and technical level of development. On the basis of the theoretical and experimental studies, it is possible to predict and manage the properties of praline candies using the national non-traditional product of tary oatmeal.

The results of experimental research will find application for practical calculations of technological equipment for molding praline candies into bundles.

About the patent research and conclusions from them. Patent studies over the past 20 years have shown that there has been almost no scientific research on the production of praline candies using the national non-traditional product of tary oatmeal.

The validity and reliability of the results obtained is confirmed by the consistency of the experimental results between themselves, carried out in laboratory, pilot plant, using modern means and methods of measurement, with similar solutions of other authors.

The work was carried out in accordance with the State Program of the Republic of Kazakhstan 042 “Applied scientific research in the field of agro-industrial complex” on “Development of techniques and technology for the creation of a new generation of products based on processed cereal crops”, “Development and production of prototypes of machinery and equipment for harvesting, deep processing and storage products”.

The purpose of the work. Development of a technological process for the production of sweets using the national food product tary oatmeal to improve the quality of the finished product.

Scientific novelty. It has been established that the mechanical model of an elastic-viscous-plastic Schofield-Scott-Blair body, which consists of a sequential connection of the Bingham and Kelvin models, corresponds to the behavior of a high-viscosity praline candy mass at a stress greater than the limiting shear stress.

The proposed rheological model of praline candy mass molding gives satisfactory convergence of experimental data with calculated ones.

The instant modulus of elasticity, retarded modulus of elasticity, volume true viscosity and volume viscosity of steady-state movement of

praline candy mass based on toloknaya tara at 298 K were determined experimentally, which corresponds to the production conditions;

A generalized rheological equation for the relative deformation of praline candy mass on time was obtained, which is valid in the interval of pressing pressures from 0 to 0.4 MPa;

The equation of praline candy mass density on pressing pressure was obtained to calculate the productivity of technological equipment.

Research objectives. Confectionery products whose recipes include peanuts are increasing every year. However, the nutritional value of these products is characterized by high caloric content, with a significant content of sugar, fat and peanuts.

Molding of fondant-praline masses by pressing out, gives an opportunity to increase the output of the ready production, to refuse from the use of starch as a molding material, to reduce the production area, to improve the working conditions.

To achieve the goal, the following research tasks are defined:

– To develop recipes for candy products on the basis of non-traditional raw materials "tary" millet oatmeal and determine the quality indicators of the finished products[1];

– To develop a rheological model of praline candy masses;

– Determine the rheological properties of candy masses with tary millet;

– To develop a method of engineering calculation of technological equipment for extruding praline candies into bundles;

– To develop a technological scheme of production of candy products with tary oatmeal.

Practical significance of the work. Recipes of praline candies "Taraz" and fondant-praline candies "Meiram" with the use of non-traditional raw materials tary millet oatmeal were developed.

The bank of experimental data on the study of rheological properties of praline candy masses using tary oatmeal was accumulated. The qualitative characteristics of praline and fondant-praline candies have been determined[2].

[1] Iztayev, A., Baibatyrov, T., Mukasheva, T., Muldabekova, B., Yakiyayeva, M. (2020). Experimental studies of the baisheshek barley grain processed by the ion-ozone mixture. Periódico Tchê Química, 17 (35), 239–258.

[2] Iztayev, A., Alimardanova, M., Iztayev, B., Yerzhanova, M., Tungyshbayeva, U., Izteliyeva, R., Tursunbayeva, S. (2021). Development of an innovative technology for accelerated cooking of no yeast bread using ion-ozonized water. E astern-*European Journal of Enterprise Technologies*, 5 (11 (113)), 85–96.

Developed and manufactured in metal, and implemented in the educational process in the training of engineering and technical personnel of the food industry:

– Experimental – industrial crusher for preliminary crushing of groats flour containers under conditions of dynamic loading;

– A new original plastometer, protected by a patent of the Republic of Kazakhstan to determine the rheological properties of praline candy masses of high viscosity and other food materials under different deformation conditions;

– Installation for fine crushing and mixing components of praline and fondant praline masses.

The method of engineering calculation of technological equipment for extruding praline candies into bundles with the use of the national non-traditional product of tary oatmeal has been developed.

The technological schemes of production of praline candies "Taraz" and "Meiram" on the basis of tary oatmeal have been developed.

The methodology and results of the study are the basis for the technological instructions for the production of praline candies with the use of tary millet oatmeal.

2. Achievement results

The first section shows the choice of research direction, based on the analysis of the current state in the production of various high-viscosity praline candy masses.

The process of food and other types of products processing by mechanical pressure is carried out under the influence of working bodies of technological equipment in compression conditions in a confined volume. Being in the working volumes of the equipment product from the action of external forces is experiencing a complex-stress state.

Depending on the conditions of deformation, products exhibit more one or other properties. It is generally accepted to use mechanical models for the convenience of studying the behavior of various materials under load.

In order to describe the rheological behavior of a complex body depending on the properties of its components, it is possible to combine in various combinations the models of the simplest ideal bodies considered above, each of which has only one physical and mechanical property. These elements can be combined in parallel or in series.

The second section contains a description of the research object, experimental facilities and research methods.

For the reason that praline masses have a large viscosity and are difficult to enter the small space between the rotors of the viscometer, it is not possible to conduct tests on standard devices.

In order to eliminate these shortcomings, a new plastometer, protected by a patent of the Republic of Kazakhstan to determine the rheological properties of praline candy masses of high viscosity under various deformation conditions has been developed and manufactured in the metal.

The new experimental and industrial crusher for pre-crushing of loose millet cereal under conditions of dynamic loading has been developed and created.

Unit for fine crushing and mixing components of confectionery masses was developed and manufactured in metal.

The third section presents the results of experimental and theoretical studies on modeling the deformation properties of praline candy masses with tary oatmeal.

In order to justify the choice of the rheological model of high-viscosity praline candy masses, it was necessary to refer to the experimental data obtained from creep experiments under shear conditions[3].

This behavior of food materials at $\tau > \tau 0$ corresponds to the Schofield-Scott-Blair mechanical model (Figure 1).

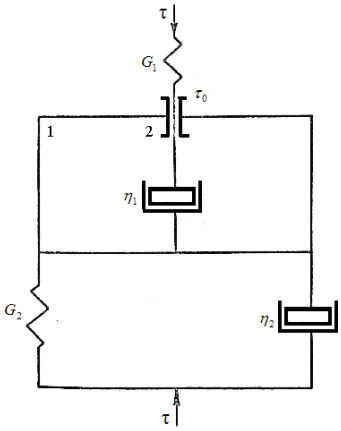


Fig. 1. Shofield-Scott-Blair mechanical model

[3] Estela Vidal Gonçalves, Suzana Caetano da Silva Lannes (2010). Reologia de chocolate., In: International *Journal of Food Science* and Technology, pp. 845–851.

It consists of a sequential coupling of the Bingham and Kelvin models[4]. The rheological equation of this model is

$$\frac{d^2\tau}{dt^2}+\left(\frac{G_1}{\eta_1}+\frac{G_1+G_2}{\eta_2}\right)\frac{d\tau}{dt}+\frac{G_1G_2}{\eta_1\eta_2}(\tau-\tau_0)=G_1\frac{d^2\gamma}{dt^2}+\frac{G_1G_2}{\eta_2}\cdot\frac{d\gamma}{dt}, \qquad (1)$$

where τ – shear stress, MPa-s; τ_0 – yield stress, MPa-s; G_1, G_2 – instant and retarded elastic moduli, MPa;

η_1 – volume "true" viscosity, MPa-c; η_2 – volumetric viscosity of the fluid flow, MPa-c; t – current time, c; $\frac{d\gamma}{dt}$ – shear rate, c^{-1}.

For the case τ = const, which is typical for the study of creep processes, from equation (1) we obtain

$$\frac{d^2\gamma}{dt^2}+\frac{G_2}{\eta_2}\cdot\frac{d\gamma}{dt}-\frac{G_2}{\eta_1\eta_2}(\tau-\tau_0)=0 \qquad (2)$$

Enter the initial conditions

$$\gamma(0)=\frac{\tau-\tau_0}{G_1};\quad \frac{d\gamma_0}{dt}=(\tau-\tau_0)\left(\frac{1}{\eta_1}+\frac{1}{\eta_2}\right) \qquad (3)$$

The solution of equation (2) under conditions (3) is

$$\gamma=(\tau-\tau_0)\left(\frac{1}{G_1}+\frac{1}{G_2}\right)+\frac{\tau-\tau_0}{\eta_1}\cdot t-\frac{\tau-\tau_0}{G_2}e^{-\frac{t}{\lambda}} \qquad (4)$$

where λ – relaxation time, s

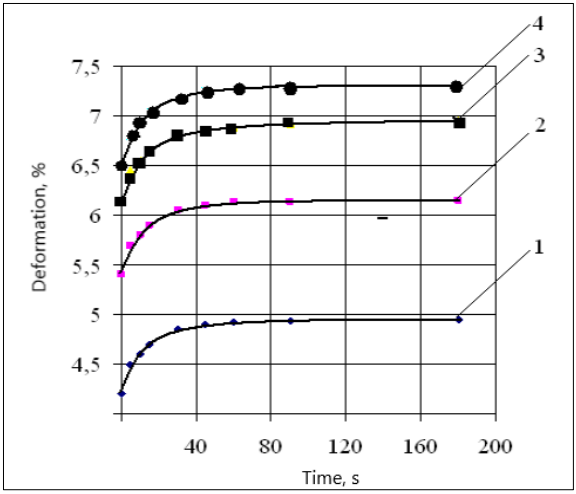
$$\lambda=\frac{\eta_2}{G_2} \qquad (5)$$

Taking into account the dependence (5) from equation (4) we obtain the rheological equation of the model of praline candy mass with tary oatmeal

$$\tau=\tau_0+\left[\frac{1}{\eta_1}+\frac{1}{\eta_2}\exp\left(-\frac{t}{\lambda}\right)\right]^{-1}\cdot\dot{\gamma} \qquad (6)$$

[4] Nurzhan Muslimov, Askhat Dalabaev, Abdymanap Ospanov, Abilkhan Sadibaev, Almaz Moldakarimov. Changes in the carbohydrate-amylase complex germination of cereal crops. *Journal of Hygienic Engineering and Design*, Vol. 40, pp. 114–118.

Determination of the deformation characteristics of praline candy mass with millet oatmeal was carried out under the conditions of compression in a closed volume. Creep curves of the candy mass were obtained at a temperature of 298 K, which corresponds to the production conditions (Figure 2).



Stress: 1-0.1; 2-0.2; 3-0.3 and 4-0.4 MPa

Fig. 2. Creep curves of praline candy mass with tary oatmeal at 298 K

Rheological parameters included in the rheological equation of state were determined from the experimental creep curves, using the following dependencies for calculation[5].

$$G_1 = \frac{\tau - \tau_0}{\gamma_0};\ G_2 = \frac{\tau}{\gamma_1};\ \eta_1 = \frac{\tau - \tau_0}{\gamma_0};\ \eta_2 = \frac{\tau}{\gamma_1}. \qquad (7)$$

Figures 3–7 show the dependences of rheological parameters, such as, G_1, G_2, η_1 и η_2 as well as praline candy mass from voltage τ.

[5] Blinnikova O. M., Babushkin V. A., Akindinov V. V., Perfilova O. V., I. M. Novikova. (2020). Production technology and mathematical method for modeling the formulation of fruit and jelly candies enriched with collagen. *IOP Conf. Series: Materials Science and Engineering*, Vol. 919, pp. 1–5.

As can be seen, in all cases, the values of rheological parameters increased with increasing tension[6].

As a result of mathematical processing of the experimental data by the least squares method, the following equations of rheological parameters were obtained

$$G_1 = A_{G1} + B_{G1}\cdot\tau;\ G_2 = A_{G2} + B_{G2}\cdot\tau;\ \eta_1 = A_{\eta1} + \cdot\tau;\ \mathrm{Ln}\,\eta_2 = B_{\eta2}\cdot\tau - A_{\eta2}, \quad (8)$$

where A_{G1}, B_{G1}, A_{G2}, B_{G2}, $A_{\eta1}$, $B_{\eta1}$, $B_{\eta2}$ and $A_{\eta2}$ – calculation coefficients.

Table 1 shows numerical values of calculated coefficients of equations (8), calculated by means of "Excel".

The proposed rheological model of formation of food materials gives satisfactory convergence of experimental data with calculated ones.

Table 1

Numerical values of the calculated coefficients of equations (8)

$G_1 = A_{G1} + B_{G1}\cdot\tau$		$G_2 = A_{G2} + B_{G2}\cdot\tau$		$\eta_1 = A_{\eta1} + B_{\eta1}\cdot\tau$		$\mathrm{Ln}\,\eta_2 = B_{\eta2}\cdot\tau - A_{\eta2}$	
A_{G1}	0,0116	A_{G2}	0,0109	$A_{\eta1}$	501	$A_{\eta2}$	0,3561
B_{G1}	0,1249	B_{G2}	1,2919	$B_{\eta1}$	1031	$B_{\eta2}$	5,8628
R	0,99	R	0,99	R	0,99	R	0,98

Development of technology for bakery products

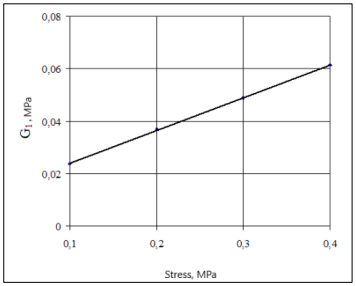


Fig. 3. The dependence of the instant modulus of elasticity G_1 of praline candy mass with tary oatmeal on the voltage τ

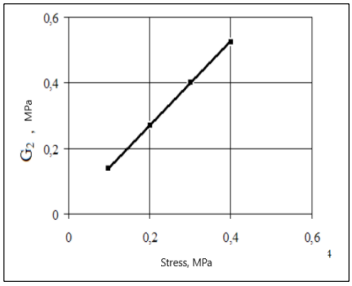


Fig. 4. The dependence of the retarded modulus of elasticity G_1 of praline candy mass with tary oatmeal on the stress τ

[6] Nurzhan Muslimov, Askhat Dalabaev, Aigul Timurbekova, Abilkhan Sadibaev, Almaz Moldakarimov, Yerman Spandiyarov. Changes in the protein-protease complex of germinated grains of leguminous crops. *Journal of Hygienic Engineering and Design*, Vol. 40, pp. 132–138.

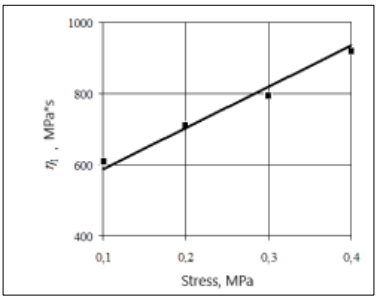


Fig. 5. Dependence of volumetric "true" viscosity of η_1 praline candy mass with tary oatmeal from the voltage τ

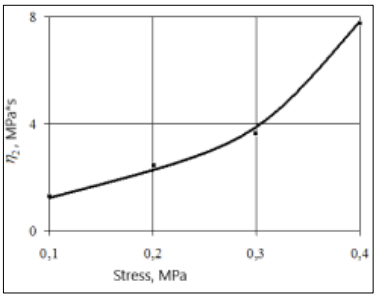


Fig. 6. Volume viscosity dependence of steady-state flow η_2 of praline candy mass with tary oatmeal from voltage τ

In the fourth section on the basis of the experimental studies the technological schemes of production of praline and fondant-praline candies based on millet cereal with high quality indicators of the finished product were developed.

Cereals with an initial moisture content of 7–10 % dried to a moisture content of 2–4 % at 350–400 K for 10–20 minutes, crushed on a crusher to get tary oatmeal, and then to particle dispersion of 0.2–0.3 mm.

The resulting praline candy mass with oatmeal was crushed to a homogeneous mass, crushed roasted nut kernels, mixed with powdered sugar, tary oatmeal, fat and cocoa powder.

On the basis of the resulting praline mass developed the recipe for "Taraz" sweets with nut substitute millet oatmeal.

It is established that in the recipe of praline masses the amount of substituted nut, provided by the recipe composition of praline masses with tary oatmeal, is 25–65 %.

Nutritional value of sweets on a grain basis "Taraz" is (g per 100 g of product): protein – 6,143; fat – 26,663; carbohydrates – 57,910; mineral substances (mg): K – 438; Mg – 112; P – 359. Energy value – 496 kcal.

Based on the definition of quality indicators candy "Taraz" established that developed a new assortment of candy products with improved taste qualities.

In order to develop a fondant-praline mass based on milk fondant and praline mass with tary oatmeal it was necessary to study the effect of the ratio of candy masses in the mixture on the quality of the mass and the bodies of candy. For this purpose, mixtures of milk fondant and praline mass on the basis of millet oatmeal were prepared.

The formulation of sweets with fondant-praline body of candies "Meiram" was developed based on the studies to determine the impact of the ratio of candy masses.

During molding the candy mass in the working volumes of the equipment experiences excessive pressure from the working bodies. Calculation of productivity of technological equipment for pressing out the confectionery mass should be made taking into account the density of the material and pressing pressure.

Figure 7 shows the results of experimental studies of behavior of praline candy mass with packaging toloknoy in conditions of compression in a confined volume at different temperatures: 296, 298, 300 and 302 K.

As can be seen, in all cases with increasing pressure of pressing up to 0.2–0.4 MPa mass density increases rapidly as most of the air is removed from the tested product, and then there is a linear relationship, which indicates the plastic deformation of the mass.

In this section, the formation of compact material and the achievement of the conditional – limit density takes place. Therefore, this section is of practical interest.

Under the influence of pressing pressure in the candy mass, complex mechanical and molecular phenomena occur, as a result of which the structure of the pressed material changes towards an increase in the number of contacts and density.

Figure 7 shows that the higher the temperature of the product, the less pressure is required to obtain a given density. This is explained by the fact that an increase in product temperature reduces the friction of the material on the inner surface of the press – mold and increases the plasticity of the material, resulting in significantly improved deformation properties of the candy mass.

The results of mathematical processing of the results of the experiments allowed the dependence of the density of praline candy masses with tary oatmeal on the pressing pressure described by the equation of N. F. Kunin and B. D. Yurchenko

$$\rho = \rho_{np} - \frac{k_0}{\alpha} e^{-\alpha P}, \qquad (9)$$

where ρ_{np} – conditional limiting density of candy mass, kg/m^3; k_0 – initial pressing ratio, kg/m^3; α – compressibility loss ratio, MPa^{-1}; P – pressing pressure, MPa.

In the interval of practical pressing pressures equation (9) in coordinates $\frac{k_0}{\alpha} e^{-\alpha P}$ represents a straight line. On this basis, we determined the coefficients of equation (9) using "Excel" tools.

Numerical values of experimental coefficients of equation (9) are given in table 2.

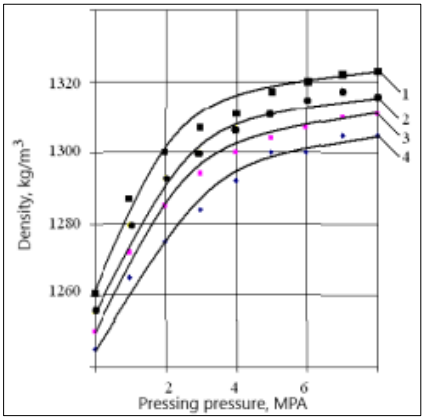
Usually a multiple correlation coefficient R is considered as an indicator of the closeness of the relationship.

The obtained value of R >0.8, therefore, we can talk about high accuracy of approximation.

For engineering calculations of machines it is necessary to know the value of the load at which the deformation of the product during its stay in the zone of action of working bodies of technological equipment reaches the limiting value.

From Fig. 2 it is seen that the nature of the creeping curves of praline candy mass with millet flour is the same, which makes it possible to look for common law for them. Concerning the process of creep can be divided into two stages: the first is unsteady with gradually decreasing speed of deformation and the second is steady with constant speed of deformation.

The first stage is of practical interest, because during this time the greatest deformation and formation of bundles of sweet mass occurs.



Temperature: 1-296; 2-298; 3-300 and 4-302 K. 3-304 K.

Fig. 7. Dependence of candy mass density on pressing pressure

Processing of experimental data made it possible to propose the dependence of material deformation γ on time t to describe by the equation

$$\gamma = \gamma_0 \left[1 + \left(A_p - B_p \gamma_0 \right) \sqrt{t} \right], \tag{10}$$

where A_p and B_p – empirical coefficients.

Table 2

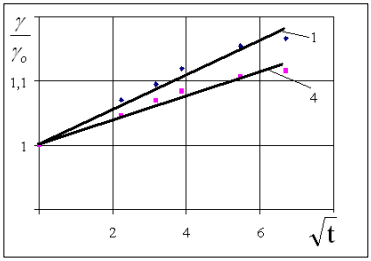
Numerical values of the experimental coefficients included in equation (8)

Temperature, K	$\rho_{пр}$	k_0	α	R
296	2716	3,84	0,0027	0,86
298	2618	3,47	0,0026	0,98
300	2503	2,90	0,0024	0,94
302	2631	3,06	0,0023	0,86

If we add the notation into equation (10). C = Ar–Bpγ0 and divide both parts by γ0 we obtain

$$\frac{\gamma}{\gamma_i} = 1 + C\ \sqrt{t} \qquad (11)$$

By constructing equation (11) in coordinates $\frac{\gamma}{\gamma_i}$ and $\sqrt{t}$ we obtain a family of lines (Figure 8), in which each line corresponds to a certain value of voltage. The tangent angles of the lines to the abscissa axis give the values of the coefficient C, and the intersection of the lines with the ordinate axis is 1.



1 – 0,1 and 4 – 0,4 MPa

Fig. 8. Dependence $\frac{\gamma}{\gamma_i}$ from $\sqrt{t}$ under the stresses

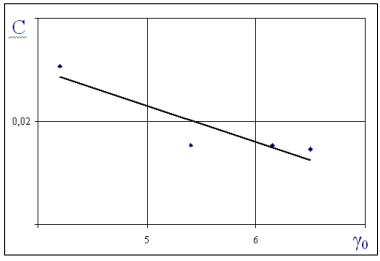


Fig. 9. Dependence C from γ0

The figure shows lines 1 and 4, corresponding to stresses of 0.1 and 0.4 MPa. The lines corresponding to the stresses of 0.2 and 0.3 MPa are between lines 1 and 4 and are not shown in Figure 8 for clarity.

For definition of factors A_p and B_p we plotted a diagram in coordinates C-γ0 (figure 9). If we continue the line up to the intersection with the ordinate axis, the segment equal to A_p is cut off on the last one. The tangent of the slope angle of the line gives B_p.

After processing the experimental data for the first stage of the creep process, a generalized equation is proposed

$$\gamma = \gamma_0 \left[1 + \left(0{,}039 - 0{,}0035 \cdot \gamma_0\right)\sqrt{t}\right] \qquad (12)$$

The deviation between the experimental data and the calculated values of the generalized equation does not exceed 12.1 %.

The obtained generalized rheological equation of the relative deformation of praline candy mass from time is valid in the interval of pressing pressures from 0 to 0.4 MPa at a temperature of 298 K.

The fifth section presents the practical application of the results of experimental studies.

Developed and manufactured in metal, and implemented in the educational process in the training of engineering and technical personnel of the food industry:

– experimental-industrial crusher for preliminary crushing of bulk tary product under conditions of dynamic loading;

– a new original plastometer, protected by a patent of the Republic of Kazakhstan to determine the rheological properties of praline candy masses of high viscosity and other food materials under different deformation conditions;

– Installation for fine crushing and mixing components of praline and fondant confectionery masses;

– Recipes protected by patents of the Republic of Kazakhstan and technological instructions for the production of praline candies with toloknoy containers “Taraz” and fondant – praline candies “Meiram” are developed;

– Developed technological schemes for the production of praline candies with toloknom tara “Taraz” and fondant – praline candies “Meiram”;

– The method of engineering calculation of screw press productivity taking into account the rheological properties of high viscosity praline candies with tary oatmeal was developed.

Economic efficiency from the introduction into the production of praline candies with tary oatmeal per 1t is 61348.8 thousand tenge.

CONCLUSION

1. The results of theoretical and experimental studies allowed to develop scientifically – justified methods of technological equipment calculation for the formation of high-viscosity praline confectionery masses using the national food product millet oatmeal.

2. Based on the results of the experimental studies the recipes for praline and praline-fondant sweets based on toloknaya tara with high quality indicators of the finished product have been developed.

3. It has been established that at a stress greater than the shear stress limit the behavior of high viscosity praline candy mass corresponds to the mechanical model of elastic – viscous – plastic body Shofield – Scott – Blair, which consists of a sequential connection of Bingham and Kelvin models.

4. Instantaneous modulus of elasticity, retarded modulus of elasticity, volumetric true viscosity and volumetric viscosity of steady-state motion of praline candy mass based on tary oatmeal at 298 K were determined experimentally, which corresponds to the production conditions.

5. A generalized rheological equation for the relative deformation of praline candy mass from time was obtained, which is valid in the interval of pressing pressures from 0 to 0.4 MPa.

6. To calculate the productivity of technological equipment, the equation of praline candy mass density on pressing pressure has been obtained.

7. The method of engineering calculation of the productivity of technological equipment taking into account the compression and rheological properties of praline candy mass of high viscosity has been developed.

8. Developed and manufactured in metal, and implemented in the educational process in the training of engineering and technical personnel of the food industry:

– an experimental-industrial crusher for preliminary crushing of loose cereal tary under dynamic loading conditions;

– a new original plastometer, protected by a patent of the Republic of Kazakhstan to determine the rheological properties of praline candy masses of high viscosity under various deformation conditions;

– installation for fine crushing and mixing components of praline and fondant confectionery masses.

9. Developed methods for the preparation of candy, protected by the RK pre-patents, technological schemes for the production of praline candy "Taraz" and fondant – praline candy "Meiram" on the basis of tary oatmeal.

Completeness assessment of the research of the set tasks. In accordance with the objectives of the research, recipes for candy products based on non-traditional raw materials as tary oatmeal of finished products, rheological model of praline candy masses, the method of engineering calculation of technological equipment for extruding praline candies into bundles, the technological scheme of production of candy products containing tary oatmeal, the rheological properties and quality indicators of candy masses with tary oatmeal are developed.

The obtained scientific results are quite consistent with the objectives and fully cover their solutions.

Recommendations and baseline data on the specific use of the results of the work. The results and conclusions, as well as the proposed methods for determining the rheological properties of high-viscosity praline candies with millet oatmeal can be used by teachers of higher and secondary educational institutions, scientific and engineering – technical personnel in the development and creation of candy masses with the addition of non-traditional components.

Assessment of technical and economic efficiency of implementation.

The results of the dissertation work were confirmed by the production tests at the Scientific-Research Institute of Food Production of M. Kh. Dulaty Taraz State University, LLP "BAURSAN" and LLP "Danegul".

Economic efficiency from introduction in production of praline candies containing tary oatmeal for 1t is 61348,8 thousand tenge.

Evaluation of the technical and economic level of the work performed in comparison with the best achievements in this area. Earlier in the composition of praline candies oatmeal of tary was not added. On the basis of determination of quality indicators of praline candies with tary oatmeal established that developed a new assortment of candy products with high biological value, with improved taste qualities.

The proposed approaches gave the most effective method of obtaining praline candies containing oatmeal from tary with high quality indicators.

SUMMARY

The line of praline candy production with the use of the national non-traditional product "tary" oatmeal was developed based on the theoretical and experimental research.

The following was developed and manufactured in the metal, and implemented in the educational process in the training of engineering – technical personnel of the food industry:

– Pilot-industrial crusher for preliminary crushing of tary and millet oatmeal under dynamic loading conditions;

– A new original plastometer, protected by a patent of the Republic of Kazakhstan to determine the rheological properties of praline candy masses of high viscosity and other food materials under different deformation conditions;

– Installation for fine crushing and mixing components of praline and fondant praline masses.

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