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

INVESTIGATION OF THE OXIDATIVE AND THERMAL TRANSFORMATIONS PROCESSES IN THE SYSTEM «OIL – LIPIDS-MAGNETITE SUSPENSION»

I. Tsykhanovska, Z. Barsova, I. Demidov, L. Pavlotskaya

It was obtained lipid-magnetite suspension (LMS) based on fine-dispersed magnetite powder. The optimum components ratio: magnetite, stabilizer and oil (in g) – 0.025:0.35:50, or in mass.% – 0.05:0.70:99.25 was established. Such ratio provides a complete coating of magnetite particles with a layer of surfactant molecules (stabilizer) and compensation of stabilizer desorption from their surface. The properties of lipid-magnetite suspension was investigated using modern physico-chemical methods of research. It was investigated the oxidation processes of various oils with LMS and without, at multiple high temperatures (from 160\(^\circ\)C to 200\(^\circ\)C): influence of thermocyclic load on oxidation level of oils; changes of physical and chemical characteristics of oils – peroxide number, acid number and iodine number during the thermocyclic load; dependence of the optical characteristics (the density in particular) of oils on the number of thermocycles. The spectrum analysis of oils with LMS was carried out. It was established that magnetite using as antioxidant additive slows down the oxidation and developed lipid – magnetite additive extends the expiration date of oils.

Keywords: oil, thermal transformations, magnetite, stabilizer, suspension, properties.

STRUCTURAL-MECHANICAL PROPERTIES OF AUBERGINE SNACKS

N. Orlova, Yu. Dyakova, R. Romanenko

Ukrainian market of dried fruits and vegetables is characterized by the development of their consumption culture as separate foodstuff and the increased interest in population to healthy food. So actual is the production and research of consumer properties of biological valuable vegetable snacks (in particular, aubergine snacks). When choosing the packaging and storage conditions of snacks important are the results of rheological
Therefore, modulus of elasticity of flexure (Young modulus) in two types of dried aubergine snacks for long-term storage depending on the type of packaging are researched. When storing snacks in polyethylene bags without hermetic closure is increasing mass fraction of moisture. This leads to a redistribution of zones of elasticity, plasticity and fracture. Samples gradually lose their crunchy consistency. When snacks are stored in polypropylene bags with sealing seam, there is no change in mass fraction of moisture and consistency.

**Keywords:** structural-mechanical properties, Young modulus, dried aubergine snacks, elasticity, plasticity.

**STABILIZATION OF AQUEOUS-ALCOHOLIC MIXTURES UNDER THE PROCESS OF ELECTROCHEMICAL ACTIVATION OF DRINKING WATER**

O. Kuzmin, V. Topol'nik, V. Mironchuk, S. Sujkov

The aim of the publication is to study the mechanisms of the equilibrium state of aqueous-alcoholic mixtures at key stages of the creation of vodka using electrochemical activation of drinking water. We have experimentally established the dependence rate of achievement of thermodynamic equilibrium and its character of aqueous-alcoholic systems, through rational waveforms hydroxyl group protons of ethanol and water, to stabilize their positions. The study has proved that steady equilibrium is characterized by the presence of combined unitary signal EtOH+H$_2$O in hydroxyl group ($\Delta\delta=0$ ppm). Unsteady equilibrium is characterized by the presence of two separate signals of EtOH and H$_2$O in hydroxyl group.

**Methods:** $^1$H NMR-spectroscopy; methods of evaluation of physicochemical and organoleptic characteristics of water, ethanol, aqueous-alcoholic mixtures, vodkas.

**Keywords:** aqueous-alcoholic mixture, vodka, $^1$H NMR spectroscopy, hydroxyl protons, electrochemical activation.

**DETERMINATION OF THE SUNFLOWER OIL STORAGE PERIOD BY THE ACCELERATED METHOD**

A. Demidova, O. Aksenova, I. Demidov

**Abstract.** Kinetics of sunflower oil is investigated at different temperatures for Volumetric installation. The data on the oxidation rate and speed of oil self-initiation are obtained. Prediction method of the storage period is developed.
The method has the following advantages: allows you to define the term pressed together shelf life form; forecasts for periods of storage do not refer to temperature and for anyone, it is possible to give broad guidelines store chains; the required amount of research can be conducted within couple days rather than months, dramatically reducing costs; the study is low-cost, because it does not require expenses on reagents.

**Keywords:** oxidation, prediction of the retention period

**Introduction.** Domestic and international food industry dramatically needs to develop the methods of accelerated determination of the terms of food storage.

This especially can be applied to food containing fat phase, especially because of its short term of storage.

As you know, the process of oils and fats oxidation can be divided into several stages. Oxidation is slow in the first stage, with the formation of mainly primary products of hydro peroxides oxidation. This is so called induction period. The end of this stage coincides with the end of the storage period of a fat-containing product. Then the oxidation stage begins, during which the hydroperoxides like avalanche accumulate and begin to form secondary oxidation products - aldehydes, ketones, hydroxyl acid, etc. At this stage, in the product hazardous to human health compounds appear very quickly, so that it is no longer a food product.

**Analysis of recent research and publications.** At present, there is no simple reliable method of accelerated study periods of oils and fats storage. There are the following instrumental methods: 2-TBA-test, diene conjugates determination, OIT determination using Ransimat equipment, Oxidograph, Omnion OSI, FIRA-Astell. SCA, HPLC and other methods have a number of significant fundamental flaws [1–5]. Equipment, which these methods require is quite expensive, and only few domestic producers may buy it.

**The purpose of the article** is to develop and test a universal method for determining the induction period of oil or fat which would be characterized by the following features:

– Low speed of research - during a day (nowadays it takes several weeks to months to determine the terms of storage);
– versatility for any oil or fat that contains antioxidants of natural or synthetic origin or has them in its composition;
– simplicity of research;
– low cost of equipment;
– the ability to create prognostic model.
The main material research. The research was carried out on Volumetric installation (Fig. 1) according to the radical chain mechanism of lipid oxidation, described in [6]. A sample sunflower refined deodorized oil was used.

![Diagram of equipment for measuring oxygen uptake](image)

**Fig. 1. equipment for measuring oxygen uptake (1 – reactor, 2 – glass capillary, 3.5 – one-pass faucet, 4 – three-way faucet, 6 – measuring burette 7 – leveling vessel)**

The method provides the determination of the dependence of a number of absorbed oxygen on time. The obtained kinetic curves allow to determine the period of the sample’s induction (in Fig. 2 it equals 36 min.).

To predict the period of oils storage, be aware that they are kept at different temperatures, so you need to determine the self-initiation speed. The rate of self-initiation can be determined as the ratio of the oxidation speed to the initiation speed:

$$W_c = \frac{W_o}{W_i}.$$  

![Kinetic curve of sunflower oil oxidation](image)

**Fig. 2. The kinetic curve of sunflower oil oxidation at the research temperature of 90°C and the amount of AIBN initiator 0.4 ml**
The initiation speed may be determined by adding different amounts of initiator or inhibitor to the sample. We used the method of adding different amounts of initiator oxidation - azodiizobutronitryl acid dissolved in xylene (the solvent that is not oxidized).

The oxidation speed periods of induction were determined by the sample oils obtained on condition of different amounts of oxidation initiator. To determine the self-initiation speed, it is necessary to determine oxidation speed and initiation of oil sample initiation at different temperatures. The research was conducted at temperatures of 90, 80 and 70°C. For each temperature the period of the sample induction on condition of different amounts of oxidation initiator was determined. The results of the research are presented in Table.

Dependence of the oxidation speed on initiation speed in the so-called Arrhenius coordinates we obtain by the following logarithm table data. This graph (Fig. 3) is self initiation speed value. Due to its extrapolation to lower 70...90°C (temperature of the research) temperature, self initiate speed value can be obtained, thus determining the term of the sample storage.

### Table

**Kinetic data of sunflower oil sample oxidation**

<table>
<thead>
<tr>
<th>The temperature of research, °C</th>
<th>The speed of initiation $W_i$, mol/l·s</th>
<th>The speed of oxidation $W_0$, mol/l·s</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>$2.8 \times 10^{-7}$</td>
<td>$7.4 \times 10^{-7}$</td>
</tr>
<tr>
<td>90</td>
<td>$3.5 \times 10^{-7}$</td>
<td>$9.1 \times 10^{-7}$</td>
</tr>
<tr>
<td>90</td>
<td>$4.9 \times 10^{-7}$</td>
<td>$9.8 \times 10^{-7}$</td>
</tr>
<tr>
<td>80</td>
<td>$4.3 \times 10^{-8}$</td>
<td>$2.33 \times 10^{-7}$</td>
</tr>
<tr>
<td>80</td>
<td>$8.5 \times 10^{-8}$</td>
<td>$2.44 \times 10^{-7}$</td>
</tr>
<tr>
<td>80</td>
<td>$1.1 \times 10^{-7}$</td>
<td>$2.6 \times 10^{-7}$</td>
</tr>
<tr>
<td>70</td>
<td>$8.2 \times 10^{-9}$</td>
<td>$1.2 \times 10^{-7}$</td>
</tr>
<tr>
<td>70</td>
<td>$2.2 \times 10^{-8}$</td>
<td>$1.5 \times 10^{-7}$</td>
</tr>
<tr>
<td>70</td>
<td>$5.2 \times 10^{-8}$</td>
<td>$1.7 \times 10^{-7}$</td>
</tr>
</tbody>
</table>
To test the experimental data obtained at high temperature (70...90°C), it is necessary to determine the kinetics of oxidation of the oil samples at normal temperature. For this purpose, peroxidation number of oil which is stored in an open vessel, exposed to light and oxygen, at ambient temperature 24°C is determined. Data, obtained from the scientific literature, demonstrate that in the initial period of oxidation, peroxide compounds accumulate. The number of secondary oxidation products during this period does not increase by more than 20%, so it is quite correct to use the data of accumulating only peroxide compounds.

**Conclusions.** The method with the following advantages was developed:

- it enables to determine the terms of storage of the sample in a short time;
- it forecasts the periods of storage including any temperature, so it is possible to give broad recommendations trading nets;
- the required amount of research can be conducted over two days, not months. This greatly reduces labor costs;
- The cost of research is low, so it does not require the expenses on reagents.
**List of sources / References**


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The article considers the directions for improving nutritional value of flour confectionery products. Results of the research of chemical composition of gingerbread with sesame extraction cake and cedar, as well as changes occurring in the composition of these products are presented. Optimal ratio of the components by the addition extraction cake to the recipe gingerbread dough is determined. The effect of additives on organoleptic characteristics of finished products’ quality is determined. The results obtained are focused on further improvement of quality characteristics of flour confectionery products. The practical true significance is in the production and implementation of flour confectionery goods of gingerbread dough with cedar and sesame seed meal in the institutions restaurant economy and the food industry to provide population of Ukraine with health food products.

Keywords: flour confectionery products, gingerbread cookies sesame and cedar oil meal nutritional value, nutrients.
PRESERVATION OF EGGPLANT FRUIT AT THEIR TREATMENT WITH ANTIMICROBIAL EFFECT SUBSTANCES

A. Tokar, S. Myroniuk

Eggplant fruits have a positive effect on metabolic processes in the human body, prevent obesity, play an important role in the prevention and treatment of cardiovascular system and are a valuable raw material for canning industry. Unfortunately, during storage a significant portion of vegetables is affected by phyto genetic microflora and physiological disorders. The successful solution of this problem can be achieved by post-harvest processing of fruits with solutions of antimicrobial action substances that boost the immune system and stability during storage. As pathogens of spoiling eggplant fruits are bacteria, fungi, yeast, it is appropriate to use antiseptics which by chemical composition are mainly acids.

Citric acid belongs to the group of carboxylic acids that slow the growth of microorganisms in normal conditions. Lowering pH of cell sap they limit the possibility of bacterial growth primarily.

SUBCRITICAL WATER AS EXTRACTANT IN THE PROCESS OF EXTRACTION OF BIOLOGICALLY ACTIVE SUBSTANCES FROM PLANT MATERIAL

V. Sukmanov, Y. Petrov, V. Zaharevich, A. Marinin

The analysis of properties of subcritical water (SCW) and nature of its influence on the target components and biologically active agents extracted from vegetable raw materials is made. The mechanism of influence of a deviation of change of temperature and pressure near a critical point upon changes of dielectric permeability, viscosity, thermal capacity, coefficient of diffusion and density of water is described. It is shown that water in these conditions behaves like polar organic solvent, and the main advantages of SCW as solvent: a combination of properties of gases with high pressures (low viscosity, high coefficient of diffusion) and liquids (the high dissolving ability); the combination of a negligible interphase tension to low viscosity and high coefficient of diffusion allowing hard currency to get on porous medium more easily in comparison with liquids; high sensitivity of the dissolving ability of SCW to change of pressure or temperature; simplicity of division of SCW and the substances dissolved in them when dumping pressure, are connected with its
microstructure and features of the processes happening at the molecular level. Dependence of the dissolving ability of SCW on state parameters in many respects is caused by special character and dynamics of hydrogen communications. It is shown that use of SCW in processes of extraction is the most reasonable, will allow to increase significantly efficiency of process and will provide high consumer qualities of the taken products.

Keywords: subcritical water, extraction, biologically active agents.

INVESTIGATION OF FATTY ACID COMPOSITION OF THERMODYNAMIC MILK-CONTAINING FILLING WITH SESAME SEEDS CONCENTRATE

M. Obozna, G. Lyubenko, F. Pertsevoy

Due to modern peculiarities of human diet, much attention is paid to the balance of the product’s chemical composition. This has challenged to create the combination of dairy and vegetable products. Therefore, a new form of scientifically substantiated thermodynamic filling is produced, and the components of dairy and vegetable origin are combined in order to increase its value. Dry skimmed milk is used in it as milk raw material, and sesame seeds concentrate and hydrocolloids, namely low-esterified citrus pectin and modified corn starch are used as vegetable raw material. Due to their joint use, the filling gets both new physical, chemical and rheological properties, and the deficiency in proteins, unsaturated fatty acids, vitamins and mineral substances and dietary fiber is compensated. Chemical composition of thermodynamic milk-containing filling with sesame seeds is investigated. The changes in fatty acid composition during the storage at temperature of 2±2 and –18±20°C are detected.

Keywords: hydrocolloids, thermodynamic filling, dry skimmed milk, sesame seeds concentrate.

CURRENT METHODS OF STUDY AND IDENTIFICATION OF ORIGIN WINES

E. Iukuridze

The ability to identify and study the origin of wine on its chemical composition is of great interest not only for regulatory bodies as a tool for detection of falsification, but also for the domestic wine industry companies interested in finding criteria for distinguishing their products. Analysis of the current state of the problem of identification of origin of wine is reflected in a significant number of publications, mostly in foreign sources. Most often to identify the origin of wine is offered to use instrumental methods of analysis - chromatography, spectral analysis, nuclear magnetic resonance. All these methods have high resolution and selectivity;
provide an opportunity to define a set of criteria, which is characteristic for a specific geographic area. It is advisable to organize a national government program database and use it in the future for the production of high quality wines geographical origin and control of their origin.

Keywords: identification methods, the origin of the wine, nuclear magnetic resonance.

QUALITY EVALUATION OF NEW FISH PRESERVES IN "NEPTUNE CHERRY" SAUCE

I. Ditrich, Y. Marchenko

The possibility of getting new fish preserves in cherry sauce «Neptune Cherry», which has high biological value and unique consumer properties: color and taste, by the addition of plant material such as fruit juice cherries. Plant ingredient, which is the main component of the sauce, was elected by geographic accessibility, consumer properties and chemical composition for reference data. The optimum concentration of solids in cherry juice for provision of harmonic organoleptic properties to preserve is determined. Results of the assessment show that fish preserves in cherry sauce containing 11% solids in cherry juice possess the best organoleptic quality. Samples of the new product carried out through the evaluation of organoleptic characteristics of new fish preserves in cherry sauce «Neptune Cherry» is developed by the five-point scale. Physical and chemical characteristics qualities are specified.

Keywords: fish preserves, cherry sauce, pacific herring of reduced commodity values, cherry juice, organoleptic characteristics, physical and chemical quality characteristics.

DETERMINATION OF THE BALANCE OF AMINO ACID STRUCTURE OF COLLAGENIC PREPARATION

N. Kushnir

The aim of the paper is to develop comparative characteristics of amino acid composition of hydrolysates produced from secondary fish raw materials.

To receive comparative characteristics of the amino acid composition of collagen hydrolysates it was necessary to determine the degree of hydrophobicity, shape of protein globules according to Fisher, calculate amino acid score of collagen hydrolysates with further balance assessment.

The highest content of amino acids in the collagen of carp scales is accounted for: glycine, proline, and alanine. As compared with the content of most amino acids in the carp skin their content is almost the same.
Therefore, Fisher curve confirms that collagen globules of carp scales and skin are spherical. Protein preparation has a low utility coefficient in comparison with the ideal protein ($\alpha = 0.25$).

This imbalance shows that amino acids of the collagen preparation can be utilized by 25% in the human body, and being in the "excess" during assimilation there are not many amino acids ($\sigma = 0.13\%$). The coefficient of differences in amino acid composition is 1.05%. Balance of essential amino acids in relation to physiological norms is also characterized by the rationality coefficient (Rc) of amino acid composition, which is low for the collagen scales. The degree of productive use of essential amino acids in the human body as a plastic material (BTsp) is 94.25%.

Keywords: collagen preparation, the amino acid composition.

DETERMINATION OF MICROELEMENT FOOD ADDITIVE "HIBISCUS" USING METHODS OF SOLID SPECTROPHOTOMETRY

E. Kostenko, E. Maksimenko, E. Butenko

The scheme determination of trace-element composition of the food additive "Hibiscus" is proposed. Preparation of tests this incineration of the dried up standards of "Hibiscus" at 460°C and dissolution in dilute HNO$_3$. Content of Pb(II), Cd(II), Zn(II), Hg(II) as determined by interphase spectrophotometry using immobilized on anion exchanger AB-17×8 pyrocatechol violet, methylthymol blue, and Chromazurol S, respectively. The content of Cu(II), Fe(III) and P(V) was determined photometrically, K, Na Ca – by flame spectrophotometry. The content of Pb(II), Cd(II), Zn(II), Hg(II), Cu(II), Fe(III) does not exceed the limit possible concentration. The table of contents of Fe$^{3+}$ in two times exceeds the data driven to literature. As "Hibiscus" in Ukraine is used as addition, but not as basic food stuff, enhanceable maintenance of Fe$^{3+}$ can not inflict harm to the organism of man.

The proposed methods of determination of ions of metals are characterized by a satisfactory rightness and productivity of results; by a high sensitiveness and selectivity; on express they are better the known analogical and standard methods. The scheme of analysis is characterized by simplicity of experiment, ecological safety, does not require a difficult expensive equipment, for maintenance of that a highly skilled personnel and stationary laboratory are needed.

Keywords: solid phase spectrophotometry, photometric analysis, metals, dyes, food additives.