Section 4. CHEMICAL, PHYSICAL, MATHEMATICAL METHODS OF RESEARCH OF FOOD PRODUCTS QUALITY

THE PECULIARITIES OF DETERMINATION OF SPIN-SPIN RELAXATION TIME IN LIQUID FOODS

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The aim and task of the article is to improve the quality of measuring spin-spin relaxation time $T_2$ of foods with high moisture content, the moisture condition of which doesn’t significantly differ from pure water. It would be useful to determine the influence limits of measurement errors on the final value of $T_2$ and to determine processing algorithm for the results of the research.

The results of determination of the spin-spin relaxation in foods with high moisture content are considered. The measurements are performed using impulse-NMR spectrometer. Preliminary evaluation of the results sensitivity depending on the possible errors of measurement is conducted. The preliminary correlation between the errors of measurement and results of the evaluation of spin-spin relaxation time are obtained. It is determined that minimum mobility of water is observed in instant coffee. This is connected with the hydration of instant coffee components. Extraction of coffee grains with varying grinding degrees determines different values of $T_2$. It is demonstrated that richness of milk considerably influences the mobility of water molecules.

Keywords: water mobility, nuclear magnetic resonance spectrometer, spin-spin relaxation.

USE ENZYMATIC CATALYSIS IN THE PRODUCTION OF BLUEBERRIES JUICE

G. Khomych

Usage of blueberries allows enriching foods with biologically active complex, that is contained in it.

The purpose is to study the chemical composition of and the impact of enzymatic catalysis on the quality of blueberry juice.
We investigated the impact of the active enzymes complex on the outlet of blueberries juice and the change of biologically active substances in it.

The mass concentrations of organic acids, sugars, phenolic compounds, amino acids in berries and blueberries juices were determined by a method of highly liquid chromatography.

Analysis of the chemical composition of blueberries has confirmed the presence of a significant number of biologically active substances in its structure. The impact of pretreated blueberries by active enzymes complex on the outlet and quality of bilberries juice was investigated. It was established that harvesting period of berries and type of pretreatment influence the composition of phenolic compounds in blueberries juices. Positive impact of enzymatic catalysis on the transition of colorful substances from the berries in the blueberries juice was confirmed. Analysis of the fractional composition of phenolic compounds and amino acid composition of juice after enzymatic catalysis by complex active enzymes confirmed that the maximum transition of phenolic compounds is achieved in the prewarmed marc by multienzymatic composition (MEC) of enzymes of pectolytic and cellulolitical actions and complex enzyme Fr. Color.

It was proved that the usage of enzymatic catalysis in the production of juice promotes the formation of finished product with increased biological value.

**Keywords:** blueberries, juice, chemical composition, enzymes, multienzymatic composition, phenolic compounds.

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**ROTATION OF WATER MOLECULES AS THE MOTION OF SPHERICAL PENDULUM IN THE INHOMOGEN FIELD FORCES**

N. Malafayev

The calculations are performed and the features of water molecules’ rotational vibrations are analyzed on the example of spherical pendulum in a field of inhomogeneous attraction forces by the form $F = G \cdot \cos^n \theta$. It is shown that the increase of the field inhomogeneity degree $n$ and bend angle of hydrogen bonds $\theta$ causes decrease of rotational oscillation frequency in this field. At the same time the phase shift of ellipse trajectories’ axes increases. The inhomogeneity of the field forces for water molecules, which corresponds to the degree $n \approx 8$ is estimated. This value may correspond to the resultant action of attraction and repulsion forces in Lennard – Jones’s potential. It is shown that for this degree of field
inhomogeneity nearby the critical temperature of water, the conditions for the rapid growth of hydrogen bonds’ bends and breaks between the water molecules is observed.

**Keywords:** rotational vibrations of water molecules, spherical pendulum, inhomogeneous field forces.

**FOOD SYSTEMS FOR MEDICATION AND PROPHYLAXIS OF DISEASES AND THE MATHEMATICAL METHODS FOR THEIR CREATION**

G. Krutovyi

The objective of the research is to develop the concept for the creation of long-term food systems aimed at disease prevention and medication, which appear as a result of calcium deficiency; suggest the types of mathematical models, methods and computer technologies for further use during the creation of the named systems, including the analysis of the expected efficiency of their functioning.

Food systems are grounded on the ingredients of wide, mass consumption. During the research it is found that the most perspective direction of the research concerning the creation of the indicated mechanism for the realization of the integrally balanced nutrition is the development of long-term food systems for various categories of consumers. The concept of medical and preventive food systems (FS) creation with the use of mathematical toolkit is formulated in the article. A chain of mathematical models of linear programming for the projection of one meal rations for different purposes, and a task model of the integral programming for daily rations optimization are developed. Formal approach to simultaneous operational identification of scores of 10 essential amino acids is suggested. The method is aimed at the identification of proteins’ biological value in medical and preventive rations.

**Keywords:** food (nutrition) systems, mathematical models, correlations between nutrients, target function.
OPTIMAL CONDITIONS FOR THE EXTRACTION OF COLOURING AGENTS KRIAS-POWDER FROM CHOKEBERRY

M. Artamonova, I. Piliugina

The influence of technological factors on the degree of the transition of colouring agent krias-powder from chokeberry in the liquid phase (contact time of krias-powder with the liquid phase, temperature, nature of the liquid phase, the content of pH-determining additives) is investigated. The procedures for the preparation of aqueous and aqueous-alcoholic extracts of krias-powder from chokeberry are developed. Optimal conditions for the extraction of colouring agent krias-powder from chokeberry are specified: temperature – 65 ... 70 °C, mass fraction of citric acid – 2 and 1 % according to the extractant, the ratio between the masses of krias-powder and liquid 1:10, hardware design – magnetic stirrer, cooking time – 15-30 minutes. In the ready extract the concentration of colouring agents are determined. It equals 6,33 and 14,66 g/dm³ for water and aqueous alcoholic extract respectively.

Keywords: krias-powder, chokeberry, extraction.

MODELING THE IMPACT OF TECHNOLOGICAL PARAMETERS ON THE DURATION OF HEAT TREATMENT OF FOOD PRODUCTS

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The paper focuses on the impact of technological parameters on the duration of heat treatment of food products. The purpose of the article is to develop the mechanism for modeling the time during which a food product gets culinary preparedness when being heated provided that its temperature field is subject to time changes and is manifold in its spatial value. The method of physical modeling has allowed developing an integral equation for estimating the activation energy of structural transformations in a food product and the time during which a food product gets culinary preparedness. The equation was solved with the help of the numerical method in Mathcad 14 system. Following the known values of the processing of potatoes in the temperature range 80° C – 100° C, it has been estimated that the activation energy of the structural transformation in a potato makes (260 ± 20) kilojoule/mole, P 95%. Based on the developed mechanism, the duration of heat treatment of potato during which it gets culinary preparedness, subject to the heating temperature in the range 75° – 175° C and linear dimensions (1 – 80 mm), has been estimated. The
modeling has been performed for potatoes that have the geometric shape of the sphere, cylinder and rectangular parallelepiped.

Theoretical results of the calculations correspond to the experimental results in the error range equal to ±10 %.

Keywords: modeling, food products, heat treatment.

ANALYSIS OF PROTEINS AND AMINO ACIDS CONTENT DURING STORAGE OF CULTIVATED MUSHROOMS PLEUROTUS OSTREATUS

I. Medvedkova

Conducting analysis of fluctuations of level of proteins and amino acids content in cultivated mushrooms Pleurotus ostreatus during different retention periods has been considered in this work. In this case storage temperature which was changed from 0°C to 6°C has the main effect.

Mushrooms of Pleurotus type are widely spread all over the world and take the second place in the world according to the volume of cultivation in industry. Trad-able peculiarities of mushrooms are characterized, first of all, by organoleptic and physical properties, one of which is nutritional value. Investigations were made on the samples of one strain HK-35.

It is commonly known that protein is of significant importance for foodstuffs because it determines biological value of the product. Food protein quality index, i.e. its amino acid compound is also of special interest.

Observations were made during 15 days. In order to store mushrooms at different temperature modes four cooling chambers were used. In every chamber a peculiar temperature mode of storage: 0±0,5°C; 2±0,5°C; 4±0,5°C; 6±0,5°C by φ = 78±2% has been set. These storage conditions are maximum approximate to the mode of mushrooms storage in trade.

The compound of amino acids was specified in fruit bodies of oyster mushrooms grown on sunflower husk. Preparation of fruit bodies’ samples was made using the method of acid hydrolysis of protein. Analysis was carried out on liquid chromatograph Hitachi L-8800 (Japan). Under our observations spores got ripen on the 12th day of storage at storage temperature of 0°C.

Carried out investigations of dynamics of protein content and some its components during the process of storage at different temperatures has shown that during 3 days quantitative composition of protein in case if it changes, it changes slightly (decreases at temperature of 0°C and increases proportionally to increase of temperature: 12,99% for 2°C and 15,75% for
Hereafter there begins abrupt increase of protein quantity because of spore formation in mushrooms. Finally on the 12th day of storage at the temperature of 0°C and 2°C and on the 15th day of storage at the temperature of 4°C and 6°C there is gradual decrease of activity of protein and its components with further decrease of its quantity in total weight of fruit body. Summarizing all above mentioned I would like to note that in context of saving integrity of protein substance in oyster mushrooms, optimal storage time of fresh mushrooms is the period of 1÷3 days at the temperature of 0÷2°C.

**Keywords:** oyster, research, protein, amino acid, temperature, shelf life.

DURATION OF FREEZING OF RAW FOOD MATERIALS WITH RESPECT TO THERMAL CHARACTERISTICS

V. Potapov, D. Semeniuk

The basis of the problem in question is the integral equation of conservation and transfer of energy in processes with phase transitions and chemical reactions. Solution of the equation is obtained in the approximation of constant body density and temperature dependency for specific heat coefficient and thermal conductivity coefficient.

The solution for the equation is obtained. It lies in duration of the process which is composed of cooling process duration and freezing process duration.

The obtained formulae are suitable for engineering calculations of durations of cooling and freezing of food products with respect to thermal characteristics.

**Keywords:** cooling, freezing, thermal conductivity, heat capacity.