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PROCEEDINGS

Volume 59, book 10.3.
Chemical technologies
&
Biotechnologies and food technologies

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&
Биотехнологии и хранителни технологии

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Book	Code	Faculty and Section
Razgrad Branch of the University of Ruse		
10.1	FRI–LCR-1-CT(R) SAT–LB-2-CT(R)	Chemical Technologies
10.2	FRI–LCR-1-BFT(R) SAT–LB-P-2-BFT(R)	Biotechnologies and Food Technologies
10.3	TUE-SSS-BFT(R)	Biotechnologies and Food Technologies
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BIOTECHNOLOGIES AND FOOD TECHNOLOGIES
&
CHEMICAL TECHNOLOGIES

Content

ERI -SSS-BFT(R)-01

RESEARCH OF THE PROCESS OF KNEADING DOUGH IN DOUGH MIXER OF CONTINUOUS ACTION[1]

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Abstract: *Mathematical simulation of the process of kneading wheat yeast dough by cam working elements in the software complex Flow Vision was carried out. The calculation grid was used to model the process. At the stage of setting of the task, the conditions of contact of interaction of the material with the working elements and the mixing chamber are specified, as well as the values of the structural and mechanical characteristics of the dough. During the study, the distance between the cam working elements were placed in the range from 2 to 10 mm (2-4-6-8-10 mm), the inspection speed was used in the range from 20 rpm to 100 rpm (20- 40 60-80-100 rpm). After settings all the necessary parameters in the program complex the stage of calculating and visualizing of the kneading the yeast dough process begins. For pseudoplastic fluids with variable product viscosity (non-Newtonian fluid), the shear stress is gradual. The distribution of the shear stress in the yeast dough in the process of kneading by the cam working elements was investigated and, as a result, the distribution of mechanical load for each position of the cam working elements in the kneading chamber. Studies related to the influence of the distance between the cams and the speed of rotation of the working element on the process of kneading the yeast dough.*

Keywords: *Modeling, Dough, Kneading, Cam*

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The paper is awarded with "Best Paper" Crystal Prize -59th Science Conference of Ruse University, Bulgaria, 2020, ISBN 978-954-712-753-1

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ERI -SSS-BFT(R)-02

THE INFLUENCE OF FLOURS FROM FOOD BY-PRODUCTS ON THE FALLING NUMBER[2]

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Abstract: *The aim of this study is to determine the impact of flour obtained from the food waste (grape pomace and tomato waste) in amounts of 4, 6, 8 and 10% on the α-amylase activity. One of the fastest methods to provide the activity of this enzyme is to establish the falling number according to Hagberg. For its determination, it is necessary to calculate the moisture content of each mixture beforehand. Analyzes have shown that the addition of flours from food by-products (grape pomace and tomato pomace) decreased the falling number. Nevertheless, with the addition of these types of flour, α-amylase activity remaied low, which is also a desirable component when preparing these products.*

Keywords: *Falling Number, By-products, Flours, α-amylase activity*

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[2] Докладът е представен на студентската научна сесия на Русенски университет филиал - Разград на 28.05.2020г. в секция Биотехнологии и хранителни технологии с оригиналното си заглавие на английски език.

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ERI -SSS-BFT(R)-03

RESEARCH OF THE PROCESS OF VACUUM COOLING OF BREAD[3]

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Abstract: *The article presents the results of research of the vacuum-evaporating method of cooling bread. It is established that the duration of cooling bread, weighing 0.5 kg, is reduced from 60-90 minutes, when cooling products in an environment with a temperature of 20ºC and relative humidity φ = 75%, up to two minutes. The influence of regime parameters of vacuum cooling process on humidity and bread temperature is investigated.*

The magnitude of the vacuum and the intensity of its creation has an important impact on the quality of bread. To ensure the bread temperature within 25 ° C, it is necessary to create a vacuum value of 97 kPa. The mode of creation of vacuum at which integrity of samples which were investigated and high intensity of cooling is provided is offered.

Keywords*: Vacuum cooling, Bread, Heat-mass transfer.*

INTRODUCTION

One of the aspects that improves the quality of finished products in the production of bread is the cooling of freshly baked bread. In most cases, baked bread is cooled on trolleys, which occupy large production areas, and cooling occurs naturally over a long period of time. Coolers are also used in enterprises, which reduce the cooling time due to air conditioning, but occupy a large area.

An improved way to intensify the technological process of food production, including bread, is the use of vacuum evaporative cooling, as its advantages include the speed of the cooling process, compact equipment and a positive impact on product quality.

The use of this method of cooling has been studied for several decades by scientists such as McDonald K., Sun, D.-W, Everington, D., Sluimer, P., Cauvain, S.P. and others.

The process of vacuum-evaporative cooling (VEO) has a positive effect on physicochemical and organoleptic quality of bakery products, increases porosity, specific volume, reduces the time spent on cooling the product, prolongs their storage time due to the absence of infection by microorganisms during cooling [1- 3].

However, the use of the proposed method in cooling rye-wheat hearth bakery products requires additional research to establish the cooling parameters, because due to too intense pressure drop there is a pressure gradient between the steam in the workpiece and the environment,

[3] Докладът е представен на студентската научна сесия на Русенски университет филиал - Разград на 28.05.2020г. в секция Биотехнологии и хранителни технологии с оригиналното си заглавие на английски език.

accompanied by destruction of the workpiece [4]. Therefore, in order to study the main parameters of vacuum-evaporative cooling of bakery products, we have developed a scheme and design of the experimental installation.

EXPOSITION

Laboratory installation and experimental procedure

The research was carried out on a laboratory installation, the scheme of which is presented in Fig. 1, and consists of: a vacuum chamber with a thermocouple arranged in it connected to a multimeter, an electronic manometer, a moisture extraction system (condenser and condensate collector), a pipeline with valves to regulate the rate of vacuum in the vacuum chamber.

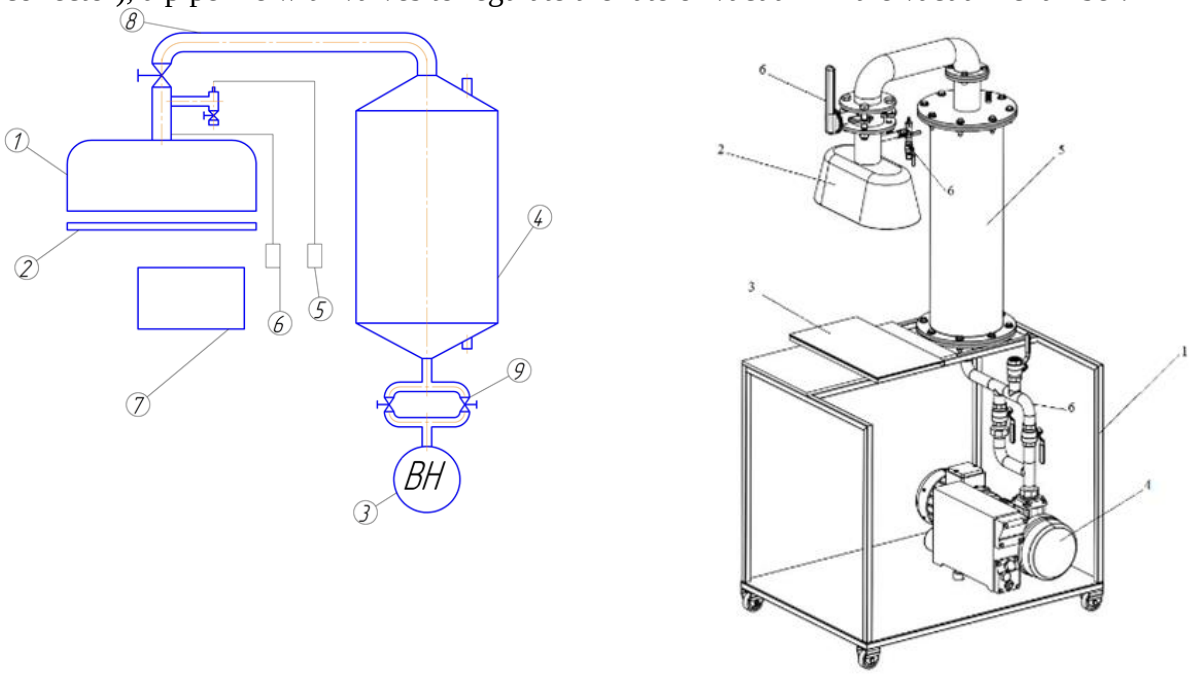

Fig. 1. Scheme of laboratory installation: 1 - vacuum chamber; 2 - vacuum chamber cover; 3 - vacuum pump; 4 - capacitor; 5 - manometer; 6 - multimeter with thermocouple; 7 - scales; 9 - pipeline.

The laboratory unit works as follows: on the lid of the vacuum chamber 2 is placed a blank (hot bread), the lid is applied to the vacuum chamber 1 and the vacuum pump 3 is turned on after reaching the required vacuum (bread temperature corresponds to boiling water at this vacuum) turn off the vacuum pump 3.

An oval hearth bread weighing 0.5 kg and a moisture content of 44% from wheat flour was used as a blank.

Scales are used to determine moisture loss, and a multimeter with a thermocouple is used to determine the initial and final temperature.

During the study of the process of vacuum cooling of bread, the following parameters were controlled:

1) initial and final mass (g)
2) initial and final temperature (^{0}C)
3) time of the experiment (sec.)
4) the depth of vacuum in the vacuum chamber (kPa.)

RESULTS AND DISCUSSION

Cooling of bread is an important technological process during which bread reaches such structural-mechanical and physical parameters that allow to carry out high-quality processes of its cutting and packing. The recommended temperature of bread for these processes is considered to be 30 ° C [5].

Since the vacuum-evaporation method of cooling occurs by removing heat by evaporating moisture from the material, the minimum temperature to which bread can be cooled is determined by the depth of vacuum with a sufficient amount of free moisture in the bread.

Given that excessive moisture loss by the workpiece is impractical, the effect of the final pressure of the environment of the vacuum evaporator on the amount of evaporated moisture from the workpiece was investigated.

The results of studies of the effect of the final pressure of the vacuum chamber on the temperature inside the workpiece and the humidity of the finished bread are presented in Fig. 2.

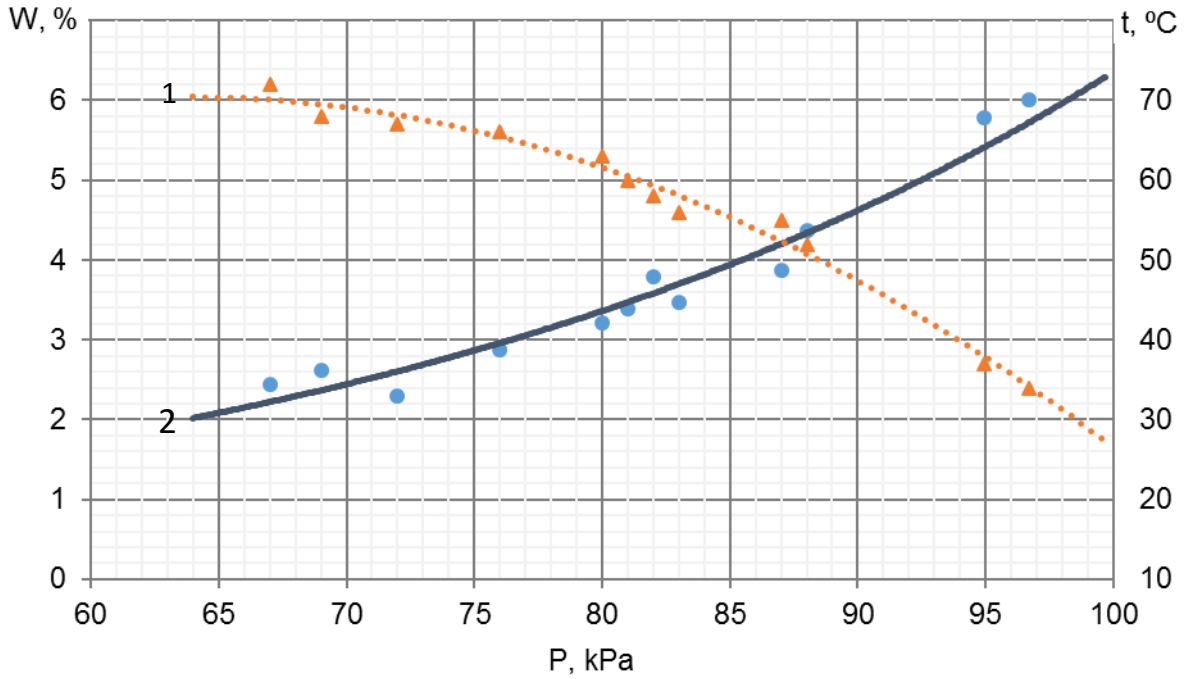

Fig. 2. Dependence of the change in the final temperature of the center of the workpiece (1) and the loss of moisture of the finished products (2) on the amount of vacuum.

From the obtained data it is established that the creation of a vacuum value of 97 kPa is accompanied by a decrease in humidity of the products from 5% to 6%. With the traditional method of cooling, the humidity is reduced by 3… 4%. This also achieves the required temperature for further processing of bread - 30 ºC.

Creating a vacuum of more than 97 kPa will lead to overcooling of products and excessive loss of moisture.

In the study of the cooling parameters of oval hearth bread made of wheat flour, it was found that the crust formed during baking has a significant resistance and prevents the diffusion of water vapor from the middle of the workpiece into the environment. In this case, the intensity of cooling will be limited by the capacity of the crust and the strength characteristics of the structure of the bread. When the pressure inside the workpiece is significantly exceeded, there is a stress that leads to deformation of the bread and the destruction of the workpiece (figure 3).

Fig. 3. Destruction of the workpiece

In the course of research work the rational mode of cooling of oval hearth bread from wheat flour to a temperature of 30 ° C was determined (figure 4).

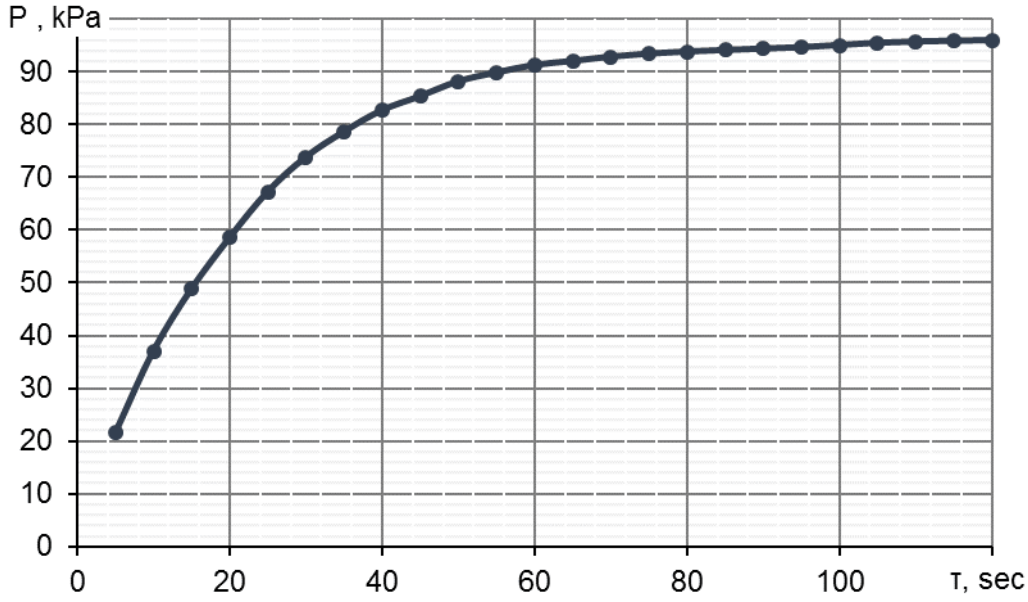

Fig. 4. The mode of creating the vacuum required to cool the bread

In this mode, the cooling time of bread weighing 0.5 kg. is 2 minutes, and the maximum rate of vacuum should not exceed 4.5 kPa / sec.

In this cooling mode, a mixture of steam and air is formed in the vacuum chamber, which is pumped out by a vacuum pump through a system of pipelines. The temperature of this mixture at the outlet of the vacuum chamber in the process of vacuum evaporation cooling is shown on figure 5.

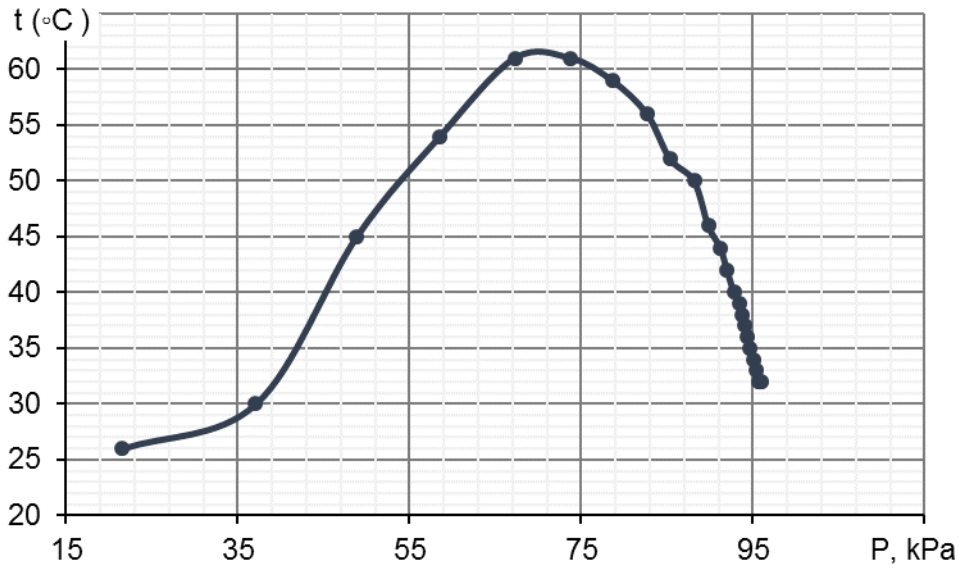

Fig 5. The temperature of the steam stream at the outlet of the vacuum chamber in the process of vacuum cooling of bread

The maximum value of the temperature of the mixture of steam and air during cooling depends on the amount and temperature of air in the vacuum chamber at the beginning of vacuuming.

CONCLUSION

The proposed mode of cooling bread by vacuum evaporation method provides cooling of oval hearth bread weighing 0.5 kg from a temperature of 98 ° C to 30 ° C for 120 sec, Instead of 1.5 - 2 hours. natural cooling, ensuring the integrity of the sample. That allows to receive all advantages of vacuum evaporating cooling, namely reduction of cooling time, improvement of qualitative indicators of products for mass grades of bakery products.

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ERI -SSS-BFT(R)-04

USE OF NON-TRADITIONAL RAW MATERIALS IN THE TECHNOLOGY OF WHIPPED DESSERT[4]

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Abstract: *The presented technology of desert with the addition of shavnat, will bring this product closer to the ideal, ie it will meet the daily human need for protein. Researched a new nontraditional cuiture- shavnat.*

Organoleptic analysis of the finished product showed that the use of shavnat puree gives the product a natural soft green color, the taste of the additive is not saturated, the consistency of the product is homogeneous.The positive influence of vegetable raw materials on organoleptic and physicochemical indicators of marshmallow quality has been established. Because the addition of sorrel to the innovative recipe allows to increase the content of digestible protein and has a positive effect on the organoleptic characteristics of the dessert.

Keywords: *Desert, Biologically activesubstances, Model, Complex, Evaluation.*

INTRODUCTION

Today, the restaurant technology product evaluation samples ocurs organoleptic characteristics, in determining the average score calculation and subsequent tasting sheet. (Kuzmin, O., Levkun, K., & Riznyk, A., 2017). So we decided to create a dessert that is not only delicious, but also low in calories.

The object of research is a dessert with the addition of vegetable puree. We determined the optimal ratio by the method of experimental research (Koretska, I., & Zinchenko, T., 2018). apple puree and shavnat puree for this dessert. The analysis of physicochemical, organoleptic and technological indicators by standard methods was also carried out (Dorokhovych, A., M., & Kovbasy, V., M., 2015).

One of the most pressing problems of the world's population is the problem of overcoming the lack of protein in the body. Human diseases are the result of such an unbalanced diet. It is worth noting that the products consumed by the population are mostly high in calories and unbalanced in terms of nutrients, which is mainly due to the presence of simple carbohydrates, fats compared to low levels of dietary fiber, minerals and vitamins.

[4] Докладът е представен на студентската научна сесия на Русенски университет филиал - Разград на 28.05.2020г. в секция Биотехнологии и хранителни технологии с оригиналното си заглавие на английски език.

PRESENTATION

Improving the technology of new dishes or products usually involves the introduction of innovative ingredients in the recipe of a new dish and is an important step to study the technological impact and determine the effect of dosing a new food additive on a product made by traditional technology. (Kuzmin, O., Levkun, K., & Riznyk, A. 2017).

Thus, we believe that the development of technology of fruit and berry and fruit and vegetable desserts of a given consistency with a high content of biologically active substances, high organoleptic characteristics is relevant. Such dishes will significantly enrich the human diet with biologically active substances, dietary fiber, improve the organoleptic characteristics of dishes and the quality of food in general and provide the population with products from natural fruits, berries and berries.

The development of innovative dessert technology is aimed at maximizing the main goal of obtaining products enriched with biologically active substances with high quality, compared to desserts made by traditional technology.

The presented technology of dessert with the addition of shavnat, will bring this product closer to the ideal, ie it will meet the daily human need for protein.

To compare the protein and dietary fiber content of shavnat with other food groups, I performed an analysis. According to the analysis, in the first place in terms of protein content is chavnat, in second place - beans, then oat bran and whey, the least in fruit.

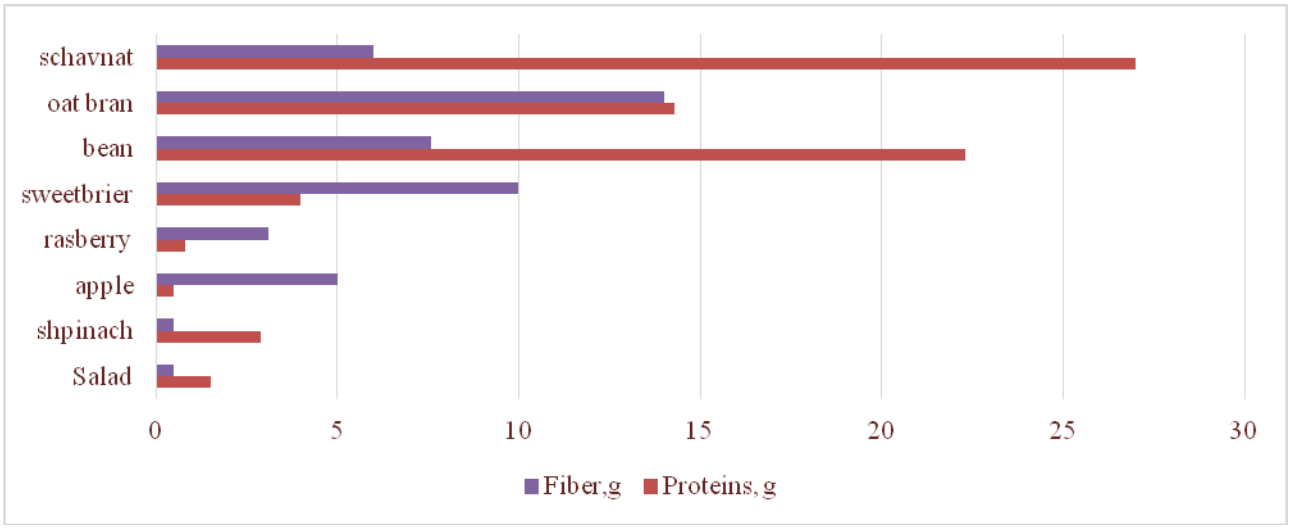


Fig. 1 Analysis of the chemical composition of vegetable raw materials
Source: own development

It is necessary to prepare semifinished product syrup made of sugar molasses and agar according to the recipe to boil at a temperature 95...98 degrees to get content of dry matter 84...85% to put 15% of shchavnat as a applesauce and to churn the mass in blender to get the mass which holds a shape.

Calculated mathematical modelling was used to study the composition of products enriched with natural additives with high-quality parameters. The quality criterion was chosen as the maximum total value of biologically active substances - vitamins and minerals.

For each pair of ingredients (apple or vegetablespuree A: B), were calculated characteristics for a model percentage with a step of 5%.

Table 1. Modeling of the composition of blended pairs

Components	Number of main components in a blended pair									
Apple (A), %	70	0	30	35	40	45	50	55	60	65
Vegetables raw (B), %	0	70	40	35	30	25	20	15	10	5

Source: own development

The task of optimizing the formulations of products was to select the components and determine their ratios, which provide the maximum approximation of the mass fraction of nutrients to the standards. Based on this principle, indicators are generated that allow to evaluate the composition of the biologically active substances and its balance in the modelling product.

The choice of the best ratio in steam was influenced by the limit on the maximum total content of organic acids, which accelerate the absorption of protein.

The analysis of the characteristics of the selected pair of ingredients and the justification for choosing the best option according to the selected quality criterion was performed as a calculation of an array of data - a set of values of the quality criterion, depending on the quantitative ratio of the components in the pair of ingredients.

Thus, for the blended pair "apple - banana puree", was formed the vector of components from the innovative product (m=2: A-30%, B-40%).

$$\vec{x} := \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix} = \begin{pmatrix} \frac{30}{100} \\ \frac{40}{100} \\ \frac{15}{100} \\ \frac{1.5+5+8.5}{100} \end{pmatrix}^T ; \quad (1) \qquad \vec{x} = \begin{pmatrix} 0.3 \\ 0.4 \\ 0.15 \\ 0.15 \end{pmatrix}^T , \quad (2)$$

where xk(k=1, 2, 3, 4) - components (in parts) of the formulation of a new product, namely x1 - amount of apple puree (in parts), x2 -amount of other puree (in parts), x3 - amount of sugar (in parts), x4 -amount of gelatin, egg white and water (in parts).

Complied condition: x1+x2+x3+x4=1.

The quantitative ratio of the main ingredients Cm was defined as:

$$c_m = \frac{x_1(m)}{x_2(m)}, \quad (3)$$

where x1(m)+x2(m)=0,7 (constant value in this research), M -nodal point number. The set of nodal points is shown in the table 2.

Table 2The calculated ratio of the content of the main components in the blended pair

Step	The ratio of the components in the blended pair								
	1	2	3	4	5	6	7	8	9
$x_1(m)$ (in parts)	0.0	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65
$x_2(m)$ (in parts)	0.70	0.40	0.35	0.30	0.25	0.20	0.15	0.10	0.05
C_m	0.0	0.75	1.0	1.33	1.8	2.5	3.67	6.0	13.0

Source: own development

The Mathcad computer system was used to calculate the values of quality criteria. Thecalculationstookintoaccountthedataonthecontentofessential amino acids intheindividualcomponentsoftheinnovativedessertandweretakenintoaccountinthedevelopment / creationof a newdessert.

Dessert zephyr, made by traditional technologies, contain up to 15% protein, but they mostly have an insufficiently balanced amino acid composition. The amount of substituted amino acids in sshavnat is 14964 mg per 100 g of dry matter of schavnat; irreplaceable - 10117 mg / 100 g; that is, essential amino acids make up 40.33% of the total number of amino acids. Analysis of the biological value of oxalic proteins by the SCOR method showed that the protein is almost balanced, the amino acid isoleucine (75% SCOR) is limited. The content of arginine and histidine is, respectively, 1301 mg and 779 mg per 100 g of dry matter of shavnat.

*Table3.*Amino acid composition of schavnat

Name of essential amino acids (EAA)	Quantity on protein	
	Chicken egg protein	Schavnat protein
Valine	5,0	4,5
Isoleucine	4,0	3,0
Leucine	7,0	7,63
Lysine	5,5	6,44
Methionine	3,5	4,0
Threonine	4,0	4,0
Phenylalanine+ Tyrosine	6,0	10,26
Tryphtophan	1,0	0,9
Total part of EAA	36	40,73

Source: own development

It necessary to form zephyr with a pastry syringe. The formed portions of semispherical zephyr need to be put to let it rest and to get dry at a temperature 18...20 degrees.

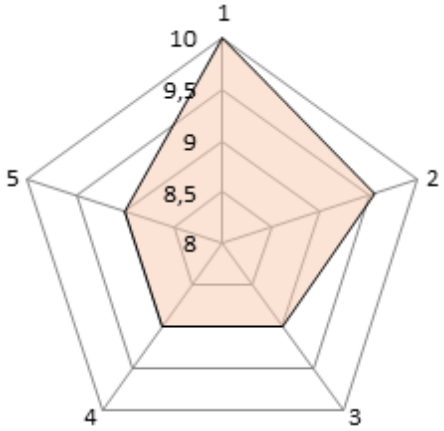
And for the comparison of several diverse specimens, the criterion S has the form:

$$S = sin\frac{2\pi}{N} \cdot \sum_{j=1}^{N}\left(f_j \cdot f_{j+1} \right), \text{ point}^2 \qquad (3)$$

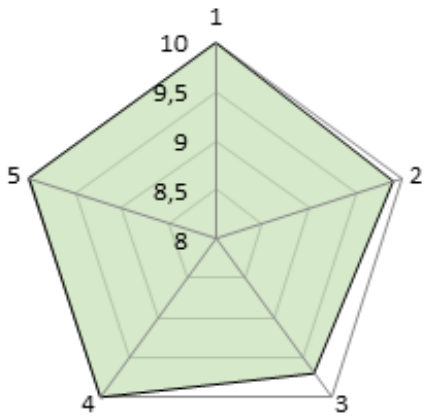
where f_j. – the meaning of a specific Quality Score, points;

N – numberofsamples.

Thequalityprofilesofthenewdessertsarepresentedbelow:



Traditional dessert, S =434 б^2

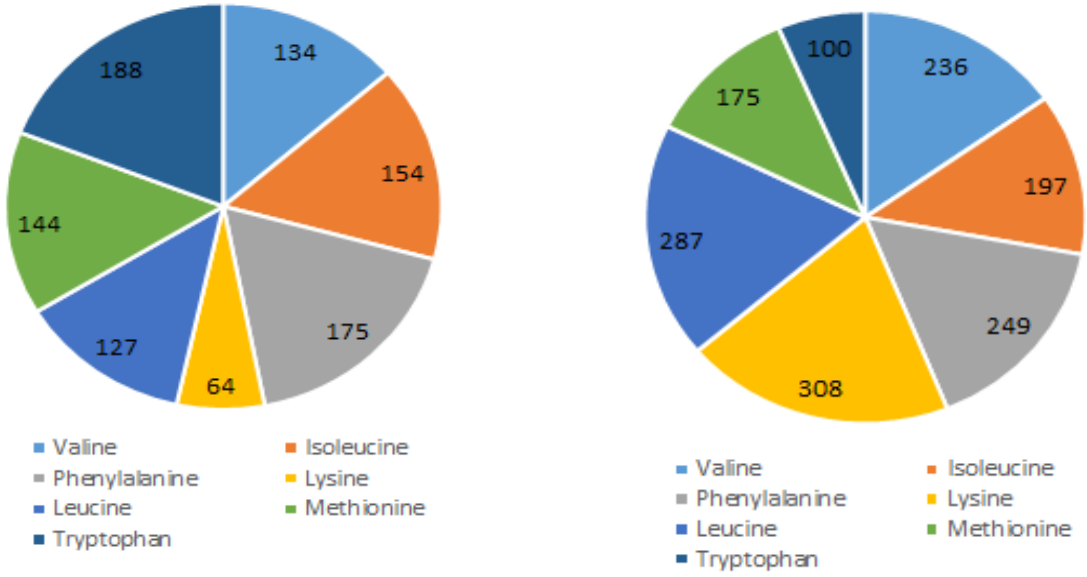


Dessert with Shavnat, S = 492 б^2

Fig. 1. Profile of quality indicators samples of desserts: 1 - Taste; 2- Арома; 3- consistency; 4- Color; 5- Form

Source: own development

The addition of sorrel to the innovative recipe allows to increase the content of digestible protein and has a positive effect on the organoleptic characteristics of the dessert.
Organoleptic analysis of the finished product showed that the use of shavnat puree gives the product a natural soft green color, the taste of the additive is not saturated, the consistency of the product is homogeneous.



a- In classic zephyr,% b - In ephyr with shchavnat,%

the amount of amino-acids in 100 grams

Fig. 2 - Classic Zephyr's Amimo-acid score and zerphyr's with shchsvnat amino-acid score
Source: own development

Based on the results of comparing the amino acid composition of the studied products, it is possible to draw a conclusion about the increase in the content of amino acids.

CONCLUSION

Shchavnat is a rich source of both protein and dietary fiber, in addition, it is rich in various trace elements, so to increase the nutritional value and enrich the human diet, it is advisable to use shchatny, which will improve organoleptic characteristics and quality of food in general, enrich biologically active substances, dietary fiber, amino acids and other essential substances.
The cost of traditional zefir and new ones is calculated and estimated. The analysis showed that the cost of zehpyr with shavnatmore profitable.Thus, the proposed technology takes place in the modern food technology marketof the world.

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ERI -SSS-BFT(R)-05

JUSTIFICATION OF OPERATING MODES OF MECHATRONIC MODULE FOR WEIGHT DOSAGE OF VISCOPLASTIC PRODUCTS[5]

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Abstract: *In the paper, the processes of extrurion and dosing of viscoplastic food products using a tensometric weighing system has been considered. The study has been carried out to determine the dynamic forces that affect the tensometric system in filling packagings proccess. The loads that products were stressed by when passing a screw feeder have been evaluated. The filling process has been investigated by simulation using the FlowVision software. To ensure uniform loads on the weighing system, the changes in the indications of the filling system when using a telescopic tube have been studied. The design of a mechatronic module for dispensing viscoplastic food products by weighting method has been proposed.*

Keywords: *Weight dosing, strain gauge system, simulation modeling, mechatronic module.*

INTRODUCTION

The development of the packaging industry and changing requirements for modern consumer packaging create the background for weighing principle of dosing. Thus, due to quick readjustment, high accuracy, and control of the dose formation parameters, strain gauge systems are widely used in machines for bulk and liquid food products dosing (Gavva O., Bespalko A., Volchko A., Kohan O., 2010). In the case of viscoplastic food products, the development of such systems is constrained by a significant dynamic tolerance in dose formation due to its rheological characteristics (Krykh H., 2007).

EXPOSITION

During the consideration of dose formation methods, it was noted that one of the most popular solutions is using of dispensers with a feed-screw.

The dosing is managed by controlling the pressure in the discharge chamber (P2). The pressure should be sufficient for deformation and moving of products, and at the same time should not result to a loss of product properties. To estimate the required screw speed, it is necessary to determine the pressure drop between the discharge chamber and the tube exit. The starting point of the calculation is ensuring of a certain consumption of products (Q).

The pressure in the discharge chamber (P_2), to ensure a certain productivity, must be:

$$P_2 = \tau + \Delta p_1 + \Delta p_2 \quad (1)$$

The product transfer into the container should be deformed uniformly, filling it. At the outlet of the tube the pressure should be greater than τ, which corresponds to the rheological properties of the product.

Using the well-known calculation method (Levit I., Sukmanov V., Afenchenko D., 2015, Bravo V. L., Hrymak A. N., Wright J. D. 2000, Mikulionok I. O. 2013), it is possible to determine

[5] Докладът е представен на студентската научна сесия на Русенски университет филиал - Разград на 28.05.2020г. в секция Биотехнологии и хранителни технологии с оригиналното си заглавие на английски език.

the pressure in the discharge chamber. The pressure difference in the tube (Δp1) is determined by the formula:

$$\Delta p_2 = \frac{8 \cdot Q \cdot \eta_{e\phi} \cdot l_2}{\pi \cdot (d/2)^4} \qquad (2)$$

η_e – effective viscosity; l_2 – tube lenght; d – tube diameter.

The pressure difference, when passing the duct reducer unit (Δp2), is determined by the formula:

$$\Delta p_1 = \frac{128 \cdot Q \cdot \eta_{e\phi} \cdot l_1 (D^3 - d^3)}{3 \cdot \pi \cdot D^3 \cdot d^3 (D - d)} \qquad (3)$$

l_1 – lenght of duct reducer unit; D,d – initial and final diameter of duct reducer unit.

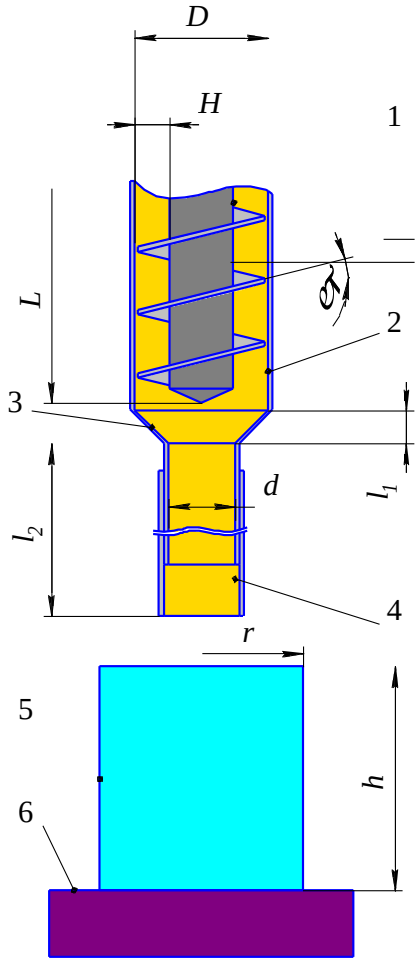

Fig. 1. Analitic model: 1 - screw; 2 - hopper; 3 - duct reducer unit; 4 - telescopic pipe; 5 - packaging; 6 - weighing element

Which in turn is used to determine the speed of screw rotation:

$$n = \left(\frac{\pi \cdot D \cdot H^3 \cdot \sin^2 \varphi}{12 \cdot \eta_{e\phi}} \cdot \left(\frac{P_2 - P_1}{L} \right) \cdot F_p + Q \right) \cdot \frac{2}{F_d \cdot \psi \cdot \pi^2 \cdot D^2 \cdot H \cdot \sin\varphi \cdot \cos\varphi} \qquad (4)$$

H - the depth of the helical surface; φ - the angle of the thread; F_p - coefficient of pressure flow formation; F_d - the coefficient of the formation of the screw surface of the screw for forced flow stopping; P1 - pressure in the loading zone.

It should be noted that in this case, the use of a telescopic tube is not taken into account. In the case of using cylindrical containers, the length of the telescopic tube is a function of the time of dose formation (3). Also at the initial time there is a gap (Δh) between the tube and the container bottom, as a result of which the movement of the tube does not start simultaneously with products filling, and therefore the final formula will be as follows:

$$l_2 = l_b - \frac{Q \cdot t_i}{\pi \cdot r^2} + \Delta h \qquad (5)$$

L_b – initial tube lenght; t_i – curent time of formation time; r – radius of container.

The force that the strain gauge system perceives includes the weight of the product in the container, the pressure that occurs when the product falls into the container and the resistance to stress, which is specified by the rheological properties of the product (4).

$$P = m \cdot g + S \cdot \rho \cdot v + \tau \qquad (6)$$

m - the mass of products in container; ρ - the bulk mass of the product; v - velocity of product falling at the point of contact with the product surface located in the conteiner; S - volumetric feeder productivity.

In the conducted simulation (Fig 2.), two variats of filling of the containers with products, using a fixed tube or a telescopic tube, were considered in order to determine the behavior of the product during the dosing and change of the strain gauge system values. The following assumptions were made in the simulation model: the dynamic parameters of the screw do not affect the output rate; the process is considered as isothermal; there are no product stagnation zones in the middle of the tube.

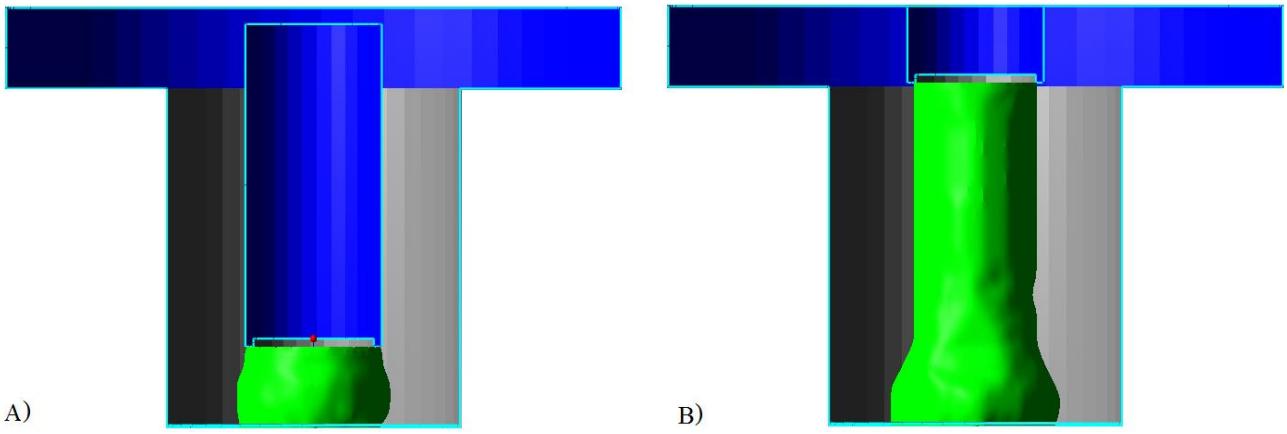

Fig. 2. Simulation model of the dosing process: A - with a fixed tube; B - with telescopic tube

It was found that when a telescopic tube was used, the forces which impact on the strain gauge system were almost linear, while a system with a fixed tube could not be approximated by line with sufficient accuracy.

Based on the simulation results (fig. 3), a mechatronic module for dosing semi-solid food products with a telescopic tube and an electronic control system is proposed (Bogdan Palchevsky, Anton Shvits, Volodymyr Pavlin 2014).

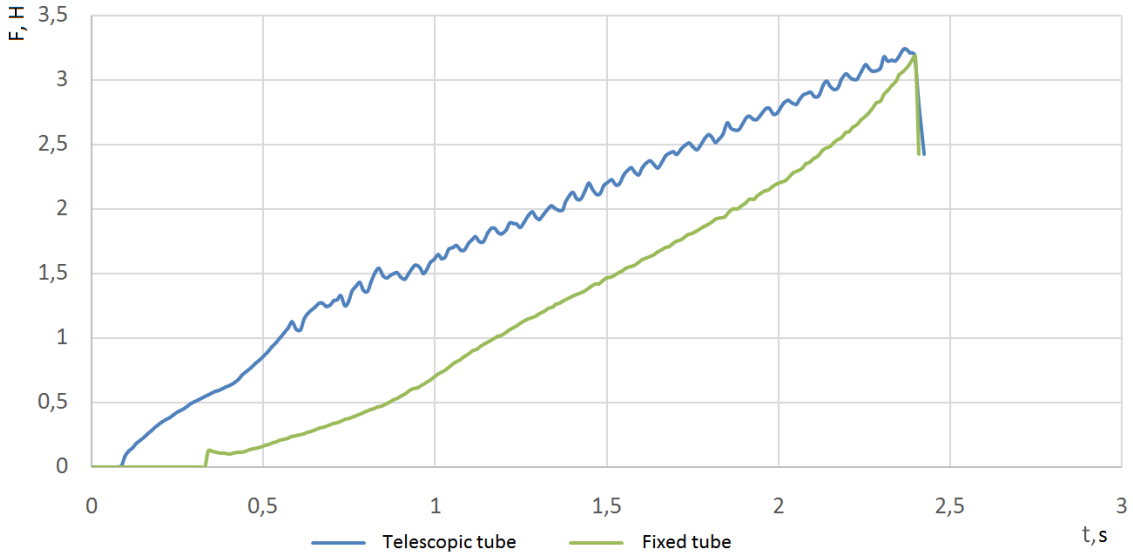

Fig. 3. Indicators of the strain gauge system in the process of dose formation

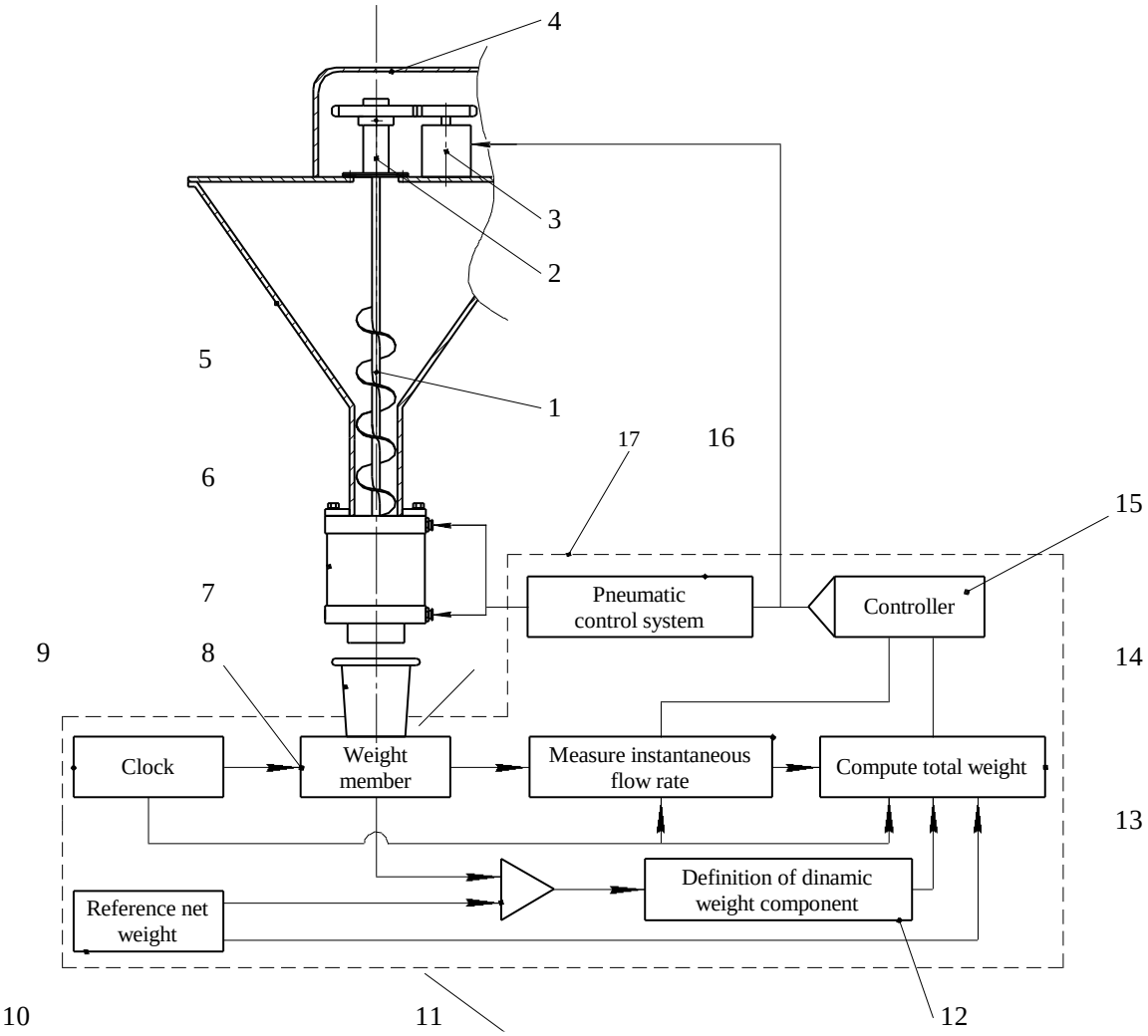

Fig. 4. Diagram of the mechatronic module of the carriage of semi-solid products: 1 - screw; 2 - drive unit; 3 - motor; 4 - cover; 5 - hopper; 6 - telescopic tube; 7 - packaging; 8 - weighing element; 9 - timer; 10 - reference net weight; 11 - comparator; 12 - definition of dynamic weight component; 13 - unit for calculating the total weight; 14 - block for determining instantaneous flow rate; 15 - controller; 16 - pneumatic control system; 17 - control system

The fig. 4 shows a diagram of the mechatronic module for weighing dosing of semi-solid products. After calibration of empty containers, the screw starts the dosing. The control system processes the data of the weighing system, determining the tolerance of the dynamic and rheological components, calculates the actual product amount in the container. The controller, using the data obtained, controls the dosing by managing the screw and telescopic tube. The screw, after the formation of 70-80% of the dose, slows down, to reduce the dynamic tolerance. The tube is rising during the dosing at the same time of container is filling. It should be noted that the "tail-back-weight" was not be taken into account.

CONCLUSION

The analysis of the modes of viscoplastic products movement in a screw feeder has been done. A simulation model has been created to study the effect of the product flow on the strain gauge system. The data obtained can be used to establish the law of change in the speed of screw rotation and the speed of tube movement to ensure accuracy of dose forming by the weight method.

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ERI -SSS-BFT(R)-06

HEALTH BENEFITS OF EATING ALMONDS [6]

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Abstract: *In this paper, we look at the health benefits of eating almonds. The knowledge about almonds from antiquity to the present day is analyzed. The wide range of applications of almond nuts and almond oil in folk medicine is traced, thanks to the valuable ingredients for the human body that are contained in them.*

The recommendations for consumption of almonds by scientists, which are based on scientifically based norms for nutrition and metabolism in the human body, are considered. The beneficial effects of regular consumption of almonds, which are the result of research by research teams from prestigious universities abroad, are presented.

Using a survey, we examined the place of consumption of almonds among our population. We have entrusted to what extent consumers are ready to include in their daily menu plant foods for which no additional processing is applied and contribute to the ecological balance in nature.

Key words: *almonds, healthy food, nutrients, survey*

ВЪВЕДЕНИЕ

Храната е много важен фактор за човешкото здраве и през последните години все по-голям брой потребители желаят да консумират безопасни и питателни храни.

Научните изследвания в областта на хранителните технологии активно подпомагат потребителите с информация за безопасността на храните и здравния риск за стоки от търговската мрежа. Провеждат се дискусии, научни изследвания, има и телевизионни предавания относно правилното хранене. Разнообразието от хранителни продукти, оказва благоприятно въздействие върху различни органи на човешкото тяло. Но производителите не винаги са лоялни при производството на храна, често се сигнализира за наличие на вредни за човешкото здраве добавки, които правят храната по-трайна, с по-добър външен вид и др.

Включването в дневното меню на растителни храни от потребителите, за които не са прилагани допълнителни преработки се оказва добра алтернатива, която спомага и за екологичното равновесие. Бадемите са от този вид храни.

Знанията за бадемите се допълват от древността до наши дни. Културните бадемови сортове са произлезли от обикновения бадем, който се среща в диво състояние в Мала Азия и Средна Азия, Персия и Сирия. Като културно растение бадемът е бил познат в Сирия и Палестина 2000 години преди новата ера. В Европа той вирее предимно в средиземноморските страни, а у нас е разпространен главно в южните райони на страната (https://finansirane.eu/).

Употребата на бадеми в народната медицина е била много популярна през вековете. През средновековието, бадемите са били основна част от рецептите в средиземноморските страни и са смятани за общодостъпни в Европа. Идеята, че ядките правят ястията от месо и пиле по-здравословни била широко възприета (http://nutisal.bg/bg/page/8/istoria-na-yadkite-bademi.html).

[6] Докладът е представен на студентската научна сесия на Русенски университет филиал - Разград на 28.05.2020г. в секция Биотехнологии и хранителни технологии с оригиналното си заглавие на български език: „Здравословни ползи от консумацията на бадемови ядки".

Научни изследвания показват, че и в наши дни продължава да нараства интересът към групата на орехоплодните видове - орехи, лешници, бадеми и кестени (Nedeva, K., Nanev, N., Stoilov, V., 2018).

Бадемите, които се използват като ядки, са така наречените сладки бадеми, но има и горчиви, които съдържат цианид и е добре да се внимава с тяхната консумация.

Сладките бадемови ядки са семената от плодовете на бадема, които се получават, след като костилките на тези плодове се отворят. Те съдържат основните хранителни вещества необходими за израстването на новото растение и може би за това са толкова полезни като „жива“ храна.

В настоящата статия се стремим да разгледаме какво място заема консумацията на бадемови ядки сред нашето население и да класифицираме здравословните ползи от тяхната консумация.

ИЗЛОЖЕНИЕ

Понастоящем 90% от органичната храна, произведена в България се изнася, в по-богатите европейски държави. В това число са и ядките - орехи и бадеми, които са предпочитани като „живи храни“ (Goranova, P., Stefanov, S., Tananeeva G., 2011).

Класификацията на здравословните свойства на бадемите, ще направим според лековитите свойства, които са използвани у нас в народната медицина и дадените лечебни ползи в различни научни публикации.

В народната медицина бадемовите ядки се използват при безсъние, малокръвие, храносмилателни смущения. Консумацията на плодовете на сладкия бадем помага за подобряване на зрението; препоръчва се при анемия, диабет, астма, плеврит. Поради високото съдържание на фосфор, са много полезни и за занимаващите се с умствен труд. Бадемовите ядки имат омекотяващо леко слабително, болкоуспокояващо и противогърчово действие. Използват се при за дразнеща кашлица, нервни разстройства, стомашни болки, безапетитие. В народната медицина, семената на сладкия бадем се използва за лечение на гастрит, язва на стомаха и язва на дванадесетопръстника, лечението на камъни в бъбреците, камъни в жлъчката и запек. Натрошените семена от сладки бадеми, смесени със захар са използвани при анемия, кашлица, изтръпване на ръцете или краката и конвулсии.

Бадемовото масло се използва като леко слабително, седативно, болкоуспокояващо, противовъзпалително средство. Външно - за омекотяване на кожата, при косопад и за заздравяване на косата и вода за уста за стоматит. Листата на бадемите се използват в лечението на диабет. От горчивите бадеми се получава бадемова вода (Aqua Amygdalarum amararum), която се прилага като болкоуспокояващо и слабо анестетично средство (https://finansirane.eu/).

В книгата „Биоконстанти на човека“, която е предназначена за лекари от практиката, под редакцията на проф. д-р Н. Бошев и авторски колектив от 11 учени, лекари, в глава 7 се дават обосновани норми за хранене и обмяна на веществата в човешкия организъм. Разглежда се количеството на основни хранителни и минерални вещества, витамини и енергия, необходими на човека, като дневни нужди за 7 възрастови групи. Препоръките за консумиране на бадемови ядки са включени към *хранителните продукти с физиологично обосновани норми за потребление в натурален вид* и към хранителните продукти, с високо съдържание на:

- *Белтъчини, въглехидрати и масти;*
- *Натрий;*
- *Калий;*
- *Калций;*
- *Магнезий;*
- *Сяра;*
- *Фосфор*
- *Хлор;*
- *Желязо;*
- *Йод;*

- *Витамин B1;*
- *Витамин C;*

Бадемите са известни със свойствата си на антиоксидант. Те са изключително богати на витамин Е (в 100 g се съдържат 229% от препоръчителната дневна доза). Той играе важна роля за предотвратяване на сърдечносъдови заболявания и рак, както и за забавяне на процеса на стареене. Високите стойности на фосфор и магнезий в бадемите спомагат за заздравяване на костите http://kulinaria.bg/products/bademovi-yadki.

Бадемовото брашно е богато на хранителни вещества и е много подходящо за въглехидратни, нискокалорични и безглутенови диети. То е отличен източник на алфа-токоферол, витамин Е, който е мастно-разтворим антиоксидант, спомагащ за понижаване на холестерола и намаляване на риска от много общи заболявания. Също така е добър източник на калций, магнезий и мед. Бадемовото брашно се използва като сгъстител, заместител на пшеничното брашно, при производството на торти, бисквити и пудинги (Topuzova, J., Karadjov, G., Chonova, V., 2012).

Редовната консумация на бадеми оказва благоприятен ефект върху телесното тегло при здрави хора, твърдят учените от Катедра по храните и храненето, Университет Пърд, Уест Лафайет, IN 47906, САЩ. Изследването проверява промяната в телесното тегло, при десет седмична ежедневна консумация на бадеми. Изводите са, че ежедневна порция бадеми от 1440 kJ, е достатъчна за осигуряване на благоприятно въздействие върху сърдечно-съдовите рискови фактори. И се дават обяснения за липсата на очаквано наддаване на теглото в изследваните лица (Hollis, J., 2007).

Шест месечни изследвания на учени от University, Loma Linda, California показват, че редовната консумация на бадемови ядки (средно 76 kJ) е помогнала за намаляване на сърдечено съдовите проблеми, при изследваните мъже и жени. И въпреки това, че ядките са мазни, по време на периода на изследване, средното телесно тегло на лицата е нараснало само с 0,40 (kg), като се отчита само нарастване на ненаситени мазнини (Fraser, GE, Bennett, HW, Jaceldo, KB, 2002).

Здравословният хранителен режим, при който се приема повече калций и витамин Д, е съществена и много важна част от профилактиката и лечението на остеопорозата. За укрепване на костната система на децата и юношите е задължително приемането на калций и витамин Д. Добър източник на калций са млякото и млечните продукти, зелените листни зеленчуци, консервираните с костите риби, бадеми, лешници и др. Витамин Д осигурява доброто усвояване на калция от храната (Bogdanova, Slavkova, K., 2016).

Полиненаситените мастни киселини и техните производни се обединяват в две семейства - на линоловата киселина или ω-6 /слънчогледово олио/ и на линоленовата или ω-3 /орехи, фъстъци, бадеми, лешници и други ядки, риби/. Главните функции на ω-3 и ω-6 мастните киселини са: натрупване на енергия в клетката, поддържане на телесната температура, предпазване кожата от изсушаване, възпроизводство на определени хормони, необходими за клетките, клетъчната биохимия и метаболизма на енергията; сърдечно-съдово и имунно здраве. Мастните киселини от групите ω-3 и ω-6 са жизнено необходима съставка в нашето хранене. Доброкачествени натурални ω-6 мастни киселини могат да се набавят чрез консумация на пресни ядки и семки, нерафинирани растителни масла или чрез влагането им хранителните продукти (Dimitrov, T., Bajcheva, S., Najdenova, N., 2008).

Линоленовата киселина се съдържа в растителните масла (от орех, рапица, соя), в някои ядки (орехи фъстъци, бадеми), в богати на мазнини риби (херинга, скумрия, селда, сьомга) и в малки количества в тъмните зеленолистни зеленчуци (в спанака). Линоловата и линоленовата киселина са важни за индивида, но не могат да се синтезират в организма на човека (Dimitrov, T., Bajcheva, S., Najdenova, N., 2008). Дефицитът на линолова киселина се проявява най-вече чрез козметични симптоми, включително суха коса, косопад и трудно зарастване на раните. Продължителната липса на линолова киселина може да наруши защитната функция на кожата и по този начин да засили склонността към възпаления, екземи, сърбеж и други кожни проблеми.

Основният източник на литий в диетата на човека са растителните храни: зърнени култури; ядки (орехи, бадеми, лешници и др.); зеленчуци (чушки, патладжан); гъби и т.н. Храни от животински произход, които съдържат по-висока концентрация на литий, са месо, яйца и мляко (Kostik, V., Angelovska, B., Bauer, B., 2013). Високите концентрации на литий не само не са опасни за човешкото здраве, но са подходящи при лечение на някои заболявания.

Набавянето на мед в човешкия организъм става основно чрез храната (75%) и водата (25%) (Squitti et al., 2014). Богати на мед храни са черният дроб, месото и рибата, някои зеленчуци (цвекло, броколи, гъби, чесън, репички, зеленолистни зеленчуци), зърнени храни (боб, леща, грах, соя), ядки (орехи, бадеми, лешници, кашу). Медта е друг есенциален метал с широк спектър биологични активности. изпълнява важна роля в протичането на хемопоезата и поддържането на нормалната структура и функция на нервната и имунната системи, необходим е за работата сърцето. Препоръчителният дневен прием на мед при човека е 10 – 50 μg/kg телесно тегло. Богати на мед храни са черният дроб, месото и рибата, някои зеленчуци (цвекло, броколи, гъби, чесън, репички, зеленолистни зеленчуци), зърнени храни (боб, леща, грах, соя), ядки (орехи, бадеми, лешници, кашу) (Aleksandrova, R., Salkova, D., 2014).

Аминокиселините помагат на организма да произвежда невротрансмитери, които влияят върху настроението. Богати източници на аминокиселини са храни като: пуешко месо, кашкавал, пиле, риба, боб, бадеми, авокадо, банани тиквено семе и др. (Ivanov, P., Sotirova, T., 2018).

По-голяма част от българските биологични храни и продукти са предназначени за външни пазари. Българските биологични пресни плодове и зеленчуци, сладка, лютеници, сушени плодове и ядки имат превъзходни вкусови качества и са високо ценени на европейския и световен пазар (Nedeva, K., Nanev, N., Stoilov, V., 2018).

Ценим ли здравословните ползи на бадемите у нас?

През май 2020 год. проведохме анкетно проучване на 80 лица, относно потребителския интерес към консумацията на бадемови ядки. Събраните данни от анкетното проучване са обработени с приложната програма MS Excel и е направен статистически анализ на резултатите.

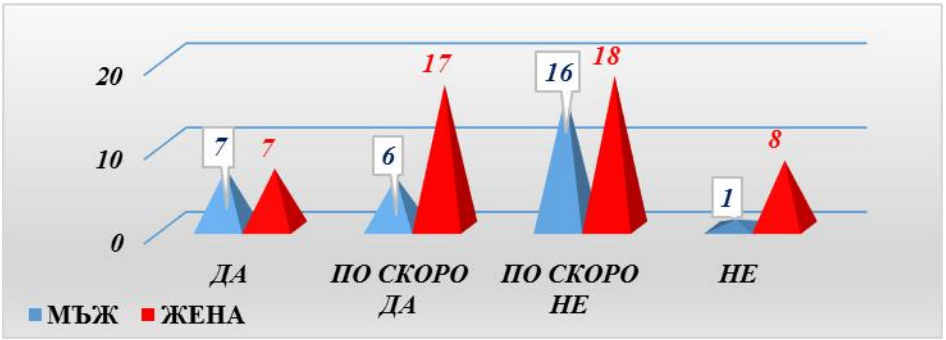
От фигура 1, се вижда, че консумиращите редовно бадеми, с отговор „да“ са 17,5%, с „по скоро да“ са отговорили 28,75% от анкетираните, най-голям брой от респондентите са дали отговор „по скоро не“ - 42,5%, а с „не“ са отговорили 11,25%. Като обобщение, може да се направи извода, че тези които са използвали частицата „не“ в отговора си са със 7,5% повече от тези които са използвали частицата „да“ в отговора си.

На фигура 2 са дадени анкетираните лица по пол. Анкетираните жени са с 20 по-вече от мъжете, което е 26%. От графиката на фигура 3, може да се види, че отговор „да“ са дали еднакъв брой мъже и жени, докато при отговор „не“ броят на жените е със 7 по-голям, от този на мъжете, при отговор „по скоро да“ жените са с 11 по вече от мъжете, а при „по скоро не“ само с 2 бройки.

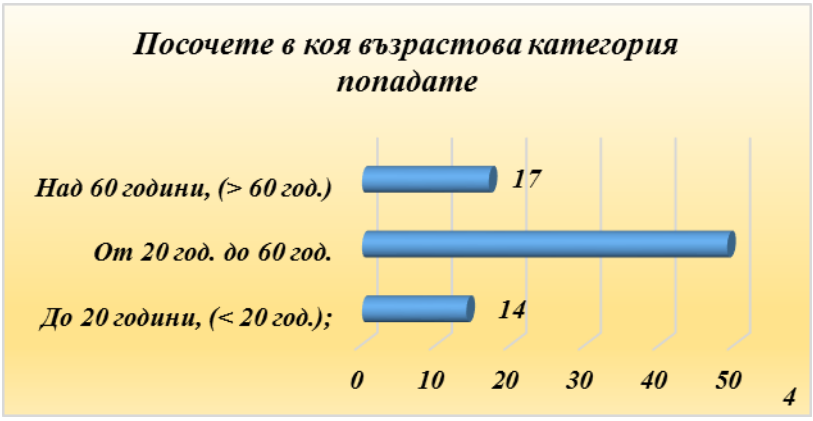
По възрастов критерии, респондентите са разделени в три групи – деца или младежи, лица в работна възраст и пенсионери. Групата на работещите е най-голяма 61,25%, а на деца и младежи е най-малка 17,5% фигура 4. На фигура 5 са дадени видят четирите вида отговори, за консумацията на бадемови ядки, на респондентите, засечени по трите възрастови групи.

Фигура 1

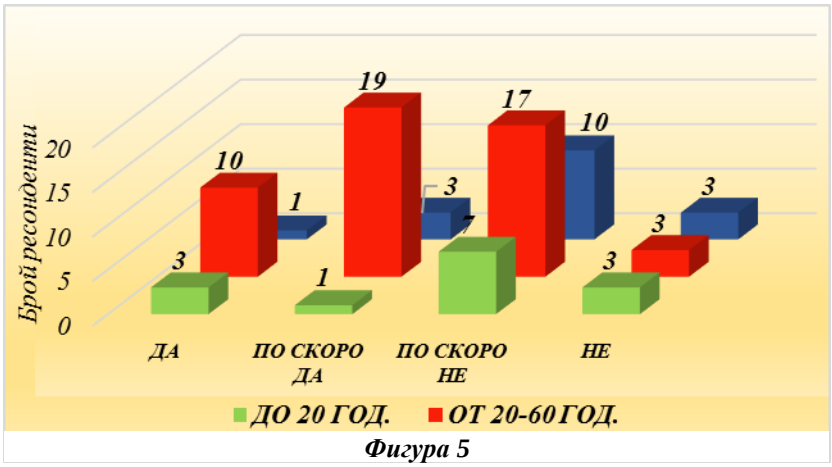
Фигура 2



Фигура 3



Фигура 4



Фигура 5

ИЗВОДИ

Направеното проучване цели да се даде по-голяма информираност за здравословен избор на хранителни продукти. Отчита се и факта, че населението в Р. България е застаряващо, а от там и заболяванията са по-големи.

Направеното анкетно проучване с български потребители през посочения период показва, че българинът прави по-добър избор на хранителни продукти чрез подобряване на културата на пазаруване, по-добрата информираност и желание за по-качествен начин на живот.

Посочени са голям брой от болестите на нашето съвремие и възможностите за преодоляването им чрез информиран и интелигентен избор на храни

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PHENOTHIAZINE DERIVATIVES [7]

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Abstract: *Phenothiazines, nitrogen- and sulfur-containing tricyclic compounds, have been known for over a hundred years. Up to now over 5000 phenothiazine derivatives have been obtained and this class of organic compounds became exceedingly important due to their varied significant biological and chemical properties. Phenothiazines exhibit valuable activities such as neuroleptic, antiemetic, antihistaminic, antipuritic, analgesic and antihelmintic. At least 100 phenothiazines were used in therapy mainly as neuroleptics. Recent reports deal with promising anticancer, antibacterial, antiplasmid, multidrug resistance (MDR) activities.*

Keywords: *Phenothiazines, Chemical structure, Biological activity*

ВЪВЕДЕНИЕ

Фенотиазините, азот- и сяра-съдържащи трициклични съединения са известни повече от сто години. От тогава до днешни дни те заемат важно място във фармацията и медицината. Едно от първите съединения от тази група, наречено метиленовото синьо, е въведено от Паул Ерлих за оцветяване на хистологични микроскопски препарати и повече от сто години се използва за това. По-късно са открити антимикробните и антихелминтни свойства на фенотиазините и започва масовото им използване през 30-те и 40-те години на миналия век. Клиничното прилагане на N-заместени фенотиазини като антихистаминни препарати (1940г.), седативи и антипсихотици (1950г.) продължават и до днес. Антипсихотиците с фенотиазиново ядро са ненадминати почти 40 години, и все още са от съществено значение за клиничното лечение на психиатричните разстройства.

През последните две десетилетия, с увеличаване на знанията за ролята на окислителния стрес в развитието на много дегенеративни разстройства, се засилва интересът към вещества с антиоксидантни свойства като потенциални терапевтици за тези заболявания. Изследванията върху лечението на болестите на Алцхаймер и Паркинсон с фенотиазин, метиленово синьо и техните производни са предпоставка за разработване на нови лекарствени средства.

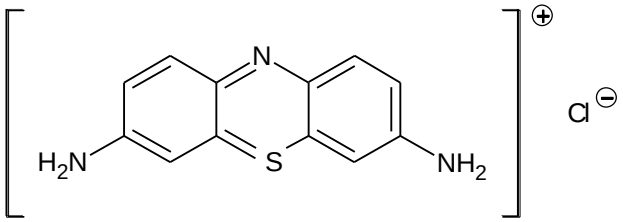
Голям проблем на съвременното общество е повишената резистентност на редица патогенни микроорганизми към използваните в практиката антимикробни средства. За успешното лечение при такива случаи трябва да се намерят алтернативни лекарствени средства. Изследванията в тази насока показват, че фенотиазинът и неговите производни са

[7] Докладът е представен на студентската научна сесия на Русенски университет филиал - Разград на 28.05.2020г. в секция Биотехнологии и хранителни технологии с оригиналното си заглавие на български език: „Фенотиазинови производни".

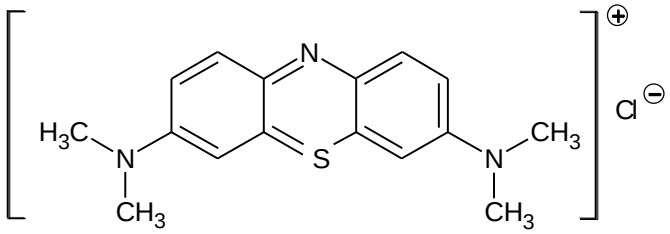
една добра възможност за справяне с множествената резистентност. Те са сравнително евтини нетоксични и широко се използват във фармацията.

ИЗЛОЖЕНИЕ

Химията на фенотиазина започва от 1876 г. със синтезирането на багрилото Lauthovo виолетово (фиг.1). Същата година Caro синтезира т.н. метиленово синьо (фиг.2).



Фигура 1. Лаутово виолетово



Фигура 2. Метиленово синьо

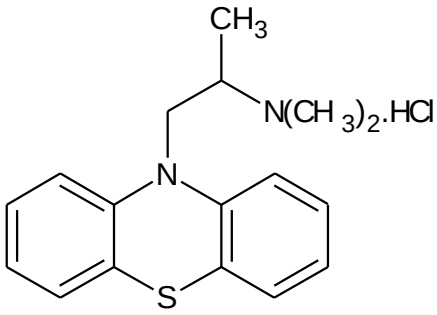
Фентиазиновото ядро е доказано от Bernthsen (1883 г.) при стапяне на дифениламин и сяра.

Последователно биват установени противомаларийното действие на метиленовото синьо, както и неговото бактерицидно действие върху причинителя на туберкулозата *Mycobacterium tuberculosis*. Успоредно с това то спира канцерогенното действие на бензантрацена, бензпирена и редица други съединения (Mitchell, S.C., 2006). Много важно е откриването на инсектицидните и противопаразитните свойства на фенотиазина (Ohlow M. & Moosmann B., 2011).

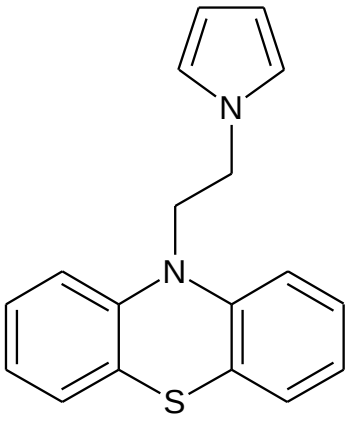
За по-късно синтезираните алкиламиноалкилни производни на фенотиазина е доказано,че притежават антихистаминно или холинолитично действие. Така се стига до синтезирането на първото фенотиазиново производно с антихистаминно действие – фенерган фиг.3). Установяването на седативното действие на последния, както и факта, че той усилва действието на барбитуровия сън при животните, дало повод на Лабори да го използва за повишаване действието на наркотичните вещества и същевременно като противошоково средство. Тази нова насока на използване на фенергана става основа за синтез на нови фенотиазинови производни, необходими в медицината (Ohlow M. & Moosmann B., 2011).

Синтезираният ларгактил (Rhone-Polenc B., 1956 г.) се оказва с ново по-мощно седативно, но по-слабо антихистаминно действие в сравнение с фенергана. Лабори и сътрудници установяват усилващото му действие върху наркотичните средства и способността му да предизвиква „изкуствена хибернация“. С това се дава нов тласък в развитието на фенотиазиновите производни. Синтезирани са редица 10–диалкиламиноалкилни производни на фенотиазина.

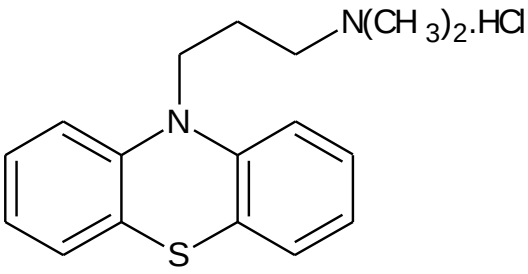
Halpern и Ducrot (1946 г.) откриват антихистаминното действие на тези съединения. Най-силно то е изразено при фенергана (фиг. 3) и пиролазота (фиг. 4), докато хлоропромазина (фиг. 5) и плежицила (фиг. 6) имат силно седативно действие (Charpentier P., 1952 г.).



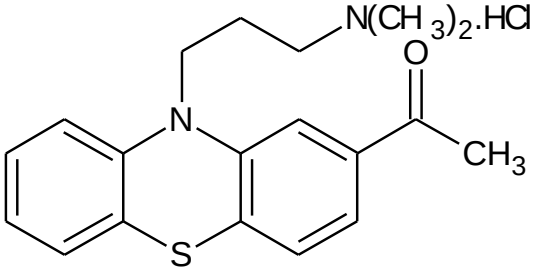
Фигура 3. Фенерган



Фигура 4. Пиролазот



Фигура 5. Хлоропромазин



Фигура 6. Плежицил

През последното десетилетие редица изследвания предимно на Kristiansen и сътр. (2000г.) показват значителна антибактериална ефективност на различни фенотиазинови производни, като тиоридазин или трифлуоропромазин срещу *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Enterococcus spp*. и най-вече срещу причинителя на туберкулозата *Mycobacterium tuberculosis*. Някои фенотиазинови производни се оказват изненадващо мощни модулатори на въздействието на антибиотиците спрямо устойчиви към тах бактерии. Например, при някои щамове на метицилин-устойчиви *S. aureus* (MSRA) минималната инхибиторна концентрацията (MIC) на оксацилин може да бъде понижена от > 256 mg/l до 1–4 mg/l чрез добавяне на 12 mg/l тиоридазин, или до 4–16 mg/l чрез добавяне на 12 mg/l хлоропромазин. Тиоридазинът и хлоропромазинът прилагани самостоятелно показват стойности на MIC съответно 32 mg/l и 32-64 mg/l. Подобно въздействие на фенотиазините върху антибиотичната резистентност е описана при еритромицин резистентната бактерия *Streptococcus pyogenes* (Kristiansen, J.E. et al., 2007).

Резистентността срещу традиционните антибиотици се очертава като медицински проблем в световен мащаб. Разработването и използването на лесно достъпни и сравнително безопасни лекарства, усилващи лечебния ефект на антибиотиците предоставят възможност за справянето с този проблем.

ИЗВОДИ

1. Фенотиазинилните съединения са азот- и сяра-съдържащи трициклични съединения известни от повече от 100 години и използвани основно като невролептици.
2. Фенотиазинът и неговите производни проявяват добра антимикробна, антиприонна, антихелминтна и инсектицидна активност.
3. Фенотиазините усилват действието на някои антибиотици.

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ENERGY PARAMETERS OF ULTRAFINE GRINDING OF PHARMACEUTICAL AND COSMETIC INGREDIENTS IN THE BEAD MILL[8]

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Abstract: *The energy parameters of the grinding process of the components of pharmaceutical and cosmetic preparations in a bead mill are considered. The purpose of research - to determine the energy parameters of ultrafine grinding of pharmaceutical and cosmetic ingredients in the bead mill. A series of experimenters was conducted where the degree of grinding was measured using USB Digital Microscope and software, the temperature was measured with a TPM-10 electronic thermometer, and the power was measured with a CNFAJ Intelligent Power Meter three-phase wattmeter. As a result of the study, we can conclude that most of the energy is spent on the work of mixing the bead-product system and the work spent on heating the structural components of the product and the interacting parts of the mill, which, in turn, depend on the rheological properties of the suspension.*

Keywords: *grinding, beads, mill, suspension, energy.*

INTRODUCTION

Fine and ultrafine grinding is necessary for materials that have an unsatisfactory dispersed and uniform composition and must provide the desired therapeutic or colorimetric effect in the pharmaceutical and cosmetic fields. Note that the finished product of the bead mill is a suspension. (Drögemeier, R., Leschonski, K. 1994).

The process of fine grinding in bead mills is influenced by many factors: mechanical energy, specific energy consumption, energy of collisions of grinding bodies, the number of effective collisions of grinding bodies with the product, as well as the residence time of particles in the mill (Mende, S., Rappl, M., 2014).

EXPOSITION

Research methodology

Materials

The following materials were taken for the study: pharmaceutical castor oil, red pigment 120 iron oxide.

Pharmaceutical castor oil is a natural product, vegetable oil from the fruits of castor oil bean. Transparent, thick and viscous, colorless or slightly yellowish liquid. It is freely soluble in ethanol (95%). It is practically insoluble in water and mineral oils. Stable substance. Dynamic viscosity at 20 ° C - 1000 MPa×s, at 40 °C - 200 MPa×s. Boiling point - 31 °C, melting point - 12 °C, freezing point -16 °C, relative density at 25 °C - 955-968 kg/m^3. In pharmacy, it is most often used in creams and ointments at a concentration of 5-12.4 % as a constituent substance and solvent for dermatological ointments, alcohol liquids, liniments, frostbite ointments) and oil injections, as well as a plasticizer in the production of tablets and capsules. It is part of many cosmetics because the

[8] Докладът е представен на студентската научна сесия на Русенски университет филиал - Разград на 28.05.2020г. в секция Химични технологии с оригиналното си заглавие на английски език.

suspension sedimentation process is significantly slowed down. In addition, the finished product has a reduced fusibility without the use of additional stabilizing impurities.

The pigment red 120 iron oxide is a dispersed system of iron oxide (III) of hexagonal structure (hematite), a powdery material of red-brown or dark red color. The chemical formula is Fe_2O_3. Humidity less than 1%. The pH of the aqueous extract is 3.5-7. Bulk density 1.0-1.1 g/cm^3. Density 5.0-5.1 g/cm^3. The shape of the particles is spherical. The predominant particle size is 0.11 mkm (according to the manufacturer's specification).

Methods

The following settings were used:

Laboratory bead mill. The working chamber is equipped with a shirt and a sampler with a sieve cartridge on the lid of the glass. The working body consists of a shaft on which 4 guide discs with 4 symmetrically located holes 10 mm in diameter are fixed. Working bodies are glass beads with a diameter of 2 mm. Grinding occurs wet (in the presence of a solvent) due to the interaction of the beads with each other, with the walls of the working chamber and the disks on the shaft and the entire contact area of the beads-product system. The three-phase engine rotates the working body with a frequency of 1350 rpm. Such a cooperation to produce, until we accept a finely tuned product, a great effect is that there is a great energy supply and a great wikid of excess energy in the view of heat (Mende S., Stenger F., Peukert W., Schweders J., 2003; Hrininh K., Hordeichuk R., Gubenia O., 2018).

Electronic thermometer TPM-10. Temperature measurement range from -50 °C to +100 °C. Measurement resolution 0.1 °C. Measurement error max 2 %. There are 2 sensors for input and output of water from the jacket of the working chamber.

Three-phase wattmeter CNFAJ Intelligent Power Meter. Able to measure electrical parameters (three-phase voltage, three-phase current, active power, reactive power, visible power, power factor, frequency, etc.). Accuracy class 0.5. Frequency 40-60 Hz, accuracy 0.1 Hz.

Particle size was determined using a USB Digital Microscope and software.

The bead mill worked with water cooling in a circulating way, the readings of the devises were taken every 30 seconds for 33 minutes. The mass of the product was 200 grams, the mass of the working bodies was 450 grams, and the water consumption was 0.03 kg/s (Hrininh K., Hordeichuk R., Gubenia O., 2018).

The installation scheme is presented in Fig.1 (Mende, S., Rappl, M., 2014; Rowe, W.B., 2014).

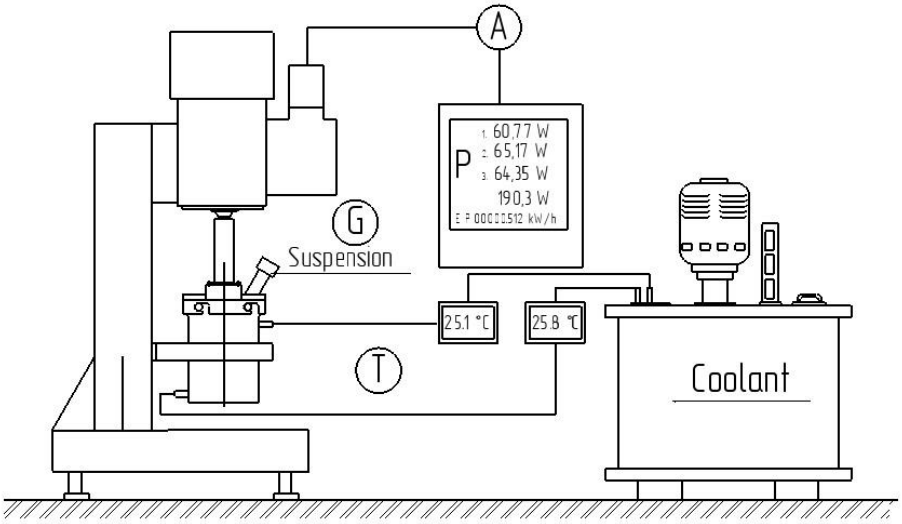

Fig. 1. Experimental installation: A - power measurement by wattmeter; T – temperature measurement by thermometer; G – particle size was recognized by computer software.

The total specific energy for the grinding process was calculated as follows: the obtained process equation is a function of power versus time, and is substituted into an integral expression.

$$E_{ts} = \int_{\tau_0}^{\tau_k} F(\tau)\, d\tau \quad (1)$$

Heat generation was calculated in a similar way, obtaining the function of the dependence of thermal energy on time.

$$E_H = \int_{\tau_0}^{\tau_k} t(\tau)\, d\tau \quad (2)$$

RESULTS AND DISCUSSION

The results of the study are presented in the graphs below.

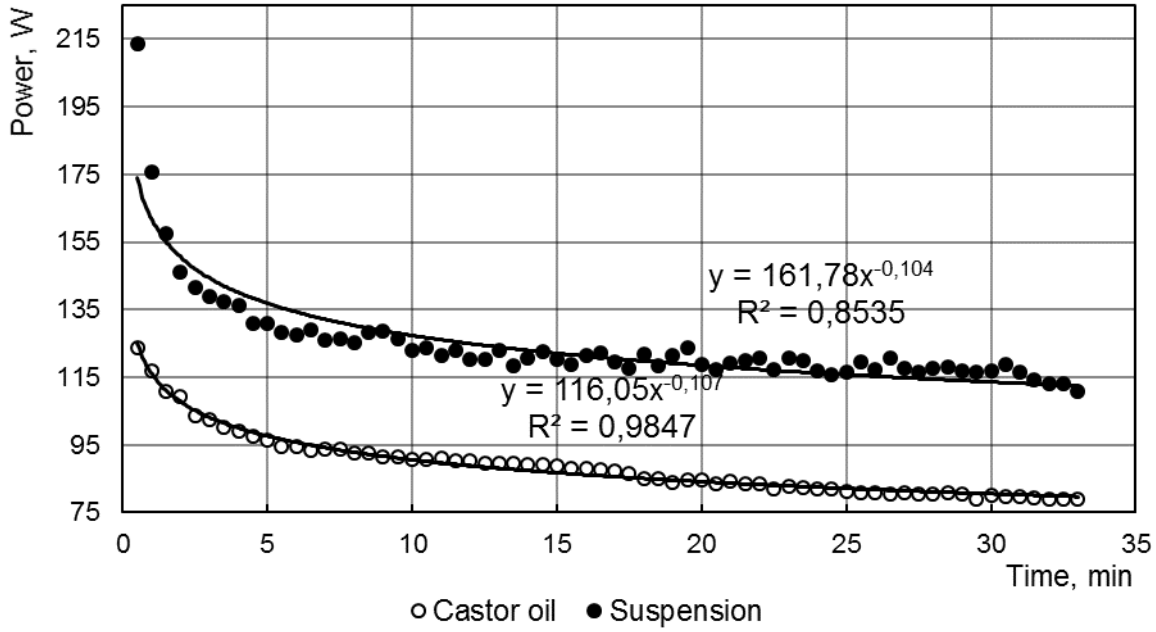

Fig. 2. Power change in time, W.

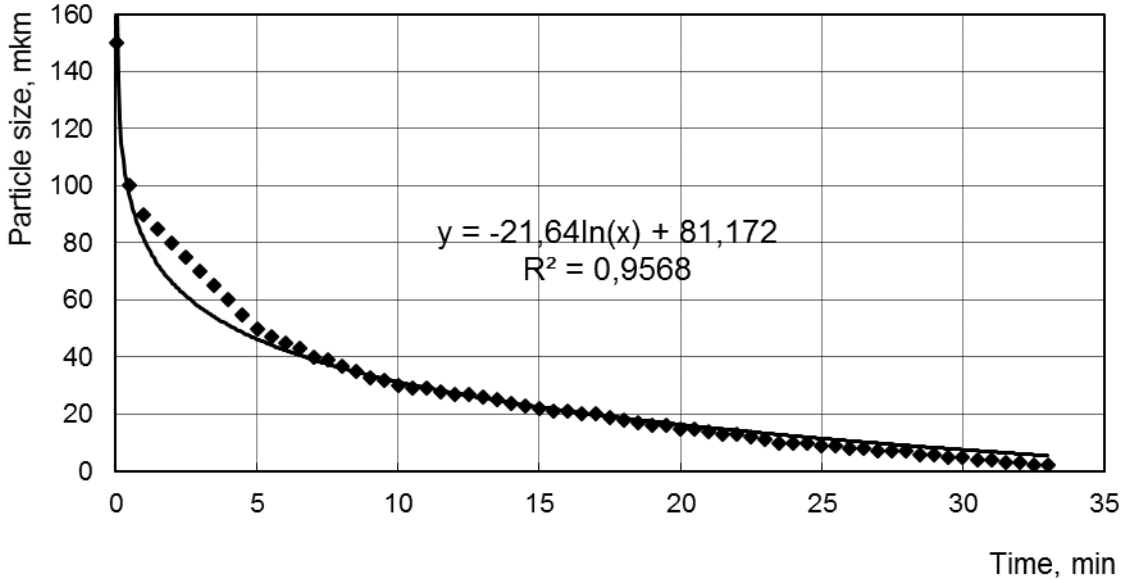

Fig. 3. Effect of grinding time on the particle size of a suspension of iron oxide red 120, mkm

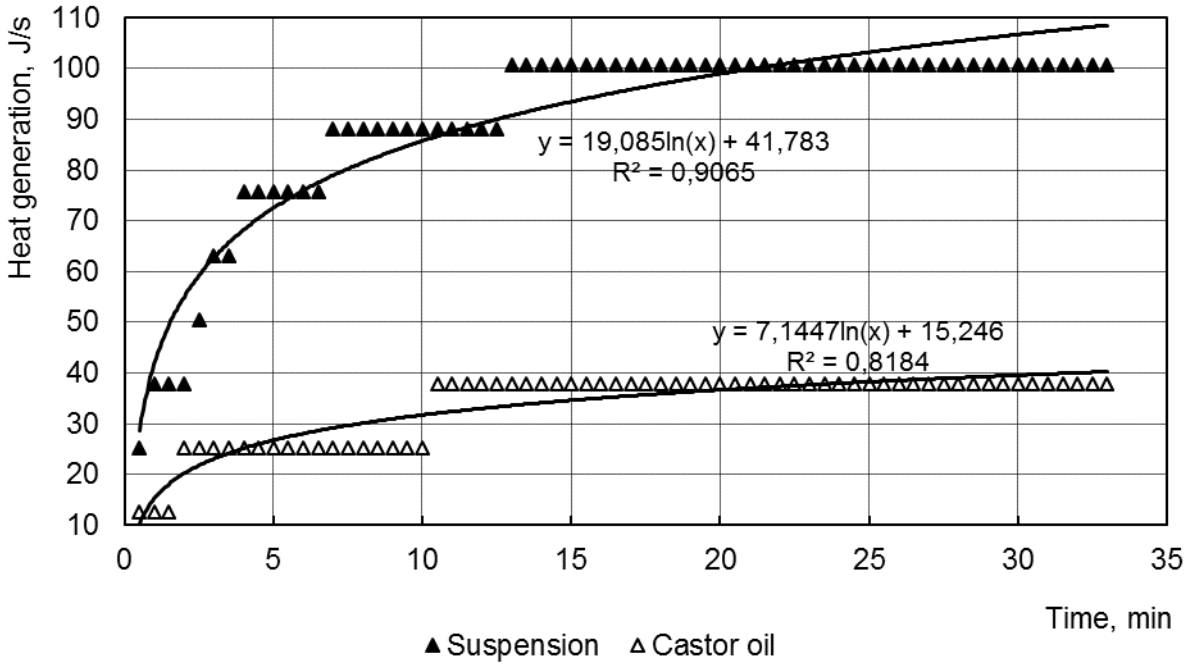

Fig.4. Dependence of heat generation on time,J/s.

Graphs of power versus time are obtained. We see a rapid drop in power in the first 6 minutes. This is due to the high energy consumption for mixing the "bead-product" system and the uniform distribution of the particle size distribution of the suspension (Kanda, Y., Kotake, N., 2007).

However, the heat schedule begins with a rapid increase in the first 10 minutes. This is due to the large increase in excess energy in the system, which is not involved in the grinding process of the dry fraction of the product.

The graph of the particle size distribution over time shows the most intense grinding in the first 10 minutes, where the particles of the dry fraction will decrease from more than 150 μm to 30 μm. Then the process slows down, but in the end we get the finished product with a particle size of 2-3 μm, which is optimal (Mende S., Stenger F., Peukert W., Schweders J., 2003).

Based on the equation of energy balance (Lisovenko A., 1982), the approximate energy balance can be represented as:

$$A = A_1 + A_2 + A_3 + A_4 + A_5, \quad (3)$$

where A_1 - work spent on mixing the system "bead-product";

A_2 - work spent on moving the working body;

A_3 - work spent on heating of structural components of a product and the parts of a mill interacting with them, J/s;

A_4 - work spent directly on grinding, taking into account the energy expended on the absorption and wetting of dry components by the dispersed medium;

A_5 - work spent on the absorption and wetting of dry components by the dispersed medium (dispersing medium penetrates into the cracks of the solid particles of the suspension, preventing the closure of cracks and removing the formed particles from each other layer of molecules adsorbed on their surface) (Lisovenko A., 1982).

Directly on the process of grinding the solid phase in suspension, energy is spent less than 1%. These costs are within the error of the devices and it is difficult to take into account separately. It is worth focusing on the energy that goes into driving the beads with a rotor with grinding discs and dissipating energy in the form of heat ($A_1 + A_3$). It should be added that the work A_1, which is spent on mixing the "bead-product" system, very much depends on the rheological properties of the suspension, which must be taken into account when modeling and conducting the process from one type of product to another (Lisovenko A., 1982).

The bead mill has a rather low efficiency due to the fact that most of the energy goes to mixing the beads, and grinding takes place in the zones of the highest speed (Mende, S., Rappl, M., 2014).

A series of experiments with different solvents and concentrations have been performed, resulting in the most energy-intensive process when grinding viscous products with a high dry matter content. We can say that the process very much depends on the initial properties of the suspension.

Table 1. Comparative analysis of energy parameters of different products

Title	Total specific energy, joule	Heat generation, joule
Water	$2{,}254\times10^5$	$1{,}940\times10^5$
Castor oil	$4{,}977\times10^5$	$2{,}160\times10^5$
Suspension castor oil 60% and pigment 40%	$6{,}731\times\mathbf{10^5}$	$2{,}594\times\mathbf{10^5}$
Suspension castor oil 80% and pigment 20%	$5{,}348\times10^5$	$3{,}826\times10^5$

CONCLUSION

The process of ultrafine grinding is a very high-energy process. Directly on the process of grinding the solid phase in suspension, energy is spent less than 1%. These costs are within the error of the devices and it is difficult to take into account separately. Most of the energy is spent on the work of mixing the "bead-product" system and the work spent on heating the structural components of the product and the interacting parts of the mill, which, in turn, depend on the rheological properties of the suspension. This must be taken into account when modeling and conducting the process from one type of product to another. The smaller the particle size and higher viscosity of the suspension, which must be milled, the greater the energy required for the process, and the more heat will be released.

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SYNTHESIS AND STUDY OF GREEN GARNET CERAMIC PIGMENTS[9]

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Abstract

The aim of paper the synthesis of new garnet ceramic pigments. The blend preparedwas ground in a ball mill and subjected to heat treatment. Green ceramic pigments were synthesized at 800°C - 1200°C. The optimal temperature for the synthesis and the most appropriate mineralizer were defined. The phases established by X-ray diffraction and infrared spectroscopy are the following minerals: $Ca_3Cr_2Si_3O_{12}$ - uvarovite, $CaSiO_3$ – wollastonite, SiO_2 – cristobalite.

The colour characteristics were measured spectrophotometrically with Tintometr RT 100 Lovibond. The particle sizes of the pigments were determined by transmission electron microscopy. The best pigments are applied in white cover glaze for faience.

Key words: *pigments, colour, ceramic, garnet*

INTRODUCTION

Ceramic pigments are inorganic colored finely dispersed powders which, when added to a material, impart certain color and change some of its properties. The pigments impart color due to the selective absorption of light waves with certain wavelengths by its crystal lattice. As a result, the pigments are colored in a color complement to the absorbed one. Most often, the color carriers of the pigments are chromophores. The latter are atoms and atom aggregations which possess the ability to impart one or another color to the substances which they are added to (Eppler R., 1987).

One of the most perfect classifications is that of Tumanov which is based on the crystalline structure of the main phase. According to this classification, pigments are spinel, garnet, zircon, villemite, mullite and other types. Furthermore, the use of this property for the classification provided wide possibilities for purposeful synthesis of pigments of various colors.

Garnets are a group of minerals different by composition but with analogous chemical formulae and similar appearance of their crystals. The transparent saturated colored garnets are demanded precious stones. The name of the group comes from the Latin word granatus which stands for the seeds of the granate tree. Garnets have various colors: purple red – almandine, colorless of yellow-green – grossular, brown or black – melanite, green – uvarovite, red – pyrope and andrdite, etc.

Recently, researchers of many countries work on the synthesis, characterization and properties of various kinds of garnet ceramic pigments obtained both from traditional raw materials

[9] Докладът е представен на студентската научна сесия на Русенски университет филиал - Разград на 28.05.2020г. в секция Химични технологии с оригиналното си заглавие на български език: „Синтез и изследване на зелени гранатови керамични пигменти".

and waste products. (Eppler R., 1987), (Galindo R., M. Llusar, M., Tena, M. A., Monrós, G., & Badenes, J. A., 2007), (Alarcon J., P. Escribamo, J. Gargallo, 1984), (Klemme, S., J. van Miltenburg, P. Javorsky, F. Wastin, 2005)

Among the known garnet chromium containing minerals, uvarovite ($3CaO{\cdot}Cr_2O_3{\cdot}3SiO_2$) is colored in green and is resistant to temperatures up to 1370^0C. On its basis, ceramic pigments are prepared are widely used for the preparation of glaze and enamel green coatings, as well as various kinds of green colored ceramic pigments.

The aim of the present work is to synthesize, study and characterize garnet ceramic pigments belonging to the system $CaO.Cr_2O_3.SiO_2$**.**

EXPOSITION

Materials and method of synthesis

For the preparation of garnet ceramic pigments in the system $CaO.Cr_2O_3.SiO_2$, the blends were defined on the basis of the stoichiometry of the main mineral – uvarovite $Ca_3Cr_2(SiO_4)_3$. The following composition was selected for the pigments – $3CaO.Cr_2O_3.3SiO_2$. The mineralizer used in the synthesis to decrease the synthesis temperature and accelerate the processes of formation of the new phase was H_3BO_3. The materials used for the synthesis were CaO, Cr_2O_3, $SiO_2.nH_2O$ and H_3BO_3.

The substance used to introduce SiO_2 into the system – $SiO_2.nH_2O$, is much more reactive than the common quartz sand and the particle sizes were dispersed in the range 2-7μm. Initially, after the heating in a platinum crucible, the contents of SiO_2 and H_2O in $SiO_2.nH_2O$ was determined to be: SiO_2 - 76,3% and H_2O - 23,7%.

The quantities of the materials from which 100 g blend is prepared were weighed with precision of 0,1 g, then they were mixed and homogenized in dry state in a planetary mill PULVERIZETE – 6, product of "FRITCH".

The sintering was carried out in a laboratory muffle oven at heating rate – 300-400^{o}C/h in air atmosphere; the blend was placed in a porcelain crucible with a lid. The isothermal period at the final temperature was 2 hours. The pigments were sintered at 800^{o}C, 900^{o}C, 1000^{o}C, 1100^{o}C and 1200^{o}C. The technological scheme of the synthesis of the pigments is presented in Fig. 1.

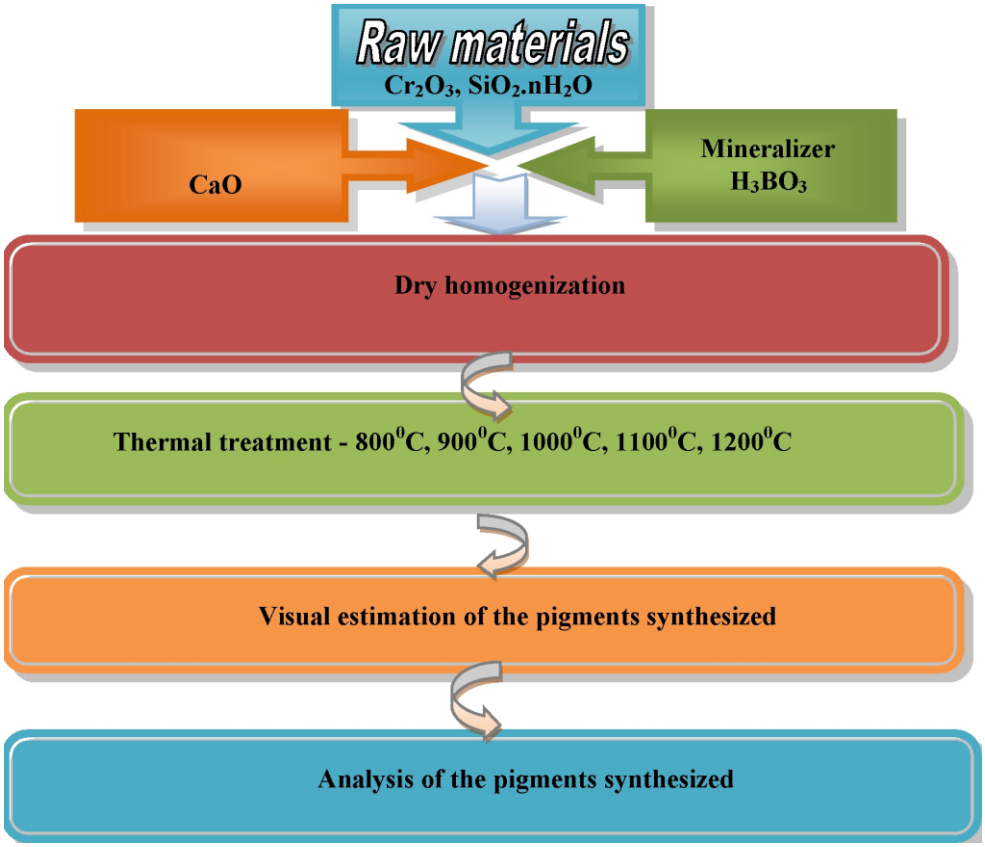

Fig.1. Technological scheme for synthesis of pigments

STUDIES OF THE PIGMENTS OBTAINED

X-ray phase analysis of the ceramic pigments obtained

X-ray phase analysis as a direct method for identification of phases. It is based on the diffraction of X-rays. The main task of the X-ray analysis was to identify the different phases individually or aim blends using the diffraction pattern registered from the sample studied.

The basic method of the phase analysis is the powder method which is widely used due to its simplicity and ease of versatility. The X-ray studies were performed on an apparatus IRIS with Cu K_α radiation and nickel filter, in the range of angles from 2 to 80°. The interplanar distances (d, nm) were calculated by the formula of Wulf-Bragg: $n.\lambda = 2d.\sin\theta$, where: λ – X-ray wavelength, nm; n – diffraction order (n = positive integer); θ – Bragg's angle of diffraction, grad.

X-ray patterns of the garnet ceramic pigments synthesized are presented in Fig.2.

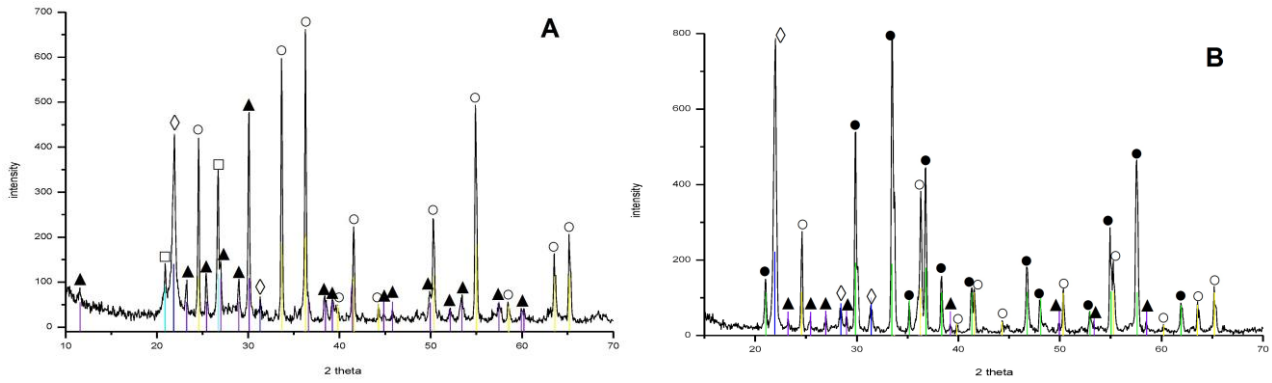

Fig.2 X-ray patterns of pigments in the system $3CaO.Cr_2O_3.3SiO_2$ taken at 900°C (A), 1100°C (B)

● - Uvarovite $Ca_3Cr_2Si_3O_{12}$ - 87 - 1007 ▲ - Wollastonite $CaSiO_3$ - 84 - 0654

◊ - Crystobalite SiO_2 - 89 - 3434 □ - Quartz SiO_2 - 79 – 1910

○ - Chromium oxide Cr_2O_3 - 82 - 1484

The pigments synthesized had stable green color and significant formation of the main phase – the mineral uvarovite $Ca_3Cr_2(SiO_4)_3$, was observed at 1100°C, although reflexes from wollastonite ($CaSiO_3$), crystobalite (SiO_2) Cr_2O_3 were also observed. Supposedly, the full transformation will occur at 1200°C and isothermal period of 2 h.

Color measurements

Color is one of the most important properties of the pigments. Colored substances absorb and transform light of certain wavelengths within the visible spectrum due to their atomic structure. Using the CIELab, not only the colors of ceramic pigments are determined but also these of other materials which means that this system is universal and it is widely used.

In the system CIELab, the color co-ordinates determined are as follows:

- L* - lightness, L*=0 – black color, L*=100 – white color
- a* - green color (-) / red color (+)
- b* - blue color (-) / yellow color (+)

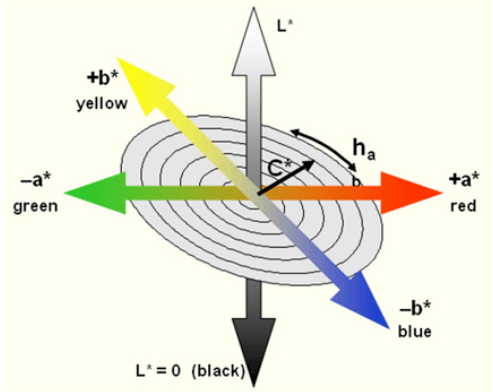

Fig.3 Color space of CIELab

The colors of the pigments were determined spectrometrically with a Tintometer RT 100 Colour. The results obtained from the measurements are presented in Table 1.

Table 1 Results obtained from the measurement of the color co-ordinates

Pigment	Color	R	G	B	L*	a*	b*
$3CaO.Cr_2O_3.3SiO_2$ 900°C		143,4	149.2	128.4	59,6	-10,2	9,2
$3CaO.Cr_2O_3.3SiO_2$ 1000°C		123,4	141.9	119,1	57,1	-10,9	9,9
$3CaO.Cr_2O_3.3SiO_2$ 1100°C		116,8	134,8	101,1	54,3	-13,4	15,9
$3CaO.Cr_2O_3.3SiO_2$ 1200°C		116,2	142,4	97,3	56,0	-18,1	21,5

It can be seen from the data presented that the co-ordinates R, G, B and L* decreased with the increase of the sintering temperature. The highest amount of green color /- a*/ was found for the pigment synthesized at 1200°C.

Electron microscopic studies of the pigments

Electron microscopy is a method for direct observation of the structure of the samples studied. To determine the topography of the samples studied, scanning electron microscopy (SEM) was employed. The SEM observations were carried out on an apparatus TESCAN, SEM/FIB LYRA I XMU at 30 kV accelerating voltage. The observations were accompanied by energy-dispersive X-ray spectroscopy (EDS) carried out with detector of Bruker.

The pigments synthesized were observed in regime of reflected electrons at low **(**1500x) and high – (3000x) magnification. The electron microscopic observations were combined with mapping EDS to view the distribution of the elements among the crystalline phases.

The particles are opaque for the electron beam and conclusions only on the shape and size of the crystals could be made, as well as their affinity to aggregation. Fig.3 shows micrographs of the pigments synthesized.

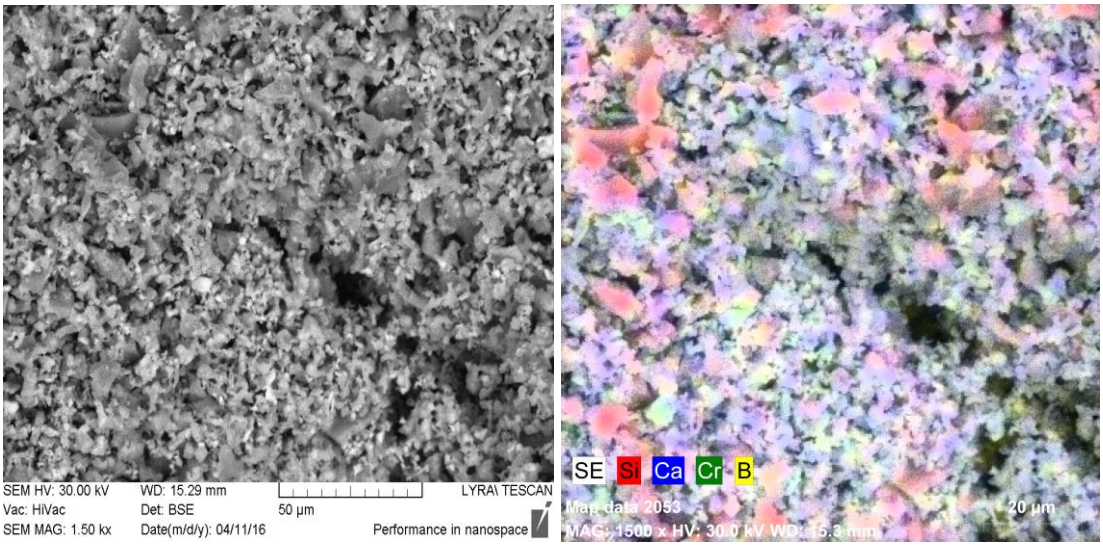

Fig. 3 Micrographs of the garnet ceramic pigments synthesized

As can be seen from the figure, the sample was polydispersed and contained two kinds of crystals: one with particle size 1- 2 μm and the other between 6 – 8 μm. The presence of smaller crystals was due to exogenic polymineral processes of formation and they correspond to the solid solution between Cr_2O_3-SiO_2 with predominating content of SiO_2. The color transition from green to orange and red in the micrograph was due to the growth of the phase with the larger particles and

recrystallization with formation of a new solid solution with final equilibrium composition $3CaO.Cr_2O_3.3SiO_2$ and stoichiometric ratio.

CONCLUSIONS

Green ceramic pigments were synthesized on the basis of the garnet uvarovite by the method of solid phase sintering. The optimal parameters of the process of synthesis were determined. The best results were obtained with the pigment synthesized at sintering temperature of 1100^oC. The pigments obtained are suitable and can successfully be use in glazes for tiles and sanitary ceramics.

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PHYSICO-CHEMICAL PROPERTIES OF KAOLIN B0-GLAZE FOR CERAMIC GLAZES[10]

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Abstract:
Kaolin occupies an exceptional place in modern life and is the basis for the development of a number of major industries such as silicate, refractory, chemical, electroporcelain, paper, plastic, rubber, cosmetics and many other industries. This wide application of kaolin in practice and the fact that this natural raw material can hardly be replaced by another natural or artificial material with similar qualities, determine the extremely large role it plays in modern life.

In the composition of the glazes Al_2O_3 is of special importance because it prevents crystallization. When in small quantities, it facilitates melting, and in larger quantities makes the glazes hard. It is imported mainly with feldspars, skulls and clay and kaolin additives, which help the glaze to adhere to the products and not to settle.
Keywords: *Kaolin, glazes, colloids, porcelain and earthenware industry.*

ВЪВЕДЕНИЕ

Приготвянето на глазурите започва с подбора и подготовката на суровините. За глазурите при фината керамика, се подбират най- висококачествени и чисти суровини. Някои от тях е желателно да се промият и сортират. Сортировката е по- ефикасна, ако тези материали предварително се калцинират (фелдшпатът до 900-1000^{0}C, а кварцът до 1250^{0}C). След калцинирането много по- ясно проличават онечистванията. Калцинирането допринася и за по- лесното смилане на суровините, тъй като те стават по- крехки. Глазури с калцинирани суровини отделят по- малко газове при стапянето и глазурната повърхност е по- гладка. Калцинирането обаче е скъпа операция и рядко се прави с основните суровини (Герасимов и колектив, 2003).

Целта на настоящата разработка е да се извърши пълен химичен и дисперсионен анализ и изследват технологичните характеристики на обогатен каолин марка B0-глазура производство на фабрика Сеново с оглед неговото използване за глазури в керамичната индустрия.

ИЗЛОЖЕНИЕ

Каолинът представлява землест мек минерал с бял до светлокремав цвят и се състои главно от минерала каолинит ($Al_2O_3.2SiO_2.2H_2O$) с или без примеси от други минерали. (Пиронков С. и др., 1991) Каолинът е единствената глина използвана в производството на фин порцелан и порцеланови съдове. Неговата белота, непрозрачност и неабразивност го правят идеален компонент в състава на различни глазури (Георгиева О. 1997). На каолин марка B0- глазура е определен веществения състав посочен в табл.1 /Атомно Емисионен спектрофотометър AES-ICP,VISTA-MPX. AES –ICP той е вид атомно-емисионен анализ с използване на плазма/.

[10] Докладът е представен на студентската научна сесия на Русенски университет филиал - Разград на 28.05.2020г. в секция Химични технологии с оригиналното си заглавие на български език: „Качествени и количествени показатели на каолин BO– глазура за глазури и емайли".

Таблица 1 Химичен състав на обогатен каолин

Химичен състав, %	
SiO_2	51.70
Al_2O_3	33.92
Fe_2O_3	0.77
TiO_2	0.27
CaO	0.15
MgO	0.21
K_2O	0.93
Na_2O	0.18
L.o.i	11.75

Каолин марка B0- глазура има съдържание на Al_2O_3 и Fe_2O_3 отговарящо на изискванията на силикатната промишленост. Това се дължи на умереното съдържание на минерала каолинит.

По съдържание на алкалоземни оксиди (CaO+MgO) количествата също удовлетворяват стандарта.

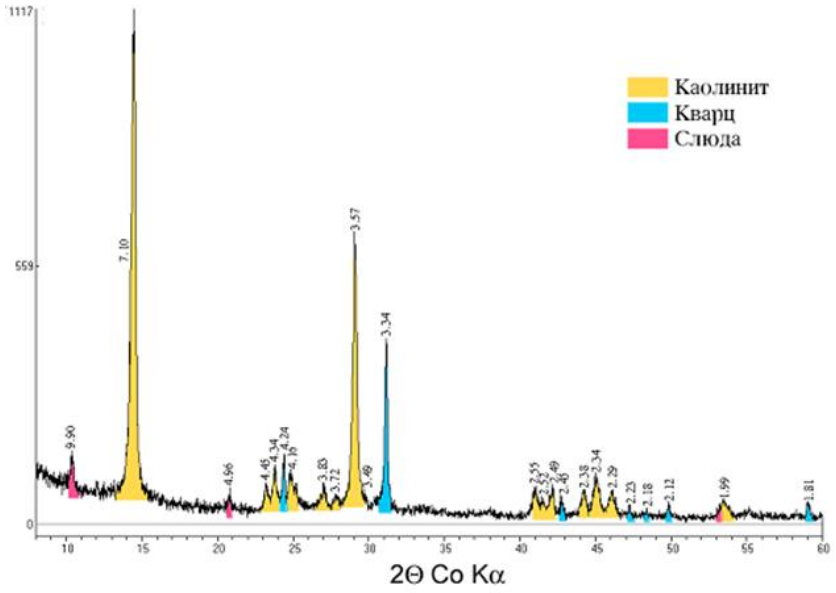
По съдържания на алкални оксиди (Na_2O+K_2O) каолин B0- глазура има по-високо съдържание в сравнение с другите марки и това е свързано с по-високото съдържание на слюди и хидрослюди. Поради по-високото съдържание на топители в обогатен каолин B0-глазура той се ползва успешно за глазури при ниски температури на изпичане.

На каолина са извършени рентгенотрафски анализи. Минералния състав е поместен в таблица 2. Анализът е извършен на дифрактометър SIEMENS D500.

Таблица 2 Минерален състав на обогатен каолин

Минерален състав /XRD Siemens D 500/, %	каолинит ~ 76
	кварц ~ 13
	слюди ~ 9
	други ~ 2

На фиг. 1 е поместена рентгенограмата на обогатения каолин B0-глазура



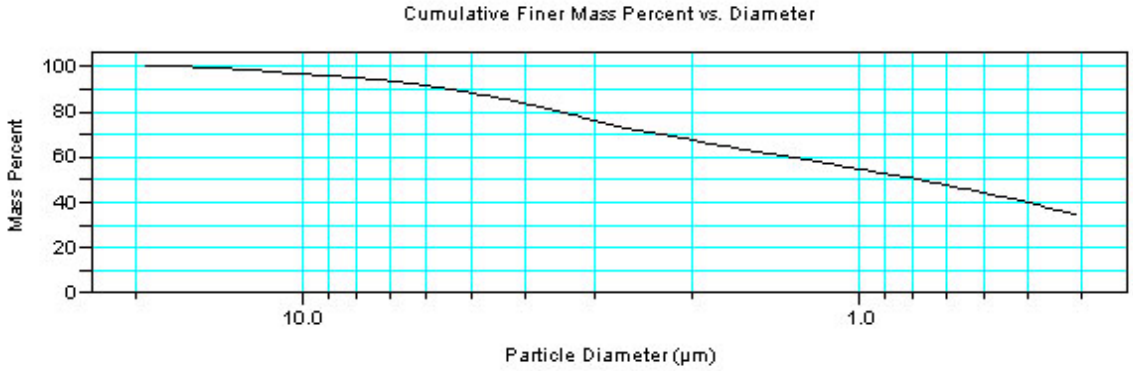
Фиг. 1. Рентгенограма на обогатен каолин B0-глазура

Основният минерал е каолинитът. Ясно са изразени пиковите и на минералите кварц, слюда. Минералите на титана не са представени забележимо.

Определен е дисперсния състав на изследвания каолин. Разпределението на частиците по големина отразява статистично тяхната зърнометрия. Размерът за големината на зърната в случая, представлява седиментационния еквивалентен диаметър или т.н. диаметър по Стокс на сферообразни частици с еднаква скорост на утаяване и плътност. Анализът е представен в таблица 3 и на фигура 2.

Таблица 3 Дисперсен състав на обогатен каолин

3. Дисперсен състав /Седиграф 5100/, %	
< 10 μm	97.7
< 5 μm	90.1
< 2 μm	72.3



Фиг.2. Дисперсен състав на Каолин B0-глазура

Резултатите от изследванията на механичната якост на огъване са представени в таблица 4.

Якостта на огъване представлява маскималното напрежение, при което материалът се разрушава под действието на огъващи усилия върху него. Използваните образци са подготвени от пластично тесто и сечението е с кръгла форма – размери дължина 150 ± 1 mm и диаметър 10 ± 1 mm /Анализатор NETZSCH модел 401-3/.

Данните са много добри за използване на каолина за керамичната промишленост.

Таблица 4 Механична якост на огъване

Механична якост на огъване (110 ºC), kg/cm^2	13.4

Вискозитет - Вискозитетът е характеристика, с която се описва степента на подвижност (деформируемост) на флуидите или свойството им да текат. Колкото по-голяма стойност има вискозитетът, толкова по-трудно се деформира флуидът и толкова по-трудно подвижен е той. Визкозитетът на каолините за керамичната промишленост е един от най важните показатели. Каолините от находищата Ветово – Сеновски район се отличават с по – висок вискозитет, в сравнение с тези от Каолиновски район. Вещественият състав и приложните свойства на каолина показват, че той приоритетно трябва да се използва за порцеланово – фаянсовата промишленост. Вискозитета е важен параметър на каолините и е свързан със скоростта на набиране на череп. Каолините с нисък вискозитет и висока вискозитетна концентрация намират приложение в санитарната керамика.

Вискозитетната концентрация е тази, при която каолиновата суспензия има вискозитет 500 mPa.s (милипаскал секунда).

Вискозитетната концентрация на каолин B0-глазура – 62 – 66 %. Това е свързано с дисперсността, кристалинността, формата на частиците, водоразтворими соли и др.

Резултатите са поместени в таблица 5.

Таблица 5 Данни за вискозитета на обогатен каолин ВО-глазура

Вискозитет "Брукфийлд", mPa.s /Spindle №3; 23 ºС/	
1. Максимална концентрация при вискозитет 5 pS, %	62.0
2. Оптимално количестно диспергатор /водно стъкло/, %	
за 10 pS	0.25
за 5 pS	0.36
3. Скорост на леене, mm^2/min	0.43

Данните от определянето на течливостта са поместени в таблица 6

Таблица 6 Данни за течливостта на обогатен каолин ВО-глазура

Време на изтичане,s	100 ml за 13 s

Линейната свиваемост се характеризира с намаляване линейните размери на формованите образци при съответните температури. Изразява се в проценти, спрямо първоначалните размери на пробните тела. Изпичането на образците става във високотемпературна лабораторна пещ Carbolite 1500ºС.
Данните за линейната свиваемост на каолините са показани в табл. 7.

Таблица 7 Резултати от линейната свиваемост в зависимост от температурата

Линейна свиваемост, %	
110 ºС	2.9
1080 ºС	5.8
1120 ºС	7.8
1180 ºС	10.6
1200 ºС	12.0
1240 ºС	14.0
1280 ºС	15.1
1360 ºС	16.6

По отношение свиваемост на сухо каолин В0 има малко по-висока свиваемост с около 0.3% в сравнение с други марки каолини и това е свързано с дисперсността и кристалинността на каолина.

Оценка на резултатите по отношение на цветовите характеристики

Измерването на анализираната проба се извършва трикратно и се оценяват статистически получените резултати. Резултатът се определя като средно аритметично./Таблица 8/

По отношение на цветовите характеристики на Каолин В0-глазура, в производствената листа на фирмата има добри показатели, дължащо се на по-ниско съдържание на Fe_2O_3.

Таблица 8 Цветови данни след изпичане на обогатен каолин

Цветови данни след изпичане /Elrepho 450/	
110 ºC	
ISO Белота R457 / Жълтина ASTM D1925, %	74.98 / 17.11
Ry, %	86.60
CIELab, L*,%	94.26
a*	0.52
в*	9.00
1150ºC	
ISO Белота R457 / Жълтина ASTM D1925, %	87.99/ 6.14
Ry, %	92.28
CIELab, L*,%	96.84
a*	0.31
в*	3.60

Данни за температурните интервали на превръщане и масовите загуби

Анализът се извършва на термична инсталация Stanton Redcroft. Дериватограмата е показана на фигура 3. Термичните превръщания показани на схема 1 се отнасят за чистия минерал каолинит. В каолините минерала каолинит обикновено е в границите 80-90%, като съдържанието на примеси е около 15% (слюди, фелдшпати, Fe, Ti, Ca, Mg и други съединения). При температури около 900 – 1000ºC започва образуването на течна фаза (стопилка). В шамота освен мулит и кристобалит има и аморфна фаза. В зависимост от режима на изпичане е възможно да не се осъществят превръщанията на кварца до кристобалит.

$$\textit{Каолинит}\ Al_2O_3.2SiO_2.2H_2O \xrightarrow{550\text{-}600\ ^0C} \textit{Метакаолинит}\ Al_2O_3.2SiO_2$$

$$\xrightarrow{950\ -\ 1000\ ^0C} \textit{Дефектен шпинел}\ 2Al_2O_3.3SiO_2\ (\text{нетраен})$$

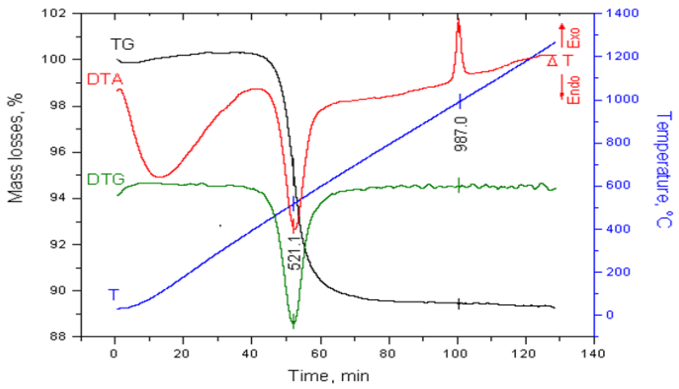
$$\text{активни } SiO_2 + \gamma Al_2O_3 \xrightarrow{1000\ -\ 1100\ ^0C}$$

$$\textit{Първичен мулит}\ 3Al_2O_3.2SiO_2 \xrightarrow{1200\ -\ 1350\ ^0C} (\text{бурна мулитизация})$$

$$\longrightarrow \textit{мулит}\ 3Al_2O_3.2SiO_2 + \textit{кристобалит}\ \mathbf{SiO_2}$$

схема 1: Термични превръщания при нагряване на минерала каолинит

На дериватограмата ясно се вижда ендотермичния ефект при 521,1°C, който се дължи на дехидратацията на каолинита. Екзотермичния ефект при 991,8°C фачална фаза на мулитизация. В таблица 9 са поместени стойностите на температурата на термичните ефекти на каолин В0- глазура.



Фиг. 3. Деференциално термичен анализ на обогатен каолин В0- глазура

Таблица 9 Термични ефекти на каолин В0- глазура

Диференциално термичен анализ /ДТА 404 PC, Netzsch/	
Ендотермичен ефект, °C	521,1
Екзотермичен ефект, °C	991,8

ИЗВОДИ

1. Изучен е веществения състав на каолини марка В0-глазура.
2. Установен е минералния състав на каолин марка В0-глазура.
3. Изследвани са термичните отнасяния на обогатеният каолин. Установен е механизма им на термична дисоциация. Получаването на отделните фази е доказано чрез химичен и рентгенофазов анализ.
4. Изучени са цветовите характеристики на изследвания каолин.
5. По отношение на дисперсния състав каолин марка В0-глазура се характеризира с финна зърнометрия. С увеличаване дисперсността на каолините, намалява максималната концентрация на твърдо вещество при каолиновите суспензии с вискозитет 500 mPa.s и намалява скоростта на леене.
6. По отношение на показател линейна свиваемост каолини марка В0-глазура са с високи стойности. Това се обяснява с по-високата дисперсност на каолин В0- глазура. Високата пластичност предопределя и по-високата механична якост на огъване на сухо. Колкото по-малки са размерите на частицити на дадени проби каолин, толкова е по-висока механичната якост на огъване в сухо състояние.
7. Цялостния анализ на химичния, минерален състав и техническите параметри на изследваният каолин показва, че той е приложими в керамичните технологии.
8. По отношение на показател време на изтичане, каолин с марка ВО- глазура е приложим при керамичните глазури.

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ERI-SSS-CT(R)-04

SYNTHESIS AND COMPLEX FORMATION OF 4- AND 5-NITRO-SUBSTITUTED PIRANDIONE DERIVATIVES OF CINAMOIL-1,3-INDANDION [11]

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Abstract: *Two nitrosubstituted pyranedione derivatives of cinnamoyl-1,3-indandione have been synthesized. They are used as ligands for obtaining complex compounds. Some physicochemical parameters of the obtained compounds have been determined, such as: melting temperature, extraction and Rf values. A significant difference in the melting temperatures of the ligands and coordination compounds was found which proves that the complexation was successful. Infrared spectral analysis of all products has been performed. After reading it, it was found that there was a significant difference in the values of the two C = O groups for the coordination compounds. This proves the coordination of the metal to the ligand with the carbonyl groups of the ligand, which leads to a decrease in the oscillation frequency in this part of the spectrum.*

Keywords: *cinnamoyl derivatives, 2-acyl-1,3-indanediones, complex compounds, IR*

ВЪВЕДЕНИЕ

В литературата се срещат няколко статии за получаване на координационни съединения на 2-ацетил-1,3-индандиона и неговите производни – с Ba(II) и Sr(II) [Ahmedova A., Burdzhiev N., Ciattini S., Stanoeva E. & Mitewa M., 2010], Fe(II) [Rusanov V., Ahmedova A. & Mitewa M., 2014] и Fe(III) [Ahmedova A., Rusanov V., Hazell A., Wolny J., Gochev G., Trautwein A. & Mitewa M., 2006], както и с Cu(II), Zn(II), Cd(II), Pb(II) [Enchev, V., Ahmedova, A., Ivanova G.,Wawer I., Stoyanov, N. & Mitewa, 2001] и Ln(III) [Filho J., Silva J., Vale J., Brito H., Faustino W., Espínola J., Felinto M. & Teotonio E., 2014]. Методиката за получаване на координационните съединения е взаимствана от налични статии за комплексни съединения на 4- и 5-нитроцинамоилни производни на 2-ацетил-1,3-индандиона [Ahmedova A., Marinova P., Pavlovic G., Guncheva M., Stoyanov N. & Mitewa M., 2012; Nikolova I., Marinov M., Dimitrov A., Marinova P. & Stoyanov N., 2016; Nikolova I., Marinov M., Marinova P., Dimitrov A. & StoyanovN., 2016; Marinova P., Nikolova I., Marinov M., Tsoneva S., Dimitrov A. & Stoyanov N., 2017; Simeonova S., Nikolova I., Stoyanov N. & Marinov M., 2015].

Имайки предвид тези данни решихме да направим опит за синтез на нитрозаместени пирандионови производни на цинамоил-1,3-индандиона, а именно: 3-бромо-9-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-*b*]пиран-4,5-дион и 3-бромо-8-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-*b*]пиран-4,5-дион.

МАТЕРИАЛИ И МЕТОДИ

Използвани са химически чисти вещества на фирмите Merck и Fluka.

Т. т. са определени на цифров апарат SMP-10.

R_f стойностите са определени в система CH_2Cl_2 : CH_3COCH_3 = 1 : 1 на плаки Kieselgel 60 F_{254}, 0,2 mm – Merk.

[11] Докладът е представен на студентската научна сесия на Русенски университет филиал - Разград на 28.05.2020г. в секция Химични технологии с оригиналното си заглавие на български език: „Синтез и комплексообразуване на 4 - и 5 - нитрозаместени пирандионови производни на цинамоил - 1,3 - индандиона".

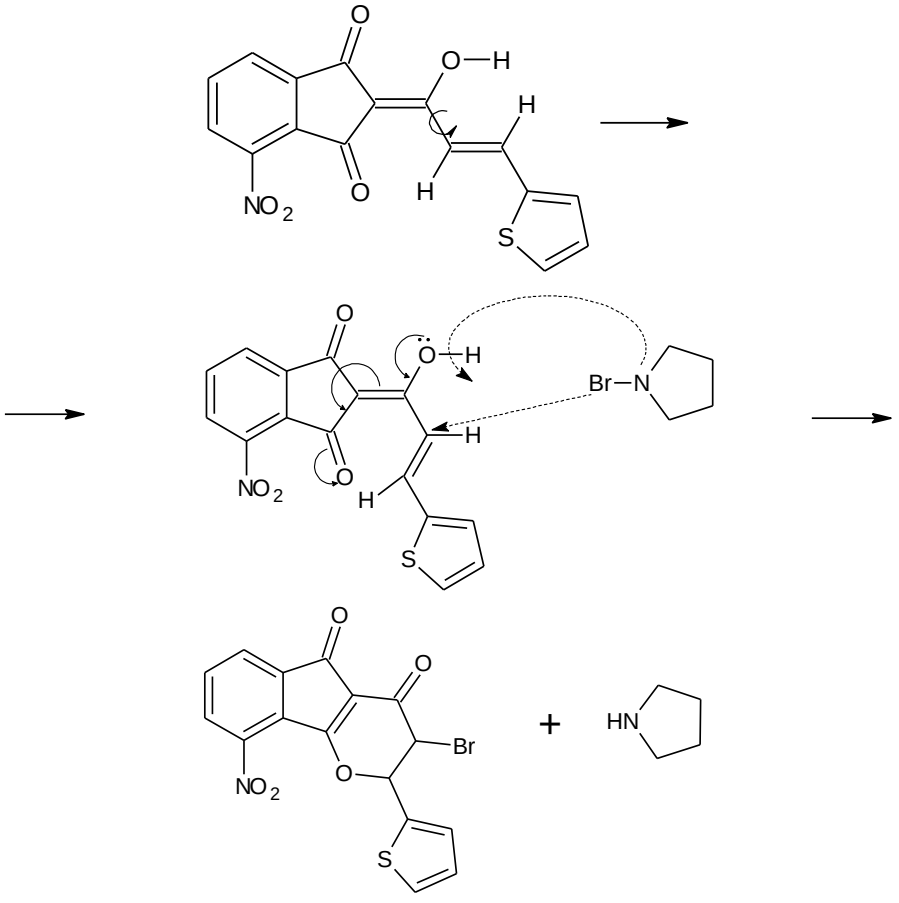
ИЧ спектрите са снети в таблета с KBr на спектрометри: FT-IR VERTEX 70 (Bruker Optics) и FT-IR 1750 (Perkin-Elmer).

МЕТОДИ НА СИНТЕЗ

➢ Получаване на 3-бромо-9-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено [1,2b]пиран-4,5-дион (I)

1 g 4-нитрозаместен цинамоил 1,3-индандион, 0.65 g бромсукцинимид и 10 mL бензен се нагряват при кипене за 1 h. Утаените кристали сукцинимид се филтруват, филтратът се изпарява до сухо и към остатъка се добавя диетилов етер. Получават се оранжеви кристали. Те се разтварят в хлороформ и при добавяне на диетилов етер изкристализира бледожълто вещество, добре разтворимо в хлороформ, диоксан, бензен, етанол и неразтворимо в основи.

Вероятният механизъм на синтезът на 2.2.1. е взаимстван от William A. Mosher &Walter E. Meier [Mosher W. A. & Meier W. E., 1970] и е представен на фиг. 1



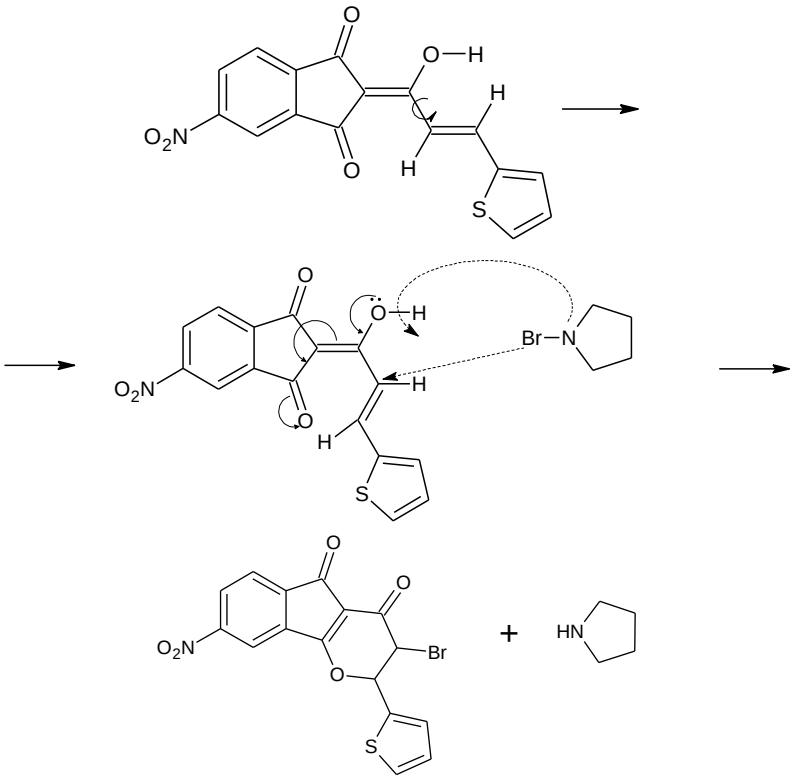
I

Фиг. 1 Механизъм на синтез на 3-бромо-9-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-b]пиран-4,5-дион

➢ Получаване на 3-бромо-8-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-b]пиран-4,5-дион

1 g 5-нитрозаместен цинамоил 1,3-индандион, 0.65 g бромсукцинимид и 10 mL бензен се нагряват при кипене за 1 h. Утаените кристали сукцинимид се филтруват, филтратът се изпарява до сухо и към остатъка се добавя диетилов етер. Получават се оранжеви кристали. Те се разтварят в хлороформ и при добавяне на диетилов етер изкристализира бледожълто вещество, добре разтворимо в хлороформ, диоксан, бензен, етанол и неразтворимо в основи.

Механизмът на синтез на 3-бромо-8-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-b]пиран-4,5-дион е аналогичен на този на 2.2.1. (фиг. 2)



II

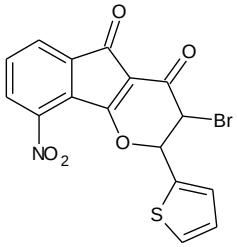
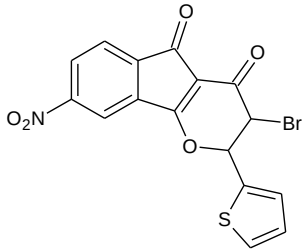
Фиг. 2 Механизъм на синтез на 3-бромо-8-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-b]пиран-4,5-дион

➢ Получаване на комплекси на 3-бромо-9-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-b]пиран-4,5-дион (I) и 3-бромо-8-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-b]пиран-4,5-дион (II) с Cu(II) йони

В колба на шлиф от 100 mL се разтварят 0.001 mol от съответното пирандионово производно, при нагряване на обратен хладник. 0.0005 mol от медната сол $(CH_3COO)_2Cu.H_2O$ се разтваря при внимателно загряване. Лигандът се разтваря в среда от диоксан (7 mL), а медната сол - в среда от метанол (10 mL). След прибавяне на разтвора на медната сол към лиганда, разтворът се охлажда до стайна температура. Полученото вещество се филтрува през филтър синя лента и се суши при стайна температура, а след това и в ексикатор над силикагел. Получените координационни съединения са прекристализирани из диоксан.

РЕЗУЛТАТИ И ОБСЪЖДАНЕ

Структурните формули и наименования на получените съединения са представени на фиг. 3

Структурна формула	Наименование по IUPAC
	3-бромо-9-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-*b*]пиран-4,5-дион
	3-бромо-8-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-*b*]пиран-4,5-дион

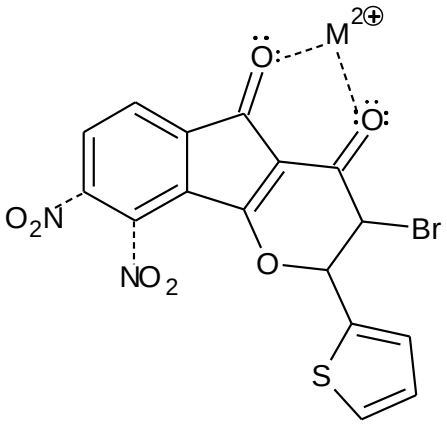
Фиг. 3 Наименования по IUPAC и структурни формули на синтезираните вещества

Синтезираните съединения са изследвани с тънкослойна хроматография, стойностите от която са съответно $R_{f\ (I)}$=0.48, $R_{f(II)}$ = 0.61.

Т. т. на I и II са съответно 164ºC и 181ºC.

Добивът на първото съединение е 57,8%, а на съединение II – 43,9%.

Получените пирандионови производни на нитрозаместени цинамоилиндандиони са използвани като лиганди за получаване на координационни съединения. Получават се незаредени комплекси под формата на аморфни утайки със светложълт цвят. Получените комплекси са охарактеризирани с вибрационна ИЧ-спектроскопия (табл.1), Мястото и начина на свързване на металът и лигандът е показано на фиг.4.



Фиг. 4 Свързване на метала към лиганда

Табл. 1 ИЧ-спектрални данни за лигандите и комплексните съединения

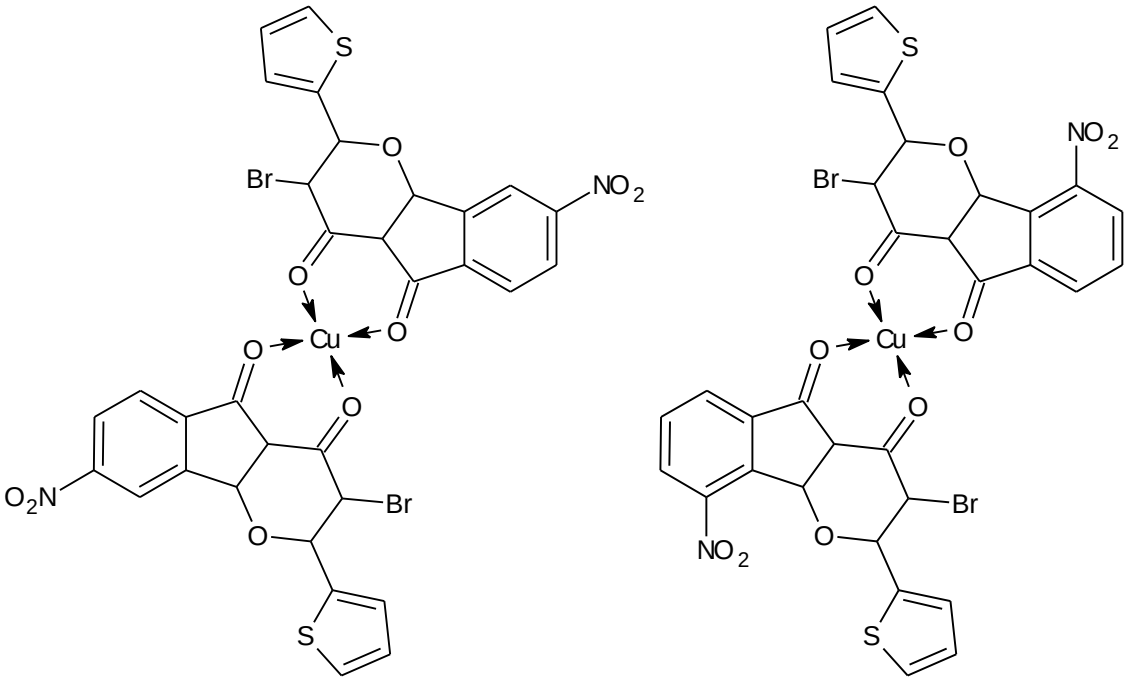
№	IR (ν_{max}, cm^{-1})					
	$\nu_{аром}$	$\nu_{C=O}$	$\nu_{C=O`}$	$\nu_{as_{NO_2}}$	$\nu_{s_{NO_2}}$	$\nu_{2-тиоф.ядро}$
I	3037	1735	1712	1536	1352	831
I+Cu	3027	1701	1678	1533	1350	829
II	3041	1752	1715	1532	1350	828
II+Cu	3025	1700	1685	1531	1350	828

От данните в таблица 1 се вижда, че има значителна ралика в трептенията характерни за карбонилните групи при лиганда и комплекса, съответно

- за C=O – 30-50 cm^{-1}
- за C=O’ – 30-35 cm^{-1}.

Това показва, че Cu(II) се координира с кислородните атоми на карбонилните групи, което довежда и до намаляване честотата на трептене на тези групи.

Cu(II) се характеризира с координационно число 4. Основавайки се на това предлагаме и евентуална структура на получените комплекси (фиг. 5)



Фиг. 5 Структурна формула на координационните съединения: а) 3-бромо-9-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-*b*]пиран-4,5-дион + Cu^{2+} и б) 3-бромо-8-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-*b*]пиран-4,5-дион + Cu^{2+}

ЗАКЛЮЧЕНИЕ

Синтезирани са 2 нови съединения:

- 3- бромо-9-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-b]пиран-4,5-дион
- 3- бромо-8-нитро-2-(тиофен-2-ил)-2,3-дихидроиндено[1,2-b]пиран-4,5-дион

Получените 4- и 5-нитрозаместени пирандионови производни са използвани като лиганди за синтез на координационни съединения с Cu(II).

Всички съединения са изследвани за установяване и доказване на структурата им.

В заключение можем да кажем, че целите на настоящото изследване са постигнати.

БЛАГОДАРНОСТИ

Изследването е проведено със съдействието на проф. д-р Нейко Стоянов, на който изказваме искрени благодарности за насоките и помощта при разработването му.

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ERI-SSS-CT(R)-05

MEASURING OF CLIMATE CHARACTERISTICS.X[12]

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Abstract: *Temperature is an important physical quantity in human life. In any given place at any given time, the physical state of the atmosphere can be described with different values of atmospheric temperature. It can be measured by an electronic weather station. Information about the current atmospheric temperature can be used in different areas of social life. The purpose of this work is to measure the atmospheric temperature in a given place at a given time.*

Keywords: *atmospheric temperature, climate characteristics, weather station.*

INTRODUCTION

Temperature is a main quantity and quantitively expresses the general notions of "hot" and "cold". Temperatur also plays an important role in different areas of science - physics, chemistry, physicochemistry, biology, etc. It is also important in human life. A person can hardly endure extreme temperature values given their influence on mood and sleep.

At a given moment in a given place, the physical state of the atmosphere is described by different values of atmospheric temperature (Maksimov, M., 2000). It can be measured by an electronic weather station, which not only measures data for a given day, but also performs analysis and predicts values for the next day. Information about the current values of atmopsheric temperature, aggregated and processed can be used in different areas of human life. Air temperature is of great importance because plants, animals and humans have different tolerance and adaptiveness to it.

DESCRIPTION AND RESULTS

At any givent moment in time, above a given region on Earth the atmosphere is described by a given temperature (Isaev, A., 2002). Earth's atmospehere has the unique property of being able to regulate its temperature, which in turn creates the needed conditions to enable and sustain life.

Atmospheric temperature is a climate characteristic of the atmosphere and can be measured direct.

All measurements in the given work were made using WH 1080, a professional weather station. The station was mounted in the region of Razgrad (202 m. above sea level). The device displays various data on the screen and so it eases everyday analysis.

The change of temperature during different periods of the day in the region we have studied is given on Fig. 1, 2 and 3.

The values measured for atmospheric temperature were statistically processed and the average monthly values were determined (S., Tsoneva, T., Peneva, P., Haralanova, T., 2019). The processing was done by software and the results are presented on Fig. 4, 5 and 6.

[12] Докладът е представен на студентската научна сесия на Русенски университет филиал - Разград на 28.05.2020г. в секция Химични технологии с оригиналното си заглавие на български език: „Измерване на климатична характеристика“.

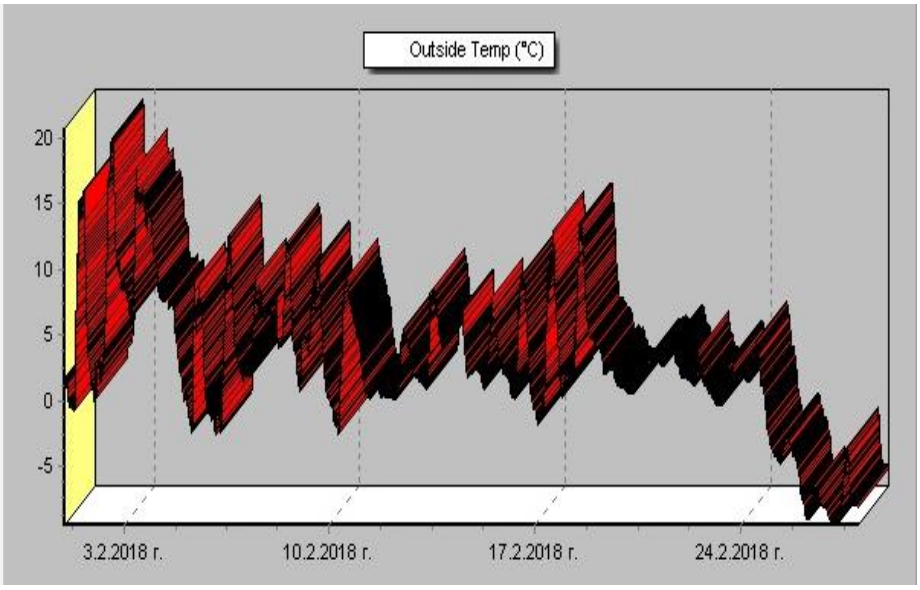


Fig. 1. Change of temperature (01.02 - 28.02.2018г.)

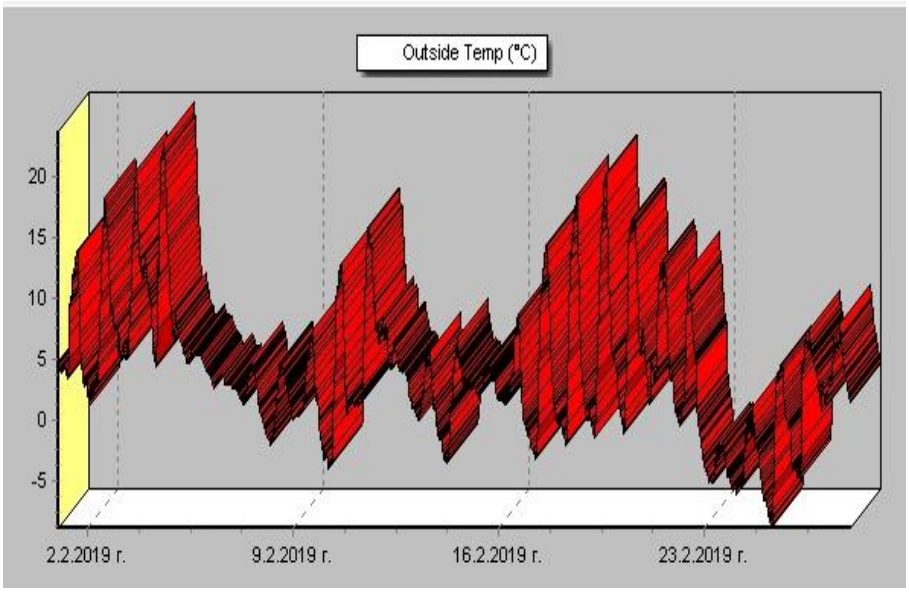


Fig. 2. Change of temperature (01.02 - 28.02.2019г.)

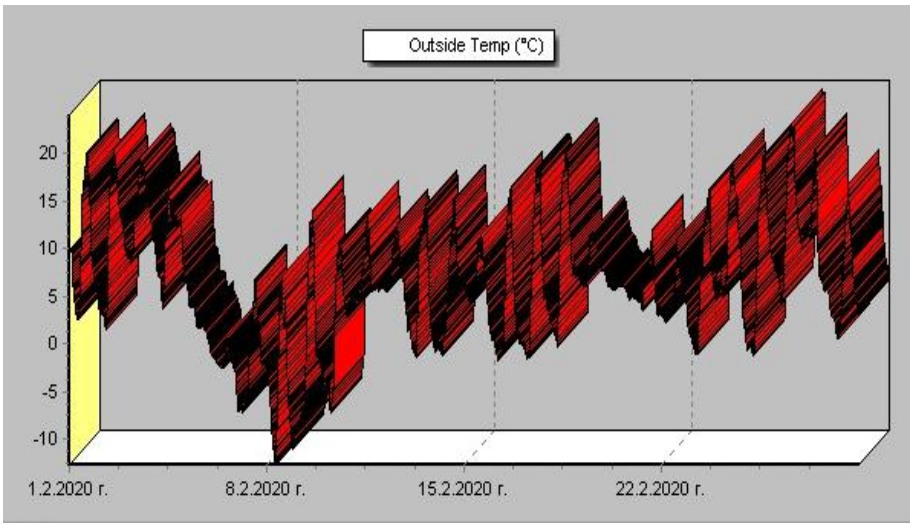
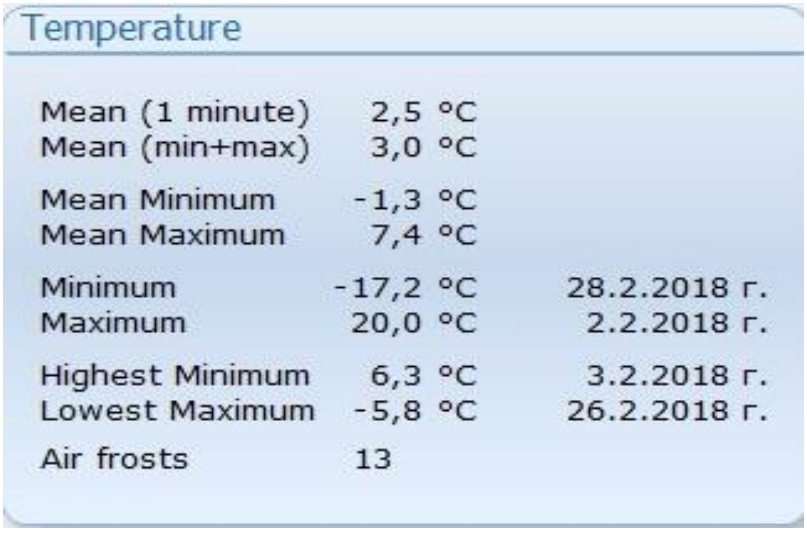


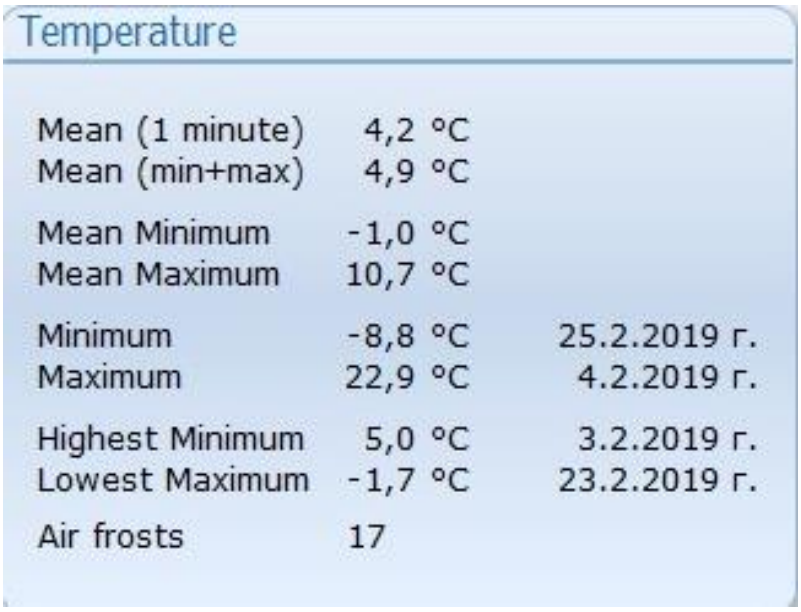
Fig. 3. Change of temperature (01.02 - 29.02.2020г.)



Temperature

Mean (1 minute)	2,5 °C	
Mean (min+max)	3,0 °C	
Mean Minimum	-1,3 °C	
Mean Maximum	7,4 °C	
Minimum	-17,2 °C	28.2.2018 г.
Maximum	20,0 °C	2.2.2018 г.
Highest Minimum	6,3 °C	3.2.2018 г.
Lowest Maximum	-5,8 °C	26.2.2018 г.
Air frosts	13	

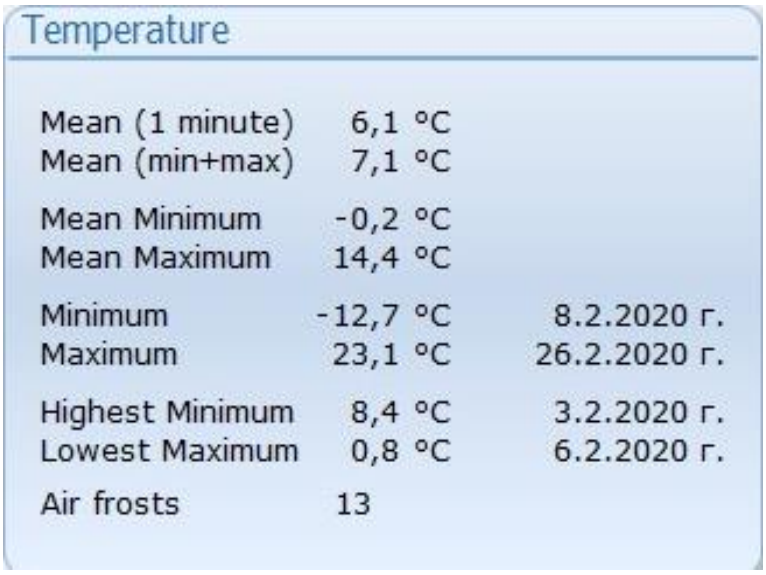
Fig. 4. Avg. Monthly values (01.02.2018 - 28.02.2018г.)



Temperature

Mean (1 minute)	4,2 °C	
Mean (min+max)	4,9 °C	
Mean Minimum	-1,0 °C	
Mean Maximum	10,7 °C	
Minimum	-8,8 °C	25.2.2019 г.
Maximum	22,9 °C	4.2.2019 г.
Highest Minimum	5,0 °C	3.2.2019 г.
Lowest Maximum	-1,7 °C	23.2.2019 г.
Air frosts	17	

Fig. 5. Avg. Monthly values (01.02.2019 - 28.02.2019г.)



Temperature

Mean (1 minute)	6,1 °C	
Mean (min+max)	7,1 °C	
Mean Minimum	-0,2 °C	
Mean Maximum	14,4 °C	
Minimum	-12,7 °C	8.2.2020 г.
Maximum	23,1 °C	26.2.2020 г.
Highest Minimum	8,4 °C	3.2.2020 г.
Lowest Maximum	0,8 °C	6.2.2020 г.
Air frosts	13	

Fig. 6. Avg. Monthly values (01.02.2020 - 29.02.2020г.)

CONCLUSIONS

From the given figures, we can clearly see the average, minimum and maximum temperatures for the given months, as well as the days at which the minimum and maximum values were achieved. Temperature is an important element that affects the Earth's atmosphere. The results obtained present an interest to the weather conditions in the given region.

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